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By

A. H. Sturtevant
California Institute of Technology

II. NEW SPECIES IN THE QUINARIA GROUP OF THE SUBGENUS DROSOPHILA

By

Warren P. Spencer
The College of Wooster

III. DESCRIPTION OF NEW SPECIES OF THE SUBGENERA HIRTODROSOPHILA AND DROSOPHILA

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The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston.

Cultivated mind is the guardian genius of Democracy, and while guided and controlled by virtue, the noblest attribute of man. It is the only dictator that freemen acknowledge, and the only security which freemen desire.

Mirabeau B. Lamar.

PREFACE

During the past several years a considerable number of undescribed forms of the genus *Drosophila* have accumulated in the laboratories at Pasadena, Wooster, and Austin. Already several of these forms have been referred to in published articles, although they had not been fully described. It was recognized by all of us that this practice could not be continued indefinitely. Since workers in all three laboratories are using these new forms in studies on comparative genetics, speciation and related problems, it has become necessary that such forms should be named and fully described. In the present publication descriptions of all the new forms of the genus *Drosophila*, for which sufficient material is available, are included.

In Article I Professor Sturtevant gives an extensive treatment of the classification of the genus *Drosophila*, and divides this genus into six subgenera, as follows: *Hirtodrosophila*, *Pholadoris*, *Dorsilopha*, *Phloridosa*, *Sophophora*, and *Drosophila*. In addition, he includes a key for the North American species of the genus *Drosophila*, and describes nine new species. In Article II Professor Spencer describes six new species belonging to the *quinaria* group of the subgenus *Drosophila*. In Article III the writer and Mr. Wheeler describe thirty-six species and one subspecies, of which all are new except five and the subspecies which have been described briefly in the literature.

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J. T. PATTERSON

Austin, Texas
February 20, 1942

I. THE CLASSIFICATION OF THE GENUS DROSOPHILA, WITH
DESCRIPTIONS OF NINE NEW SPECIES

A. H. STURTEVANT

William G. Kerckhoff Laboratories of the Biological Sciences
California Institute of Technology,
Pasadena, California

CONTENTS

	PAGE
Introduction	7
Discussion of characters	7
Branches of arista	8
Shape and hairiness of third antennal segment	8
Structure of front	8
Orbital bristles	8
Oral bristles	9
Carina	9
Cheeks	9
Hairs below carina	9
Acrostichal hairs	9
Acrostichal bristles (including prescutellars)	10
Color and pattern of thorax	10
Dorsocentral bristles	11
Anterior scutellars	11
Sternopleural bristles	11
Tarsal ornaments of male	11
Preapical tibial bristles	12
Abdominal bands	12
Opaque areas on abdominal tergites	13
Wing-vein indices	13
Bristles of costa	13
Wing color	14
Malpighian tubes	14
Testes	15
Ventral receptacle	15
Spermathecae	16
Eggs	16
Larvae	16
Puparia	17
Chromosomes	17
Mating habits	19
Food habits	20
Classification of the genus <i>Drosophila</i>	21
General account	21
Species referred to separate genera	27

	PAGE
Subgenera and species groups of <i>Drosophila</i> , with included species.....	27
Subgenus <i>Hirtodrosophila</i>	27
Subgenus <i>Pholadoris</i>	28
Subgenus <i>Dorsilopha</i>	28
Subgenus <i>Phloridosa</i>	28
Subgenus <i>Sophophora</i>	28
Subgenus <i>Drosophila</i>	30
Species vs. subspecies	32
Description of new species	33
<i>Drosophila victoria</i>	33
<i>Drosophila cordata</i>	34
<i>Drosophila elliptica</i>	35
<i>Drosophila emarginata</i>	36
<i>Drosophila biopaca</i>	37
<i>Drosophila rectangularis</i>	38
<i>Drosophila sellata</i>	39
<i>Drosophila pinicola</i>	40
<i>Drosophila floricola</i>	42
Key to North American species of <i>Drosophila</i>	43
Literature cited	51

INTRODUCTION

The present account represents an attempt to bring up to date the work on the classification of *Drosophila*. It cannot be considered final—for certainly more species remain to be discovered in the Nearctic region, and our knowledge of most other parts of the world is very inadequate. Even among the known species, much remains to be done on the structure, cytology, behavior, and geographical distribution—and the data in these fields will undoubtedly lead to modification of many of the tentative conclusions here outlined.

Discussion of Characters

The present section contains an account of each of the characters most commonly studied in the genus. In each case the distribution throughout

the genus is indicated, together with methods and difficulties of determination and description. Most of the characters recorded as ratios show some intraspecific variation; in each case what has been attempted is to give an approximate average value.

Branches of arista.

I formerly distinguished between branches above and below the main axis. As Duda has often pointed out, however, the main axis is usually forked at its apex, and this makes for ambiguity; accordingly what is here usually recorded is the total number of branches, including the terminal fork as two.

This number is variable within a species; what has been attempted is to determine an approximate average value. The range of averages is from 7 (*Pholadoris victoria*, several of the obscura species-group of *Sophophora*, *Phloridosa floricola*, and most members of the following species-groups of *Drosophila*: *melanica*, *repleta*, *pinicola*, and *carbonaria*) to 12 (*Drosophila tripunctata*). The *willistoni* species-group of *Sophophora* and the *quinaria*, *guttifera*, and *funebis* groups of *Drosophila* also have numerous (10 or 11) branches.

Shape and hairiness of third antennal segment.

The third antennal segment is unusually large and is clothed with very long hairs in the subgenus *Hirtodrosophila*. The length of these hairs varies considerably in the rest of the genus; in *Drosophila guttifera* they are as long as in some species of *Hirtodrosophila*.

Structure of front.

The size, shape and distinctness of outline of the orbital lines and ocellar triangle, and of the velvety frontal lines, shows much variation from species to species, but so far no attempt has been made to describe them accurately.

In *Pholadoris victoria* there is a conspicuous V-shaped bristle-bearing shining mark on the front that has not been observed elsewhere in the family—though what appears to be the same structure is found in related families, being especially marked in the *Milichiid* *Desmometopa*.

Orbital bristles.

The orbitals are regularly three in number—two reclinate and one proclinate. The anterior reclinate, lying usually between the other two, is called the middle orbital, even when (as sometimes happens) it is situated at the same level as the proclinate one or even slightly anterior to it. The relative sizes of these bristles are of importance in classification; the middle one is regularly the shortest, and is $\frac{1}{6}$ to $\frac{1}{3}$ the length

of the anterior one in most groups. It is in general slightly longer in the *obscura* group, and in *guttifera*, *pinicola*, and *carbonaria*.

Oral bristles.

The anterior oral bristle, or vibrissa, is always conspicuous; the bristle just behind it may be nearly as long, or much smaller. If the species are divided into those where the second oral is greater or less than $\frac{1}{2}$ the length of the first, it is found that the group with a short second oral includes the subgenera *Hirtodrosophila*, *Pholadoris*, and *Phloridosa*, the *obscura* group of *Sophophora*, and the *melanica*, *repleta*, *robusta*, *pinicola*, and *polychaeta* groups of *Drosophila*.

Carina.

The carina is narrow, and low near the clypeal margin of the face, in *Hirtodrosophila* and in the *affinis* sub-group of species. In general it is narrower in *Sophophora* than in *Drosophila*; perhaps the narrowest one in the latter subgenus is found in *pinicola*. *Pholadoris*, *Dorsilopa*, and *Phloridosa* all have it rather broad.

Cheeks.

The "greatest width of cheek" is to be taken as the perpendicular from the lower rear corner of the head to the margin of the eye, this distance to be taken as a projection when the head is placed with its sagittal plane at right angles to the line of vision. It is often more convenient to use the width in a perpendicular axis—i.e., from the lowest point of the eye. In general, the cheeks are narrow in *Pholadoris*, *Hirtodrosophila*, *Sophophora*, and in a few species of *Drosophila* (e.g., *cardini*, *testacea*, *robusta*, *carbonaria*).

Hairs below carina.

A few minute hairs are found just above the clypeal margin in the *gray* sub-group of the *saltans* relatives—i.e., *saltans*, *biopaca*, *earlei*, *sellata*, and *rectangularis*. So far as known this character does not occur elsewhere in the genus.

Acrostichal hairs.

The number of rows of acrostichal hairs often increases anteriorly; it is described on the basis of counts taken just anterior to the anterior dorsocentrals. Even with this precaution it is often not a very reliable character, as it is variable in some species and difficult to determine in others. It has been the rule to key any species known to be subject to such difficulties both ways.

The character is, in general, of little importance in delimiting groups of species. The two sub-groups represented by *obscura* and *affinis* differ

in that the first has 8 rows, the second 6; the melanica group has 6, as does also the quinaria group; the repleta group usually has 8, though a few show only 6. No numbers of rows other than 6 or 8 are certainly known as normally characteristic for any species of the genus.

Acrostichal bristles (including prescutellars).

Differentiated acrostichal bristles occur in the genus either as a pre-sutural pair (in the testacea group—subgenus *Acrodrosophila* of Duda), or as a pair just in front of the scutellum—the prescutellars. These latter are characteristic of the subgenus *Pholadoris*, and occur in several other poorly understood forms (e.g., *sigmoides* and *florae*). There are occasional indications of enlarged hairs in this position in some of the larger species of the repleta group, but in none of these are such hairs as distinct as in the species named. Duda recognizes this as a definite sub-generic character, using it as the sole stated basis for separating his *Paradrosophila*. The type of this subgenus, *Drosophila pictipennis* Kertész, is an East Indian species that is not obviously related to any American form.

Color and pattern of thorax.

The ground color of the thorax—with which is closely correlated that of the head and abdomen—may be roughly described as yellowish or blackish, with a somewhat intermediate reddish brown type that occurs in the funebris and polychaeta groups. The yellowish series includes some rather dark brownish forms, and some that are but little darker than these have been classed as blackish; in other words, there is not a very sharp line between the two types, and yet the distinction remains in general a convenient one.

The yellow species sometimes show a more or less distinct pattern of longitudinal mesonotal or pleural dark stripes (the mesonotal ones best developed in *Dorsilopha* and in *guttifera*, the pleural ones in *Dorsilopha* and in *Hirtodrosophila*), but do not usually have a pollinose mesonotum. This general color is found in most *Hirtodrosophila*, in *Dorsilopha*, in the *willistoni* and *melanogaster* groups of *Sophophora*, and in the *quinaria*, *guttifera*, *testacea*, *tripunctata*, *cardini*, and *immigrans* groups of *Drosophila*.

The remaining groups are all more or less blackish, often with strong pollinosity. The pollinose areas are in many forms limited, to give a pattern. In the repleta group this is a spotted pattern, each hair and bristle arising from a non-pollinose area. In other groups (e.g., the pollinose subgroup of the saltans group, in the *robusta* and *melanica* groups, in *Hirtodrosophila alabamensis*, and elsewhere) this pattern is in the form of longitudinal stripes that are usually rather indefinite in outline and that are often broken at the suture or elsewhere.

Dorsocentral bristles.

There are regularly two pairs of dorsocentrals, both posterior to the suture. In several forms, such as *funebri* or *virilis*, it is not unusual to find somewhat enlarged hairs in the dorsocentral rows anterior to the dorsocentral bristles, and in almost any species occasional specimens have a well developed bristle in this position on one or both sides of the thorax. Only in the polychaeta group (*polychaeta* and *illota*) does the possession of three pairs appear to be the usual condition.

The distance between the anterior and posterior dorsocentrals varies from species to species; it is shortest—i.e., the anterior is inserted furthest to the rear—in the subgenus *Phloridosa*.

Anterior scutellars.

The anterior pair of scutellar bristles are convergent in some *Hirtodrosophila* (e.g., *duncani*), *Dorsilopha*, the *melanogaster* and *obscura* groups of *Sophophora*, the *robusta*, *funebri*, *polychaeta*, *carbonaria*, *cardini*, and *immigrans* groups and most of the *melanica* and *repleta* groups of *Drosophila*. They are divergent in some *Hirtodrosophila*, in *Pholadoris*, *Phloridosa*, the *saltans* and *willistoni* groups of *Sophophora*, and in the *quinaria*, *guttifera*, *virilis*, *transversa*, and *tripunctata* groups (and the species *ritae* and *nigromelanica*) of *Drosophila*.

Sternopleural bristles.

As pointed out by Kikkawa and Peng, the relative length of the anterior and posterior sternopleural bristles is a useful specific character. They use the term "sterno-index" to indicate the ratio, anterior divided by posterior. This ratio ranges from about .2 (*Phloridosa*) or .3 (*Dorsilopha* and the *saltans* and *willistoni* groups) to .8 or .9 (*Pholadoris*, *polychaeta*, and most of the *virilis*, *repleta*, *melanica*, and *immigrans* groups).

Tarsal ornaments of male.

The sex-combs on the basal tarsal segment of the first leg of the male of *melanogaster* and *simulans* are familiar. The males of the other members of the *melanogaster* group and of all the *obscura* group have such a comb, and a similar but somewhat smaller one also on the second tarsal segment. In the *affinis* subgroup this distal comb is reduced to a single tooth. In *ananassae* and *takahashii* both combs are much reduced in size; in *bipunctinata* the proximal one is broken, to give in effect two parallel combs on the basal segment and a very small third one on the second segment; in *montium*, *rufa*, *auraria*, *nipponica*, and *ficuspila* both combs are very long and conspicuous. In *montium* and *auraria*, observations on the mating indicate that these combs are made use of in holding the female during copulation. Examination of all species indicates that there is a strong correlation between the number of teeth in a comb—i.e., its length—and the angle at which it is placed. The very long combs are parallel

to the axis of the tarsus, the very short ones are nearly at right angles to that axis, and the combs of intermediate length are at corresponding angles.

Other types of sexual differences are also found on the first tarsi. In immigrans the two basal segments are clothed with long dense hair in the male, and in several species (notably in *hydei*) there are fewer long hairs on these segments. In others these hairs are not so long, but are conspicuously recurved (e.g., *occidentalis*, *virilis*, *funebri*, or *micromelanica*). These long or recurved hairs (except those in immigrans) are, like the sex-combs, usually on the inner surface of the segment.

Preapical tibial bristles.

These bristles are small or absent on the first and second tibiae in most species of *Hirtodrosophila*, and in *Dorsilopha*; elsewhere they are distinctly evident on all three tibiae. In the *obscura* group and in *ananassae* those on the first tibiae are unusually long.

Abdominal bands.

The shape of the posterior dark areas on the abdominal tergites offers good specific differences, but is somewhat inconvenient to use. In pinned material the shrinkage of the abdomen often obscures the pattern hopelessly, and even in living material allowances have to be made for some darkening with the age of the specimen, for different superficial appearances due to the degree of distension of the abdomen, and for sexual differences.

There are two fairly distinct types of dark bands: some are broken or definitely narrower in the mid-dorsal region, whereas others are uniform in width or are broader in the median line. The narrowing is sometimes slight, and is in general most evident in newly emerged females; determinations on young live specimens will often be contradicted by observations on old dead ones. The rule is that the narrowing begins with the proximal band and extends posteriorly—i.e., if one band is narrowed or broken it is the anterior one, if two they are the two basal ones, etc. In general, no more than the anterior band (if any) is narrowed except in the subgenus *Drosophila*. In that subgenus from 3 to 5 bands are usually narrowed, though in such forms as *micromelanica*, *virilis*, or *carbonaria* the whole abdomen is so dark that the determination of the point becomes impracticable.

In some forms—especially in the *quinaria* and *guttifera* groups—there is a further breaking of the abdominal bands, to form rows of spots. In some members of the *repleta* group there is a lateral pale area on each tergite, the shape and extent of which is helpful in classifying that difficult group.

Sexual differences in abdominal color are most frequent in the posterior tergites, which often have more extensive black areas in males than in females—as in *melanogaster*, *simulans*, or *funebri*.

Opaque areas on abdominal tergites.

In the saltans group there are curious opaque heavily chitinized areas on the fifth abdominal tergites of the females, that have not been observed in any other forms. These areas are single and in the median line in all except *biopaca*, which has a pair of lateral ones. They are not usually easy to make out in pinned material. In live specimens they are conspicuous, and of a characteristic shape in each species; these shapes have been utilized in forming the specific names of the six members of the group here described as new. The histological nature of these areas and their function (if any) are not known.

Wing-vein indices.

The four indices appearing in the species descriptions are the following: costal index (length second section of costa/length third section); fourth vein index (length fourth—i.e., distal—section of fourth vein/length third section); 4c index (length third section of costa/length third section of fourth); 5x index (length distal section of fifth vein/length posterior crossvein). The first two of these are somewhat less variable and more useful as specific characters. All show interspecific variability, and the attempt has been to record average values.

The costal index ranges from about 1.2 in *bipectinata* to 4.4 in *immigrans*. It is in general 3.0 or less in *Sophophora*, and in this subgenus is highest in the *obscura* group. In *Drosophila* it is usually 3.0 or greater (2.2 in *guttifera*, 2.0 in *polychaeta*, 2.5 in *carbonaria*, 2.4 in *arizonensis*, 2.5 in *peninsularis*, 2.6 to 2.9 in several other forms). It is less than 2.0 in *Pholadoris*, varies from 1.9 to 3.8 in *Hirtodrosophila*, 3.1 in *Dorsilopha*, 2.1 to 3.6 in *Phloridosa*.

The fourth vein index shows a weak but definite negative correlation with the costal index—i.e., if the second vein ends near the wing tip (high costal index), the posterior crossvein is likely also to be distally placed (low fourth vein index). The extreme values observed for the fourth vein index are 1.0 in *deflecta* and 2.7 in *auraria*. Values as high as 2.0 are rare except in *Sophophora*, *Pholadoris*, and *Dorsilopha*.

Duda has described the venation extensively in terms of the curvature of the veins. This procedure is often helpful, especially in the case of the sinuate posterior crossvein of *flexa*, *sigmoides*, and some of the *quinaria* group. The gentle curves often found in the longitudinal veins are difficult to describe in words, but furnish useful diagnostic characters when pictures are available.

Bristles of Costa.

The costal margin has heavy though short bristles from the base of the wing to a point between the ends of the second and third veins. The point at which these bristles disappear is a satisfactory species character, but varies much as between closely related forms—i.e., it is not useful as

a group character. The extremes noted are in several members of the repleta group, where only the basal $\frac{1}{4}$ of the third costal section is bristled, and in guttifera (about $\frac{3}{4}$ of the third section bristled) and polychaeta ($\frac{9}{10}$ of the third section bristled).

At the tip of the first section of the costa there is usually one pair of these bristles that is longer than the others, one directed diagonally upwards, the other diagonally downwards. In most species these are approximately equal in size, but in *immigrans*, *magnafumosa*, *chagriniensis*, *cardini*, *putrida*, and *floricola* one of them is so little differentiated from the adjacent bristles that it is simplest to describe the situation by saying that only one bristle is present. Differences in the lengths of these two bristles are also recorded in *grisea*, *spinofemora*, and *macrospina limpiensis*; it is not certain whether these are more or less marked than the differences noted by other observers—since the last three records are due to Patterson and Wheeler, who may have been more precise in their descriptions of this character than some of the rest of us have been.

Wing color.

In many species the wings are uniformly transparent gray, with yellow to dark brown veins. In some forms (e.g., many members of the repleta group) the tip of the first costal section is black. In others there is a clouding of the wing blade along the veins; this appears first along the cross-veins and at the junctions of the longitudinal veins with the costa (e.g., various members of the *quinaria*, *immigrans*, and *virilis* groups). In guttifera there are also clouds around the sense-organs along the veins. In other forms there is a general darkening of the blade of the wing, especially as the specimens age. In such a form as *robusta* the darkening is most marked along the veins; in *nebulosa* it becomes intense over a still greater portion of the blade. More complex patterns occur in the family, but are unusual in the genus itself. Perhaps the commonest such pattern consists of a large well-defined very dark spot at the tip of the second vein (e.g., *suzukii*, several species of *Scaptomyza*, and numerous members of other acalypterate families). More complex types of banding occur (as in *calloptera*, many of the Hawaiian forms described by Grimshaw, etc.); but most of these cannot be assigned to any of the subgenera here recognized, and it may be doubted if they are properly to be included in the genus.

Malpighian tubes.

Two stalks arise from opposite sides of the gut near its posterior end; each branches a short distance from its base, and each branch bears a Malpighian tube. The two tubes arising from one stalk lie anterior to their bases, those from the other posterior.

The anterior pair are simple, unbranched, and yellowish with white tips, in all but two of the species dissected. In *cardini* there is a single tube,

forked only at its apex; in *floricola* there is no tube, the stalk being a blind sac that is much smaller than that of the posterior pair.

There are two posterior tubes in all forms dissected, but in many species their distal ends are fused to form a loop around the gut. In *Pholadoris victoria*, and in *Drosophila cardini* and *robusta* the ends are merely closely apposed, without the formation of a continuous lumen (the same condition occurs in *Scaptomyza graminum*). In *Hirtodrosophila duncani* and *orbospiracula*, *Dorsilopha busckii*, *Phloridosa floricola*, and in all species of the subgenus *Drosophila* examined (except *cardini* and *robusta*, just described), the fusion is complete and involves a continuous lumen. All the species of *Sophophora* examined have the distal ends free, and not apposed—which is the usual situation in the related families that I have studied.

Testes.

The testes show specific differences in color, but I have done little with this—partly because there is some effect of age on the character.

The shape of the testis is a good group character. The organ is more or less elliptical in *Pholadoris* (*victoria*, and *coracina* according to Kikkawa and Peng) and in the subgroup that includes *obscura* and *pseudoobscura*. It is somewhat longer and slightly curved (about the shape of a banana) in *Hirtodrosophila duncani*, and is much longer and spirally coiled in all other forms studied. There are differences in length of the spirally coiled types, but these are hard to estimate exactly; among the shorter ones are those found in the *affinis* subgroup and in the *melanogaster* group, whereas the organ is very long in most species of the subgenus *Drosophila*.

Ventral receptacle.

The length of this organ is very highly correlated with that of the testis. It is a simple short tube or pocket in *corvina* and in the *obscura* subgroup, longer and having about 3 irregular coils in *duncani*, still longer in the *melanogaster* group and *affinis* subgroup, and is a long fine tube in the other species examined. In the *saltans* group this tube is looped into a long coil, like a skein of wool, and the whole skein is then bent into the form of the letter M. In *Phloridosa floricola* and in most members of the subgenus *Drosophila* (*micromelanica*, *putrida*, and *pinicola* are exceptions) there is a “minor coiling” or kinkiness, such that the whole organ resembles a tangled spring.

Of the other *Drosophilid* genera, the species dissected show the following types: *Amiota* and *Sinophthalmus*, a simple recurved pocket, much like that of some of the *obscura* group; *Gitona*, slightly longer and folded, but shorter than *duncani*; *Scaptomyza* and *Leucophenga*, long, fine, not kinky; *Stegana*, long, fine, kinky. In *Chymomyza* and *Mycodrosophila* the organ is long and fine, but my notes do not indicate whether it is kinky or not.

Spermathecae.

There are two spermathecae in all members of the genus examined, though in some forms they are rudimentary. In *auraria*, *montium*, and *floricola* the organs are within the usual size-range, but are scarcely chitinized at all; in *nigromelanica* they are fully chitinized but very small; in *micromelanica*, *polychaeta*, *hydei*, *mulleri*, and several of the other members of the *repleta* group (see descriptions by Patterson and Wheeler) they are both small and weakly chitinized.

The spermathecae are telescoped at the base in all members of the genus that I have seen. They vary greatly in size and shape (see figures in Sturtevant 1921, pp. 36-37), but I have been unable to discover any useful group characters in these differences.

Eggs.

There are no filaments and no remains of follicle-cells in *Phloridosa floricola*. There are two blunt filaments in *Sophophora*, two tapering ones in the *melanica* group. In the *saltans* and *willistoni* groups and in *ananassae* and *bipectinata* the apical $\frac{1}{3}$ to $\frac{1}{2}$ of each filament is greatly expanded and flattened. In the *quinaria* and *guttifera* groups there are three filaments, of which the two anterior are tapering, and the posterior evidently represents a fusion of the posterior pair present in the rest of the subgenus. Four tapering filaments occur in *Dorsilopha busckii* and in all the subgenus *Drosophila* except the *melanica*, *quinaria*, and *guttifera* groups just mentioned; four are also present in *Hirtodrosophila duncani* and *orbospiracula*. In *Pholadoris* there are from 6 to 9 filaments.

Among the other genera in the family the following numbers of filaments have been observed: *Amiota* and *Stegana*, none; *Scaptomyza*, 2 (*graminum*) or 4 (*adusta*, *terminalis*); *Mycodrosophila*, 4; *Chymomyza*, 8 to 10.

Larvae.

There are a number of species—*Pholadoris victoria* (and *P. coracina* according to Kikkawa and Peng), the *saltans* group, and *cardini*, in which the larvae "skip," by the same mechanism as that which is well known in *Piophilina* and a few other *Acalypterae* (Professor Patterson informs me that this habit is found also in the *Drosophilid* genus *Gitona*). The larva siezes its posterior end with its mouthhooks, and stretches. The hooks pull loose suddenly, the larva straightens with considerable force, and as a result is thrown several inches into the air. It seems clear that this curious habit—for which there is no obvious adaptive explanation—must have arisen several times independently. No structural peculiarity of the mouth-hooks or of the region that they grasp has been observed.

The larvae of *Dorsilopha busckii* have a series of fleshy dorsal processes, resembling those of certain *Anthomyiidae*, but not observed in any other *Drosophilid*.

It may be noted here that the larvae of *Clastopteromyia inversa* (found in the spittle-masses of Cercopidae on alder at Middleboro, Mass., and at Mendham, N.J.) have structures similar to those figured by Malloch and McAtee for *Aulacigaster* under the name of "pseudopodia." The ventral hooklets of the 6 anterior abdominal segments are aggregated into small rounded areas, one on each side of each segment. These button-like areas are on elevated leg-like processes, which the larva in fact uses in locomotion, in a manner strongly suggestive of the action of the abdominal "prop-legs" of a caterpillar.

Puparia.

The color, size, and texture of the puparium show much inter-specific variation, as does the angle between the posterior spiracles. However, I have paid attention only to the anterior spiracles in most cases. Here there are two useful characters: the number of branches of the spiracle, and the length of the "horn."

The number of branches per anterior spiracle ranges from an average of 4 (*coracina*, according to Kikkawa and Peng) to 23 (*bifurca*). It is in general low (10 or less) in *Hirtodrosophila*, *Pholadoris*, *Dorsilopha*, and *Sophophora*. It is about 11 in *Phloridosa floricola*, and in *Drosophila* is not often as low as 10 (though scattered species such as *pinicola*, *micromelanica*, and *occidentalis* have 7 to 8, and *transversa* has only 5).

The anterior spiracles are often on a definite stalk, and the length of this stalk (plus the spiracle) in relation to the length of the puparium itself has been recorded for many species. Each "horn" is $1/10$ (or less) the length of the puparium in *Hirtodrosophila*, *Pholadoris*, and *Sophophora* (slightly longer in *melanogaster* and *simulans*); about $1/5$ the puparium in *Dorsilopha* and *Phloridosa*. In *Drosophila* the horns are rather short in the *quinaria*, *guttifera*, *pinicola*, *virilis*, *testacea*, *tripunctata*, *funnebris*, *melanica*, *polychaeta*, and *cardini* groups—though in many of these they are longer than in most *Sophophoras*. In *robusta* the horns are $2/5$ the puparium, in *immigrans* they are about $1/2$, and in *longicornis* about $2/3$.

Chromosomes.

Sturtevant and Novitski (1941) have discussed the chromosome configurations of the genus on the basis of 6 "elements," represented by the 6 pairs of chromosomes of *virilis* or the six separate euchromatic elements of the salivary gland chromosomes of *melanogaster* or *pseudoobscura*. These typically consist of 5 rods and a dot.

The earlier cytological observations have been summarized by Kikkawa and Peng; the present discussion is based on their list, on the new data in the present publication, on the data given by Sturtevant (1940) and by Sturtevant and Novitski (1941), and on a few unpublished data from this laboratory.

The six elements are all separate and unmodified in their gross structure—i.e., the virilis configuration is found, in the following species: *virilis*, *novamexicana*, *transversa*, *phalerata*, *tripunctata*, *macroptera*, *macrospina*, *repleta* (also *mulleri*, *ramsdeni*, and about 10 other members of the *repleta* group here reported by Patterson and Wheeler), *micromelanica*, *cardini*, and *similis*—all belonging to the subgenus *Drosophila*; and in *Sophophora subobscura*.

Essentially the same arrangement is found also in *funebri*, *histrio*, *longicornis*, *hamatofila*, *palustris*, *subpalustris*, *subquinaria*, *occidentalis*, *suboccidentalis*, and *hydei*—all apparently with an extra amount of heterochromatin on the X. *Hirtodrosophila orbospiracula* is apparently also to be reckoned as a variant from this type.

A modification of this type is found in which one of the rod-shaped chromosomes has acquired a non-terminal centromere, becoming a J or small V. This occurs in *montana*, *melanospila*, and *neorepleta* (where the V is an autosome), and probably in *Sophophora elliptica*.

There is thus a total of over 35 known members of the subgenus *Drosophila* in which all 6 elements are separate, as opposed to two *Sophophoras* and one *Hirtodrosophila*.

In another series of species two of the rod-shaped elements are attached, to give a large V, with three rods and a dot remaining. This occurs in *Sophophora pseudoobscura* and *miranda* (where the large V is the X); in *Drosophila texana* (where the V is an autosome); and in *calloptera* (subgenus uncertain) and *Scaptomyza adusta* (where the X is not yet identified).

Subterminal or median centromeres are found in the rods associated with single large V's in several forms. There is one small V in *melanica*, *nigromelanica*, "melanissima" of Kikkawa and Peng, and in *sordidula*—all of the subgenus *Drosophila*. Two J's occur with a large V in *Hirtodrosophila duncani* and in all the members of the *affinis* subgroup of *Sophophora* that have been examined; and three small V's and a large one are recorded for *Sophophora obscura*. In all these cases the large V appears to be the X.

Two large V's result from fusion of 4 rods, leaving a rod and a dot. This is the familiar configuration of *melanogaster*, and is found in *simulans* and five other members of the *melanogaster* group—the rod being X wherever it has been identified. The same arrangement is recorded for *Chymomyza amoena* and *Scaptomyza graminum*—again with X as the rod. In several other forms the same configuration is recorded, with no identification of the X: *Pholadoris coracina*; *Drosophila vibrissina*, *quinaria* and *munda*; *bromeliae* and *florae* (subgenus uncertain); *Chymomyza procnemis*; *Mycodrosophila dimidiata*.

The single rod has acquired a subterminal centromere in *Sophophora robusta*, in which also X is a large V, not a separate element.

Still another modification from this type occurs in *Sophophora ananassae*, and probably also in *biplectinata* and *montium*, where part of the element A (X of *melanogaster*) has become attached to the dot. In *ananassae* and *biplectinata* the remaining portion of X has also acquired a median centromere. It is possible that *fuliginea* also belongs here, its metaphase configuration resembling that of *montium*.

In the other types that can be analyzed the dot has become attached to a rod, to give a J, the short arm of which is often overlooked. This seems not to have been observed except in cases where there has also been fusion of rods.

The type with one large V, 2 rods and a J is known in *immigrans* and in the related *komaii* in the subgenus *Drosophila*. Apparently this arrangement is present in *Pholadoris victoria*, with the added property that both rods have acquired subterminal centromeres.

The two rods of this type are fused, to give 2 large V's and a J, in the *willistoni* group and all the *saltans* group except *elliptica*, and in *takahashii* (according to observations of Mr. George T. Rudkin) of *Sophophora*; in *Drosophila pinicola*; and in *Dorsilopha busckii*. In *takahashii* and *busckii* the J is the X—i.e., its composition must be A-F; in all the other forms named the chromosome in question is autosomal.

There remain a number of configurations not yet correlated with the general scheme; they will need a determination of the distribution of heterochromatin, and perhaps genetical study as well. The following examples may be cited: *polychaeta* (Mr. Novitski's preparations show one large V, two somewhat smaller V's, one J, one rod, one dot); *fulvalineata*, with five rods and a small V; *bizonata* and *Cladochaeta nebulosa* (three nearly equal V's and a dot).

Mating habits.

The mating habits have been observed in more than 20 species since the summary previously given (Sturtevant 1921) was written. The most striking new types are the following:

Hirtodrosophila duncani. As first observed by Dr. W. P. Spencer, the female inflates her abdomen when sexually excited. The phenomenon is quite marked and unmistakable; it has not been observed elsewhere.

Drosophila polychaeta. No vibration, circling, or other preliminary movements seen. The male follows the female, touching her abdomen with his proboscis and fore tarsi. He then grasps the tips of her wings with his first and second pairs of legs, and doubles his abdomen underneath. If successful in mating he retains this same position, never mounting further, and the wings of the female are never spread. Ten copulations observed; each lasted about 30 seconds. Numerous unsuccessful attempts at mating.

In *auraria* and in *montium* it seems clear that the very large sex-combs assist the male in retaining his grasp on the abdomen of the female. In *elliptica*, *emarginata*, and *cordata*, the female gives a characteristic

“switching” reaction during copulation, as though attempting to remove the male.

Mounting precedes copulation in *auraria*, *montium*, *carbonaria*, *polychaeta*, and apparently in *duncani*, as well as in the previously described *Chymomyza amoena* and *C. procnemis*.

The female spreads her wings before the male mounts in *nebulosa*, *funebri*, *hydei*, *repleta*, and *virilis* (all previously reported), and also in *rectangularis*, *mojavensis*, *micromelanica*, *carbonaria*, and *cardini*.

The duration of copulation averages 5 minutes or less in *Phloridosa lutzii*; *Sophophora nebulosa*, *affinis*, and *montium*; *Dorsilopha busckii*; *Drosophila robusta*, *virilis*, *polychaeta*, *hydei*, *linearepleta*, *repleta*, and *mojavensis*. No member of the *repleta* group is known except the four last named above. The longest duration observed is in *immigrans* (average 53 minutes); next come *cordata*, *macrospina*, and *carbonaria*—all about 30 minutes.

In general the mating habits do not seem to furnish useful group characters. It is possible that more observations, both on additional species and more exact descriptions of those already observed, may change this situation. Two possible group characters are referred to above (“switching” in a *saltans* subgroup, and brief copulation in the *repleta* group).

Food habits.

Several more or less distinct kinds of feeding and breeding habits may be recognized among the species of *Drosophila*. Most species may be roughly characterized as general scavengers, fruit feeders, sap feeders, or fungus feeders.

The general scavengers feed on decaying vegetable matter (such as potatoes, cabbages, and sometimes manure), occasionally on animal matter (*busckii* and *funebri* are common about stale formalin-preserved material in laboratories), and are also often to be found on decaying fruit with the next group of species. In the temperate zone these species are all associated with man; with the possible exception of *funebri* (which has perhaps recently changed from a fungus diet) they are all introduced in the United States. Included here are *busckii*, *funebri*, *repleta*, *hydei*, and the tropical *ananassae*.

The fruit-feeders in the temperate zone are also introduced forms associated with man. Members of the sap-feeding group are likewise to be found about fruit; but during the early part of the summer there is in general no available native food-material for the fruit-feeders; it is accordingly not surprising that the species that are largely limited to fruit are of tropical origin. This group includes *melanogaster*, *simulans*, and *immigrans*.

The sap-feeders are to be found on many kinds of bleeding trees—both conifers and dicotyledons. *Pinus*, *Quercus*, *Betula*, and *Populus* are perhaps the most favored trees, but the largest populations I have seen

have been on *Vitis*. This feeding habit occurs in *Pholadoris*, in the obscure group of *Sophophora*, in the *melanica*, *robusta*, *tripunctata*, and *pinicola* groups of *Drosophila*, and in the species *californica* and *occidentalis* of *Drosophila*. All of these are attracted to fruit, and certainly breed on it when it is available.

The fungus-feeders are to be found around either *Agarics* or *Boletus*. They are absent in most of California, where the long dry summers prevent growth of fungi at times when the temperature is high enough for *Drosophila* to breed. This group includes *transversa*, the *testacea* group, *guttifera*, so far as is known all of the subgenus *Hirtodrosophila*, and the related genera *Leucophenga* and *Mycodrosophila*.

Another type of feeding habit is represented by *quinaria*, *deflecta*, *palustris*, and *subpalustris*. The first is common about tomato plants, even before the fruit is ripe, and I have taken it in early spring on water-cress. The remaining three species are associated with water-plants—especially *Nymphaea* and *Sagittaria*. Apparently these forms breed on moist decaying parts of such succulent plants. It should be noted that these species are closely related; they are also close to *occidentalis* (a sap-feeder), and to *transversa* and *guttifera* (fungus-feeders).

A similar feeding-habit is that of utilizing decaying parts of desert succulents, such as *Cactaceae*, *Yucca*, or *Agave*. This habit, found in *mojavensis*, is perhaps to be correlated with the fact that the related *repleta* and *hydei* are general scavengers.

Still another feeding habit is that of utilizing flowers. This is found in the tropical floras, *lutzii*, *alfari*, and *tristani*, and in the Californian *floricola*. Observations on the latter indicate that the chief larval food is pollen; this group alone seems therefore not to be dependent on yeast and bacteria, for it is clear that in all the other types the medium itself is not the chief direct food supply. Several kinds of flowers are used; both in California and in the tropics there are records for *Malvaceae* (*Gossypium* in Jamaica, *Hibiscus* in California), *Datura*, morning-glories, and melon. In both regions *Datura* is most frequently used.

CLASSIFICATION OF THE GENUS DROSOPHILA

GENERAL ACCOUNT

As outlined previously (Sturtevant 1939), an attempt has been made to develop a classification that is as free of personal bias as I could make it. A table was made up, including 56 species of *Drosophila* and two of *Scaptomyza*. For each of these the condition of 33 characters was noted. These characters are mostly included in the summary given herewith; the table itself has not been reproduced, because it would give a false impression of accuracy. A number of the characters used do not permit exact classification in all species, and it would be misleading to record

the best estimate I have been able to make—which is what appears in the table.

Three criteria were adopted, and every character which satisfied all of these was entered in the table.

(a) Every species must be capable of classification for the character. Size of sex-combs, for example, was not included because some species have no sex-combs.

(b) At least two species must be included in a class. The dorsal processes of the *busckii* larvae occur only in this species, and therefore cannot give any information about the relationships of the species; they were not included.

(c) Two characters obviously likely to be closely related developmentally or in terms of natural selection were not both included. This criterion is not easy to apply, but seems a necessary one to keep in mind.

Some characters have been entered as “present” or “absent,” others as numerical values. In the latter case, since there is usually some intra-specific variability, an arbitrary degree of difference has been set as significant.

From this primary table two new tables have been made up; these may be described and discussed separately.

The second table shows the total numbers of differences, with respect to the 33 chosen characters, between each pair of the 58 species. The values in this table run from 0 to 25. They may be taken as giving indexes of the degrees of difference between the species concerned; and it seems fair to assume that they will also serve to indicate something about closeness of relationship.

Since, as pointed out, some of the characters used are rather indefinite, it is certain that a complete reconstruction of the primary table would not give just the same values for the second table. There would also be differences if different characters were used, or if different arbitrary values were selected as significant ones. One test has been carried out to obtain some idea of the extent to which the values of the second table may be taken to indicate true degrees of divergence. A new primary table was made up, based on 20 of the species included in the first primary table, and utilizing 11 characters that are wholly independent of the original 33 (5 of these 11 concern the chromosomes and the mating habits, not included in the original table because neither is known for all 58 species). From this a new second table was constructed, showing numbers of differences (among the 11 characters) between all pairs among the 20 species. A correlation table was then made up, for corresponding values in the two separate second tables. The result obtained was not unexpected; for values up to about 12 differences in the large table or 4 in the smaller one, there is an unmistakable positive correlation; for values higher than this there is little or no correlation. In other words, considering only the larger table, numbers of differences less than about

12 indicate probable relationship, and it is likely that, below this level, the table gives an indication of relative *degrees* of relationship; differences greater than 12 in number are of little significance. Twelve to fifteen differences mean little more than do twenty or more; but 6 are probably indicative of closer relationship than are 8 to 10.

The third table, derived from the primary 58x33 one, shows the correlation between different characters. This represents an attempt at weighting the characters. Every taxonomist recognizes certain characters as "good" and others as "poor" for the delimitation of groups above the species level. "Good" in this sense may be taken, I think, as implying that the character serves as a useful index of the probable nature of other characters. If this be granted, the best characters are those that show the highest correlations with the maximum number of other characters. In other words, the purpose in making the third table is to determine which are the "best" characters, in the sense in which the term is ordinarily used, by a method that is as free of personal equation as I can make it.

Study of this third table shows at once that there is a single group of highly correlated characters, and that no other strong correlations are present (except in a few cases of characters limited to a few species). The three most satisfactory correlations are as follows (see below for significance of the numbers in parentheses) :

Egg filaments	Ventral receptacle		Egg filaments	Posterior Malpighian tubes		
	kinky	not kinky		free	apposed	fused
0	1 (0)	0	0	0	0	1 (0)
2	2	25 (24)	2	23	1 (0)	3
3	6	0	3	0	0	6
4	18	5 (2)	4	0	2	21 (18)
8	0	1 (0)	8	0	1 (0)	0

Ventral receptacle	Posterior Malpighian Tubes		
	free	apposed	fused
kinky -----	0	2	25 (24)
not kinky -----	23	2 (0)	6 (3)

Examination of the exceptional classes in these, and in the tables showing definite correlations of other characters with these three, shows that several species are repeatedly to be found in the lists of exceptions. These include the two species of *Scaptomyza*, *duncani*, *victoria*, *busckii*, and *floricola*. If these 6 are removed, the values shown in parentheses in the table are obtained. The four named species of *Drosophila* have accordingly here been placed in separate subgenera (*Hirtodrosophila*, *Pholadoris*, *Dorsilophia*, and *Phloridosa*, respectively).

The remaining 52 species then fall easily into two distinct assemblages—recognized as the subgenera *Drosophila* and *Sophophora*.

Turning now to the second table, the ranges of numbers of differences within and between the subgenera (and the genus *Scaptomyza*) are as shown:

	Scapto- myza	Hirtodro- sophila	Phola- doris	Phlori- dosa	Dorsi- lopha	Droso- phila	Sopho- phora
<i>Scaptomyza</i>	8	10	12-16	15	13	5-21	8-20
<i>Hirtodrosophila</i>	10	---	15	17	15	8-20	9-19
<i>Pholadoris</i>	12-16	15	---	15	15	11-19	12-18
<i>Phloridosa</i>	15	17	15	---	11	9-18	13-22
<i>Dorsilopha</i>	13	15	15	11	---	9-15	10-18
<i>Drosophila</i>	5-21	8-20	11-19	9-18	9-15	1-18	9-25
<i>Sophophora</i>	8-20	9-19	12-18	13-22	10-18	9-25	0-18

With the exception of a single pair of species, *Drosophila pinicola* and *Scaptomyza terminalis* (5 differences) the minimum number of inter-subgeneric differences is 8. Further examination of the second table shows that, within the three groups that have more than one studied species (*Scaptomyza*, *Drosophila*, *Sophophora*), this value of 8 is, in each case, also the minimum by means of which it is possible to interrelate the whole group by successive pairs—a circumstance that may be taken as confirming the validity of the subgeneric separations.

Within each of the two large subgenera there exist some correlations of characters that are not present when the whole genus is considered. This is quite marked in the case of *Sophophora*, and easily leads to the recognition of four distinct species-groups, two of which are again easily split into two subgroups. The characteristics and component species of these are listed elsewhere in this paper.

Correlations are less evident in the subgenus *Drosophila*, which in general seems more complex than does *Sophophora*. The 14 species-groups are less satisfactorily delimited, and in some cases less homogeneous, than are those of *Sophophora*. The *quinaria* group, for example, might easily be made either to exclude *transversa* or to include *guttifera*, rather than *vice versa* as is here done. The *robusta* group is not very clearly distinct from the *repleta* one—and in fact even the *funebria* and *melanica* groups might perhaps be united to the *repleta* one.

The relationships between the subgenera are difficult to evaluate. Perhaps the most interesting species here is *Drosophila pinicola*, which shows the following numbers of differences: from *virilis* 7, from *carbonaria* 8, from all other members of its own subgenus 9 or more; from *Scaptomyza terminalis* 5, from *S. graminum* 10; from *Hirtodrosophila duncani* 8, from *Sophophora affinis*, *algonquin*, *athabasca*, and *azteca* 9 each. If *pinicola* is disregarded, the minimum differences of the subgenus *Drosophila* become: from *Hirtodrosophila* 11, from *Scaptomyza* 10, from *Sophophora* 12—the only inter-group difference as low as 8 then remaining being that between *Scaptomyza* and *Sophophora* (*graminum-athabasca*).

It therefore seems reasonable to regard *pinicola* as a primitive type, and to suppose that the related *obscura* group is primitive in the subgenus *Sophophora*. Both *Scaptomyza* and *Hirtodrosophila* may also be supposed to be related to this common *Drosophila*-*Sophophora* stock.

Within *Sophophora*, the *melanogaster* and *willistoni* groups may be supposed to be derived directly from the *obscura* one, and the *saltans* one from the *willistoni* one (Sturtevant 1940). Any phylogeny of the subgenus *Drosophila* must be very speculative at present. Tentatively, one may surmise that the main developmental line is through the following species-groups: *pinicola*, *virilis*, *tripunctata*, *funebis*, *repleta*, *robusta*, *immigrans*—in that order. On this basis the *quinaria* group arose from the *virilis*-*tripunctata* region, and the *guttifera* and *testacea* groups from the *quinaria* one; the *melanica* group from the *repleta* one; *polychaeta* from the *funebis*-*repleta* region; *carbonaria* from the *repleta*-*melanica* region; and the *cardini* group from the *robusta* one.

Dorsilopa is most like *virilis*, *testacea*, and *quinaria* of the subgenus *Drosophila* (9 differences). *D. busckii* is one of the species included in the trial 20x11 table made to check the results of the primary 58x33 table. A table of total differences among the 44 possible ones has been made up for these 20 species—i.e., a new "second table." This table leads in general to the same conclusions as the standard second table; but in the case of *busckii* it fails to confirm the resemblance to *virilis* (no members of the *testacea* or *quinaria* groups are included), and in fact suggests that *busckii*, while remote from all the other 19 forms, is perhaps least different from the *melanogaster* group of *Sophophora*. Incomplete descriptions of species of *Hirtodrosophila* other than *duncani* suggest that some of these (*orbospiracula*, for example) may in fact be the closest relatives of *busckii*.

Phloridosa comes closest to the *repleta* group of *Drosophila*, with *virilis* nearly as similar; *Pholadoris* has only a suggestion of relationship to *robusta* and to *polychaeta* of the subgenus *Drosophila*.

The same general method has been adopted in an attempt to determine the probable relationships of certain other genera of *Drosophilidae*, for which rather less information is available, with the following results:

Zaprionus vittiger Coquillett. Alcoholic material from Dr. G. Eloff has yielded the following characters: sterno-index .4; abdominal dark bands slightly narrowed in mid-dorsal region; ventral receptacle moderately long and slender, not kinky; spermathecae well-developed, brown, chitinized; eggs with 4 long tapering filaments, each about .9 length of egg; puparial horn about $\frac{1}{6}$ puparium; anterior spiracle with about 9 branches. The form appears to be about equally distant from *Dorsilopa*, *Hirtodrosophila*, and *Drosophila* (most like *pinicola* and *cardini* in this subgenus).

Clastopteromyia inversa (Walker). Dissection, and examination of larvae and puparia, have been made. The closest relatives appear to be

Dorsilopha, *Drosophila* (repleta, robusta, and quinaria groups), and *Scaptomyza*.

Chymomyza amoena (Loew) and *procnemis* (Williston). Nearest *Drosophila* (pinicola, quinaria, and guttifera groups).

Mycodrosophila dimidiata (Loew). Nearest *Pholadoris*.

Amiota leucostoma Loew. Nearest *Pholadoris*, *Mycodrosophila*, and perhaps *Hirtodrosophila*.

Sinophthalmus and *Gitona* appear to be rather close to each other, and to be related to *Amiota*. This is possibly the most primitive group of genera in the family. *Stegana* and *Leucophenga*, close to each other, resemble *Chymomyza*; they are perhaps also related to *Amiota* or to *Hirtodrosophila*.

Finally, an attempt has been made to estimate the position of the family *Drosophilidae*. A table was made up including 40 genera (*Scatophaga*, *Conops*, and 38 assorted *Acalypterae*) classified for 29 characters. The characters include six from Frey's (1921) account of the mouthparts (in some cases based on my own study of these organs), four from the female genitalia (Sturtevant 1925-1926), and 19 from the external structure of the imagines—including most of the characters commonly utilized in the delimitation of families and larger groups. The *Drosophilid* genera *Drosophila*, *Stegana*, *Gitona*, and *Sinophthalmus* were included, as were the following that have at various times been referred to the family: *Periscelis*, *Trioxscelis*, *Diastata*, *Aulacigaster*, and *Leiomyza*.

The following numbers of differences were minimal for the genera indicated:

Drosophila: 2 (*Stegana*, *Gitona*); 4 (*Sinophthalmus*); 8 (*Anthomyza*); 9 (*Desmometopa*, *Periscelis*, *Leptocera*).

Stegana: 2 (*Drosophila*, *Sinophthalmus*); 3 (*Gitona*); 8 (*Anthomyza*, *Tethina*, *Phyllomyza*); 9 (*Periscelis*, *Desmometopa*, *Diastata*, *Leptocera*, *Leucopis*, *Sphaerocera*).

Gitona: 2 (*Drosophila*, *Sinophthalmus*); 3 (*Stegana*); 7 (*Anthomyza*); 8 (*Aulacigaster*, *Leptocera*); 9 (*Borborus*, *Desmometopa*, *Diastata*, *Tethina*).

Sinophthalmus: 2 (*Stegana*, *Gitona*); 4 (*Drosophila*); 7 (*Anthomyza*); 8 (*Borborus*, *Aulacigaster*, *Leucopis*, *Phyllomyza*); 9 (*Desmometopa*, *Leptocera*, *Periscelis*, *Sphaerocera*, *Tethina*).

Anthomyza: 6 (*Aulacigaster*); 7 (*Desmometopa*, *Gitona*, *Stegana*); 8 (*Drosophila*, *Stegana*, *Ochthiphila*); 9 (*Diastata*, *Leucopis*, *Psila*, *Sapromyza*).

Aulacigaster: 6 (*Anthomyza*); 8 (*Gitona*, *Sinophthalmus*, *Piophila*); 9 (*Desmometopa*, *Diastata*, *Leucopis*, *Ochthiphila*).

Desmometopa: 4 (*Phyllomyza*); 7 (*Anthomyza*); 9 (*Drosophila*, *Gitona*, *Sinophthalmus*, *Stegana*, *Aulacigaster*, *Diastata*).

Phyllomyza: 4 (*Desmometopa*); 8 (*Stegana*, *Sinophthalmus*); 9 (*Tethina*).

The chief conclusions to be drawn here are negative. The *Drosophilidae* are not closely related to the *Agromyzidae*, *Trypetidae*, *Lonchaeidae*, *Sepsidae*, *Helomyzidae*, *Ephydridae*, *Astiidae*, *Sapromyzidae*, *Sciomyzidae*, or *Chloropidae*. The suggestion of relationship to the *Milichiidae* is unexpected; those to the *Anthomyzidae* and to *Aulacigaster* have often been pointed out before.

Incidentally, some other results of a study of this table may be indicated. The *Ephydridae* (*Ephydra*, *Dichaeta*, *Hydrellia* studied) are very remote from all other included forms. *Canace* and *Tethina*, which have been compared to them, do not come as close as does *Diastata*—but even this latter resemblance does not seem significant. *Chlorops* and *Periscelis* are also remote from any other of the forms studied, and from each other. The *Trixoscelidae* and *Helomyzidae* appear to be related to the *Sapromyzidae*; *Coelopa* perhaps also belongs near here. The *Sepsidae*, *Piophilidae*, *Clusiidae*, and *Psilidae* are related to each other; another group includes the *Trypetidae*, *Lonchaeidae*, and *Ortalidae*, from which the *Calypterae*, *Agromyzidae*, and *Sciomyzidae* appear to be not remote.

SPECIES REFERRED TO SEPARATE GENERA

The following species that were included in *Drosophila* in my former account now seem best referred to the genera indicated.

Zygothrica Wiedemann. Malloch and Duda both recognize as one of the most important characteristics here the large shining ocellar triangle, that reaches the anterior margin of the front. The genus should include *Drosophila vittatifrons* Williston and *D. poeyi* Sturtevant.

Microdrosophila Malloch (synonym, *Incisurifrons* Duda). Anterior dorsocentral placed nearly as far anterior to posterior one as distance between dorsocentral rows; fourth-vein index about 4.0. The type species is *Drosophila quadrata* Sturtevant.

Diathoneura Duda. Anal cell and anal vein absent; carina low or absent; no prescutellars; postverticals minute; dark species. Includes *Drosophila splendida* Williston, *D. opaca* Williston, *D. dubia* Sturtevant, *D. metallica* Sturtevant, *D. superba* Sturtevant, and a number of other tropical species described by Duda.

Clastopterymyia Malloch. Anal cell and anal vein absent; carina low; prescutellars present; yellowish species; wings strongly clouded. The type species is *Drosophila inversa* Walker; also includes *D. paradoxa* Lamb, *C. foridana* Malloch (Florida), and *C. triseta* Malloch (Costa Rica).

Subgenera and species groups of Drosophila, with included species

Subgenus **Hirtodrosophila** Duda. Type, *longecrinita* Duda (Formosa). (Synonym *Dasydrosophila* Duda, as change of name).

Third antennal segment large, covered with unusually long hairs. Carina narrow, short, practically absent on lower part of face. Arista usually

with one branch below in addition to terminal fork. Sterno-index .5 or less. So far as known, all are fungus-feeders.

Duda has referred to this subgenus a number of Oriental and Neotropical forms, and I have also included *D. duncani* Sturtevant from the eastern United States. An examination of Philippine specimens of the type-species in my collection led me later to question this reference (Sturtevant 1940); but it now seems most likely that the group is a valid one and should also include *alabamensis* Sturtevant *prognatha* Sturtevant (both, as well as *duncani*, already tentatively referred here by Duda), *longala* Patterson and Wheeler, *orbospiracula* Patterson and Wheeler, *cinerea* Patterson and Wheeler, *grisea* Patterson and Wheeler, and *chagrinsensis* Stalker and Spencer. The seven Nearctic species are all rare—perhaps only because systematic collection of fungus-feeding forms has been somewhat neglected.

The only two species that I have had available in stocks—*duncani* and *orbospiracula*—are very distinct. Further study of the subgenus will undoubtedly permit the recognition of a number of species-groups.

Subgenus **Pholadoris**,* subg. nov. Type *Drosophila victoria*, sp. nov.

Shining dark species; prescutellars present; a V-shaped shining bristle-bearing area on front; egg-filaments 6 to 8; posterior Malpighian tubes apposed at distal ends; testis short, not coiled; ventral receptacle short, not coiled or kinky; skipping larvae.

Includes *D. coracina* Kikkawa and Peng (Japan) and a number of undescribed forms.

Subgenus **Dorsilopha**, subg. nov. Type, *Drosophila busckii* Coquillet.

Yellowish species, mesonotum longitudinally striped; preapicals not evident on second and third tibiae; larvae with dorsal processes; 4 egg-filaments; posterior Malpighian tubes fused; ventral receptacle not kinky; sterno-index about .3.

No other species known.

Subgenus **Phloridosa**, subg. nov. Type, *Drosophila floricola*, sp. nov.

Shining black or brown species; bristles and branches of arista short; sterno-index .3 or less; anterior Malpighian tubes absent; posterior Malpighian tubes fused to form a loop around the gut; testes long, spirally coiled; eggs without filaments or remains of follicle cells; flower-feeding species.

Includes *D. lutzii* Sturtevant, *D. alfari* Sturtevant, *D. tristani* Sturtevant. *D. mauiensis* Grimshaw, from Hawaii, perhaps also belongs here.

Subgenus **Sophophora** Sturtevant. Type *D. melanogaster* Meigen (*D. fasciata* auct.)

Eggs with 2 blunt filaments; ventral receptacle not kinky; posterior Malpighian tubes free at their distal ends; sterno-index .6 or less; anterior spiracle and its stalk not over $\frac{1}{5}$ length of puparium; second to fifth abdominal tergites with posterior dark bands that are never broken or narrowed in mid-dorsal line; cheeks always relatively narrow.

*This and the next two subgeneric names are anagrams of *Drosophila*.

Four distinct species-groups may be recognized:

1. saltans group. Dark species; long fine ventral receptacle; long spiral testes; one or two opaque heavily chitinized areas on fifth abdominal tergite of female; skipping larvae; no sex-combs; filaments of eggs much expanded apically; sterno-index .3 to .4; anterior scutellars divergent; tropical America.

Two sub-groups. (a) grayish markings on mesonotum; minute hairs present below carina; saltans Sturtevant, biopaca Sturtevant, rectangularis Sturtevant, sellata Sturtevant, earliei Sturtevant, and presumably prosaltans Duda.

(b) No gray mesonotal pattern; no minute hairs below carina; cordata Sturtevant; elliptica Sturtevant, emarginata Sturtevant.

2. willistoni group. Yellowish species; long fine ventral receptacle; medium long spiral testes; no opaque areas on tergites; larvae do not skip; no sex-combs; sterno-index .3; egg-filaments much expanded at apices; anterior scutellars divergent; tropical America.

Includes willistoni Sturtevant and nebulosa Sturtevant.

3. melanogaster group. Yellowish species; rather long ventral receptacle; medium long spiral testes; no opaque areas on tergites; larvae do not skip; sex-combs present; sterno-index .5 to .6; anterior scutellars convergent; apparently native to tropical and sub-tropical regions of Old World, but several now much more widely distributed.

Includes melanogaster Meigen, simulans Sturtevant, takahashii Sturtevant, ananassae Doleschall, bipectinata Duda, montium de Meijere, auraria Peng. Also, from rather less complete data, it seems safe to add to this list unipectinata Duda, miki Duda, rufa Kikkawa and Peng, nipponica Kikkawa and Peng, ficusphila Kikkawa and Peng, and lutea Kikkawa and Peng. Suzukii (Matsumura) is perhaps best placed here, but is in some respects more like the next species-group (see Sturtevant and Novitski 1941, p. 536).

4. obscura group. Dark species; no opaque areas on tergites; larvae do not skip; sex-combs present; preapicals on first tibiae unusually long; sterno-index about .6; anterior scutellars convergent; second oral small; middle orbital large; north temperate zone.

There are two subgroups here: (a) Several teeth in distal sex-comb; 8 acrostichal rows; ventral receptacle short; testes elliptical; carina broad, flat. Includes pseudoobscura Frolowa, miranda Dobzhansky, subobscura Collin, obscura Fallén, tristis Fallén, and several undescribed European species.

(b) One tooth in distal sex-comb; 6 acrostichal rows; ventral receptacle nearly as long as in group 3; testes rather short, but still spirally coiled; carina narrow, not flat; American species. Includes affinis Sturtevant, algonquin Sturtevant and Dobzhansky, athabasca Sturtevant and Dobzhansky, azteca Sturtevant and Dobzhansky, narragansett Sturtevant and Dobzhansky, seminole Sturtevant and Dobzhansky.

Subgenus **Drosophila** Fallén. Type *Musca funebris* Fabricus.

Three or four egg-filaments (two in the melanica group), at least anterior ones tapering; ventral receptacle long, fine, usually kinky; testes long, spiral; posterior Malpighian tubes forming a closed loop around the gut, their distal ends sometimes merely apposed but usually fused and with a continuous lumen; dark posterior bands on abdomen usually narrowed or broken in mid-dorsal line; sterno-index usually .5 or more; cheeks often wide; puparial "horns" often more than $\frac{1}{5}$ length of puparium.

This is the largest and most complex of all the subgenera. It is difficult to arrange in subdivisions; there are a number of species that clearly belong to the subgenus, but that are not sufficiently well understood to be placed satisfactorily (e.g. *melanderi* Sturtevant, *macroptera* Patterson and Wheeler, *rubrifrons* Patterson and Wheeler, *bizonata* Kikkawa and Peng, *lugubrina* Duda, and *vibrissina* Duda).

The following species-groups may be recognized:

1. *quinaria* group. Yellowish species, shining; eggs with 3 filaments; cross-veins clouded; abdominal dark bands often broken into spots; arista with 9 to 11 branches.

Includes *quinaria* Loew, *deflecta* Malloch, *palustris* Spencer, *subpalustris* Spencer, *occidentalis* Spencer, *suboccidentalis* Spencer, *munda* Spencer, *subquinaria* Spencer, and *transversa* Fallén. Probably also to be included are *phalerata* Meigen and *nigromaculata* Kikkawa and Peng.

2. *guttifera* group. Yellowish, mesonotum striped; 3 egg-filaments; wings with numerous black spots; second oral large; third antennal segment with longish hairs; costal index about 2.2; sterno-index about .4; fungus-feeder.

Includes only *guttifera* Walker.

3. *pinicola* group. No minor coils in ventral receptacle; grayish brown species; carina narrow; middle orbital $\frac{1}{4}$ other two; "horns" of puparium scarcely $\frac{1}{10}$ length of puparium; sterno-index about .5.

Includes only *pinicola* Sturtevant.

4. *virilis* group. Blackish species; anterior scutellars divergent; posterior cross-vein clouded; sterno-index .8 to .9.

Includes *virilis* Sturtevant, and the species or subspecies *americana* Spencer, *texana* Patterson, Stone and Griffin, *novamexicana* Patterson, and *montana* Patterson and Wheeler.

5. *testacea* group (= subgenus *Acrodrosophila* Duda). Yellowish or brownish species; a pair of presutural acrostichal bristles; ventral receptacle with no minor coils; fungivorous.

Includes *testacea* von Roser and *putrida* Sturtevant.

6. *tripunctata* group. Yellow; third to fifth abdominal tergites each with a median black spot; arista with about 12 branches; costal index about 4.3.

Includes *tripunctata* Loew, and perhaps *histrion* Meigen.

7. *funnebris* group. Reddish brown species; sterno-index about .7; "horn" about $\frac{1}{5}$ length of puparium; arista with 10 to 11 branches; male abdomen largely shining black.

Includes *funnebris* (Fabricius), *macrospina* Stalker and Spencer, and *subfunnebris* Stalker and Spencer.

8. *repleta* group. Grayish mesonotum, each hair and bristle arising from a black or dark brown spot; 6 to 9 branches of arista; "horn" of puparium usually more than $\frac{1}{4}$ length of puparium; costal index from 2.5 to 3.5.

Includes *repleta* Wollaston, *hydei* Sturtevant, *mulleri* Sturtevant, *melanopalpa* Patterson and Wheeler, *neorepleta* Patterson and Wheeler, *linearepleta* Patterson and Wheeler, *fuliginea* Patterson and Wheeler, *nigrospiracula* Patterson and Wheeler, *leonis* Patterson and Wheeler, *hydeoides* Patterson and Wheeler, *nigrohydei* Patterson and Wheeler, *bifurca* Patterson and Wheeler, *pachea* Patterson and Wheeler, *aldrichi* Patterson and Crow, *buzattii* Patterson and Wheeler, *mojavensis* Patterson and Crow, *meridiana* Patterson and Wheeler, *mercatorum* Patterson and Wheeler, *peninsularis* Patterson and Wheeler, *ritae* Patterson and Wheeler, *brevicarinata* Patterson and Wheeler, *longicornis* Patterson and Wheeler, *hamatofila* Patterson and Wheeler, and (on the basis of less complete information) also *fasciola* Williston, *ramsdeni* Sturtevant, *californica* Sturtevant, and *maculipennis* Duda.

9. *robusta* group. Large blackish species; posterior Malpighian tubes apposed, not with a continuous lumen; costal index about 4.0; arista with about 9 branches; "horn" $\frac{2}{5}$ length of puparium.

Includes *robusta* Sturtevant and probably also *colorata* Walker and *sordidula* Kikkawa and Peng.

10. *melanica* group. Blackish species; two egg-filaments, each about the same length as the egg; sterno-index .7 to .8; second oral not over half first; arista with 7 to 8 branches.

Includes *melanica* Sturtevant, *micromelanica* Patterson, *nigromelanica* Patterson and Wheeler, and (with less certainty) *melanissima* Sturtevant (also the distinct Japanese species described by Kikkawa and Peng under this name), and perhaps *pseudomelanica* Sturtevant.

11. *polychaeta* group. Large reddish brown species; three pairs of postsutural dorsocentrals; costal index about 2.0; fourth vein index 1.8 to 2.2.

Includes *polychaeta* Patterson and Wheeler, probably also *illota* Williston, and perhaps *grandis* Kikkawa and Peng.

12. *carbonaria* group. Very dark species; middle orbital almost as long as anterior; pupae with strongly roughened surface.

Includes only *carbonaria* Patterson and Wheeler.

13. *cardini* group. Reddish or yellowish brown, shining; larvae skip; posterior Malpighian tubes apposed but not with continuous lumen; cheeks narrow; sterno-index about .5; costal index about 3.9.

Includes *cardini* Sturtevant, perhaps also *similis* Williston, *albirostris* Sturtevant, and *metzii* Sturtevant.

14. *immigrans* group (subgenus *Spinulophila* Duda, = *Acanthophila* Duda). Dull yellowish; a row of short thick spines on first femur; costal index over 3.0; "horn" about half length of puparium.

Includes *immigrans* Sturtevant, *spinofemora* Patterson and Wheeler, and (with less data to go on) *komaii* Kikkawa and Peng, *nasuta* Lamb, *monochaeta* Sturtevant, *balneorum* Sturtevant, *rubra* Sturtevant, *signata* Duda, *annulipes* Duda, *ruberrima* de Meijere, *subfasciata* de Meijere, *mediostriata* Duda, and *maculifrons* Duda.

SPECIES VS. SUBSPECIES

The authors of the present series of papers do not agree on the status of some of the forms described (see also Dobzhansky, 1941). I feel that several of the types here described as species are better treated as subspecies, as follows:

- D. *mulleri*, subsp. *mojavensis*
- D. *virilis*, subsp. *americana*, *texana*, *novamexicana*, *montana*
- D. *occidentalis*, subsp. *suboccidentalis*

It seems likely that some other forms should also be considered as subspecies (e.g., *arizonensis* a subspecies of *mulleri*, *subfunebri* a subspecies of *macrospina*) if more data were available.

Several criteria are involved here. They will not always agree, and in any case it is clear that an element of personal judgment must always be involved in settling this question. However, the following seem to me the most important elements:

(a) Distinct species must be separable on the basis of ordinary preserved material. This is in order to make it possible for a museum man to apply a name to his material. The necessity for such a provision seems to me to be obvious, since only in this way can effective use be made of the whole technique of taxonomy.

(b) Cross fertility between distinct species is in general absent or so slight as to make unlikely any transfer of genes from one to the other in nature. This criterion is difficult to apply, and seems to me of secondary value for that reason. Geneticists are likely to emphasize its importance, taxonomists to minimize it. It is clearly of first importance for evolutionary theory, but even in the best understood cases it is still difficult to judge how much actual transfer of genes occurs.¹

¹If two forms produce a hybrid with some degree of fertility, the extent to which there is an exchange of genes will depend on the following factors:

- a. The frequency with which the two forms cross under natural conditions.
- b. The effective population size of each of the two parental forms.
- c. The degree of fertility of the F₁, and the frequency of mating with other F₁'s or with each of the parental forms.
- d. The fertility of each of the various types of hybrids produced in later generations.
- e. Ecological differences between the two forms, and the nature of the various hybrid types with respect to selection based on such differences.

Each of these is difficult to evaluate, so that one will practically always have to resort to indirect evidence, or in borderline cases to poorly founded guesses.

(c) Subspecies usually replace each other geographically, species may do so but are more likely to show extensively overlapping distribution areas. This criterion is one that taxonomists usually emphasize. It is clearly helpful, but can never be decisive (unless made so by artificial definition). Our knowledge of distribution areas of *Drosophila* is still too imperfect in most cases to make possible a rigorous use of this principle. It should also be pointed out that this criterion alone is not adequate. *Drosophila pseudoobscura* is gradually replaced by *athabasca* as one travels northward in British Columbia, and by *affinis* as one travels eastward in central Texas. Both replacement zones are typical of those recorded for subspecies; but they concern wholly distinct types, that are very different morphologically, are certainly wholly cross-sterile, and that have geographical forms within themselves that show much less sharp replacement zones.

DESCRIPTIONS OF NEW SPECIES

***Drosophila victoria*, sp. nov.** (subgenus *Pholadoris*).

External characters of imagines.

♂ ♀ Arista with about 7 branches. Antennae brown, third segment black. Front velvety, reddish; orbits and triangle shining black, as is also a V-shaped mark with its ends between anterior ocellus and posterior orbital and its apex at anterior edge of front; this V-shaped mark bears a row of about 6 mesially directed bristles on each of its arms. Middle orbital about $\frac{1}{5}$ other two. Second oral about $\frac{1}{2}$ first. Carina broad, flat; face dark brown; no hairs below carina. Cheeks dark brown, scarcely $\frac{1}{6}$ greatest diameter of eye. Eyes with short, dark pile.

Acrostichal hairs in 6 rows; prescutellars small but clearly differentiated. Anterior scutellars divergent. Mesonotum and scutellum dark brown, almost black, subshining. Pleurae brown, somewhat pollinose. Legs brown, femora and basal halves of tibiae darker. Sterno-index about .7. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen black, brownish at base.

Wings clear. Costal index about 1.9; 4th vein index about 2.4; 4c index about 1.3; 5x index about 1.4. Two bristles at apex first costal section. Heavy spines on basal $\frac{3}{5}$ of third costal section.

Length body 2.0 mm.; wings 1.8 mm.

Internal characters of imagines.

Anterior Malpighian tubes two, simple; posterior with their distal ends apposed, but without a continuous lumen.

Testes oval, dark.

Spermathecae two, chitinized, dark, small, telescoped at base.

Ventral receptacle short, broad, curved.

Other characteristics, relationship, and distribution.

Eggs.—Eight tapering anterior filaments and a series of shorter apical processes. Each filament is about $7/10$ the length of the egg.

Larvae.—The larvae skip.

Puparia.—Anterior spiracle with about 4 branches, it and its very short stalk scarcely $1/10$ the length of puparium.

Mating habits.—Not studied.

Chromosomes.—Spermatogonial figures show one large and one small pair of V's and two pairs of J's (E. Novitski).

Relationships.—Near coracina Kikkawa and Peng, from Japan. There are also other (undescribed) relatives in North America.

Distribution.—About cottonwoods at several points along the edges of the deserts of southern California. The type material is from Andreas Canyon, near Palm Springs.

This species, or one very similar to it, has been taken by Drs. D. D. Miller and H. D. Stalker at Rochester, N.Y. It is probable that the record of a skipping larva of *Drosophila* from sap in Illinois (Malloch) refers to the same form.

Professor Patterson records what also appears to be the same form, though it usually has fewer egg-filaments and his description of the chromosomes differs slightly, from Las Cruces, Silver City, New Mexico; Tombstone Canyon, Mule Mountains, Cave Creek, Chiricahua Mountains, Arizona; Cottonwood Canyon, Utah; Magdalena, Hermosillo, State of Sonora, Mexico.

Habits.—This species, like its undescribed relatives, apparently feeds on sap, and is commonest around cottonwood trees (*Populus* spp.).

Drosophila cordata*, sp. nov. (subgenus *Sophophora*).*External characters of imagines.**

♂. Arista with about 8 branches. Antennae brown, third segment darker. Front reddish brown, velvety; orbits and triangle grayish pollinose. Middle orbital about $1/5$ other two. Second oral nearly as long as first. Face brown; carina narrow; no minute hairs below carina. Cheeks brown; their greatest width about $1/6$ diameter of eye. Eyes with short pile.

Acrostichal hairs in 6 rows. No prescutellars. Anterior scutellars divergent. Mesonotum and scutellum dark brown—almost black—slightly pollinose, no markings. Pleurae brown, paler below. Legs yellowish brown, femora darker. Sterno-index about .3. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark brown, slightly paler toward base of each tergite.

Wings clear. Costal index about 2.3; 4th vein index about 2.5; 4c index about 1.3; 5x index about 1.0. Two bristles at apex first costal section. Third section of costa with heavy bristles on its basal $2/5$.

Length body 1.7 mm.; wings 1.7 mm.

♀. Abdomen with more marked pale basal bands on tergites. A median opaque area on fifth tergite that is shaped like a conventionalized heart.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched, posterior Malpighian tubes not fused at their apices.

Testes in a spiral of about 4 gyres.

Ventral receptacle long, fine, not kinky; resembling a skein of wool folded as a whole into the shape of the letter M.

Spermathecae two, chitinized; spherical with a basal telescoping, and with an apical indentation that comes to a sharp point from which there is a pattern of radiating lines.

Other characteristics, relationship, and distribution.

Eggs.—Two filaments, broadly expanded on their apical halves, about $\frac{1}{2}$ the length of the egg.

Larvae.—The larvae skip.

Puparia.—About 6 branches of anterior spiracle; these plus their short stalk scarcely $\frac{1}{10}$ length of puparium.

Mating habits.—Relatively little wing movement during courtship. During copulation the female gives the "switching" reaction that was also seen in *elliptica* and *emarginata*, though it is less marked here. The only copulation timed lasted for 29 minutes.

Chromosomes.—Two pairs of V's and a pair of rods.

Relationships.—Closest to *elliptica* and *emarginata*, here described as new.

Distribution.—Quirigua, Guatemala (T. Dobzhansky).

***Drosophila elliptica*, sp. nov. (subgenus Sophophora).**

External characters of imagines.

♂. Arista with about 8 branches. Antennae gray, third joint dark brown. Front dark brown, orbits and a narrow anterior median line polished. Middle orbital $\frac{1}{5}$ other two. Second oral nearly as long as first. Carina narrow, not flattened or sulcate. Face dark brown. Cheeks dark brown; their greatest width scarcely $\frac{1}{6}$ greatest diameter of eyes, width in vertical axis scarcely $\frac{1}{10}$ diameter of eyes. Eyes with heavy dark pile. No minute hairs below carina.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Whole thorax dark blackish brown, dull. Coxae and femora black, tibiae and tarsi brown. Sterno-index about .4. Apical bristles on 1st and 2nd tibiae, preapicals on all three; preapical on front leg not as long as diameter of tibia. Tarsi of front leg without sex-combs or other sexual characters.

Abdominal tergites shining black. Hypopygium large.

Wings slightly blackish. Costal index about 2.1; 4th vein index about 2.0; 5x index about 1.2; 4c index about 1.2. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal 3/10.

Length body 2.0 mm. (in pinned specimen); wings 2.0 mm.

♀. Abdominal tergites, especially three apical ones, with yellowish basal bands. On the fifth tergite there is a large median opaque area, elliptical in shape, and including the whole width of the black band.

Length 2.25 mm.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched, short; posterior ones two, free.

Testes long, spiral (7-8 gyres).

Spermathecae heavily chitinized, strongly telescoped at base, no apical indentation, pear-shaped, with two thickened rings at the base.

Ventral receptacle long, thin, not kinky, arranged like a skein of wool that has been bent (as a whole) into the shape of the letter M.

Other characteristics, relationship, and distribution.

Eggs.—2 filaments, equal in length to the egg itself, their apical halves greatly expanded.

Larvae.—The larvae "skip," like those of *saltans*, *cardini*, and others.

Puparia.—Each anterior spiracle with about 6 branches; it plus its stalk about 1/10 the length of the puparium itself.

Mating habits.—Little wing movement; occasional "scissors" and "vibration" of both wings simultaneously by the male. Female does not spread her wings before male mounts. Usual method of mounting and final position. Female very restless, especially for the first few minutes of copulation, frequently giving a characteristic "switching" reaction (as in *D. emarginata*). In copula 16 minutes in only case timed.

Chromosomes.—Four pairs of rods, one pair of small V's, and one pair of small J's. (Dr. D. D. Miller).

Relationship.—Close to *D. emarginata* and *D. cordata*, here described as new.

Distribution.—Pachuca, Mexico (T. Dobzhansky).

***Drosophila emarginata*, sp. nov. (subgenus *Sophophora*).**

External characters of imagines.

♂. Arista with about 8 branches. Antennae brown, third section darker. Front yellowish, blackish around ocelli. Middle orbital 1/4 other two. Second oral 3/4 first. Face yellowish brown; carina narrow; no minute hairs below carina. Cheeks yellowish; their greatest width 1/5 diameter of eye. Eye with rather long dense pile.

Acrostichal hairs in 6 rows. No prescutellars. Anterior scutellars divergent. Humeri, mesonotum, and scutellum yellowish brown, unmarked. Pleurae brown. Legs yellowish brown, femora darker.

Anterior sternopleural $\frac{1}{3}$ length of posterior. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dull brownish black, each tergite with a rather poorly defined basal brown band.

Wings clear. Costal index about 2.1; 4th vein index about 1.8; 4c index about 1.1; 5x index about 1.6. Two bristles at apex first costal section. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.0 mm.; wings 2.0 mm.

♀. Fifth abdominal tergite with a large opaque elliptical area on its posterior border, this area distinctly emarginate anteriorly in the median dorsal line.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched.

Posterior Malpighian tubes separate, ends free.

Testes long, spiral.

Ventral receptacle long, fine, not kinky, in the M-shaped skein usual for the saltans group (see *elliptica*, etc.).

Spermathecae two, chitinized, pear-shaped, strongly telescoped at base, without apical indentation or basal collar.

Other characteristics, relationship, and distribution.

Eggs.—Two filaments, expanded on their apical $\frac{2}{3}$, each slightly longer than the egg.

Larvae.—The larvae skip.

Puparia.—Anterior spiracle with about 7 branches; it and its short stalk scarcely $\frac{1}{10}$ length of puparium.

Mating habits.—Circling; "scissors" movement; female does not spread her wings before male mounts. Here, as in *elliptica* and to a lesser extent *cordata*, the female gives a marked "switching" reaction, as though trying to dislodge the male, at intervals throughout copulation. Seven copulations timed; duration from 12 to 34 minutes, with an average of about 25 minutes.

Chromosomes.—Two pairs of V's and a pair of rods.

Relationships.—Nearest *elliptica* and *cordata*.

Distribution.—Quirigua, Guatemala (T. Dobzhansky).

***Drosophila biopaca*, sp. nov.** (subgenus *Sophophora*).

External characters of imagines.

♂. Arista with about 8 branches. Antennae gray, third segment dark brown. Front gray, frontal lines reddish, broad. Middle orbital about $\frac{1}{4}$ other two. Second oral nearly as long as first. Carina narrow; face brown; a few small hairs below carina. Cheeks gray, their greatest width about $\frac{1}{6}$ greatest diameter of eyes. Eyes with medium pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Mesonotum dark brown, with a gray stripe between middle acrostichal rows, and a wider one including each dorsocentral row.

There is also a gray line lateral to the dorsocentral line (on each side), curving out from the posterior end of the dorsocentral stripe and rejoining it at the suture. Humeri gray. Scutellum dark brown, with grayish margin and central area. Pleurae brown, sutures gray. Legs brown. Sterno-index about .3. No sexual characters on front tarsi. Apical bristles on 1st and 2nd tarsi, preapicals on all three.

Abdomen gray, each tergite with a broad black posterior band that is broader in the mid-dorsal region; the fifth one covers nearly the whole tergite.

Wings clear. Costal index about 2.0; 4th vein index about 1.9; 4c index about 1.2; 5x index about 1.3. Two well-developed bristles at apex first costal section; third costal section with heavy bristles on its basal 4/10.

Length body 1.7 mm. (in pinned specimen); wing 1.8 mm.

♀. Fifth abdominal tergite with a better developed gray basal band; the dark apical band includes a pair of lateral opaque areas.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched.

Posterior Malpighian tubes not fused at distal ends.

Testes in a spiral of about 5 gyres.

Spermathecae weakly chitinized, ovoid, with a "collar" at base; envelop thin. Ventral receptacle very long, without "minor coils," resembling a skein of wool that has been bent, as a whole, into the shape of an M.

Other characteristics, relationship, and distribution.

Eggs.—Two filaments that are slightly longer than the egg and are greatly flattened and expanded on their apical halves.

Larvae.—The larvae skip.

Puparia.—Each anterior spiracle with about 7 branches; it and its short stalk less than 1/10 the length of the puparium.

Mating habits.—Vibration of one wing, occasional circling; usually mate with little preliminary courtship. Copulations observed to last from 3 to 18 minutes—averages about 10 minutes.

Chromosomes.—Two pairs of V's and a pair of rods.

Relationships.—Near to *rectangularis* and *sellata*, here described as new, and also to *saltans* Sturtevant and *earlei* Sturtevant.

Distribution.—Quirigua, Guatemala (type locality, T. Dobzhansky); Balboa, Panama Canal Zone (J. Schultz).

***Drosophila rectangularis*, sp. nov.** (subgenus *Sophophora*).

External characters of imagines.

♂. Arista with about 9 branches. Antenna brown, third segment darker. Front reddish brown, orbits and triangle black, pollinose. Middle orbital about 1/5 other two. Second oral nearly as long as first. Carina narrow; face brown; a few minute hairs below carina. Cheeks brown; their greatest width about 1/5 greatest diameter of eye. Eyes with short pile.

Acrostichal hairs in 6 rows. No prescutellars. Anterior scutellars divergent. Mesonotum brownish black, with a narrow gray stripe between median acrostichal rows, one in each dorsocentral row, and a more lateral one connected with the dorsocentral one at the suture. Scutellum dark brown, margins slightly grayish. Humeri brown. Pleurae brown, sutures grayish. Legs yellowish brown, femora and bases of tibiae slightly darker. Anterior sternopleural $\frac{1}{3}$ length of posterior. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen black, each tergite with a narrow basal gray band.

Wings clear. Costal index about 2.3; 4th vein index about 2.1; 4c index about 1.3; 5x index about 1.3. Two bristles at apex first costal section. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 1.8 mm.; wings 1.8 mm.

♀. Fifth abdominal tergite with a rectangular opaque mark.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched; posterior free, not forming a loop.

Testes long, in a spiral of 7 to 8 gyres.

Ventral receptacle long, thin, in a single coil that is not bent into the M-shape found in *sellata*, *biopaca*, etc.

Spermathecae two, chitinized; pear-shaped, with no apical indentation; strongly telescoped at base; two basal collar-like ridges.

Other characteristics, relationship, and distribution.

Eggs.—Two filaments, much expanded on their apical $\frac{2}{5}$; about $\frac{4}{5}$ the length of the egg.

Larvae.—The larvae skip.

Puparia.—Anterior spiracles with about 6 branches; these and their short stalk scarcely $\frac{1}{10}$ length of puparium.

Mating habits.—Vibration of one wing. Female spreads her wings before male mounts. No "switching" by female during copulation. Six timed copulations lasted from 12 to 19 minutes, average 17 minutes.

Chromosomes.—Two pairs of V's and a pair of rods.

Relationships.—Near *biopaca*, *sellata*, *saltans*, and *earlei*.

Distribution.—Orizaba, Mexico (T. Dobzhansky).

***Drosophila sellata*, sp. nov.** (subgenus *Sophophora*).

External characters of imagines.

♂. Arista with about 8 branches. Antennae reddish brown, third segment blackish anteriorly. Front gray, frontal lines reddish brown. Middle orbital about $\frac{1}{5}$ other two. Second oral nearly as long as first. Carina narrow; face brown; a few small hairs below carina. Cheeks gray; their greatest width about $\frac{1}{5}$ diameter of eye. Eyes with short pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Mesonotum gray, with the following brown markings: a

median spot just behind the suture; a pair of interrupted stripes inside the dorsocentral rows; three short stripes in a line just outside the dorsocentral rows. Scutellum gray. Pleurae gray, brownish ventrally. Legs brown, femora almost black. Anterior sternopleural $\frac{1}{3}$ posterior. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen black, four basal segments each with a grayish yellow basal band that is narrower in the median line and does not reach the lateral edge of its tergite.

Wings clear; a black spot at tip of first costal section. Costal index about 1.7; 4th vein index about 2.0; 4c index about 1.5; 5x index about 2.0. Two bristles at tip of first section of costa. Third section of costa with heavy spines on its basal $\frac{2}{5}$.

Length body 1.7 mm.; wing 1.7 mm.

♀. A median dark opaque area on fifth abdominal tergite, that is elliptical and strongly narrowed in the median line to give a saddle-like shape.

Internal characters of imagines.

Posterior Malpighian tubes with distal ends free.

Testes long, spirally coiled.

Ventral receptacle long, fine, not kinky, resembling a skein of wool that is folded (as a whole) into the shape of an M.

Spermathecae 2, black, chitinized, spherical, telescoped at base.

Other characteristics, relationship, and distribution.

Eggs.—Two filaments, somewhat expanded on their apical halves, each about $\frac{4}{5}$ the length of the egg.

Larvae.—The larvae skip.

Puparia.—Anterior spiracles with about 6 branches; they and their short stalks scarcely $\frac{1}{10}$ the length of puparium.

Mating habits.—Vibration with one wing at a time, circling, rapid scissors movement; much excitement. The one copulation timed lasted for 15 minutes.

Chromosomes.—Two pairs of V's and a pair of rods.

Relationships.—Near *biopaca* and *rectangularis*, here described as new. It is also evidently much like *prosaltans* Duda, from Paraguay. The chief reason for not applying that name to it is the distribution, plus the fact that I have not seen Duda's material.

Distribution.—Antigua, Guatemala City (type locality), Guatemala; Chilpancingo, State of Guerrero, Mexico (all collections by T. Dobzhansky).

***Drosophila pinicola*, sp. nov.** (subgenus *Drosophila*).

External characters of imagines.

♂. Arista with about 7 branches. Antennae gray, third segment dark brown. Front gray, dull; frontal lines broad, velvety, red. Middle orbital

$\frac{1}{4}$ other two. Second oral less than $\frac{1}{3}$ first. Carina high, narrow, flattened, slightly sulcate. Face grayish brown. Cheeks yellowish brown; their greatest width $\frac{1}{5}$ greatest diameter of eyes. Eyes somewhat oblique, covered with medium pile. No minute hairs below carina.

Acrostichal hairs irregular, usually in 6 rows but may also be counted as 8; no prescutellars; anterior scutellars nearly parallel. Mesonotum dull grayish brown, with darker indistinct markings in dorsocentral rows, above humeri, and in transverse suture connecting these areas. Pleurae grayish brown. Coxae yellow; femora dark brown; tibiae brownish yellow, darker at base; tarsi brownish yellow, two terminal segments much darker. A few short fine slightly recurved hairs on anterior face of the tarsi. Sterno-index about .6. Apical bristles on 1st and 2nd tibiae, preapicals on all three. Preapicals on first nearly as long as diameter of tibia.

Abdominal tergites brown, with broad shining black apical bands that reach the posterior margin of the tergites on the sides of the abdomen. The basal black band is definitely narrowed in the mid-dorsal line; the 5th one covers nearly the whole tergite. Hypopygium large.

Wings clear except for a cloud on posterior crossvein. Veins dark brown. Costal index about 3.1; 4th vein index about 1.4; 5x index about 1.0; 4c index about 0.7. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{4}{10}$.

Length body $2\frac{1}{2}$ mm. (in pinned specimen); wings 2 mm.

♀. No fine recurved hairs on front tarsi. Second dark abdominal band slightly narrowed in mid-dorsal line.

Internal characters of imagines.

Anterior Malpighian tubes two, unbranched; posterior fused into a loop around the gut, lumen continuous.

Testes rather broad, in a spiral of about two gyres.

Spermathecae strongly chitinized, telescoped at base, indented at apex, slightly broader than long. Ventral receptacle long, fine, coiled, not kinky.

Other characteristics, relationship, and distribution.

Eggs.—Four tapering filaments, the two anterior ones more slender than the posterior, their length half that of the egg.

Larvae.—The larvae do not skip.

Puparia.—Each anterior spiracle with about 7 branches; anterior spiracle with scarcely any stalk, .1 the length of the puparium.

Mating habits.—Not studied.

Chromosomes.—Three pairs: X is J-shaped, Y is V-shaped, each arm about as long as the long arm of the X; there are two pairs of autosomes, a V and a rod, each of the three arms concerned being about the length of the short arm of the X (E. Novitski).

Relationships.—This species constitutes a special group in the subgenus *Drosophila*, its closest ally in the subgenus apparently being *virilis*. *Pinicola* is also closest to *Scaptomyza* and to the subgenus *Sophophora*

(obscura-affinis species group) among all the members of its subgenus yet studied. Its peculiar chromosome group is difficult to interpret; otherwise it appears to be a very primitive form.

Distribution.—Pacific Grove, Pinnacles National Monument, Sequoia National Park, Pasadena, San Gabriel Canyon, mountains north of Beaumont, slopes of Mt. San Jacinto (type locality), Andreas Canyon, California.

This species has been found usually in association with conifers. At Sequoia Park it was observed on moist spots on the trunks of *Sequoia gigantea*; it is probably a sap-feeder. In the laboratory it is difficult to breed, and can be kept in culture only at low temperature.

***Drosophila floricola*, sp. nov.** (subgenus *Phloridosa*).

External characters of imagines.

♂. Arista with about 7 short branches. Antennae black. Front dark velvety brown, orbits and ocellar triangle shining black. Middle orbital $\frac{1}{4}$ other two. Second oral $\frac{1}{4}$ first. All bristles of entire animal short. Carina broad, flat, sharply angled. Face black. No hairs below carina. Cheeks dark brown, black posteriorly; their greatest width about $\frac{1}{4}$ greatest diameter of eye. Eyes with short pile.

Acrostichal hairs in 8 rows. No prescutellars. Anterior dorsocentrals less than half as far from posterior ones as the latter are from each other. Anterior scutellars divergent. Humeri, mesonotum, and scutellum somewhat shining brownish black, without markings or pollinosity. Pleurae black, slightly pollinose. Coxae and femora black, tibiae dark brown, tarsi lighter brown. Anterior sternopleural $\frac{1}{5}$ posterior. Apicals on first and second tibiae, preapicals on all three.

Abdomen black, 5th tergite yellowish brown, 4th sometimes brown.

Wings clear. Costal index about 2.5; 4th vein index about 1.7; 4c index about 1.0; 5x index about 1.2. No conspicuous bristles at apex first costal section. Third costal section with heavy spines on its basal $\frac{3}{5}$.

Length body 2 mm.; wings 2 mm.

♀. Fourth abdominal tergite paler than in ♂.

Internal characters of imagines.

Anterior Malpighian tubes absent; their common base present, smaller than that of posterior pair.

Posterior Malpighian tubes fused to form a loop around the gut.

Testes reddish orange, very long and slender, in a tight coil of many gyres.

Spermathecae two, weakly chitinized, strongly telescoped at base, elongate.

Ventral receptacle long, narrow, with marked "minor coils."

Other characteristics, relationship, and distribution.

Eggs.—Naked—i.e., without filaments or remains of follicle cells on their surfaces.

Larvae.—The larvae do not skip.

Puparia.—About 11 branches to anterior spiracle; it and its stalk about $\frac{1}{5}$ length of puparium.

Mating habits and chromosomes.—Not studied.

Relationships.—Nearest to *tristani* Sturtevant, from Costa Rica; also close to the Neotropical *lutzi* Sturtevant and *alfari* Sturtevant.

Distribution.—Pasadena, Monrovia, Elsinore, Palm Canyon, all in southern California.

The larvae feed in flowers, apparently chiefly on pollen. The adults are to be found in the flowers, often in large numbers. They have been taken in *Datura* (probably the chief natural food-plant), *Hibiscus*, melon, morning-glory, and calla lily.

This form was not observed until October, 1941; a full season of collecting will probably extend its known geographical range and list of food-plants.

A few specimens have been reared in the laboratory on the usual cornmeal-molasses medium, but it has not so far been possible to maintain a strain through successive generations.

KEY TO NORTH AMERICAN SPECIES OF *DROSOPHILA*

In the key that follows, no attempt has been made to include the numerous species described by Duda. The student who has to deal with Neotropical forms will need to use his full paper (Duda 1925).

Other keys that may be useful are to be found in the following papers: Bryan, 1938—Hawaii.

Duda, 1924—Old World.

Kikkawa and Peng, 1938—Japan and neighboring regions.

Malloch, 1924, 1927—Australia.

Malloch, 1934—Samoa.

Malloch, 1935—Marquesas Islands.

Malloch and McAtee, 1924—American genera, species of the District of Columbia region.

Sturtevant, 1921—North America.

Sturtevant, 1927—Oriental region.

Additional notes are given by Sturtevant (1923) and by Stalker and Spencer (1939).

In the following key the *virilis* and *repleta* species-groups (couplets 61–63 and 93–117) have been written by Professor Patterson and Mr. Wheeler, and the *quinaria* group (couplets 26–36) by Professor Spencer, who has also contributed couplet 87.

1. Mesonotum yellow, with distinct black longitudinal stripes, the median one bifid posteriorly; preapical bristles evident only on third tibiae....*busckii* Coq.

Mesonotum gray, each hair and bristle arising from a black or dark brown spot, these spots sometimes largely fused; costal index 2.4 to 3.6; arista with 6 to 9 branches.....	<i>repleta</i> group	93
Mesonotum not as above, usually unmarked or with a rather indistinct pattern		2
2. A row of short stout bristles on lower apical part of each front femur, the row parallel to the axis of the femur; costal index about 4.4.....	<i>immigrans</i> Sturt.	
No row of femoral bristles.....		3
3. Prescutellar bristles small but distinct.....		4
No prescutellar bristles.....		8
4. Wings more or less clouded; posterior crossvein sinuate.....		5
Wings clear; posterior crossvein straight.....		6
5. Wings largely blackish, a clear spot between second and third veins and another between third and fourth; eastern United States.....	<i>sigmoides</i> Loew	
Wings largely clear, clouded on crossveins and at tips of longitudinal veins; tropical	<i>flexa</i> Loew	
6. Dull, yellowish or brownish; tropical.....		7
Shining, black or dark brown; United States.....	<i>victoria</i> Sturt.	
7. Yellow species.....	<i>bromeliae</i> Sturt.	
Brown species; found in flowers.....	<i>florae</i> Sturt.	
8. A pair of presutural bristles, often small, but definitely larger than surrounding hairs; yellowish or brownish.....		9
No presutural acrostichal bristles.....		10
9. Presutural acrostichals about as long as anterior dorsocentrals, nearly erect	<i>testacea</i> v. Roser	
Presutural acrostichals only slightly larger than surrounding hairs, little elevated from surface of thorax	<i>putrida</i> Sturt.	
10. Acrostichal hairs in six rows.....		11
Acrostichal hairs in eight rows.....		70
11. Yellowish or reddish species.....		12
Blackish or dark brown species.....		37
12. Wings with about 13 black spots; mesonotum striped; first 2 to 4 oral bristles nearly equal.....	<i>guttifera</i> Walker	
Wings strongly clouded, especially on anterior portion and along posterior crossvein		13
Wings clear, at most with crossveins and tips of longitudinal veins clouded....		14
13. Carina only a knob above; second oral small; middle orbital about $\frac{1}{4}$ other two	<i>sororia</i> Williston	
Carina broad; second oral $\frac{3}{4}$ first; middle orbital $\frac{1}{2}$ other two.....	<i>nebulosa</i> Sturt.	
14. Face white; carina large; tropical.....		15
Face yellow or brown.....		16
15. Front yellow; abdomen banded.....	<i>albirostris</i> Sturt.	
Front brown; abdomen black.....	<i>metzii</i> Sturt.	
16. Carina small, confined to upper part of face, usually narrow.....		17
Carina larger, reaching well below middle of face.....		20
17. Third antennal segment long, clothed with very long hairs.....		18
Third antennal segment as usual; small tropical species		19
18. Costal index about 3.8; 4th vein index about 1.4.....	<i>duncani</i> Sturt.	
Costal index about 1.9; 4th vein index about 2.0.....	<i>prognatha</i> Sturt.	
19. Costa and crossveins clouded; costal index about 2.0.....	<i>sororia</i> Williston	
Wings clear; costal index about 1.8.....	<i>nana</i> Williston	
20. Large yellow species (2.8 mm. pinned); middle orbital about half length of anterior; only one large oral bristle; wings clear.....	<i>ordinaria</i> Coq.	
Not entirely as above.....		21
21. Anterior scutellars convergent.....		22
Anterior scutellars divergent.....		23

22. Only one large oral bristle; costal index about 3.0.....*melanderi* Sturt.
 Two nearly equal oral bristles; costal index about 3.9.....*cardini* Sturt.
23. Wings clear..... 24
 At least the posterior crossvein clouded..... 26
24. Costal index about 1.8; second oral nearly as long as first; small tropical
 species.....*willistoni* Sturt.
 Costal index about 3.0; second oral minute..... 25
25. Mesonotum with median dark stripe.....*magnafumosa* Stalker and Spencer
 Mesonotum with no markings.....*orbospiracula* Patterson and Wheeler
- 26.¹ Costal index about 4.2..... 27
 Costal index 3.5 or less..... 28
27. Cheeks $\frac{1}{3}$ diameter of eyes; abdomen with no median spots
macroptera Patterson and Wheeler
 Cheeks $\frac{1}{2}$ diameter of eyes; abdomen with median spots on 3rd, 4th, and
 5th tergites.....*tripunctata* Loew
28. Eggs with 4 filaments; tropical.....*similis* Williston
 Eggs with 3 filaments; nearctic..... 29
29. Mesonotum with longitudinal stripes; posterior crossvein more or less
 sinuate..... 30
 Mesonotum not longitudinally striped; posterior crossvein straight..... 32
30. Abdominal tergites each with 4 (may be 2 on 5th) distinct black spots
deflecta Malloch
 A broad median and two lateral yellowish stripes on abdomen..... 31
31. Posterior crossvein slightly sinuate; small dark clouds on crossveins and
 apices of L 2, 3, and 4.....*palustris* Spencer
 Posterior crossvein strongly sinuate; heavy black clouds on crossveins and
 apices of L 2, 3, 4, 5.....*subpalustris* Spencer
32. Abdomen with dark apical bands, broken in mid-dorsal line but not into
 spots..... 33
 Abdomen with distinctly spotted pattern..... 35
33. Wings with narrow black clouds on posterior crossveins.....*munda* Spencer
 Wings with heavy black clouds on both crossveins..... 34
34. Medially directed recurved hairs on male fore-tarsus shorter than thickness
 of tarsus.....*occidentalis* Spencer
 Medially directed recurved hairs on male fore-tarsus longer than thickness
 of tarsus.....*suboccidentalis* Spencer
35. Wings clouded at apices of longitudinals as well as on crossveins; medially
 directed recurved hairs on male fore-tarsus longer than thickness of
 tarsus and humerus.....*quinaria* Loew
 Wings not distinctly clouded at apices of longitudinals; medially recurved
 hairs on male fore-tarsus shorter than thickness of tarsus and scanty.... 36
36. Anterior and posterior crossveins with wide black clouds; Rocky Mountain
 region.....*subquinaria* Spencer
 Anterior and posterior crossveins with narrow dark clouds; Eastern United
 States.....*transversa* Fallén
37. "Middle" orbital placed below the proclinate one, over $\frac{1}{2}$ its length; carina
 small, confined to upper part of face; third antennal segment large,
 oval.....*alabamensis* Sturt.
 Not entirely as above..... 38
38. Anterior scutellar bristles convergent..... 39
 Anterior scutellar bristles divergent..... 51
39. Third antennal segment large; pleurae striped.....*cinerea* Patterson and Wheeler
 Third antennal segment as usual..... 40

¹Couplets 26-36 by W. P. Spencer.

40. Carina narrow; sex-combs present on male tarsi; preapical on first tibia longer than diameter of tibia..... 41
 Carina broader; no sex-combs; first preapical shorter than diameter of tibia.. 46
41. Proximal sex-comb with 8 to 10 teeth, nearly parallel to axis of tarsus; species larger and more brownish than the five following ones
algonquin Sturt. and Dobzh. 42
 Proximal sex-comb with 4 to 6 teeth, more oblique..... 42
42. Front slightly pollinose when viewed laterally; sex-comb with short teeth... 43
 Front scarcely pollinose..... 44
43. Front not pollinose when viewed from vertex; mesonotum not uniformly pollinose, with longitudinal stripes.....*seminole* Sturt. and Dobzh. 43
 Front pollinose when viewed from vertex; mesonotum uniformly pollinose
narragansett Sturt. and Dobzh. 44
44. Teeth of sex-comb distinctly longer than greatest diameter of tarsal segment*affinis* Sturt. 45
 Teeth of sex-comb scarcely longer than greatest diameter of tarsal segment.. 45
45. Mesonotum with four relatively distinct less pollinose longitudinal stripes (two inside and two outside the dorsocentral lines); Calif. to Central America*azteca* Sturt. and Dobzh. 45
 Mesonotum with two relatively less distinct longitudinal stripes (inside the dorsocentral lines); Alaska and Oregon to Maine and Tenn.
athabasca Sturt. and Dobzh. 46
46. Second oral over half length of first..... 47
 Second oral less than half length of first..... 48
47. Costal index about 4.0; middle orbital very small.....*pseudomelanica* Sturt. 47
 Costal index about 2.5; middle orbital nearly as long as anterior one
carbonaria Patterson and Wheeler 48
48. Posterior crossvein clouded; first coxae black; costal index about 4.0..*robusta* Sturt. 48
 Posterior crossvein clouded; first coxae yellowish; costal index about 3.1
pinicola Sturt. 49
 Posterior crossvein not clouded, though whole vane of wing may be somewhat smoky 49
49. Costal index less than 3.0; first coxae black.....*micromelanica* Patterson 49
 Costal index more than 3.0; first coxae brown..... 50
50. Mesonotum blackish brown; cheek $\frac{1}{4}$ diameter of eye.....*melanica* Sturt. 50
 Mesonotum brownish black; cheek $\frac{1}{2}$ diameter of eye.....*melanissima* Sturt. 51
51. Wings with conspicuous dark pattern; mesonotum and scutellum marked with velvety black; front and antennae pale yellow; tropical
calloptera Schiner 51
 Wings clear or with clouds on crossveins..... 52
52. Carina narrow below; third antennal segment large, clothed with long hairs.. 53
 Carina broader below; third antennal segment as usual..... 55
53. Mesonotum brown, striped; 4th vein index about 1.6; a single bristle at distal costal break.....*chagrinensis* Stalker and Spencer 53
 Mesonotum gray, striped; two bristles at distal costal break..... 54
54. Cheeks $\frac{1}{2}$ diameter of eyes; mesonotum with median dark stripe
grisea Patterson and Wheeler 54
 Cheek $\frac{1}{4}$ diameter of eye; no median dark mesonotal stripe
cinerea Patterson and Wheeler 55
55. Costal index over 4.0; 4th vein index about 1.3; large species.....*colorata* Walker 55
 Costal index less than 4.0; 4th vein index over 1.3..... 56
56. Bristles small; brown species, no pollinosity; only one conspicuous oral bristle; tropical; found in flowers.....*lutzii* Sturt. 56
 Bristles larger; more or less pollinose; not found in flowers..... 57
57. Anterior sternopleural at least half as long as posterior..... 58
 Anterior sternopleural less than half as long as posterior..... 64

58. Middle orbital $\frac{1}{4}$ anterior; cheeks $\frac{1}{8}$ diameter of eye.....*pinicola* Sturt.
Middle orbital $\frac{1}{4}$ to $\frac{1}{2}$ anterior; cheek $\frac{1}{4}$ to $\frac{1}{8}$ diameter of eye..... 59
59. Third costal section with heavy bristles on its basal third; 2 egg-filaments;
sterno-index about .7.....*nigromelanica* Patterson and Wheeler
Third costal section with heavy bristles on basal half or more; 4 egg-fila-
ments; sterno-index .8 to .9..... 60
60. Posterior crossvein narrowly clouded.....*virilis* Sturt.
Posterior crossvein broadly clouded..... 61
- 61.² Costal index 3.0 to 3.3; 4c index to .85; 5x index about 1.0; arista with
about 7 branches; 3rd costal section with heavy bristles on its basal
 $\frac{1}{2}$ to $\frac{3}{8}$; wings long, usually about as long as body; mesonotum with
two rather prominent stripes..... 62
Costal index 2.5 to 2.8; 4c index .95 to 1.0; 5x index about 1.2; arista with
8 to 9 branches; 3rd costal section with heavy bristles on its basal $\frac{3}{4}$;
wings long, but usually shorter than the body length; mesonotum with
but faint striping..... 63
62. Only one prominent oral bristle, the 2nd not more than $\frac{1}{4}$ length of first,
usually less; terminal tarsal segments of fore legs black; 3rd costal
section with heavy bristles on scarcely more than the basal $\frac{1}{2}$;
abdomen grayish brown.....*montana* Patterson and Wheeler
Second oral bristle about $\frac{3}{4}$ length of first; terminal tarsal segments of
fore legs scarcely darker than rest of leg; 3rd costal section with heavy
bristles on its basal $\frac{3}{8}$; abdomen dark gray to black.....*novamexicana* Patterson
63. (The two following species cannot be separated morphologically, but can
be distinguished cytologically as follows:)
Metaphase plate of ♀ and ♂ with 3 pairs of rods, one pair of V's and
one pair of dots.....*texana* Patterson, Stone and Griffen
Metaphase plate of ♀ with one pair of rods, 2 pairs of V's and one pair
of dots; ♂ with 4 rods, 3 V's and one pair of dots.....*americana* Spencer
64. Mesonotum without gray or pollinose pattern; no minute hairs below carina... 65
Mesonotum with definite gray markings; minute hairs below carina..... 66
65. Legs yellowish brown, femora darker.....*cordata* Sturt.
Coxae and femora dark brown, almost black.....*elliptica* Sturt.
66. A median dark spot near center of mesonotum; femora dark brown.
sellata Sturt.
No median dark area on mesonotum..... 67
67. Dark brown areas evident on femora and tibiae..... 68
Femora and tibiae scarcely darkened..... 69
68. Anterior dark stripes inside dorsocentral rows not reaching level of anterior
dorsocentral.....*saltans* Sturt.
Dark stripes between dorsocentral rows reaching level of posterior dorso-
central.....*rectangularis* Sturt.
69. Median pale thoracic stripe as wide as adjacent dark stripes.....*earlei* Sturt.
Median pale thoracic stripe scarcely half width of adjacent dark stripes
biopaca Sturt.
70. Yellowish or pale brown species..... 71
Blackish or dark brown species..... 79
71. Crossveins clouded; costal index about 4.0..... 72
Wings clear..... 73
72. Abdominal bands broken into spots; width of cheek not over $\frac{1}{4}$ diameter
of eye.....*transversa* Fall.
Abdominal bands interrupted at most in median dorsal line; cheek about $\frac{1}{3}$
diameter of eye.....*rubrifrons* Patterson and Wheeler

²Couplets 61-63 by J. T. Patterson and M. R. Wheeler.

73. Three pairs of postsutural dorsocentrals; middle orbital $\frac{1}{2}$ length of anterior; costal index 2.1; 4th vein index 1.8.....*illota* Williston
Two pairs of dorsocentrals..... 74
74. Anterior scutellars convergent..... 75
Anterior scutellars divergent..... 78
75. Pale yellowish, all hairs and bristles yellowish; tropical.....*torrei* Sturt.
Not pale, hairs and bristles black or dark brown..... 76
76. Costal index about 3.9; mesonotum striped.....*fulvalineata* Patterson and Wheeler
Costal index about 2.2; sex-comb on male tarsus..... 77
Costal index about 1.5.....*ananassae* Doleschall
77. Vertical diameter of eye about 5 times width of cheek in same axis; male genital arch with hook-like process.....*melanogaster* Meigen
Vertical diameter of eye about 7 times width of cheek in same axis; male genital arch with clam-shell-like process.....*simulans* Sturt.
78. Thorax without pattern; sterno-index about .4
orbospiracula Patterson and Wheeler
Thorax with four faint longitudinal stripes; sterno-index about .3
longata Patterson and Wheeler
79. Shining, not at all pollinose; bristles and branches of arista short; found in flowers..... 80
Bristles and branches of arista of usual length; not found in flowers..... 82
80. Costal index about 3.6; femora yellow.....*alfari* Sturt.
Costal index about 2.8; femora black or dark brown..... 81
81. Abdomen and mesonotum black.....*tristani* Sturt.
Mesonotum dark brown; abdomen dark brown basally, yellowish apically
floricola Sturt.
82. Fourth vein index 2.0 or more; 3 pairs of postsutural dorsocentrals
polychaeta Patterson and Wheeler
Fourth vein index less than 2.0; 2 pairs of dorsocentrals..... 83
83. Brown species; anterior scutellars convergent; costal index over 3.0..... 84
Blackish, more or less pollinose..... 86
84. Cheeks $\frac{1}{7}$ greatest diameter of eyes.....*macrospina* Stalker and Spencer
Cheeks $\frac{1}{4}$ to $\frac{1}{2}$ greatest diameter of eyes..... 85
85. Heavy spines on male anal plate curved slightly upward; row of peg-like bristles on egg-guide does not extend to dorsal edge of terminal process
funebri Fabricius
Heavy spines on male anal plate curved slightly downward; bristles on egg-guide extend well onto dorsal edge of terminal process
subfunebri Stalker and Spencer
86. Costal index 4.0 or more..... 87
Costal index 3.0 or less..... 88
87. Carina broad, scarcely sulcate; mesonotum and scutellum dark brown, indistinctly marked, if at all.....*robusta* Sturt.
Carina narrow, deeply sulcate; mesonotum and scutellum light brown, the former distinctly striped and mottled.....*colorata* Walker
88. Sex-combs present on two basal segments of first tarsi of males; anterior scutellars convergent..... 89
No sex-combs; anterior scutellars divergent (*coffeata* and *annularis* not known for latter character)..... 90
89. Femora and tibiae yellowish brown, scarcely blackened; development at 25° C. requires 13 to 14 days, with less than a day's difference for males and females.....*pseudoobscura* Frolowa
Femora and tibiae distinctly blackish; development period at 25° C about 15 days for females, about 17 for males.....*miranda* Dobzhansky

90. No gray pattern on mesonotum.....*emarginata* Sturt.
 Definite gray pattern on mesonotum..... 91
91. Crossveins slightly clouded.....*annularis* Sturt.
 Crossveins not clouded..... 92
92. One prominent oral bristle; carina sulcate.....*coffeata* Williston
 Two large oral bristles; carina not sulcate.....*earlei* Sturt.
- 93.³ Costal index 3.0 or above..... 94
 Costal index below 3.0..... 104
94. Cheeks over $\frac{1}{2}$ diameter of eyes; palpi brown.....*californica* Sturt.
 Cheeks less than $\frac{1}{2}$ diameter of eyes, usually about $\frac{1}{3}$; palpi pale yellow..... 95
95. Long recurved hairs present on medial side of fore tarsi, at least in males..... 96
 No long recurved hairs on fore tarsi..... 97
96. Apex of first costal section black; arista with about seven branches
nigrohedei Patterson and Wheeler
 Apex of first costal section not black; arista with about nine branches
bifurca Patterson and Wheeler
97. Lateral areas of abdominal segments solid brown..... 99
 Lateral regions of abdominal segments with pale or yellow central areas..... 98
98. Wings clear; apex of first costal section not blackened
hamatofila Patterson and Wheeler
 Crossveins moderately clouded; apex of first costal section black
longicornis Patterson and Wheeler
99. Wings somewhat dusky; legs black; front sooty black
fuliginea Patterson and Wheeler
 Wings clear; legs brownish or yellowish; coxae sometimes darker; front
 brown..... 100
100. Sterno-index about .66; two indistinct longitudinal stripes in acrostichal
 region, especially in ♀.....*pachea* Patterson and Wheeler
 Sterno-index .80 or greater; thorax not noticeably striped..... 101
101. Costal index about 3.0..... 102
 Costal index 3.3 to 3.5..... 103
102. Arista with about 7 branches; cheeks $\frac{1}{3}$ diameter of eyes; sterno-index about
 .80; legs brownish; lateral areas solid.....*nigrospiracula* Patterson and Wheeler
 Arista with about 8 branches; cheeks $\frac{1}{4}$ diameter of eyes; sterno-index about
 .90; legs yellowish brown, fore coxae darker brown; lateral region of
 abdominal segments with yellowish central area.....*repleta* Wollaston
103. Legs pale yellowish brown, fore coxae yellowish, not darkened.....*hydei* Sturt.
 Legs tannish yellow, fore coxae and femora light brown
hydeoides Patterson and Wheeler
104. Acrostichal hairs in 8 rows; costal index 2.4 or greater..... 105
 Acrostichal hairs in 6 rows; costal index about 1.8; spots of thorax fusing to
 form a broad median stripe and a pair of narrow anterior stripes just
 inside dorsocentral rows; medium sized fly from West Indies
fasciola Williston
105. Crossveins more or less clouded..... 106
 Wings clear..... 108
106. Second oral about half length of first; sterno-index about .80; 5x index
 above 1.5; length body to 2.5 mm.....*meridiana* Patterson and Wheeler
 Second oral $\frac{1}{4}$ or $\frac{1}{2}$ length of first; sterno-index about .70 to .75; 5x index
 below 1.5; length body to 3.4 mm..... 107
107. Posterior crossvein clouded, anterior slightly so; vane of wing clear; spots
 of thorax fusing into two long brown stripes in outside acrostichal
 rows; third costal section with heavy bristles on its basal $\frac{1}{2}$
linearepleta Patterson and Wheeler

³Couplets 93-117 by J. T. Patterson and M. R. Wheeler.

- Anterior and posterior crossveins moderately clouded, a slight darkening at tip of second longitudinal vein; spots of thorax not forming stripes; third costal section with heavy bristles on its basal $\frac{1}{4}$
leonis Patterson and Wheeler
108. Carina short dorsoventrally, low dorsally, broad and high ventrally, very widely sulcate; one prominent oral bristle followed by an irregularly disposed series of hairs.....*brevicarinata* Patterson and Wheeler
 Carina normally broadened below, rounded or triangular, moderately sulcate; oral bristles normal..... 109
109. Carina triangular, flaring rather widely below, not rounded; recurved hairs on tibiae and some on tarsi; apex of first costal section not blackened
ritae Patterson and Wheeler
 Carina evenly rounded below, not triangular or flaring; no recurved hairs on tibiae; apex of first costal section blackened..... 110
110. Palpi black or nearly so; front blackish.....*melanopalpa* Patterson and Wheeler
 Palpi pale yellow or clear; front yellow or light to dark brown, not blackish... 111
111. Arista with about 6 branches; second oral about $\frac{1}{4}$ length of first
neorepleta Patterson and Wheeler
 Arista with 7 or 8 branches; second oral at least $\frac{1}{2}$, often $\frac{1}{2}$, length of first.... 112
112. Spots between dorsocentral rows largely fused to form two irregular stripes; abdominal bands; without pale lateral areas.....*ramsdeni* Sturt.
 Numerous spots between dorsocentral rows, these not fusing to form stripes; pale lateral areas present on abdominal segments..... 113
113. Arista with about 8 branches; third costal section with heavy bristles on its basal $\frac{1}{2}$ or nearly so; length often to or beyond 3.0 mm..... 114
 Arista with about 7 branches; third costal section with heavy bristles on its basal $\frac{1}{2}$ or $\frac{1}{4}$; length usually less than 3.0 mm..... 115
114. Body color rather dark brown, abdominal pattern distinct, bands dark, median interruption pronounced; abdomen clear, whitish ventrally, testes showing through distinctly, light yellow
peninsularis Patterson and Wheeler
 Body color light brown with a washed-out appearance; abdominal pattern faded and indistinct, bands light, interruptions indistinct; abdomen yellowish ventrally, testes showing through very faintly, light in color
mercatorum Patterson and Wheeler
115. Abdomen very pale yellow, bands and other markings very faded and indistinct; exceedingly faint blackish bands near bases of tibiae of 2nd and 3rd legs; last tarsal segments brown; cheeks about $\frac{1}{4}$ diameter of eyes.....*mojavensis* Patterson and Crow
 Abdomen yellow, bands rather distinct to angle of tergites with small dark areas in their apical corners; dark bands on all tibiae and usually on distal ends of femora; tarsi pale; cheeks about $\frac{1}{2}$ diameter of eyes..... 116
116. Costal index about 2.4; 4th vein index about 1.7; sterno-index about .80; antennae brown; third costal section with heavy bristles on its basal $\frac{1}{2}$
arizonensis Patterson and Wheeler
 Costal index 2.6 to 2.8; 4th vein index 1.9 to 2.2; sterno-index .65 to .75; antennae yellowish or tannish brown; third costal section with heavy bristles on its basal $\frac{1}{4}$ 117
117. Abdominal bands distinct, separated from the triangular area in the apical corner of the tergite; testes yellow, placed posteriorly; eyes red
mulleri Sturt.
 Abdominal bands less distinct, those of the last one or two segments with a basal connection between the band and the triangular marginal area; testes deep orange, placed nearly in the middle of the adomen; eyes vermilion.....*aldrichi* Patterson and Crow

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II. NEW SPECIES IN THE QUINARIA GROUP OF THE
SUBGENUS DROSOPHILA

WARREN P. SPENCER

College of Wooster

CONTENTS

	PAGE
Introduction	55
Acknowledgments	57
Description of New Species	58
<i>Drosophila munda</i>	58
<i>Drosophila subquinaria</i>	59
<i>Drosophila occidentalis</i>	60
<i>Drosophila suboccidentalis</i>	61
<i>Drosophila palustris</i>	63
<i>Drosophila subpalustris</i>	64
Literature cited	66

INTRODUCTION

Sturtevant (1939) has pointed out the desirability of constructing a scheme of classification of *Drosophila* species indicating their degree of genetic relationship and has divided the genus into three subgenera. It has, moreover, been recognized that within a subgenus there occur further subdivisions into "groups" of closely related species and subspecies. Several taxonomic and genetic papers emphasizing the species group have been published recently (see Sturtevant and Dobzhansky 1936; Stalker and Spencer 1939; Sturtevant 1940; Patterson, Stone, and Griffen 1940; and Patterson and Crow 1940). This procedure calls attention to those forms which may be expected to offer the most favorable material for studies in experimental evolution.

The group to which attention is here called contains the following described species: *D. transversa* Fallén, *guttifera* Walker, *quinaria* Loew, and *deflecta* Malloch. Descriptions of six new forms are added: *D. munda*, *subquinaria*, *occidentalis*, *suboccidentalis*, *palustris*, and *subpalustris*. As all of these species have been kept in culture through several generations, series of specimens of each have been sent to the United States National Museum, Washington, D.C. Each is designated as a paratype series with no one individual selected as the type.

It is not our purpose herewith to present a full account of the biology of the group. However, for the convenience of any who may care to work with these species we include a brief statement.

Ecologically the group may be designated as "fungus feeders." Sturtevant (1921) in his description of *transversa* states that, "this species breeds on various kinds of fleshy fungi, where it is usually to be found in great numbers, along with *D. putrida* Sturtevant." The author has made many collections of *transversa* from fleshy fungi. Patterson (written communication) reports that Mainland and Wheeler found both *suboccidentalis* and *subquinaria* feeding on a fungus of the genus *Coprinus*. While fungus feeding is typical other food habits have been evolved. Sturtevant (1921) indicates that *quinaria* is a fruit-feeder, and that it is frequently found about tomato plants and on windfall apples. A summary of our collection records in Ohio taken under a great variety of conditions, using yeasted banana bait, indicates a probable sex dimorphism in food preferences in this species. Between three and four times as many females as males were captured from banana traps. However, in collecting specimens directly from tomato and potato plants no such disparity of sexes appeared. Where *quinaria* were quite abundant in a large tomato patch relatively few were drawn to banana traps. This indicates more restricted feeding habits than in many other species.

Both *palustris* and *subpalustris* have been taken in considerable numbers in a large swamp area, the Killbuck Bottoms, Wayne County, Ohio. Wild larvae of the former were found feeding on decaying leaf stalks

of the broad-leaved arrowhead, *Sagittaria latifolia*, and adults were reared out from this material. Sturtevant (1921) reports that *guttifera* is a fungus feeder. It would seem probable that there has been an evolution from such a form as *transversa*, feeding on fleshy fungi in upland wooded areas, through *quinaria* in moister wooded areas to swamp inhabiting forms such as *palustris*, *deflecta*, and *subpalustris* living on decaying water plants. With gradual drying of swamp areas such a food habit might in turn evolve into leaf-mining.

Cytologically most of the species in this group have six chromosome pairs, a pair of long rods, four pairs of medium rods, and a pair of dots. However, variations occur such as the two pairs of V's, pair of rods, and pair of dots in *quinaria* and *munda*, the satellites on the X's of *suboccidentalis* and the V-shaped Y of *subquinaria*.

Occidentalis and *suboccidentalis* have been crossed. *Palustris* and *subpalustris* will also hybridize. In the latter case some strains are much more compatible than others in interspecies crosses, as evidenced by a large series of crosses attempted from stocks originating from different wild pairs. It seems probable that other interspecific crosses may be found in this group.

None of the species has been used extensively for genetic study. However, the author has found one or more mutant types in *palustris*, *subpalustris*, *munda* and *transversa*. In the latter a javelin-like recessive mutant is frequent in wild stocks from diverse localities, a case similar to light in *repleta*, net in *immigrans*, and bobbed in *hydei*.

Geographically *transversa* and *quinaria* occupy the eastern United States, and are replaced westwards by *subquinaria*, *munda*, *occidentalis* and *suboccidentalis*. Whether the *transversa* of the eastern United States is actually the same species as the European *transversa* described by Fallén can only be determined by comparison of living stocks. The swamp forms have only been recorded in the eastern United States, with *guttifera* much more abundant in the southeast than in the northeast. The food habits of all members of the group are probably such as to lead to the establishment of small discontinuous colonies or populations, a condition favorable to rapid evolution.

All of the species known in this group have been cultured in the laboratory except *deflecta*. The usual procedure for culturing *Drosophila* species may be followed with these precautions. Temperature should be kept at 23 C or below (possibly below 21 C for *occidentalis* and *suboccidentalis*). Food should have a rather soft texture as young larvae of these species do not burrow readily into firm food cakes on which many *Drosophila* thrive. Aging of parent flies with one or two transfers to fresh food is advantageous. As some of the species are "caty-leptic" it is well to add paper to culture vessels to absorb excess moisture and to avoid miring of the flies in food medium.

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DESCRIPTION OF NEW SPECIES

***Drosophila munda*, sp. nov.**

External characters of imagines.

♂. Arista with about 10 branches; 3 below terminal fork. Antennae dull yellowish brown, third joint darker. Front light brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{5}$ posterior. Second oral bristle $\frac{4}{5}$ first. Palpus yellow, two or three prominent bristles. Carina flat, broad below, narrow above. Face light brown. Cheek light brown; greatest width about $\frac{1}{5}$ greatest diameter of eye. Eye dull red; heavy yellow pile; large and round.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about $\frac{3}{4}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. A few short, recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, and 4, interrupted in mid-dorsal line and reaching $\frac{2}{3}$ distance to lateral margin of tergite; two large, dark brown triangular spots on tergite 5; tergite 6 dark brown.

Wings clear; posterior crossveins with narrow, black clouds. Costal index about 3.5; 4th vein index about 1.9; 5x index about 1.1; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{3}{5}$.

Length body 2.7 mm. (in live specimen); wings 2.7 mm.

♀. Last abdominal tergite lighter in color than in male.

Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes lemon yellow, spiral, with about 2 proximal heavy gyres to coil reversal point; from there 1 heavy and 9 or 10 thin outer or distal gyres.

Spermathecae elongated dome-shaped, chitinized. Ventral receptacle thin spiral of about 65 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 12 branches; horn-index about 17.

Chromosomes.—Metaphase plate shows a pair of rods, 2 pairs of V's and a pair of dots.

Relationship.—Belongs to the quinaria group of the sub-genus *Drosophila*.

Distribution.—This species was first collected at Cave Creek, Chiricahua Mountains, Arizona, in September, 1940. Other collections have

been made in Tombstone Canyon, Mule Mountains, Arizona; top of Chiricahua Mountains, Arizona; Sonita, Arizona; Ramsey Canyon, Huachuca Mountains, Arizona; Mangus Canyon, near Silver City, New Mexico; Whitewater Creek, Black Mountains in Gila National Forest, New Mexico; Bonita River, Sacramento Mountains, New Mexico. Collections were made by G. B. Mainland, R. P. Wagner, and M. R. Wheeler, University of Texas.

***Drosophila subquinaria*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches; 2 or 3 below terminal fork. Antennae yellow. Front light brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{6}$ posterior. Second oral bristle $\frac{4}{5}$ first. Palpus light yellow; two or three medium bristles. Carina flat to slightly sulcate, narrow above, broad below. Face yellow. Cheek yellow; greatest width about $\frac{1}{4}$ greatest diameter of eye. Eye red; short yellow pile; medium size and round.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about $\frac{3}{4}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs yellow. Apical bristles on first and second tibiae; preapicals on all three. In all about 6 or 7 very short, recurved hairs on median side of foretarsus.

Abdomen yellow; tergites 2, 3, 4, 5 with 4 prominent black spots on each; 2 large black spots on tergite 6; spots tend to be triangular, but may be somewhat united; narrow, dark lateral margins on each tergite.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 2.9; 4th vein index about 1.75; 5x index about 1.0; 4c index about .91. Large upper and smaller lower bristle at apex of first costal section; third costal section with heavy bristles on its basal $\frac{3}{5}$.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdominal tergites 2, 3, 4, 5, 6 with 4 prominent black spots on each; also narrow, dark lateral margins on each tergite; spots may be somewhat united. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes bright lemon yellow, spiral, with 3 heavy inner gyres and about 8 thin outer gyres.

Spermathecae dome-shaped, chitinized. Ventral receptacle thin irregular spiral of about 25 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .54 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer and thicker median.

Puparia.—Light brown. Each anterior spiracle with 8 short branches which are not outwardly reflexed; horn-index about 20.

Chromosomes.—Metaphase plate shows a pair of long rods, the X's, 4 pairs of medium rods, and a pair of dots; in the male a V-shaped Y.

Relationship.—Belongs to the quinaria group of the subgenus *Drosophila*; nearly related to *D. quinaria*.

Distribution.—This species was first collected at Manitou Springs, Colorado, in July, 1941. Other collections have been made at Estes Park, Colorado; Grand Teton National Park, Wyoming; Iron Creek, Yellowstone, Wyoming; Madison River, Yellowstone, Wyoming; Big Cottonwood Canyon, Utah. Collections were made by G. B. Mainland and M. R. Wheeler, University of Texas.

Comparison with D. quinaria.

D. quinaria, with which this species might be confused, differs from *D. subquinaria* in having a slightly larger body size; eye pile longer; abdominal spots smaller and less likely to fuse together; eye slightly flattened along lower posterior margin; second oral $\frac{2}{3}$ length of first; a double row of long recurved hairs on medial side of male fore-tarsus, at least 12 to 15 of these all longer than thickness of tarsus; clouds on apex of second, third, and fourth veins; and a larger egg.

***Drosophila occidentalis*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches; 3 below terminal fork. Antenna brown. Front brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{5}$ posterior. Second oral bristle $\frac{4}{5}$ first. Palpus yellow; two prominent bristles. Carina rounded, broad below, narrow above. Face light brown. Cheek light brown; greatest width about $\frac{1}{4}$ greatest diameter of eye. Eye red; sparse yellow pile; round and medium size.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about $\frac{3}{4}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. About 9 short (not as long as tarsal thickness) recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, and 4, narrowly interrupted in mid-dorsal line and reaching $\frac{2}{3}$ distance to lateral margin of tergite; tergites 5 and 6 almost solidly dark brown or black, with a very narrow light band in mid-dorsal line.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 3.0; 4th vein index about 1.8; 5x index about 1.2; 4c index about .9. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{2}{3}$.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching $\frac{2}{3}$ distance to lateral margin of tergite; band on tergite 5 tending to break into 2 parts on either side; dark brown area not interrupted in mid-dorsal line in tergites 6 and 7. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes light orange yellow, spiral, with about 2 proximal heavy gyres to coil reversal point; from there 2 heavy gyres and about 8 thin outer or distal coils.

Spermathecae elongated dome-shaped, chitinized. Ventral receptacle thin spiral of about 50 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 10 branches; horn-index about 25.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods, and a pair of dots.

Relationship.—Belongs to the *quinaria* group of the sub-genus *Drosophila*.

Distribution.—This species was collected by Th. Dobzhansky at Monterey, and Mt. San Jacinto, California.

***Drosophila suboccidentalis*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches; 3 below terminal fork. Antennae brown. Front brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{3}$ posterior. Second oral bristle $\frac{4}{5}$ first. Palpus yellow; two prominent bristles. Carina rounded, broad below, narrow above. Face light brown. Cheek brown; greatest width about $\frac{1}{4}$ greatest diameter of eye. Eye red; sparse yellow pile; round and medium size.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about $\frac{3}{4}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. About 9 long (longer than tarsal thickness) recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching $\frac{2}{3}$ of distance to lateral margin of tergite.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 3.0; 4th vein index about 1.8; 5x index about 1.2; 4c

index about .9. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{2}{3}$.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching $\frac{2}{3}$ distance to lateral margin of tergite; band on tergite 5 tending to break into 2 parts on either side; dark brown area not interrupted in mid-dorsal line in tergites 6 and 7. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes salmon, spiral, with about $2\frac{1}{3}$ heavy inner gyres to coil reversal point; from there 1 heavy gyre and about 7 thin outer or distal coils.

Spermathecae elongated cap-shaped, chitinized. Ventral receptacle thin spiral of about 60 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 10 branches; horn-index about 25.

Chromosomes.—Metaphase plate shows a pair of rods with dot-like element attached at end of each (these rods are the X's), 4 pairs of medium rods, and a pair of dots. In male the Y is a long rod, the one X showing the satellite.

Relationship.—Belongs to the quinaria group of the sub-genus *Drosophila*, and closely related to *D. occidentalis*, with which it can be crossed.

Distribution.—This species was first collected by A. H. Sturtevant at Jackson, Wyoming, in July, 1940. Other collections were made by G. B. Mainland and M. R. Wheeler at Manitou Springs, Colorado; Estes Park, Colorado; Black Hills, 11 miles from Custer, South Dakota; Jackson's Canyon, 13 miles southwest of Casper, Wyoming; Grand Teton National Park, Wyoming; Iron Creek, Yellowstone, Wyoming; Madison River, Yellowstone, Wyoming; Pocatello, Idaho; Wasatch Range, 3 miles west of Liberty, Utah; Tushar Mountains, 5 miles west of Junction, Utah; and Ogden River near Ogden, Utah.

Comparison with D. occidentalis.

In general the abdomen of the male is considerably darker in *D. occidentalis*, due to more extensive pigmentation of tergites 5 and 6. The median break in the apical band on tergite 5 is much more extensive in *suboccidentalis*. The testis color of *occidentalis* is orange yellow; that of *suboccidentalis* is salmon. The best distinguishing character is the fore-tarsus of the male. In *occidentalis* the medially directed hairs are shorter than the thickness of the tarsus, while in *suboccidentalis* they are considerably longer than the thickness of the fore-tarsus.

Drosophila palustris*, sp. nov.*External characters of imagines.**

♂. Arista with about 9 branches; 2 or 3 below terminal fork. Antennae light brown, third joint darker. Front light brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{4}$ posterior. Second oral bristle $\frac{2}{3}$ first. Palpus yellow; one prominent bristle. Carina flat, narrow above, broad below. Face light yellow. Cheek brownish yellow; slightly darker spot under lowest point of eye; greatest width about $\frac{1}{4}$ greatest diameter of eye. Eye red; posterior lower margin flat, making eye slightly pointed below; short yellow pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about $\frac{3}{5}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum shining yellowish brown, with 3 lighter stripes, a median and 2 lateral, just inside the dorsocentral rows. Scutellum yellowish brown, darker at apex. Legs light yellow. Apical bristles on first and second tibiae; preapicals on all three. 5 to 7 thin, very short recurved hairs on median side of fore-tarsus.

Abdomen shining dark brownish gray; 3 broad light yellow stripes running the length of the abdomen, one mid-dorsal and 2 lateral; the edge of each tergite just lateral to lateral yellow stripes is tipped with black; yellow stripes narrowed posteriorly.

Wings brown; dark clouds at apex of L 2, 3, 4. Crossveins clouded; on posterior crossvein cloud heavier at ends of vein. Posterior crossvein slightly sigmoid. Costal index about 3.1; 4th vein index about 1.5; 5x index about .7; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 2.8 mm. (in live specimen); wings 2.9 mm.

♀. Length body 3.0 mm.; wings 3.1 mm.

Internal characters of imagines.

Testes bright yellowish orange, spiral, with about 2 heavy proximal gyres to coil reversal point; from there one heavy and 6 or 7 thin outer or distal gyres.

Spermathecae cap-shaped, chitinized. Ventral receptacle thin spiral of about 60 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .60 mm. long; 3 filaments, 2 thin lateral, and 1 slightly longer, thicker median.

Puparia.—Golden brown. Each anterior spiracle with about 14 branches; horn-index about 8.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods and a pair of dots.

Relationship.—Belongs to the quinaria group of the sub-genus *Drosophila*.

Distribution.—Collections have been made from Killbuck Bottoms, Wayne County, Ohio; near Overton, Wayne County, Ohio; Odell's Lake, Holmes County, Ohio by Harrison Stalker and the author; Rochester, New York by Harrison Stalker; Morristown, New Jersey by A. H. Sturtevant; and Chain Bridge, Virginia, by J. R. Malloch. Specimens of this species are in collection of Illinois Natural History Survey from Illinois.

Note.—This species was first described by J. R. Malloch under the name *Drosophila lativittata*. However, this name is to be rejected as a homonym as the same author had used it in a prior description of an Australian species of *Drosophila* (see Malloch, J. R., 1923. Proc. Linn. Soc. N. S. Wales, 48:618). We are therefore proposing as a substitute the name *palustris* and publishing a fuller description.

***Drosophila subpalustris*, sp. nov.**

External characters of imagines.

♂. Arista with about 10 branches; 2 or 3 below terminal fork. Antennae light brown, third joint darker. Front light brown. Middle orbital $\frac{1}{3}$ anterior and $\frac{1}{4}$ posterior. Second oral bristle $\frac{1}{2}$ first. Palpus yellow; one prominent bristle. Carina flat, narrow above, broad below. Face light yellow. Cheek shining brownish yellow; slightly darker spot under eye; greatest width about $\frac{1}{5}$ greatest diameter of eye. Eye dark red; lozenge shaped, lower portion ending in blunt point; short yellow pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent; posterior scutellars tend to be erect. Sterno-index about .8. Anterior dorsocentrals about $\frac{3}{4}$ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum shining yellowish brown, with 3 lighter stripes, a median and 2 lateral, just inside the dorso-central rows. Scutellum brown, darker toward apex. Legs light yellow. Apical bristles on first and second tibiae; preapicals on all three. About 9 or 10 long recurved hairs on median side of fore-tarsus.

Abdomen shining dark brownish gray; 3 broad light yellow stripes running the length of the abdomen, one mid-dorsal and 2 lateral; the edge of each tergite just lateral to lateral yellow stripes is tipped with black; yellow stripes narrowed posteriorly.

Wings smoky gray-brown; heavy dark clouds at apex of L 2, 3, 4, and 5, on anterior crossvein and at both ends of posterior crossvein. Posterior crossvein distinctly sigmoid. Costal index about 3.0; 4th vein index about 1.1; 5x index about .7; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 2.9 mm. (in live specimen); wings 3.0 mm.

♀. Length body 3.1 mm.; wings 3.2 mm.

Internal characters of imagines.

Testes light yellow, spiral, with about 2 proximal heavy inner gyres to coil reversal point; from there one heavy and about 7 outer or distal light coils.

Spermathecae cap-shaped, chitinized. Ventral receptacle thin relatively short spiral of about 35 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .65 mm. long; 3 filaments, 2 thin lateral, and 1 slightly longer, thicker median.

Puparia.—Golden brown. Each anterior spiracle with about 14 branches; horn-index about 5.5.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods and a pair of dots.

Relationship.—Belongs to the quinaria group of the subgenus *Drosophila*, and closely related to *D. palustris* with which it can be crossed.

Distribution.—This species was first collected in the Killbuck Bottoms, Wayne County, Ohio, by Harrison Stalker and the author in July, 1939. Subsequent collections in 1940 and 1941 have been made from the same region. It has also been taken at Odell's Lake, Holmes County, Ohio.

Comparison with D. palustris.

Drosophila subpalustris differs from *D. palustris* in darker wings with much heavier clouds, and a distinctly sigmoid posterior crossvein; egg filaments thinner; eye darker in color; more lozenge shaped; pupal horns longer; testes lighter yellow; mesonotum and abdomen slightly darker; long recurved hairs on fore-tarsus.

The species seems also closely related to *D. deflecta* Malloch.

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III. DESCRIPTION OF NEW SPECIES OF THE SUBGENERA
HIRTODROSOPHILA AND DROSOPHILA

J. T. PATTERSON AND MARSHALL R. WHEELER

Genetics Laboratory, The University of Texas

CONTENTS

	PAGE
Introduction	69
Description of species	70
<i>Drosophila orbospiracula</i>	70
<i>Drosophila longala</i>	71
<i>Drosophila cinerea</i>	71
<i>Drosophila grisea</i>	72
<i>Drosophila texana</i>	73
<i>Drosophila novamexicana</i>	74
<i>Drosophila montana</i>	75
<i>Drosophila macrospina limpiensis</i>	76
<i>Drosophila melanopalpa</i>	77
<i>Drosophila neorepleta</i>	78
<i>Drosophila linearepleta</i>	79
<i>Drosophila fuliginea</i>	80
<i>Drosophila nigrospiracula</i>	81
<i>Drosophila leonis</i>	82
<i>Drosophila hydeoides</i>	84
<i>Drosophila nigrohydei</i>	84
<i>Drosophila bifurca</i>	85
<i>Drosophila pachea</i>	87
<i>Drosophila ritae</i>	87
<i>Drosophila brevicarinata</i>	88
<i>Drosophila longicornis</i>	90
<i>Drosophila hamatofila</i>	91
<i>Drosophila peninsularis</i>	92
<i>Drosophila mercatorum</i>	93
<i>Drosophila aldrichi</i>	94
<i>Drosophila mojavensis</i>	95
<i>Drosophila arizonensis</i>	96
<i>Drosophila buzzatii</i>	97
<i>Drosophila meridiana</i>	99
<i>Drosophila nigromelanica</i>	100
<i>Drosophila micromelanica</i>	101
<i>Drosophila polychaeta</i>	102
<i>Drosophila carbonaria</i>	103
<i>Drosophila spinofemora</i>	104
<i>Drosophila macroptera</i>	105
<i>Drosophila fulvalineata</i>	106
<i>Drosophila rubrifrons</i>	107
Literature cited	109

INTRODUCTION

In writing up the descriptions of the new species we have followed, in the main, a "model description" prepared by Professor Sturtevant. This model includes as items for description various external and internal characters of the adult fly, and, in addition, certain features of the egg, puparium and chromosomes. The relationship of each species to other members of the subgenus and genus and its distribution are also included.

The color of the eyes, testes and puparia is given for each species, and is followed by references in parentheses to a standard work on colors. The publication referred to is the "Dictionary of Color" by Maerz and Paul. Since color varies with age, efforts were made to use flies which were approximately of the same age—about three days old. Exceptions were cases of wild-type flies which failed to breed in the laboratory, and consequently the exact age could not be determined. All color determinations were made by the artist, Mrs. Sarah Brooks Martin.

All of the descriptions are based on a study of living specimens, and the species are arranged under a scheme of classification recently proposed by Sturtevant (1939), and more fully developed in the first article of this publication. He has divided the genus *Drosophila* into six subgenera. All of the forms described in this article belong to his subgenera *Hirtodrosophila* and *Drosophila*. We have also followed, with a few minor exceptions, his plan of arranging within the subgenus *Drosophila* the various species into groups. These groups vary in size from those represented by a single known species to one which has over twenty known species. The latter is the complex *repleta* group, which eventually will be divided into several sub-groups. We have already separated off six species from this complex into a sub-group called the *mulleri* group. At the end of the article are three species which as yet have not been assigned to any of the groups. Of the thirty-seven forms described in this article, thirty-one are new, while six (including the subspecies) have been described briefly in the literature, but are here given a fuller description.

We are grateful to Professor Sturtevant for suggesting several of the new names and for other valuable suggestions, and to him and Professor Spencer for supplying certain stocks which otherwise would not have been available to us. Credit for these will be found among the descriptions. We are indebted to Dr. L. C. Rosenblad for use of his unpublished manuscript which covers the dissections and descriptions of the reproductive systems of some thirty-six species, of which nine are included in the present article. These are, *D. aldrichi*, *D. carbonaria*, *D. hamatofila*, *D. longicornis*, *D. meridiana*, *D. micromelanica*, *D. nigromelanica*, *D. polychaeta*, and *D. texana*. We are under very great obligation to Mrs. Martin who dissected all of the other new species and made detailed drawings of the entire group. Finally, we are grateful to Dr. A. B. Griffen and Miss Linda T. Wharton for the care they have taken in determining the metaphase chromosome numbers from smear preparations of the larval brain cells.

DESCRIPTION OF SPECIES

***Drosophila orbospiracula*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches, only one below in addition to terminal fork. Antennae yellowish tan, third joint darker. Front tan, orbits slightly yellowish. Middle orbital $\frac{1}{4}$ other two. First oral bristle large and prominent; second minute, not more than $\frac{1}{6}$ length of first. Carina rather short, but much broader below, rounded, not sulcate. Palpi clear in color, with one prominent bristle. Cheeks light yellow, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes brilliant red (Pl. 1-F 12), with short yellow pile.

Acrostichal hairs irregular, but usually in 8 rows; no prescutellars. Anterior scutellars divergent. Thorax light tannish brown, shining and without markings. Sterno-index about .43. Legs light yellow, nearly clear; a dark line down ventral surface of fore coxae. Apical bristles on first and second tibiae, those on first small; preapicals on all three, those of first and second small.

Abdomen yellow, each segment with a rather narrow brown band, widest in mid-line, narrowing towards margin but failing to reach it.

Wings clear. Costal index about 3.0; 4th vein index about 1.83; 5x index about 2.0; 4c index about .83. Two prominent bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.6 mm. (in live specimen); wings 2.7 mm.

♀. Abdominal bands widest medianly, narrowed toward margin, reaching it as a narrow line at least on basal segments.

Internal characters of imagines.

Testes light pink (Pl. 1-G 1), with one large and 3 small inner coils, and five outer coils or gyres.

Spermathecae large, spherical and chitinized. Ventral receptacle with about 12 loose coils and 7 flattened, closely appressed loops, arranged in the following sequence: 4 coils, 3 loops, 3 coils, 4 loops and 5 coils; the whole structure lies flat against the ventral surface of the uterus.

Other characteristics, relationship, and distribution.

Eggs.—4 rather thick filaments, each with a slight but noticeable waviness.

Puparia.—Orange brown color (Pl. 10-I 10). Each anterior spiracle with about 8 short, pointed branches arranged radially with one at center of circle; horn-index about 20.0.

Chromosomes.—Metaphase plate of female shows 5 pairs of rods and a pair of dots; each X chromosome has a dot-like element attached at end. Male plate shows 4 pairs of rods, a pair of dots and an unpaired X.

Relationship.—Belongs to the subgenus *Hirtodrosophila*.

Distribution.—Only record, male and female collected along Upper Oak Creek, Chisos Mountains, Brewster County, Texas, on August 13, 1941.

***Drosophila longala*, sp. nov.**

External characters of imagines.

♂, ♀. Arista with about 8 branches, only one below in addition to terminal fork. Antennae light tan, third joint darker. Front reddish brown. Middle orbital about $\frac{1}{4}$ other two. Only one prominent oral bristle. Palpi dark, one prominent and several smaller bristles. Carina only moderately wider below, lower portion of face widening from lower end of carina. Cheeks almost clear, darker towards face; their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes very dark red (Pl. 4—L 6), with dark pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars divergent. Sterno-index .33. Thorax tannish brown, pollinose; four faint brown longitudinal stripes, darkest anteriorly, one in each dorsocentral row and two in acrostichal rows. Legs pale yellow. Apical and preapical bristles of first tibiae very small; preapical of second tibiae very small if present at all, apical present; preapical only on third tibiae.

Abdomen yellowish brown, the entire apical margin dark brown, with darker brown projections medianly to anterior margin; inter-segmental areas creamy yellow. A small dark area at the angle of the tergite of the first complete segment.

Wings clear. Costal index about 2.88; 4th vein index about 1.56; 5x index about 1.33; 4c index about .78. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 2.6 mm. (in live specimen); wings 3.0 mm. Females slightly larger.

Internal characters of imagines.

Testes pale yellow (Pl. 9—G 1), with 4 inner and 4 outer coils or gyres.

Spermathecae spherical, chitinized. Ventral receptacle has 6 loops each with irregular coils at each end, the whole structure lying flat against the ventral surface of the uterus.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; determined by dissection of the ovary.

Relationship.—Belongs to the subgenus *Hirtodrosophila*.

Distribution.—Only record is a pair of flies collected in October, 1941, at White Water Camp, Gila National Forest near Glenwood, New Mexico.

Notes.—The pair of flies were kept in the laboratory for nearly a month, but during this time the female laid no eggs.

***Drosophila cinerea*, sp. nov.**

External characters of imagines.

♀. Arista with about 8 branches, only one below basal to terminal fork. Antennae brownish, third joint dark brown with black hairs and very large. Front dark gray. Middle orbital about $\frac{1}{3}$ first. Palpi brownish

black. Face light gray. Cheeks light gray, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes orange-red (Pl. 1-I 12).

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars straight. Mesonotum gray with bluish-gray stripe just inside dorso-central row, median region light gray. Pleurae gray. Four bluish-gray stripes located as follows: One from edge of mesonotum to presutural bristle; one from humerus to base of wing, bending dorsally to post-alar bristle; one from anterior edge of pteropleura to ventral angle of metanotum; one along entire dorsal edge of sternopleura. Scutellum gray. Legs grayish-brown, each segment darker near its joint. Apical bristles on first and second tibiae, those of first small; preapicals on all three, those on first and second small.

Abdomen yellowish gray, each segment with a bluish-gray band without median interruption, and wider in mid-line.

Wings dusky gray, veins grayish-brown. Costal index about 2.25; 4th vein index about 2.29; 5x index about 2.43; 4c index about 1.14. Apex of first costal section black, with two well-developed bristles. In the specimen described a partially developed, extra crossvein was present between the 4th and 5th longitudinal veins, about half way between anterior and posterior crossveins.

Body length 2.05 mm. (in live specimen) ; wings 2.65 mm.

Relationship and distribution.

Relationship.—Belongs to the subgenus *Hirtodrosophila*.

Distribution.—Two records: (1) a female trapped in a fungus patch near Hemphill in east Texas, (2) a second female was taken in a trap at Walnut Creek and Cameron Road about nine miles north of Austin, Texas. The first was taken on August 14, 1940, the second on September 15, 1940. The description is based on the Hemphill specimen.

***Drosophila grisea*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches, only one below in addition to terminal fork. Antennae yellowish brown, third joint somewhat darker. Front blackish brown, pollinose; anterior portion brownish orange. Middle orbital $\frac{1}{3}$ other two. One large oral bristle, the second not more than $\frac{1}{5}$ length of first. One prominent palpal bristle; palpi dark. Carina very narrow between antennae, broad near middle, narrowed again below. Face yellowish brown. Angle of cheeks grayish yellow, brown on either side, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark red (Pl. 5-L 12), with light colored pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Thorax dark gray, a darker area running down the mid-line; two lighter pollinose areas extending down between dorsocentral rows. Scutellum pollinose. Sterno-index about .53. Legs light brownish yellow. Apical bristles on first and second tibiae, those of first small; preapicals on all three, those of first and second small.

Each abdominal segment with an apical light grayish, brown band, which has an anterior projection in the median line separating two small basal yellow areas; before the angle of the tergites, the bands widen to include the entire segment, forming solid lateral areas. Entire abdomen is somewhat pollinose.

Wings clear, crossveins slightly clouded. Costal index about 3.1; 4th vein index about 1.6; 5x index about 1.45; 4c index about .74. Two prominent bristles at apex of first costal section, dorsal one twice the length of ventral. The third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 3.0 mm. (in live specimen); wings 3.0 mm.

♀. Abdominal bands lighter brown, pollinose; median projection to anterior margin as in male, but the small basal areas which they interrupt are light brown.

Internal characters of imagines.

Testes burnt-orange (Pl. 10–J 10), with 4 small inner and 5 outer coils or gyres.

Spermathecae chitinized. Ventral receptacle with 5 basal coils followed by 5 large, flattened, closely appressed loops; the whole structure lies flat against the ventral side of uterus.

Relationship and distribution.

Relationship.—Belongs to the subgenus *Hirtodrosophila*.

Distribution.—The only record is from Rustler's Park, Chiricahua Mountains, Arizona, where several specimens were captured.

Notes.—We were not able to breed this species in the laboratory. Eggs dissected out from the ovaries had 4 rather short filaments, which were flakey in appearance.

***Drosophila texana* Patterson, Stone and Griffen 1940. *Genetics* 26:164.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae brownish amber, third joint darker. Front brown. Middle orbital $\frac{1}{2}$ anterior and $\frac{1}{3}$ posterior. Second oral bristle about $\frac{3}{4}$ first; third also large. Palpi with one prominent bristle. Carina broadest below, sulcate; somewhat sulcate along its entire length. Cheeks grayish yellow, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes deep vermilion-like (Pl. 1–L 12), with dense pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .90. Mesonotum tannish brown, pollinose; darker down acrostichal rows. Pleurae tannish brown, sternopleurae blackish. Scutellum brown. Legs amber colored, tibiae and basal portion of femora darker, especially on third legs. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark grayish black, one or two basal segments lighter in mid-line.

Wings slightly dusky, veins brown; posterior crossveins clouded. Costal index about 2.7; 4th vein index about 1.75; 5x index about 1.2; 4c index about 1.0. Apex of first costal section with two enlarged bristles. Third costal section with heavy bristles on its basal $\frac{3}{4}$.

Length body 3.0 mm. (in live specimen); wings 2.7 mm.

♀. Length body 3.3 mm.; wings 2.9 mm.

Internal characters of imagines.

Testes bright orange (Pl. 9-G 10), with 3 inner and 5 outer coils or gyres.

Spermathecae chitinized. Ventral receptacle spiral with about 50 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments, anterior pair very thin and frequently break off.

Puparia.—Burnt-orange (Pl. 11-B 11). Each anterior spiracle with about 14 branches; horn-index about 15.0, with stem nearly absent. The puparia show anal pore of larval stage, a conspicuous character present in the puparia of all members of the group.

Chromosomes.—Metaphase plate shows 3 pairs of rods, one pair of V's and a pair of dots. The arms of the V-shaped element correspond to chromosomes 3 and 4 of *D. virilis*.

Relationship.—Belongs to the virilis group of the subgenus *Drosophila*; closely related to *D. americana*.

Distribution.—This species has been collected at several points in central and northeastern Texas, and in eight other states as follows: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Tennessee. Type material developed from single fertile female collected at Georgetown, Texas, in September, 1938.

***Drosophila novamexicana* Patterson 1941. Amer. Nat., 75:535.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae tannish, third joint darker. Front tannish brown. Middle orbital about $\frac{1}{2}$ anterior, $\frac{1}{4}$ posterior. Second oral bristle about $\frac{3}{4}$ first, third slightly enlarged. Palpi yellow with one large bristle. Carina somewhat wider below, sulcate along its length. Face yellowish. Cheeks grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark tomato-red (Pl. 3-K 12), with dense pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index .84. Mesonotum rusty brown, pollinose; darker brown stripe in acrostichal region, lighter, pollinose, down mid-line. Mesopleural and pteropleural sclerites burnt brown. Scutellum yellowish brown. Legs brownish yellow, tibiae and tarsi slightly darker than femora. Apical bristles on first and second tibiae, preapicals on all three.

Abdominal segments very dark gray, or appearing almost black at times, each segment interrupted medianly, the interruptions becoming narrower posteriorly.

Wings slightly dusky, veins brown; posterior crossveins clouded. Costal index about 3.0; 4th vein index about 1.7; 5x index about 1.0; 4c index about .81. Two well-developed bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{2}{3}$.

Length body 3.0 mm. (in live specimen); wings 2.8 mm.

Internal characters of imagines.

Testes translucent, deep orange (Pl. 11–H 11), with 3 inner and 5 outer coils or gyres.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots, as in *D. virilis*, but the salivary chromosomes of the two species differ in respect to several inversions.

Relationship and distribution.

Relationship.—Belongs to the virilis group of the subgenus *Drosophila*.

Distribution.—A single record of a male trapped near Silver City, New Mexico, in November, 1940. The description is based on males from a derived stock which arose from a cross between *D. americana* females and the original male.

***Drosophila montana*, sp. nov.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae tannish brown, third joint very much darker, almost black. Front dark brown, darker posteriorly. Middle orbital slightly less than $\frac{1}{2}$ anterior, $\frac{1}{3}$ posterior. First oral bristle long, second slender, about $\frac{1}{4}$ length of first. Palpi tannish, darker near tip, with one prominent bristle. Carina broad below, rounded, very shallowly sulcate. Face brownish. Cheeks dark grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark tomato-red (Pl. 3–K 12), with dense pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .82. Thorax dark blackish brown, pollinose, a brownish black stripe down entire acrostichal region, a lighter pollinose area in mid-line. Pleurae burnt brown; scutellum brown. Legs brownish, coxae a little darker; distal tarsal joints blackish. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen grayish brown, at least basal segment lighter in mid-line.

Wings somewhat dusky, veins brown; posterior crossveins clouded. Costal index about 3.3; 4th vein index about 1.5; 5x index about 1.0; 4c index about .7. Two well-developed bristles at apex of first costal section. Third costal section with heavy bristles on slightly more than the basal $\frac{1}{2}$.

Length body 3.2 mm. (in live specimen); wings 3.2 mm.

♀. Length body 3.4 mm.; wings 3.3 mm.

Internal characters of imagines.

Testes brilliant dark orange for the 3 inner and first outer coils (Pl. 9–L 12), outer 3 and $\frac{1}{2}$ coils or gyres same color but transparent.

Spermathecae ovoid, heavily chitinized. Ventral receptacle spiral with about 38 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Basic color deep brownish-orange (Pl. 13-A 12) with black markings. In some strains and under optimum food conditions, the older puparia turn nearly black. Each anterior spiracle has about 14 branches; horn-index about 11.0.

Chromosomes.—Metaphase plate shows 4 pairs of rods, one pair of small V's and a pair of dots. The V-shaped element is not the result of fusion of rods, but is due to an inversion or insertion in chromosome 2 which has placed the centromere near the middle of the euchromatic arm.

Relationship.—Belongs to the virilis group of the subgenus *Drosophila*.

Distribution.—We have collected this species at the following places: Estes Park, Colorado; Grand Teton and Yellowstone Parks, Wyoming; Ogden, Salt Lake City, Junction, and Zion National Park, Utah; Glenwood, New Mexico. It lives at elevations of from 4,500 to 10,000 feet, and is usually found at or above 6,500 feet. Type material from Grand Teton National Park.

Notes.—This species has two color phases, light and dark. The description is based on the darker form. The light form has a color pattern similar to that of *D. novamexicana*, but it has the same metaphase configuration of chromosomes as the darker form. This species is the most nearly isolated of any member of the group.

***Drosophila macrospina limpiensis*, Mainland 1941. Genetics, 27:155.**

External characters of imagines.

♂, ♀. Arista with about 9 branches. Antennae light brown, third joint darker. Front light brown. Middle orbital $\frac{1}{3}$ anterior, $\frac{1}{4}$ posterior. Second oral bristle $\frac{3}{4}$ length of first. Palpi pale yellow, with three prominent bristles. Carina rather small, narrow above, broader below, rounded. Face brownish tan. Cheeks light tannish gray, their greatest width about $\frac{1}{5}$ greatest diameter of eyes. Eyes scarlet-red (Pl. 1-K 12), with fine, light colored pile.

Acrostichal hairs in 8 rows; two median rows diverging somewhat just above level of posterior dorsocentrals. No prescutellars. Anterior scutellars convergent. Sterno-index about .58. Thorax light brown, shining; a slightly darker brown stripe in mid-acrostichal region, dividing somewhat at the level of the anterior dorsocentrals and, in general, following the diverging acrostichal hairs. Scutellum brown. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen blackish brown, shining, with median interruptions on all but about the last two segments; two or three basal segments with proximal brownish yellow areas extending to about the angle of the tergites. Spine of the genitalia tends to be somewhat straighter than in *D. m. macrospina*.

Wings clear, veins brown. Costal index about 2.87; 4th vein index about 1.35; 5x index about 1.1; 4c index about .74. Two well-developed bristles at apex of first costal section, dorsal one about twice the length of the ventral. Third costal section with heavy bristles on its basal $\frac{2}{5}$.

Length body 2.8 mm. (in live specimen); wings 2.7 mm. Females average slightly longer in body length.

Internal characters of imagines.

Testes sandy-yellow (Pl. 10-K 7), with 4 inner coils of large diameter, and 7 smaller outer coils or gyres. Ejaculatory sac has two posterior diverticula.

Spermathecae bell-shaped, lightly chitinized. Ventral receptacle with about 45 coils, last 30 coils very fine and in a tangled mass.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; posterior pair slightly heavier than anterior.

Puparia.—Dark amber (Pl. 10-K 11). Each anterior spiracle with about 13 branches; horn-index about 5.6.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of very small dots; in male the Y is shorter than the X and has a dot-like element attached at end.

Relationship.—Belongs to the macrospina group of the subgenus *Drosophila*.

Distribution.—This new subspecies was first collected in Limpia Canyon of the Davis Mountains in west Texas, in July, 1939. Since then we have collected a large series of strains from the following places: Radium Springs, Silver City, and Glenwood, New Mexico; Chiricahua and Huachuca Mountains, Patagonia, and San Bernardino, Arizona; Zion National Park, Utah; Punta de Agua, Magdalena, and Hermosillo, Sonora, Mexico. Type material from Limpia Canyon, Texas.

***Drosophila melanopalpa*, sp. nov.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae dark brown, third joint blackish. Front black, anterior and middle orbitals arising from a silvery pollinose spot, posterior orbital from a brown spot, with a silvery area between it and the verticals. Middle orbital nearly $\frac{1}{2}$ anterior, $\frac{1}{3}$ posterior. Second oral about $\frac{1}{4}$ first. Palpi nearly black, with several prominent bristles. Carina broad below, moderately sulcate. Face brownish black. Cheeks grayish yellow at their angles, darker on both sides; their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark red (Pl. 4-L 10), with short black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .83. Halteres pale, basal segments, especially second, with a dark brown area laterally. Thorax dark brown, bristles arising from blackish, brown spots, irregularly fused and leaving grayish pollinose, unspotted areas. Pleurae dark brown, an indefinite blackish

stripe from base of halteres to fore coxae. Scutellum very dark brown, grayish areas alternating with bristles, a small pollinose area in the mid-basal region. Legs pale with a smoky cast, fore coxae and femora blackish; black bands near bases of tibiae; all tibiae somewhat blackened; distal ends of femora blackish. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale yellow, each segment with a dark brown apical band, interrupted medianly, continued anteriorly somewhat at edge of interruption and reaching the anterior margin at the angle of the tergite, terminating there. Apical corners with triangular areas connected to central bands by narrow apical bands except on first complete segment on which there is a basal but no apical connection.

Wings clear, veins brown; apex of first costal section black with two large bristles. Costal index about 2.8; 4th vein index about 1.5; 5x index about 1.0; 4c index about .83. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 3.0 mm. (in live specimen); wings 2.7 mm.

♀. Banding on abdomen as in male, apical connections on bands and lateral areas broader.

Internal characters of imagines.

Testes sulphur-yellow (Pl. 9-K 1), with 8 inner and 8 outer coils or gyres.

Spermathecae oval-shaped, chitinized. Ventral receptacle spiral with about 116 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; posterior pair thicker than anterior and occasionally split at end.

Puparia.—Reddish-orange (Pl. 3-E 12). Each anterior spiracle with about 12 branches; horn-index about 3.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of V's; in male Y is much shorter than X.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*; very closely related to *D. neorepleta*.

Distribution.—We have collected eight specimens of this species at Cave Creek, Chiricahua Mountains, Arizona, in August, 1941.

***Drosophila neorepleta*, sp. nov.**

External characters of imagines.

♂. Arista with about 6 branches. Antennae brown. Front dark brownish black, posterior orbits lighter, pollinose; anterior orbits black. Middle orbital about $\frac{1}{2}$ other two. Second oral bristle fine, not more than $\frac{1}{4}$ first. Palpi pale, with several bristles. Carina evenly broadened from base, forming an elongate triangle, sulcate. Face brown. Cheeks gray, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes deep red (Pl. 3-L 6), with short dark pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .74. Halteres clear, basal segment with brown spots laterally. Thorax brownish black, bristles arising from black spots, unspotted areas pollinose; very little fusion of spots. Pleurae dark brown. Legs amber, fore coxae and femora darkened somewhat; black bands near bases of tibiae, blackish areas near distal ends of femora. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with a dark brown, apical band, interrupted medianly; bands reach the anterior margin at the angle of the tergite and terminate there, leaving yellow areas between the bands and the triangular brown lateral areas in the apical corners of the tergites; in the last one or two segments there is a small, indefinite apical connection between the band and the lateral area.

Wings clear, veins brown; apex of first costal section darkened, with two heavy bristles. Costal index about 2.7; 4th vein index about 1.68; 5x index about 1.2; 4c index about .9. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 2.9 mm. (in live specimen); wings 2.5 mm.

♀. Abdominal bands connected apically with lateral areas on all but the first complete segment. Length body 3.0 mm.; wings 2.8 mm.

Internal characters of imagines.

Testes pale yellow (Pl. 10-G 1), with 4 inner and 6 or 7 outer coils or gyres.

Spermathecae oval-shaped, slightly chitinized. Ventral receptacle spiral with about 107 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Amber colored (Pl. 9-J 6). Each anterior spiracle with about 14 branches; horn-index about 3.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a J-shaped autosomal pair; in male Y is shorter than X.

Relationship.—Belongs to the *repleta* group of the subgenus *Drosophila*; closely related to *D. repleta* Woll.

Distribution.—The stock upon which the description is based was sent to us by Dr. A. H. Sturtevant. The original flies were collected at Sacapulas, Guatemala (T. Dobzahnsky).

***Drosophila linearepleta*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae tannish brown. Front rusty brown, lighter anteriorly; posterior half of orbits, ocellar triangle and a narrow median line lighter, pollinose; center of ocellar triangle black; anterior portion of orbits darker brown. Middle orbital $\frac{1}{2}$ anterior, $\frac{1}{3}$ posterior. Second oral bristle fine and about $\frac{1}{5}$ length of first.

Palpi pale yellow, with two prominent bristles distally. Carina broad and high below, moderately sulcate. Face light brown. Cheeks grayish yellow, darker posteriorly, their greatest width nearly $\frac{1}{3}$ greatest diameter of eyes. Eyes bright blood-red (Pl. 3-L 6), with long, black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .75. Thorax grayish brown, each bristle arising from a dark brown spot, those of the outside pairs of acrostichals fusing to form two brown stripes extending posteriorly to just above level of anterior dorsocentrals; other spots irregularly fused. Pleurae brownish black, indistinct dark stripes from base of wings to humerus, from base of wings to coxae and across sternopleurae. Legs tannish yellow, fore coxae and femora nearly black; black bands near bases of tibiae, distal ends of femora and, to a lesser extent, at bases of femora. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark yellow, each segment with a dark brown apical band, medianly interrupted; bands project anteriorly along interruption and at angle of the tergites, forming solid lateral areas except on first complete segment where the band is distinct from lateral area.

Wings clear, veins brown; posterior crossveins clouded, anterior slightly so. Apex of first costal section black, with two large bristles. Costal index about 2.8; 4th vein index about 1.5; 5x index about 1.2; 4c index about .83. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 3.0 mm. (in live specimen); wings 2.7 mm.

♀. Length body 3.4 mm.; wings 2.9 mm.

Internal characters of imagines.

Testes pale lemon-yellow (Pl. 9-K 1), with 5 inner and 6 outer coils or gyres.

Spermathecae bell-shaped, chitinized. Ventral receptacle spiral with about 52 irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Bright-orange (Pl. 10-L 12), with chrome-brown shading toward anterior end. Each anterior spiracle has about 14 branches; horn-index about 3.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—The stock upon which the description is based was sent to us by Professor A. H. Sturtevant. The original flies were collected at Antigua, Guatemala (T. Dobzhansky).

***Drosophila fuliginea*, sp. nov.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae tannish brown, third joint darker. Front sooty black, ocellar triangle and orbits posterior to anterior orbital silvery gray; orbits anterior to the anterior orbitals tannish brown.

Middle orbital $\frac{1}{3}$ other two. Only one prominent oral bristle, second about $\frac{1}{4}$ length of first. Carina broad below, somewhat flattened. Palpi dirty yellow with several bristles. Face grayish black. Cheeks black, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes maroon red (Pl. 4-L 10), with long black pile.

Acrostichal hairs very irregular, in 6-8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .85. Pleurae black; mesonotum pollinose gray, each bristle arising from a black spot, these fusing into large, irregular splotches. Legs black, tarsi, especially those of hind legs, with slightly yellowish cast. Apical bristles on first and second tibiae, preapicals on all three.

Abdominal tergites black, with a narrow yellow interruption medially; a small, narrow basal yellowish area often visible on either side of median interruption; lateral areas solid.

Wings slightly dusky, veins somewhat dusky; apex of first costal section slightly darkened. Costal index about 3.0; 4th vein index about 1.61; 5x index about 1.16; 4c index about .77. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Length body 3.1 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes transparent lemon-yellow (Pl. 10-J 1), with 7 inner and 8 outer coils or gyres. Paragonia very large.

Spermathecae bell-shaped, heavily chitinized. Ventral receptacle spiral, with 60-65 slightly irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 stout filaments, with rudimentary branches sometimes present.

Puparia.—Transparent orange (Pl. 10-I 9), the flattened anterior portion is edged with black. Each anterior spiracle has about 17 branches; horn-index about 4.3.

Chromosomes.—Metaphase plate shows one pair of rods, 2 pairs of large V's and a pair of small V's.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—Has been collected in considerable numbers around Silver City, Glenwood, and Capitan, New Mexico. Type material from Silver City.

***Drosophila nigrospiracula*, sp. nov.**

External characters of imagines.

♂, ♀. Arista with about 7 branches. Antennae light brown, third joint darker. Front dark brown, lighter anteriorly; orbits slightly pollinose, bristles of anterior orbits arising from dark spots. Middle orbital bristle $\frac{1}{2}$ length other two. Second oral bristle $\frac{1}{2}$ length of first. Carina evenly

broadened, sulcate. Face light brown. Cheeks yellowish gray, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 2–L 12), with long black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Whole thorax dark brownish gray, bristles arising from dark brownish spots, which fuse to form large dark areas surrounding lighter and smaller pollinose areas. Sterno-index .8. Legs brown, fore coxae lighter; an indistinct dark band near base of each tibia, strongest on hind leg. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark yellowish gray, each segment with a dark gray band almost as wide as entire segment, narrowly interrupted; bands continue to margin where they form solid lateral areas.

Wings clear. Costal index about 3.0; 4th vein index about 1.5; 5x index about 1.0; 4c index about .8. Apex of first costal section very slightly darkened, with two well-developed bristles. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 3.0 mm. (in live specimen); wings 2.6 mm.

Internal characters of imagines.

Testes bright orange (Pl. 10–H 10), with 6 inner and 6 outer coils or gyres.

Spermathecae black, slightly chitinized; ventral receptacle long, loose spiral, with approximately 70 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 very thin filaments, each about $\frac{1}{3}$ longer than egg.

Puparia.—Orange colored (Pl. 11–I 10). Each anterior spiracle black, with about 17 branches; horn-index about 3.3.

Chromosomes.—Metaphase plate shows 5 pairs of rods and one pair of dots in both male and female.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—First collected in September, 1940, in Sabino Canyon, Santa Catalina Mountains, and in desert ten miles from Tucson, Arizona, by G. B. Mainland. In August, 1941, our stock collectors captured nearly a thousand specimens near Magdalena, Sonora, Mexico.

Notes.—In Arizona and Sonora it has been found only in association with the giant cactus *Carnegiea gigantea*. However, in the latter place specimens were also found feeding on the fruit of the organpipe cactus, *Cereus Thurberi*. Type material from Tucson, Arizona.

***Drosophila leonis*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae tannish brown, third joint slightly darker. Front tannish brown, darker posteriorly; posterior half of orbits lighter, orbital bristles arising from blackish spots; ocellar triangle blackish. Middle orbital about $\frac{1}{2}$ other two. One prominent oral

bristle, second only about $\frac{1}{4}$ length of first. Palpi light brown with several long, thin bristles. Carina broad below, sulcate. Face tannish brown. Cheeks grayish, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes vermilion-like (Pl. 2-K 12), with long black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .70. Mesonotum pollinose gray, the bristles arising from blackish brown spots, these fusing into irregular splotches. Pleurae gray, an indefinite, darker band running from propleura to base of the haltere, and another, even more indistinct, from the humerus to the wing base. Scutellum dark brown, the margin pollinose gray, the scutellar bristles arising from dark brown areas. Legs tannish brown, fore coxae a little darker; a narrow black band on either side of the tibio-femoral joints, darkest on hind legs; the bands of the tibiae darker than those of the femora. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with an apical dark brown band, interrupted medianly. At the interruption the bands extend a little anteriorly, and at the angle of the tergites they extend completely to the base; lateral areas of posterior segments are solid, those of the anterior segments have an irregular yellow area in their centers.

Wings clear; anterior and posterior crossveins moderately clouded; slight darkening at tip of second longitudinal vein. Apex of first costal section dark. Costal index about 2.8; 4th vein index about 1.7; 5x index about 1.35; 4c index about .98. Apex of first costal section with two well-developed bristles. Third costal section with heavy bristles on its basal $\frac{1}{4}$.

Length body 2.7 mm. (in live specimen); wings 2.5 mm.

♀. Length body 3.0 mm.; wings 2.9 mm.

Internal characters of imagines.

Testes with 3 inner, bright orange colored coils (Pl. 9-J 9) and 2 and $\frac{1}{2}$ outer, light cream colored coils or gyres (Pl. 9-E 2). The ejaculatory sac large with two very large posterior diverticula.

Spermathecae small, spherical, not chitinized. Ventral receptacle spiral with about 30 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 thin filaments.

Puparia.—Brownish-orange (Pl. 11-E 12). Each anterior spiracle has about 7 branches; horn-index about 10.0.

Chromosomes.—Metaphase plate shows 6 pairs of rods; one pair of autosomes has dot-like elements attached to ends; Y is shorter than X in male.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—The stock upon which the description of this new species is based was sent to us by Professor A. H. Sturtevant. The original flies were collected at San Josecito, Nuevo Leon, Mexico.

Drosophila hydeoides*, sp. nov.*External characters of imagines.**

♂, ♀. Arista with about 7 branches. Antennae brown, third joint darker. Front dark brown, posterior section of orbits pollinose. Middle orbital bristle $\frac{1}{3}$ other two. Second oral bristle half as long as first. Carina broad below, distinctly sulcate. Face brown. Cheeks yellowish gray, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes wine colored (Pl. 5-L 6), with dense, short, black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Whole thorax dark brownish gray, bristles arising from dark brown spots which fuse into shapeless splotches that intermingle with lighter pollinose areas. Sterno-index about .88. Legs tannish yellow, fore coxae and femora light brown; a dark band near base of each tibia, an independent one near distal end of each femur; bands darkest on hind legs. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with a wide, medianly interrupted dark brown or black band, which reaches the anterior margin at the angle of the tergite, forming solid dark lateral areas.

Wings clear. Costal index about 3.5; 4th vein index about 1.7; 5x index about 1.0; 4c index about .78. Apex of first costal section slightly darkened, with two prominent bristles. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 3.0 mm. (in live specimen); wings 2.8 mm.

Internal characters of imagines.

Testes translucent, tinged with yellow, with about 20 inner and 25 outer coils or gyres.

Spermathecae flask shaped, slightly chitinized. Ventral receptacle long spiral with about 330 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Burnt-orange (Pl. 11-L 8). Each anterior spiracle with about 22 branches; horn-index about 4.5.

Chromosomes.—Metaphase plate shows 6 pairs of rods, with X and Y unequal, the Y being shorter.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—Strain used in description came from flies collected at San Josecito, Nuevo Leon, Mexico, and was sent to us by Professor A. H. Sturtevant.

Drosophila nigrohydei*, sp. nov.*External characters of imagines.**

♂. Arista with about 7 branches. Antennae tannish brown, third joint much darker. Front dark brown, posterior orbits, ocellar triangle and a narrow median line lighter, pollinose; orbital bristles arising from brown

spots; anterior orbits dark brown. Middle orbital bristle $\frac{1}{2}$ anterior, $\frac{1}{3}$ posterior. Only one prominent oral bristle, second about $\frac{1}{5}$ first. Palpi pale yellow, with several prominent bristles. Carina very low and flat dorsally, broad and high below, sulcate. Face brown. Cheeks grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark red (Pl. 5—L 6), with dark pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .83. Thorax brown, bristles arising from dark brown spots which fuse into rather large, irregular splotches; unspotted areas grayish pollinose. Pleurae burnt brown. Scutellum dark brown, grayish pollinose areas along margin anterior to each bristle. Legs amber, black bands near bases of tibiae, distal ends of femora blackish, third legs darkest; fore femora often darkened. Apical bristles on first and second tibiae, preapicals on all three. Medially directed recurved hairs on male fore tarsus of length equal to or slightly greater than width of tibial joint.

Abdomen dark yellow, each segment with a wide, dark brown apical band, interrupted medianly; the bands reach the anterior margin at the angle of the tergite forming solid lateral areas.

Wings clear, veins brown; apex of first costal section blackish, with two large bristles. Costal index about 3.3; 4th vein index about 1.6; 5x index about .94; 4c index about .8. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 3.2 mm. (in live specimen); wings 2.9 mm.

♀. Length body 3.6 mm.; wings 3.1 mm.

Internal characters of imagines.

Testes bright chrome-yellow (Pl. 9 1—L 1), with 10 inner and 12 outer coils or gyres.

Spermathecae bell-shaped, slightly chitinized. Ventral receptacle spiral with about 340 fine, regular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Reddish amber (Pl. 11—L 11). Each anterior spiracle with about 17 branches; horn-index about 6.3.

Chromosomes.—Metaphase plate shows 6 pairs of rods with constriction in X in female; 6 pairs of rods with Y shorter than X, in male.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—Collected at Oak Creek, Chisos Mountains, Texas, and Cave Creek, Chiricahua Mountains, Arizona. Type material from Chisos Mountains.

***Drosophila bifurca*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches. Second joint of antennae yellowish brown, third joint dark brown, covered with fine tan colored hairs. Front

dark brown, orbits lighter. Middle orbital $\frac{1}{3}$ other two. Only one prominent oral bristle, which is about twice the length of other five. Carina sulcate. Face light brown. Cheeks yellowish brown, their greatest width nearly $\frac{1}{3}$ greatest diameter of eyes. Eyes brick-red (Pl. 5-L 11), with thick dark pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Mesonotum and scutellum pollinose brown, each bristle and hair arising from a dark brown dot; a faint light stripe along mid-dorsal line, and just lateral to each dorsocentral row. Pleurae pollinose brown, darker in some specimens. Sterno-index .8. Legs yellowish brown; apical and preapical bristles on first and second tibiae, preapicals on third. Last tarsal joints darker brown. Very long recurved hairs on medial side of fore tarsi in male.

Abdomen yellowish gray, each segment with a wide medially interrupted light brown band on its posterior margin; these bands nearly reach the anterior margin laterally, where they terminate in deep brownish areas.

Wings clear. Costal index about 3.6; 4th vein index about 1.3; 5x index about .8. 4c index about .6. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 4.5 mm. (in live specimen); wings 3.4 mm.

♀. Abdominal bands wider and darker than in male; medial interruptions narrower. Length body 4.5 mm.; wings 3.5 mm.

Internal characters of imagines.

Testes creamy white (Pl. 10-F 1), spiral, with about 23 small inner coils and 28 outer coils or gyres. Paragonia are tubular with distal ends twisted or coiled.

Spermathecae spherical, clear and not chitinized. The ventral receptacle is very long, finely coiled with an average of about 735 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; posterior pair split for about $\frac{1}{3}$ length, each filament with either two or three forks; anterior filaments usually not split.

Puparia.—Rust colored (Pl. 4-A 12); each anterior spiracle with about 23 branches; horn-index 2.8.

Chromosomes.—Metaphase plate shows five pairs of rods and one pair of dots; constrictions in all rod-shaped chromosomes.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—Single females collected at Eagle Pass and Ft. Worth, Texas; rather common in Limpia and Wild Rose Canyons in West Texas; three specimens collected at Tombstone Canyon, Mule Mountain, Arizona. Type material from Wild Rose Canyon.

Drosophila pachea*, sp. nov.*External characters of imagines.**

♂. ♀. Arista with about 7 branches. Antennae light brown, third joint dark brown. Front dull brown, orbits and anterior region lighter. Middle orbital $\frac{1}{3}$ other two. Second oral nearly $\frac{1}{2}$ first. Carina broad below, sulcate. Palpi yellowish brown, with several bristles arising from a dark brown spot. Face light brown. Cheeks grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 2-K 12), with short black pile.

Acrostichal hairs in 8 rows; slightly enlarged prescutellar hairs. Mesonotum dark, dull brown, in male with a slight amber cast; very indistinct darker areas at bases of some bristles, these fusing to form very faint lighter lines along dorsocentral rows and mid-line, leaving two dark stripes in acrostichal region; striping very faint on male, more noticeable on female. Sterno-index .66. Legs light yellowish brown. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark brown, the two basal segments lighter or partially interrupted medially.

Wings clear, veins dark. Costal index about 3.1; 4th vein index about 1.6; 5x index about 1.21; 4c index about .85. Two heavy bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.3 mm. (in live specimen); wings 1.9 mm.

Internal characters of imagines.

Testes yellow (Pl. 9-J 5), with 16 inner transparent coils and 12-15 outer coils or gyres.

Spermathecae chitinized, with long non-chitinized stems. Ventral receptacle very tightly coiled spiral, irregularly twisted about other organs, and with about 330 coils.

Relationship and distribution.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—A single record of two males and two females taken by stock collectors about three miles north of Hermosillo, Sonora, Mexico, in August, 1941.

Notes.—We were not able to breed these flies in the laboratory, hence do not know character of egg, puparia, or chromosomes.

Drosophila ritae*, sp. nov.*External characters of imagines.**

♂. Arista with about 7 branches. Antennae tan, third joint darker. Front tannish brown, lighter anteriorly; orbits and ocellar triangle pollinose. Middle orbital about $\frac{1}{2}$ other two. Second oral bristle about as long as first. Carina triangular, flaring below and not rounded, sulcate.

Face tannish brown. Cheeks yellowish gray, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 2-L 11), with long black pile.

Acrostichal hairs irregular, usually in 8 rows; slightly enlarged prescutellar hairs. Anterior scutellers divergent. Thorax reddish brown, a narrow pollinose line in mid-dorsal region; bristles arising from indistinct brown spots. Sterno-index .88. Legs pale yellow, with faint, indistinct dark bands near base of tibiae and apices of femora, darkest on hind legs. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen grayish yellow, each segment with a brown band, about as wide as entire segment, interrupted medially and extending to margin on all but first two segments, forming solid lateral areas.

Wings clear. Costal index about 2.8; 4th vein index about 1.5; 5x index about 1.1; 4c index about 1.1. Apex of first section of costal vein not darkened, has two prominent bristles. Third section of costa with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.5 mm. (in live specimen); wings 2.2 mm.

♀. Abdominal segments with interrupted bands narrower medially in female, widening to reach the anterior margin at angle of tergite and forming solid lateral areas.

Length body 3.3 mm.; wings 2.6 mm.

Internal characters of imagines.

Testes yellowish (Pl. 9-L 1), with 2 inner and three outer coils or gyres. Spermathecae not chitinized. Ventral receptacle with about 18 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long slender filaments.

Puparia.—Light orange (Pl. 10-J 8). Each anterior spiracle with about 17 branches; horn-index about 3.5.

Chromosomes.—Metaphase plate shows 5 pairs of rods and one pair of dots.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—A strain of this species was first sent to us by Dr. A. H. Sturtevant. The original flies had been collected at Santa Rita, Arizona. We have since collected it at the following places: Wild Rose and Limpia Canyons and Chisos Mountains, Texas; Silver City and Glenwood, New Mexico; Tombstone Canyon, Mule Mountains, and Ramsey Canyon, Huachuca Mountains, Arizona. Type material from Wild Rose Canyon, Texas.

***Drosophila brevicarinata*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae tannish brown, third joint darker. Front brown, rusty brown anteriorly, posterior orbits and large ocellar triangle lighter, pollinose; anterior orbits brown. Middle orbital about $\frac{1}{2}$ other two. One prominent oral bristle followed by an irregularly

disposed series of hairs. Palpi very pale yellow, with several prominent bristles. Carina short dorsoventrally, low dorsally, broad and high ventrally, widely sulcate. Face pale yellow. Cheeks grayish yellow, their greatest width a little more than $\frac{1}{3}$ greatest diameter of eyes. Eyes scarlet-like (Pl. 1–L 12), with dense dark pile.

Acrostichal hairs in 8 rows, irregular; no prescutellars. Anterior scutellars convergent. Sterno-index about .83. Thorax grayish brown, pollinose, bristles arising from small dark brown spots; very little fusion of spots into splotches. Pleurae grayish yellow. Legs yellow, a black band near base of tibiae, very faint on first and second legs; distal end of third femora slightly blackened. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with a narrowly interrupted, wide brown band, each side of each band with a shallow, basal yellow concavity; bands extend laterally to form lighter but solid areas, except on first complete segment where the lateral area is separate from the band.

Wings clear, veins light brown. Costal index about 2.8; 4th vein index about 1.8; 5x index about 1.1; 4c index about .97. Apex of first costal section with two well-developed bristles. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.3 mm. (in live specimen); wings 2.0 mm.

♀. Abdominal bands narrower, occupying center of segments and with narrower interruptions than in male; all segments with bands and lateral areas continuous.

Length body 2.8 mm.; wings 2.4 mm.

Internal characters of imagines.

Testes bright yellow (Pl. 10–L 2), with 3 inner and 3 outer coils or gyres.

Spermathecae small, spherical and not chitinized. Ventral receptacle spiral with about 25 slightly irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Reddish brown (Pl. 11–G 12). Each anterior spiracle with about 9 branches; horn-index about 10.5.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*; closely related to *D. ritae*, which it somewhat resembles.

Distribution.—The stock upon which the description is based was sent to us by Professor A. H. Sturtevant. The original flies were collected at San Josecito, Nuevo Leon, Mexico.

Drosophila longicornis*, sp. nov.*External characters of imagines.**

♂. Arista with about 7 branches. Antennae tannish brown, third joint darker. Front chocolate brown, lighter anteriorly; orbits pollinose, with bristles arising from black spots; ocellar area and narrow median line lighter and pollinose. Middle orbital $\frac{1}{3}$ other two. Second oral $\frac{1}{2}$ length of first. Carina only slightly broader below, slightly sulcate. Face tannish. Cheeks pale, grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 1-I 12), with short black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Several hairs enlarged anterior to and in same row with dorso-centrals. Thorax gray, bristles arising from blackish brown spots, which fuse to form two irregular stripes along acrostichal rows. Sterno-index .8. Legs light brownish yellow; dark band near base of each tibia, fainter one near distal end of each femur. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale, grayish yellow, each segment with a brown band interrupted medially and in lateral area, leaving a narrow elongate brown area on the margin.

Wings clear, crossveins moderately clouded. Costal index about 3.2; 4th vein index about 1.9; 5x index about 1.3; 4c index about .9. Apex of first costal section black with two heavy bristles. Third costal section with heavy bristles on its basal $\frac{1}{4}$.

Length body 2.6 mm. (in live specimen); wings 2.2 mm.

♀. Bands of abdominal segments darker, with lateral areas usually solid. A small indistinct lateral interruption is sometimes visible in anterior segments. Length body 2.9 mm.; wings 2.5 mm.

Internal characters of imagines.

Testes empire-yellow (Pl. 9-K 3), with 2 inner and 3 outer coils or gyres.

Spermathecae very small, spherical, with chitinized inner structure enveloped by a transparent covering. Ventral receptacle elongated with about 15 loosely arranged coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long slender filaments.

Puparia.—Jonquil color (Pl. 9-J 5). Each anterior spiracle with about 12 branches; horn-index 1.5, longest horns for any known *Drosophila*.

Chromosomes.—Metaphase plate shows 4 pairs of short rods, one pair of long rods and a pair of dots; in male the long pair is represented by a long and short rod, the X and Y chromosomes.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—Absent or extremely rare in north and east Texas, but very common in central and southern parts of state and ranges down into

the states of Coahuila and Nuevo Leon, Mexico. Westward, its distribution range extends into west Texas, New Mexico and Arizona. A single specimen was taken in Zion National Park, Utah. In Sonora, Mexico, specimens were trapped at Magdalena and Hermosillo. Type material from Austin, Texas.

Notes.—Nothing very definite is known about its food habits. The life cycle lasts for over a month, due to the long time required for the adults to mature.

***Drosophila hamatofila*, sp. nov.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae tannish brown. Front light brown, lighter anteriorly; orbits and a small median area lighter, pollinose. Middle orbital $\frac{1}{4}$ other two. Second oral $\frac{1}{2}$ length of first. Carina truncate below, moderately sulcate. Face tannish yellow. Cheeks pale yellowish gray, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 1–I 12), with long black pile.

Acrostichal hairs irregular, usually in 8 rows; no prescutellars. Anterior scutellars convergent. Mesonotum gray pollinose, with slightly reddish cast; spots from which bristles arise not very prominent. Pleurae light brownish gray. Sterno-index .8. Legs pale yellow, occasionally a slightly darker band near base of tibiae, but not usually visible. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with an interrupted light brown band which fades away laterally. Margins of tergites with very faint, indistinct, light brown areas.

Wings clear. Apex of first costal section clear with two heavy bristles. Costal index 3.1; 4th vein index about 1.6; 5x index about 1.3; 4c index about .85. Heavy bristles on basal $\frac{1}{4}$ of third costal section.

Length body 2.5 mm. (in live specimen); wings 2.3 mm.

♀. Abdominal bands darker, lateral margins solid, lighter in anterior segments. Length body 2.9; wings 2.5 mm.

Internal characters of imagines.

Testes yellowish white (Pl. 9–D 1), with 4 inner and 5 outer coils or gyres.

Spermathecae small, chitinized, with ridges radiating from center and giving a corrugated appearance. Ventral receptacle spiral with 15 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments, each terminating in a small hook.

Puparia.—Buff colored (Pl. 11–K 7). Each anterior spiracle with about 11 branches; horn-index 2.3.

Chromosomes.—Metaphase plate shows 4 pairs of short rods, one pair of long rods and a pair of dots; the long rods are the sex-chromosomes and in the male are represented by a long rod and a small V, the X and Y.

Relationship.—Belongs to the repleta group of the subgenus *Drosophila*.

Distribution.—Its distribution range extends from about the 95th meridian in Texas westward into New Mexico, Arizona and California. It is common in central and southwestern Texas. West of Texas it has been taken at the following places: Las Cruces and Radium Springs, Gila National Park, New Mexico; Rustler's Park and San Bernardino, Arizona; Zion National Park, Utah; Magdalena, Sonora, Mexico, and at several points in California. We have also seen one specimen from Muzquiz, Coahuila, Mexico. Type material from Round Rock, Texas.

Notes.—At Round Rock, Texas, it was found feeding on the fruit of the common prickly pear, *Opuntia lindheimeri*.

***Drosophila peninsularis*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae tannish brown, third joint darker; hairs of second segment arising from dark spots. Front tannish brown, orbits pollinose; posterior orbitals, verticals and hairs of anterior dorsal orbit arising from brown spots. Middle orbital $\frac{1}{3}$ other two. Second oral bristle about $\frac{1}{3}$ length of first. Carina broadened below, moderately sulcate. Face very light brown. Cheeks pale yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes vermilion-like (Pl. 3-K 12), with short black pile.

Acrostichal hairs in 8 rows; slightly enlarged hairs at prescutellar position. Anterior scutellars convergent. Mesonotum tannish brown, bristles and hairs arising from brown spots. Pleurae pale, grayish yellow; an indistinct gray stripe from about the base of fore coxae to base of halteres; sterno-pleurae somewhat darkened. Sterno-index about .78. Legs pale yellow, with dark band near base of tibiae, a fainter one near apex of femora. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellowish, each segment with an interrupted, dark grayish band, which reaches anterior margin at angle of tergites. Lateral margins with elongate dark area, those of posterior segments with an apical connection with central band.

Wings clear. Costal index about 2.5; 4th vein index about 1.6; 5x index about 1.25; 4c index about .95. Apex of first costal section dark, with two bristles. Heavy bristles on basal $\frac{1}{2}$ of third costal section.

Length body 2.7 mm. (in live specimen); wings 2.2 mm.

♀. Length body 3.4 mm.

Internal characters of imagines.

Testes canary-yellow (Pl. 9-L 5), with 2 and $\frac{1}{2}$ inner and 3 outer coils or gyres.

Spermathecae very slightly chitinized. Ventral receptacle arises as straight tube which terminates in about 24 irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long, slender, slightly wavy filaments.

Puparia.—Golden-orange (Pl. 9—L 9). Each anterior spiracle has about 15 branches; horn-index 3.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; the Y is a small V.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—This species has been collected in Florida only, at the following places: Lake McKethan, Avon Park, Miami, Everglades, Myakka State Park and Withlacoochee River. Type material from Lake McKethan.

Notes.—With the exception of three specimens collected at a produce house in Miami, it has always been found in the country.

***Drosophila mercatorum*, sp. nov.**

External characters of imagines.

♂. Arista with 7 or 8 branches. Antennae very light brown, bristles on second segment arising from darker spots, third joint darker brown. Front light brown, ocellar area and a narrow median area lighter and somewhat pollinose; orbits lighter and pollinose, middle and posterior orbital setae of anterior orbit arising from darker brown areas. Middle orbital about $\frac{1}{2}$ other two. Second oral about $\frac{1}{2}$ length of first. Carina broad below, moderately sulcate. Palpi pale yellow with several long, thin bristles. Face very light tan. Cheeks pale yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes cherry red (Pl. 2—L 12), with long black pile.

Acrostichal hairs in 8 rows; hairs of prescutellar position slightly enlarged. Anterior scutellars convergent. Sterno-index about .83. Mesonotum light pollinose brown, bristles arising from dark brown spots. Pleurae light tannish brown, an indistinct darker band from base of fore coxae to base of halteres. Legs very pale yellow, an indefinite faint, blackish band near base of each tibia, darkest on third leg. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale lemon-yellow, each segment with an exceedingly faint grayish band, interrupted medianly. Near angle of tergite the band tends to turn anteriorly to base. Laterally it persists only as a very faint grayish area in the apical corners of the lateral areas.

Wings clear. Costal index about 2.8; 4th vein index about 1.7; 5x index about 1.33; 4c index about .91. Apex of first costal section blackened, with two prominent bristles. Third costal section with heavy bristles on its basal $\frac{2}{5}$.

a narrow brown area. Length body 3.0 mm.; wings 2.8 mm.

♀. Abdominal bands as in male, but darker brown and more widely interrupted. Lateral margins of all but last one or two segments with a narrow brown area. Length body 3.0 mm.; wings 2.8 mm.

Internal characters of imagines.

Testes pale yellow (Pl. 9-E 1), with one and $\frac{1}{2}$ inner and 2 and $\frac{1}{2}$ outer coils or gyres.

Spermathecae spherical, not chitinized. Ventral receptacle arises as straight tube which terminates in about 6 coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long, slender wavy filaments.

Puparia.—Light orange (Pl. 10-K 7). Each anterior spiracle has about 16 branches; horn-index about 5.5.

Chromosomes.—Metaphase plate shows 3 pairs of rods, one pair of large V's and a pair of small V's; small dot-like element attached to end of each X chromosome; Y chromosome is absent in male.

Relationship.—Belongs to repleta group of the subgenus *Drosophila*.

Distribution.—First collected at Santa Barbara and Bell, California, in 1940 by Mr. G. B. Mainland, who also captured a single specimen in a produce house in Tucson, Arizona. In June, 1941, another specimen was taken in a produce house in New Orleans, Louisiana. A slightly darker strain of this same species occurs in the Hawaiian Islands, where it has been called *D. mulleri*. Mr. E. C. Zimmerman of the University of Hawaii kindly sent us specimens collected at Honolulu. Breeding tests between strains from California and Hawaii demonstrate that the two forms belong to the same species. This species has always been taken in fruit stores or produce houses. Type material from Santa Barbara, California.

Drosophila aldrichi* Patterson and Crow 1940. Tex. Pub., 4032: 251.*External characters of imagines.**

♂. Arista with about 7 branches. Antennae tan, third joint darker. Front tannish brown, orbits and large ocellar triangle lighter, pollinose; bristles arising from black spots. Middle orbital about $\frac{1}{2}$ other two. Second oral bristle about $\frac{1}{3}$ length of first. Carina broad below, sulcate. Palpi pale with several prominent bristles. Face tannish yellow, very pale. Cheeks pale yellowish gray, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes vermilion-like (Pl. 2-H 12), with dense black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index .75. Mesonotum grayish brown, the bristles arising from dark brown spots. Pleurae brownish gray, a faint indistinct burnt brown stripe from base of halteres to base of coxae and one across sternopleura; both variable in intensity. Legs pale brownish yellow, a black band near base of each tibia, faint on front leg. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale yellow, each segment with an interrupted brown band which bends toward and reaches the anterior margin at the angle of the tergite, leaving a triangular lateral area separated from the central band except on the last two segments where there is a basal connection.

Wings clear, veins brown; apex of first costal section black. Costal index about 2.6; 4th vein index about 2.2; 5x index about 1.3; 4c index about 1.1. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{4}$.

Length body 2.5 mm. (in live specimen); wings 2.2 mm.

♀. Lateral areas of abdominal bands less distinctly separated from central band than in male.

Internal characters of imagines.

Testes deep orange (Pl. 10–L 12), with 2 inner and 2 and $\frac{3}{4}$ outer coils or gyres.

Spermathecae spherical, not chitinized. Ventral receptacle poorly formed, twisted and usually without distinct coiling.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; anterior pair about $\frac{2}{3}$ length of posterior pair.

Puparia.—Orange-tan color (Pl. 12–L 5). Each anterior spiracle with about 9 branches; horn-index 2.3.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; in male Y is shorter than X.

Relationship.—Belongs to the *mulleri* group of the subgenus *Drosophila*. Closely related to *D. mulleri* Sturtevant. *Mulleri* females crossed to *aldrichi* males produce a few hybrids which are completely sterile. The reciprocal cross is sterile.

Distribution.—This species is found scattered over most of Texas. A single male was sent to the laboratory by Dr. Albert P. Blair, who collected the specimen in the Wichita Mountains near Lawton, Oklahoma. Our stock collectors trapped 59 specimens of this species in a cactus patch near Hermosillo, Sonora, Mexico, in August, 1941.

Notes.—This species feeds and breeds on the common prickly pear, *Opuntia lindheimeri*. It is found in great numbers in south Texas where this species of cactus is abundant. Type material from Austin, Texas.

***Drosophila mojavensis* Patterson and Crow 1940. Tex. Pub., 4032:251.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae tannish brown, third joint darker. Front light brown, orbits and large ocellar triangle lighter, pollinose; orbital bristles arising from light brown, non-pollinose areas. Middle orbital scarcely less than $\frac{1}{2}$ other two. Second oral about $\frac{1}{2}$ length of first. Carina broad below, sulcate. Palpi pale yellow, with small bristles only. Face tannish. Cheeks yellowish gray, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes vermilion-like (Pl. 1–I 12), with dense black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .8. Mesonotum light brownish yellow, bristles arising from medium brown spots; unspotted areas somewhat

pollinose. Legs pale yellow; exceedingly faint dark bands near base of tibiae of second and third legs; last tarsal joints brown. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale yellow, each segment with a faded and indefinite, interrupted brown band, tending to bend anteriorly at the angle of the tergite, but fading away; small narrow brown areas along margin of the segments, leaving lateral areas otherwise unmarked.

Wings clear, veins brown; apex of first costal section black. Costal index about 2.9; 4th vein index about 1.8; 5x index about 1.3; 4c index about .94. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.4 mm. (in live specimen); wings 2.0 mm.

♀. Bands of abdomen continuing laterally, not fading as noticeably as in male. Length body 2.6 mm.; wings 2.3 mm.

Internal characters of imagines.

Testes semi-transparent, bright yellow (Pl. 9-K 1), with 2 and $\frac{1}{2}$ inner and 2 outer coils or gyres. Paragonia sometimes coiled.

Spermathecae not chitinized. Ventral receptacle with about 15 loose coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Apricot color (Pl. 10-G 7). Each anterior spiracle with about 11 branches; horn-index about 3.8.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; in male Y is shorter than X.

Relationship.—Also closely related to *D. mulleri*. *Mulleri* females crossed to *mojavensis* males produce fertile female and sterile male hybrids. The reciprocal cross is sterile.

Distribution.—The stock upon which the description of this new species is based came from flies collected at Mesquite Springs, Death Valley, California, by Dr. W. P. Spencer. A second stock has been sent to us by Dr. A. H. Sturtevant. The original flies were collected by Mr. K. Mampell in the Chocolate Mountains, just east of Salton Sea, California.

Notes.—Professor Spencer has informed us that this species is common in the California deserts. He found it breeding in rotting barrel cactus, *Echinocactus acanthodes*. He suggested the species name.

Drosophila arizonensis, sp. nov.

External characters of imagines.

♂. Arista with about 7 branches. Antennae brown, third joint much darker. Front light brown, orbits and large ocellar triangle lighter, pollinose; orbital bristles and hairs of anterior orbits with basal blackish spots. Middle orbital about $\frac{2}{3}$ length of anterior and $\frac{1}{2}$ length of posterior. Second oral about $\frac{1}{3}$ length of first. Carina broad below, sulcate.

Palpi pale yellow, with several bristles. Face light brownish yellow. Cheeks light gray, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes reddish (Pl. 1-D 12), with short black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index .79. Mesonotum light brown, bristles arising from darker brown spots. Legs brownish yellow, indistinct black bands near bases of tibiae. Apical bristles on first and second tibiae, preapicals on all three.

Abdominal segments brownish yellow, each with an interrupted brown band which bends to the anterior margin at the angle of the tergite, leaving a small, irregularly triangular brown area in the apical corner.

Wings clear, veins brown; apex of first costal section black. Costal index about 2.4; 4th vein index about 1.7; 5x index about 1.4; 4c index about 1.0. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.3 mm. (in live specimen); wings 2.0 mm.

♀. Abdominal bands bend to anterior margin where they expand into small basal areas. Length body 2.6 mm.; wings 2.1 mm.

Internal characters of imagines.

Testes composed of 3 bright orange colored (Pl. 9-L 11) inner coils and 3 golden colored (Pl. 9-J 6) outer coils or gyres.

Spermathecae very slightly chitinized. Ventral receptacle with about 17 very irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments.

Puparia.—Chrome-orange (Pl. 9-J 7). Each anterior spiracle with about 11 branches; horn-index about 4.0.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; the Y is shorter than the X in the male.

Relationship.—Belongs to the mulleri group of the subgenus *Drosophila*. This species is more closely related to *mojavensis* than to any other member of the mulleri species group. *Mulleri* females crossed to *arizonensis* males produce a few sterile male hybrids; reciprocal mating is cross-sterile.

Distribution.—Mr. G. B. Mainland collected specimens of this species in Pima County, Arizona, in September, 1940. Since then our stock collectors have taken it in southeastern Arizona, Silver City, New Mexico, and in Sonora, Mexico. Type material from Pima County, Arizona.

Drosophila buzzatii, sp. nov.

External characters of imagines.

♂. Arista with about 7 branches. Antennae yellowish brown, third joint slightly darker. Front dark brown, orbits and small median area pollinose; bristles arising from blackish spots. Middle orbital about $\frac{1}{3}$

other two. Second oral about $\frac{1}{3}$ length of first. Carina broad below, sulcate. Palpi pale yellow, with several bristles. Face yellowish brown. Cheeks grayish yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes vermilion-like (Pl. 2-K 12), with short black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index about .8. Mesonotum grayish brown, bristles arising from darker brown spots; an indefinite grayish pollinose line down middle of acrostichal rows. Legs pale yellow, a narrow black band near base of each tibia, very faint on fore legs. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen grayish yellow, segments with narrowly interrupted, wide, dark brown bands, nearly complete laterally, and enclosing small, irregular yellow basal areas, often missing on posterior segments.

Wings clear, veins brown; apex of first costal section black. Costal index about 2.7; 4th vein index about 1.6; 5x index about 1.1; 4c index about .9. Two well-developed bristles at apex of first costal section; third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.4 mm. (in live specimen); wings 2.0 mm.

♀. Enclosed yellow areas of lateral region of abdominal segments more distinct than in male. Length body 2.6 mm.; wings 2.1 mm.

Internal characters of imagines.

Testes orange-cinnamon (Pl. 11-L 12), with 3 irregular inner coils and 3 outer coils or gyres. Ejaculatory sac with two small posterior diverticula.

Spermathecae not chitinized. Ventral receptacle spiral, with about 14 irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long slender filaments.

Puparia.—Transparent, orange-amber (Pl. 10-H 9). Each anterior spiracle with about 14 branches; horn-index about 3.0.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; in male Y is shorter than X.

Relationship.—Belongs to the mulleri group of the subgenus *Drosophila*. Males of this species are cross fertile with females of *D. mulleri*, producing a few abnormal sterile hybrids, which usually die in the pupa stage. These males are also cross fertile with females of *D. arizonensis*, but the hybrid larvae die in mid-larval stage.

Distribution.—The stock upon which the description of this new species is based was sent to us by Dr. A. Buzzati-Traverso of Pavia, Italy. It was derived from flies collected at Trapani, Sicily. A second stock came from the Cold Spring Harbor Laboratory. The original flies were collected by Dr. S. Horowitz in the Province of Cordoba, Argentina. Crosses between the two strains produce normal, fully fertile offspring, but the salivary

chromosomes of the F_1 larvae show a small inversion in one of the chromosome pairs. Type material from Cordoba, Argentina.

***Drosophila meridiana*, sp. nov.**

External characters of imagines.

♂, ♀. Arista with about 8 branches. Antennae light yellowish brown. Front brown, light tannish anterior to line drawn between anterior orbital bristles; orbits and ocellar triangle scarcely $\frac{1}{2}$ length of first. Carina moderately broadened, narrowed somewhat above middle, sulcate. Face light brown. Cheeks pale grayish yellow, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes dark red (Pl. 2-K 11), with short black pile.

Acrostichal hairs irregular, in about 8 rows; no prescutellars. Anterior scutellars convergent. Thorax grayish brown, bristles arising from dark brown spots. Sterno-index about .81. Legs pale yellow, black band near end of each tibia, fainter one near distal end of each femur; bands of hind legs darkest. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with an interrupted dark brown band which bends to anterior margin at angle of tergite, retaining a medium sized apical connection with a dark area on the lateral margin; connections of first and second segments broken or indistinct.

Wings clear, both crossveins slightly clouded. Costal index about 2.6; 4th vein index about 1.9; 5x index about 1.7; 4c index about 1.1. Apex of first costal section much darker, with two prominent bristles. Third costal section with heavy bristles on its basal $\frac{2}{5}$.

Length body 2.3 mm. (in live specimen); wings 2.2 mm.

Internal characters of imagines.

Testes cream colored (Pl. 9-I 5), with 2 inner and three outer coils or gyres. Ejaculatory sac has two posterior diverticula.

Spermathecae chitinized and shaped like a raisin seed. Ventral receptacle spiral with about 17 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long thin filaments, with anterior pair longer than posterior.

Puparia.—Orange colored (Pl. 10-K 9). Each anterior spiracle with about 19 branches; horn-index about 3.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; in male Y is shorter than X.

Relationship.—Belongs to the mulleri group of the subgenus *Drosophila*. It is cross-sterile to all other members of the mulleri group.

Distribution.—This species has been collected in the following counties in Texas: Bell, Brewster, Cameron, Hidalgo, Jim Wells, Maverick, Randall, Sterling, Travis, and Williamson. It has also been taken at Morrilton, Arkansas; Cross Lake, Louisiana; Leroy Percy State Park, Mississippi; Eva and Shelby State Park, Tennessee. Type material from Austin, Texas.

Drosophila nigromelanica*, sp. nov.*External characters of imagines.**

♂. Arista with about 8 branches. Antennae brownish black, third joint black. Front dark brown. Middle orbital $\frac{1}{3}$ other two. Second oral bristle about $\frac{1}{3}$ length of first. Carina blackish brown, sulcate. Face blackish brown. Cheeks grayish, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 3-L 6), with dense black pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Whole thorax dark brownish black, dull. Sterno-index about .71. Legs brownish black, tibiae darker; last tarsal joints, especially of fore legs, darker. Two apical bristles on first tibiae, one on second, pre-apicals on all three.

Abdomen deep, dull yellow, each segment with a dark brown band nearly as wide as entire segment, extending solidly to lateral margins; bands of all but last two segments have indistinct median interruptions, variable in degree.

Wings dusky, veins dark. Costal index about 3.4; 4th vein index about 1.5; 5x index about 1.1; 4c index about .74. Two large bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 2.3 mm. (in live specimen); wings 2.1 mm.

♀. Abdominal bands of mature specimens almost black, shining.

Length body 3.0 mm.; wings 2.4 mm.

Internal characters of imagines.

Testes orange (Pl. 9-I 12), with 3 inner and 3 outer coils or gyres. Ejaculatory sac without diverticula.

Spermathecae small and chitinized. Ventral receptacle spiral with about 18 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—2 filaments, each about equal to length of egg.

Puparia.—Jonquil colored (Pl. 9-J 5) and clustered on inner surface of container as in *melanica*. Each anterior spiracle with about 11 branches; horn-index about 5.0.

Chromosomes.—Metaphase plate shows 2 pairs of rods, one pair of large V's, one pair of small V's and a pair of dots.

Relationship.—Belongs to *melanica* group of the subgenus *Drosophila*.

Distribution.—We have collected this species at the following places: Anderson, Cherokee, Hardin, Liberty, Jefferson, Nacogdoches, Sabine and Shelby Counties of East Texas; Ft. Payne, Alabama; Morrilton, Arkansas; Columbus, Mississippi; Great Smoky National Park, Eva and Memphis, Tennessee; Palatka, Florida. We have also examined strains from Anderson, Indiana; Wooster, Ohio; Sand Springs, Oklahoma; and Woods Hole, Massachusetts. Type material from Hardin County, Texas.

Notes.—A woods inhabiting species, which we have never found in towns or cities. In the "Big Thicket" of East Texas we have found it feeding on various kinds of fungi, both on the ground and in the hollow of an oak tree.

***Drosophila micromelanica* Patterson 1941. Proc. Nat. Acad. Sci. 27:394.**

External characters of imagines.

♂. Arista with about 7 branches. Antennae grayish black. Front dull blackish. Middle orbital $\frac{1}{3}$ other two. Second oral bristle scarcely half as long as first. Carina somewhat broad, slightly sulcate. Two prominent palpal bristles. Face grayish black. Cheeks grayish black, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes bright, deep red (Pl. 2—L 12) with short, dense dark pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars convergent. Whole thorax dull blackish, pleurae grayish in some specimens. Sterno-index about .8. Legs grayish black. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen pale yellow, a gray band running centrally across each segment to lateral margins, increasing slightly in width towards margin and nearly reaching anterior edge. The band on the first segment is distinctly interrupted at the middle.

Wings clear, veins brown. Costal index 2.8; 4th vein index about 1.9; 5x index about 1.2; 4c index about .9. Two well-developed bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{1}{4}$.

Length body 2.4 mm. (in live specimen); wings 1.9. mm.

♀. Abdomen grayish yellow, segmental bands darker and wider, increasing in width laterally. Length body 2.5 mm. (in live specimen); wings 2.2 mm.

Internal characters of imagines.

Testes have 2 cream colored inner coils, and 3 apricot colored (Pl. 9—I 7) outer coils or gyres. Ejaculatory sac without diverticula.

Spermathecae small, spherical, almost transparent, not chitinized. Ventral receptacle arises from uterus as straight tube and then forms tangled mass without definite orientation or coiling.

Other characteristics, relationship, and distribution.

Eggs.—2 filaments, slender and tapering to distal ends.

Puparia.—Brownish buff (Pl. 9—H 7), arranged on inside of container in groups of 3 to 5. Each anterior spiracle has about 8 branches; horn-index about 8.5.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; X chromosomes have small attached element at end.

Relationship.—A small fly belonging to the melanica group of the subgenus *Drosophila*. This new species has several characters in common

with other members of the group, but tests have shown that it is cross sterile to all other known species of the group.

Distribution.—This species was first collected by Mr. Dean R. Parker in 1934 at Austin, Texas, and also at Waco, Texas, in 1935. Since then we have collected it at about twenty other points in the State, and at nine places in other states, as follows: Chiricahua and Huachuca Mountains, Arizona; Lake McKethan, Perry, Inverness, Lake Tsala Apopka, Withlacoochee River, Florida; Silver City, New Mexico; Great Smoky National Park, Tennessee. Type material from Austin, Texas.

***Drosophila polychaeta*, sp. nov.**

External characters of imagines.

♂. Arista with about 9 branches. Antennae tan, third joint darker. Front yellowish brown. Middle orbital $\frac{1}{2}$ of anterior and $\frac{1}{3}$ posterior. Second oral bristle scarcely $\frac{1}{2}$ first. Carina broad below, not sulcate or flattened. Face brownish yellow. Cheeks pale yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark red (Pl. 3–L 12), with short black pile.

Acrostichal hairs irregular but usually in 8 rows; no prescutellars. Anterior scutellars convergent. Whole thorax tannish brown, somewhat shining. One greatly enlarged bristle in each dorsocentral row just in front of the anterior dorsocentral, constituting a third pair in the series; one or two moderately enlarged hairs anterior to the extra dorsocentrals, and in the first row lateral to them. Sterno-index .8. Legs pale yellow, tibiae and tarsi a little darker. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen in newly emerged specimens dark grayish brown, solid. In older specimens the segments become tannish brown, darker posteriorly.

Wings slightly dusky. Two very large bristles at apex of first costal section. Third costal section with heavy bristles on all but the distal $\frac{1}{10}$. Costal index about 2.0; 4th vein index about 2.2; 5x index about 1.3; 4c index about 1.3.

Length body 2.85 mm. (in live specimen); wings 2.45 mm.

♀. Length body 3.6 mm.; wings 2.8 mm.

Internal characters of imagines.

Testes deep orange (Pl. 10–I 10), with two inner and 2 and $\frac{1}{2}$ outer coils or gyres.

Spermathecae not chitinized. Ventral receptacle composed of about 15 coarse, loosely arranged coils.

Other characteristics, relationship, and distribution.

Eggs.—4 long thin filaments, the anterior pair about $\frac{5}{6}$ of posterior pair.

Puparia.—Very light orange (Pl. 9–K 7). Each anterior spiracle with about 14 short branches; horn index about 10.3; anal pore visible, as in all members of the virilis species group.

Chromosomes.—Metaphase plate shows 2 pairs of rods, 1 pair of V's, 2 pairs of J's, and a pair of dots. X has a constriction near end.

Relationship.—Belongs to the polychaeta group of the subgenus *Drosophila*.

Distribution.—This species was first collected by Mr. Thorp Ray on the wharfs of the fruit companies of Galveston, Texas. We have also taken it there on piles of refuse bananas, which had come from southern Mexico and Central America. The flies must have been introduced from one or both of these areas, since it has never been found elsewhere than at Galveston.

Notes.—It breeds prolifically on the banana-agar-yeast food.

***Drosophila carbonaria*, sp. nov.**

External characters of imagines.

♂ Arista with about 7 branches. Antennae brown, third joint black. Front brownish black. Middle orbital almost as long as anterior, a little over $\frac{1}{2}$ length of posterior. Carina widened below, sulcate. Face brown. Cheeks blackish gray, their greatest width about $\frac{1}{4}$ greatest diameter of eyes. Eyes deep red (Pl. 4—L 8), with short black pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars convergent. Whole thorax black, slightly shining. Sterno-index .57. Halteres brownish yellow. Legs black, all tarsi brownish. Apical bristles on first and second tibiae, rather small on first tibia, preapicals on all three, small on second tibia.

Abdomen solid black, shining.

Wings clear. Costal index about 2.5; 4th vein index about 1.64; 5x index about 1.14; 4c index about .96. Two prominent bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{2}{5}$.

Length body 2.3 mm. (in living specimen); wings 2.0 mm.

♀. Abdominal segments shining black, with a very narrow apical, pale yellow line on basal segments. Ventral plates brownish.

Length body 2.9 mm.; wings 2.3 mm.

Internal characters of imagines.

Testes orange-red (Pl. 2—D 12), with about 5 inner coils and 3 outer coils or gyres.

Spermathecae chitinized. Ventral receptacle with about 18 loose, rather coarse coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments, each equal to the length of egg.

Puparia.—Florida-gold (Pl. 10—L 8), surface rough. Each anterior spiracle with about 11 branches. Horn index about 7.6.

Chromosomes.—Not known.

Relationship.—Belongs to the carbonaria group of the subgenus *Drosophila*.

Distribution.—This species has been collected at the following places: In Texas, Austin, Beeville, Brownwood, Carrizo Springs, Davis Mountains, Dilley, Henly and Uvalde; in Arizona, Ashton Draw and William's Ranch near San Bernardino. A rare species; of the 28 specimens collected, 22 were taken in Texas and 6 in Arizona.

Notes.—This species has usually been collected in woods along streams. A few were taken from windfall oranges at Dilley and Carrizo Springs. It does not breed well on the banana-agar-yeast medium unless the food is rather soft. Type material from Austin, Texas. Dr. Sturtevant suggested the species name.

***Drosophila spinofemora*, sp. nov.**

External characters of imagines.

♂. Arista with about 10 branches. Antennae pale amber-yellow, third joint slightly darker. Front yellowish tan, orbits lighter, pollinose. Middle orbital $\frac{1}{2}$ length of anterior, $\frac{1}{3}$ length of posterior. Second oral more than half as long as first. Palpi pale yellow, with two prominent bristles. Carina evenly broadened below, rounded, not flat or sulcate. Face pale amber-yellow. Cheeks pale yellow, their greatest width scarcely $\frac{1}{5}$ greatest diameter of eyes. Eyes bright orange (Pl. 1-E 12), with light colored pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Sterno-index .53. Mesonotum amber colored, without markings. Legs pale yellow. Apical bristles on first and second tibiae, that of second tibia very large; preapicals on all three. A row of about 12 short, stout, spine-like bristles on lower apical part of fore femora.

Abdomen pale yellow, each segment with an exceedingly faint apical band, usually merely a dull yellow, sometimes slightly brownish, fading away entirely before reaching the lateral margin. Bands are vaguely interrupted in mid-line.

Wings slightly dusky, with a very slight clouding on the anterior and posterior cross veins; veins darkened. Costal index about 3.37; 4th vein index about 1.39; 5x index about 1.3; 4c index about .7. Apex of first costal section with two well-developed bristles, the dorsal one large and stout, the ventral one smaller and thin. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 3.0 mm. (in live specimen); wings 2.4 mm.

♀. Abdomen slightly darker. Length body 3.1 mm.; wings 2.7 mm.

Internal characters of imagines.

Testes semi-transparent, very pale cream (Pl. 9-C 1), with 3 inner and 3 outer coils or gyres. Ejaculatory sac has two posterior diverticula.

Spermathecae large, spherical and chitinized. Ventral receptacle spiral with about 20 irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments; anterior pair thin, posterior pair heavy for about $\frac{3}{4}$ length, with distal $\frac{1}{4}$ either finely branched or curled.

Puparia.—Transparent orange (Pl. 9–I 9). Each anterior spiracle has about 18 branches; horn-index about 2.0.

Chromosomes.—Metaphase plate shows 2 pairs of rods, a pair of V's and a pair of dots in both sexes.

Relationship.—Belongs to the immigrans group of the subgenus *Drosophila*.

Distribution.—The stock upon which this description is based was sent to us by Mr. E. C. Zimmerman of the University of Hawaii.

The original flies were collected at Honolulu.

Notes.—This species has been called *D. immigrans* Sturtevant in Hawaii, but is not the cosmopolitan species, although the two forms are similar in many of their characters. Breeding tests show that the two species are cross-sterile.

Drosophila macroptera*, sp. nov.*External characters of imagines.**

♂. Arista with about 10 branches. Antennae tan, third joint somewhat darker. Front tannish brown. Middle orbital about $\frac{1}{4}$ other two. Second oral bristle about as long as first. Carina only slightly wider below, flat, not rounded or sulcate. Palpi light yellowish tan, with several prominent bristles. Face tannish yellow. Cheeks pale yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes red (Pl. 1–H 12), with light colored pile.

Acrostichal hairs in 6 rows, irregular; no prescutellars. Anterior scutellars divergent. Mesonotum and pleurae tannish brown, without markings, finely pollinose. Sterno-index about .6. Legs pale yellowish tan. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark yellow, each segment with a broad, apical brown band, extending to margin except on basal segment; each segment, except basal one, with median projection which reaches the anterior margin, becoming larger and darker in posterior segments; band of basal segment thinner and weakly interrupted medially.

Wings with anterior and posterior crossveins clouded, remainder clear. Costal index about 4.2; 4th vein index about 1.6; 5x index about 1.2; 4c index about .6. Apex of first costal section with two well-developed bristles. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 3.2 mm. (in live specimen); wings 3.3 mm.

♀. Abdominal bands slightly narrower than those of male, and often failing to reach lateral margins.

Internal characters of imagines.

Testes peach colored (Pl. 10—E 5), with 2 inner and 2 and $\frac{1}{2}$ outer coils or gyres. Ejaculatory sac with two very long, slender diverticula, which are irregularly twisted about other organs.

Spermathecae spherical with brown chitinized core. Ventral receptacle a tangled mass with about 11 irregular coils.

Other characteristics, relationship, and distribution.

Eggs.—4 slender filaments.

Puparia.—Orange-amber (Pl. 11—H 12). Each anterior spiracle with about 18 branches; horn-index 6.0.

Chromosomes.—Metaphase plate shows 5 pairs of rods and a pair of dots; in male the Y is shorter than the X.

Relationship.—Belongs to the subgenus *Drosophila*.

Distribution.—This form has been taken in Estes Park, Colorado, Zion National Park, Utah, the Chiricahua Mountains and Huachuca Mountains, Arizona, and at Glenwood and Capitan, New Mexico. Professor Th. Dobzhansky sent in specimens of this species which he had collected at Pikes Peak, Colorado, and in the Uinta Mountains, Utah. Type material from Estes Park, Colorado.

Drosophila fulvalineata*, sp. nov.*External characters of imagines.**

♂. Arista with about 9 branches. Antennae brown. Front brownish yellow, lighter anteriorly. Middle orbital $\frac{1}{4}$ other two. Second oral bristle little more than $\frac{1}{3}$ length of first. Carina large, broad, with a narrow median ridge running its full length. Face pale yellowish tan. Cheeks pale yellow, their greatest width about $\frac{1}{3}$ greatest diameter of eyes. Eyes dark red (Pl. 2—I 12), with short black pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars convergent. Mesonotum tannish brown with a darker median stripe, wider beyond middle; anterior half of stripe and narrow median line of expanded posterior half, pollinose; remainder of posterior half dark grayish brown. Areas between the median stripe and dorsocentral rows shining; adjacent areas lightly pollinose, intermingled with indefinite darker, shining areas. Pleurae tannish brown, darker stripe running from base of fore coxae to base of halteres. Transverse suture deep and prominent. Sterno-index .75. Legs pale yellow; a narrow dark band near base of each tibia, very faint in fore-legs, darkest in hind legs. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen yellow, each segment with a grayish, black band reaching only to the angle of the tergite; those of the basal segments with broad interruptions, those of posterior segments much narrower.

Wings clear. Costal index about 3.9; 4th vein index about 1.7; 5x index about 1.2; 4c index about .7. Apex of first costal section moderately darkened, with two enlarged bristles. Third costal section with heavy bristles on its basal $\frac{1}{3}$.

Length body 3.3 mm. (in live specimen); wings 2.9 mm.

♀. Length body 3.6 mm.; wings 3.1 mm.

Internal characters of imagines.

Testes sulphur-yellow (Pl. 11—L 3), with 6 inner and 6 outer coils or gyres.

Spermathecae flask-shaped, slightly chitinized. Ventral receptacle long spiral with about 60 fine coils.

Other characteristics, relationship, and distribution.

Eggs.—4 fine tapering filaments of about equal length.

Puparia.—Reddish orange (Pl. 4—A 12). Each anterior spiracle with about 20 branches; horn-index 6.4.

Chromosomes.—Metaphase plate shows 5 pairs of rods and one pair of V's, with the Y shorter than the X in the male.

Relationship.—Belongs to the subgenus *Drosophila*.

Distribution.—We have collected this species at the following places: Cave Creek, Chiricahua Mountains, Ramsey Canyon, Huachuca Mountains, Arizona; Gila River, near Silver City and Gila National Forest, Glenwood, New Mexico; Zion National Park, Utah. Type material from Cave Creek, Arizona.

Notes.—Very difficult to maintain in laboratory on the banana-agar-yeast food. This species has been taken on fleshy fungus in New Mexico.

***Drosophila rubrifrons*, sp. nov.**

External characters of imagines.

♂. Arista with about 8 branches. Antennae dark brown. Front dark velvety maroon, lighter anteriorly; posterior portion of orbits and ocellar triangle dark brown, roughly elevated. Middle orbital about $\frac{1}{4}$ other two. Second oral bristle about as long as first. Carina flat and narrow between antennae, broad and rounded below. Palpi small, tannish brown. Face brown. Cheeks brownish yellow, their greatest width about $\frac{1}{3}$ diameter of eyes. Eyes deep red (Pl. 4—L 12), with short dense pile.

Acrostichal hairs in 8 rows; no prescutellars. Anterior scutellars divergent. Thorax golden brown, densely pollinose; two lighter stripes just within the dorsocentral rows, leaving a dark stripe down mid-line. Stern-index about .6. Legs yellowish brown, hind femora slightly darker. Apical bristles on first and second tibiae, preapicals on all three.

Abdomen dark yellow, each segment with a wide apical, dark brown band, narrowly interrupted medianly, except on last two segments; bands widened laterally forming solid areas to margin of segment.

Wings slightly brownish, clouded on anterior and posterior crossveins and at apex of second longitudinal vein, with slight clouding at apices of third and fourth veins. Costal index about 4.0; 4th vein index about 1.8; 5x index about 1.4; 4c index about .7. Two prominent bristles at apex of first costal section. Third costal section with heavy bristles on its basal $\frac{1}{2}$.

Length body 2.6 mm. (in live specimen) ; wings 2.8 mm.

♀. Length body 3.0 mm.; wings 2.9 mm.

Internal characters of imagines.

Testes burnt orange (Pl. 11-F 11), with 3 slightly colored inner coils and 5 outer coils or gyres. Ejaculatory sac has two posterior diverticula.

Spermathecae spherical, chitinized. Ventral receptacle with about 35 loosely arranged coils.

Other characteristics, relationship, and distribution.

Eggs.—4 filaments, as determined by dissection of ovary.

Chromosomes.—Not known.

Relationship.—Belongs to the subgenus *Drosophila*.

Distribution.—Specimens of this species have been taken at Rustler's Park, Chiricahua Mountains, Arizona, at an elevation of 8,300 feet. It has also been collected at White Water Camp, Gila National Forest, near Glenwood, New Mexico. Type material from Rustler's Park.

Notes.—We have not been able to breed this species in the laboratory. At Rustler's Park it was found feeding on fungus.

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