WILD-TYPE AND MUTANT STOCKS OF MORMONIELLA[1]

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THE use of the parasitic wasp *Mormoniella vitripennis* (Walker) for studies of spontaneous and radiation-induced mutations has made numerous mutant types available for teaching and research purposes. These mutants are maintained in a stock center established at Dartmouth College and supported by the National Science Foundation; the lists and descriptions in this report are intended to serve as a reference for individuals who wish to make use of the stocks or follow research reports in which the mutants are discussed.

Most of the visible mutations in Mormoniella affect eye or body color, but some alter other morphological traits. The wild-type eye is colored reddish-brown; mutant colors range from black through dark red, bright red, light red ("peach" or "tinged"), and oyster-white. The wild-type irridescent bronze-green body color (darker in females than in males) is changed to bronze-red, copper-yellow, dark blue, blue-green, reddish tints, or purple in mutants. All mutants are recessive to wild-type genes; many are female-sterile or nearly female-sterile, requiring crosses of mutant males by heterozygous females in maintaining stocks; and most are less viable than the wild type.

The linkage map provided in this report includes all loci which have been genetically mapped. Gene orders within each linkage group are in some cases tentative. A detailed report on linkage in Mormoniella is in preparation.

METHODS

The Mormoniella stock center contains most of the known wild-type and mutant stocks of the wasp. Investigators are invited to deposit research cultures in it for protection and distribution; teachers and research workers can obtain cultures without cost by writing to the center. All cultures are maintained on the host *Sarcophaga bullata* Parker and are reset at least once a month. Shipments are made in sections of plastic tubing; most cultures are shipped as young (white) pupae. The stock center also supplies detailed directions for culturing and handling Mormoniella, and a list of references to research publications dealing with the genetics of the insect.

Most stocks are maintained by placing six or seven male pupae with an equal number of females in glass vials, allowing the pupae to eclose and mate for 24 hours, and adding five host pupae. After 11 days at room temperature (about 23°C) the hosts are opened and the cultures are checked to be sure mating occurred; the wasps are then returned to the vials and refrigerated at 4°C until the next setting. When refrigerated, the wasps are light-colored pupae; immediately

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before resetting they are darkened at room temperature and checked to be sure no contamination or mutation occurred. Old cultures are discarded after about three months refrigeration, but any diapause larvae that are present are removed from cultures and saved at 4°C for a year, as protection against loss of stocks.

Techniques used in raising and handling Mormoniella and its host are discussed in detail by WHITING (1955).

THE STOCKS

In this report, the stocks are listed in six groups (three tables) to facilitate description of their characteristics. The groups include: wild-type stocks, body-color mutants, non-*R* (and untested) eye-color mutants, morphological mutants, *R*-locus mutants, and multiple-mutant stocks. Mutants are designated by a descriptive name and, in most cases, a stock number. Non-*R* eye-color mutants are named by comparing males with colored plates in *A Dictionary of Color* (MAERZ and PAUL 1950), using procedures outlined by SAUL and KAYHART (1956). These mutants can be grouped into 13 phenotypic classes, and mutants within each class are given the same descriptive name, usually taken from the named Maerz-Paul plate nearest to that corresponding to the class. Body-color mutants fall conveniently into seven groups; again, mutants within a group are given the same descriptive name. Adoption of this system has resulted from the finding of many genes at different loci giving similar phenotypes, and has required the renaming of some mutants reported by SAUL and KAYHART (1956). Old names of such mutants are indicated within parentheses after the new names in Tables 1 to 3.

Information about each wild-type stock and mutant stock (other than R mutants) (Table 1) includes the name, stock number, published name, and symbol if any (within parentheses if revised by this listing), investigator who found the mutant, origin (from wild type if not otherwise noted), special characteristics such as lethality or female sterility ("f"-"fertile", "fs"-"female sterile", "lf"-"females have low fecundity"), and allele group, if any. Names of investigators are designated by initials: SB, SUE BECKER; DB, DORIS BUSH; SC, SARAH CASPARI; GF, GLADYS FRIEDLER; RG, R. GLASS; NH, NELLIE HARRIS; MEG, M. E. GROESBECK; MK, MARION KAYHART; RPK, R. P. KERNAGHAN; BM, BERNARD MILROOD; DR, DAVID RAY; KR, KENNETH ROBERTSON; GS, G. SALT; GBS, G. B. SAUL 2nd; SS, SUE SAUL; HS, H. SCHNEIDERMAN; PWW, P. W. WHITING.

Five wild-type stocks are listed in Table 1, Section I: Ith, from Ithaca, New York; MI, from Macomb, Illinois; WH, from Woods Hole, Massachusetts (WHa produces high frequencies of diapause larvae and WHb produces normal frequencies); and CE, from Cambridge, England. All have reddish-brown eyes (Maerz-Paul, 8:H-8) and irridescent bronze colored bodies. Females have darker antennae, darker body color, and larger wings than males.

The following descriptive classes have been used in naming the body color mutants in Table 1, Section II:

blue (*bl*)—front (upper part of face) blue, dorsal thorax sometimes blue.

bluegrass (*bgs*)—front green with blue tint, dorsal thorax has green glints. Approaches wild types at high temperatures.

bluegreen (*bg*)—front ranges from green to bluegreen.
copper (*cop*)—front the color of polished copper, dorsal thorax sometimes more yellow than that of wild type.
grey (*g*)—pupal body color grey, turning black.
plum (*pm*)—front the color of red plums.
purple (*pu*)—dorsal thorax purple; front may also be purple.
violet (*vio*)—front green with a purple streak; dorsal thorax has red and green glints.

All groups described above, except plum, purple, and violet, vary with temperature. Mutants of the bluegreen type, especially, approach the wild phenotype at high temperatures.

Table 1, Section III, includes non-*R* and untested eye-color mutants. Descriptive classes used in naming these mutants are:

black (*bk*)—dark in color; some quite black. Maerz-Paul 48:L-12 or 48:L-1 (*bk*-576 locus).
currant (*cur*)—fairly bright red. Maerz-Paul 3:L-10.
garnet (*ga*)—medium red. Maerz-Paul 3:L-11.
mahogany (*mh*)—dark red. Maerz-Paul 7:L-10.
modifier (*mf*)—phenotypically wild-type except in combination with red or scarlet mutants; interaction then yellow or orange.
orange (*or*)—similar to scarlet, but slightly more yellow, Maerz-Paul 2:D-12.
oyster (*oy*) and pellucid (*pl*)—grayish white. Maerz-Paul 4:A-7.
paprika (*pap*)—dull orange. Maerz-Paul 2:K-12.
peach (*pe*)—grayish white with a pinkish tint. Maerz-Paul 3:A-11.
reddish (*rdh*)—medium red. Maerz-Paul 6:I-11.
red eyed pupae (*rep*)—pupal eye color red in +/*pe*-333 females.
scarlet (*st*)—bright orange-red. Maerz-Paul 2:L-11.
tile (*tl*)—rust red. Maerz-Paul 3:D-12.

Various morphological mutants which are not primarily characterized by changes of eye color or body color are listed in Table 1, Section IV. The following descriptions refer to genes in that list.

bar (*bar*)—eyes narrow and facets reduced in number.
bent (*bt*)—thorax bent ventrally or laterally, abdomen shortened.
big eyes (*be*)—eyes enlarged and project dorsally.
cleft (*cl*)—ocellar region defective; dorsal cleft between eyes; number of antennal segments reduced.
duckleg (*dkg*)—tarsal region of posterior pair of pupal legs turns outward.
elongated eyes (*ele*)—eyes extend dorsally to variable extent; most extreme in *st* DR *vg* males; genetic behavior unknown.
flexed (*fx*)—mesothorax duplicated, metathorax reduced; both wing pairs of equal size.
glass (*gl*)—facets poorly differentiated and reduced in number.
hunchback (*hb*)—dorsal thoracic segments compressed to give hunchbacked appearance.
mickey mouse (*mm*)—head deeply cleft dorsally, eyes protuberant. (*bu*, bulgy, of C.B.S. Co.)
microcephalic (*mcl*)—head small and narrow.
protruding (*pro*)—ocellar region slightly protuberant.
reverant (*rev*)—legs of pupae folded toward ventral midline.
short wings (*sw*)—mesothoracic wings small.
small eyes (*se*)—eyes small, facets reduced in number; the *se*-14 is also microcephalic.
stumpy (*stp*)—abdomen slightly shortened and broadened. Effect more extreme in *stp*-361, than in *stp*-211; *stp*-1 lacks one abdominal segment.
twisted (*tw*)—variable abnormal thoracic segmentation, causing lateral curvature of pupae and adults.

unfolded (*unf*)—mesothoracic wings small, eclosion often incomplete in dorsal thoracic region.

vestigial (*vg*)—wings very small and rudimentary.

white appendages (*wa*)—body color of young pupae white; appendages remain white; variable abnormalities of appendages.

TABLE 1

Wild-type and mutant stocks other than R *mutants. For explanation of symbols and initials, see text*

Stock name	Finder	Origin	Female fertility	Allelic to
Section I: Wild types				
CE	GS	Spontaneous	f	....
Ith	HS	Spontaneous	f	....
MI	RG	Spontaneous	f	....
WHa	GBS	Spont. from WHb	f	....
WHb	PWW	Spontaneous	f	....
Section II: Body-color mutants				
bl-13	SC	X ray	f	....
bl-105	DB	Spontaneous	fs	....
bl-106	SC	X ray	fs	....
bl-107	SC	X ray	lf	....
bl-108 (greenblue; *gb*)	PWW	Spontaneous	f	....
bl-109 (blue; *bl*)	MK	Spontaneous	fs	....
bl-120	SC	X ray	f	....
bl-627	PWW	Spontaneous	fs	....
bl-5101	GBS	X ray	f	....
bgs-532	SS	X ray	fs	....
bg-122	GBS	X ray	f	....
bg-211	GBS	X ray	fs	....
bg-212	SS	Spontaneous	fs	....
bg-321	GBS	X ray	fs	....
bg-350	?	?	f	.....
bg-362	GBS	X ray	fs	....
bg-363	GBS	X ray	f	....
bg-452	GBS	X ray	fs	....
bg-531	GBS	X ray	fs	....
bg-594	GBS	X ray	fs	....
cop-1	SS	Spont. from *rdh*	f	....
cop-2	GBS	Spont. from *bg*-211	f	....
cop-8	SC	X ray	f	....
cop-14	SC	X ray	fs	....
cop-131	GBS	X ray	f	....
cop-221	GBS	X ray	f	....
cop-241	GBS	X ray	f	....
cop-242	GBS	X ray	fs	....
cop-317	GBS	X ray	f	....
cop-318	GBS	X ray	f	....
cop-351	?	?	f	....
cop-362	GBS	X ray	fs	....
cop-411	GBS	X ray	fs	....

TABLE 1—Continued

Wild-type and mutant stocks other than R *mutants. For explanation of symbols and initials, see text*

Stock name	Finder	Origin	Female fertility	Allelic to
cop-441	GBS	X ray	f	....
cop-463	GBS	X ray	f	....
cop-591	GBS	X ray	f	....
cop-1317	SS	Spontaneous	fs	....
g	SS	Spontaneous	lethal at eclosion	....
pm-541	GBS	Spontaneous	fs	....
pu	PWW	In WHb	f	....
pu-416	GBS	X ray	fs	....
vio-6	SC	X ray	fs	....
Section III: Non-*R* and Untested Eye-color mutants				
bk-1	GBS	X ray	f	....
bk-113	SC	X ray	f	*bk*-424
bk-211	GBS	Spontaneous	f	....
bk-341	GBS	X ray	f	....
bk-361	GBS	X ray	f	....
bk-362	GBS	X ray	f	....
bk-423	GBS	X ray	f	*bk*-576
bk-424	MEG	X ray	f	....
bk-425	PWW	Spont. from *st*-DR	f	*bk*-211
bk-441	GBS	X ray	f	*bk*-576
bk-451	GBS	X ray	f	*bk*-576
bk-461	GBS	X ray	f	*bk*-576
bk-571	GBS	X ray	f	*bk*-576
bk-576	PWW	Spont. from *da*-GF	f	....
bk-577	PWW	Spont. from *da*-GF	f	*bk*-576
bk-578	SC	X ray	f	*bk*-576
cur-213	GBS	X ray	f	....
cur-252	GBS	X ray	fs	....
cur-321	GBS	X ray	fs	....
cur-351	GBS	X ray	f	....
cur-441	GBS	X ray	lf	....
cur-541	GBS	X ray	f	....
ga	MK	X ray	f	....
ga-1	SS	Spont. from *bg*-594	f	....
ga-107	SC	X ray	f	....
ga-116	SC	X ray	f	....
ga-119	SC	X ray	f	....
ga-120	SC	X ray	fs	....
ga-121	GBS	X ray	fs	....
ga-212	GBS	X ray	fs	....
ga-251	GBS	X ray	f	....
ga-341	?	?	f	....
ga-376	SC	X ray	f	....
ga-531	GBS	Spontaneous	f	....
ga-533	GBS	X ray	f	*ga*-531

TABLE 1—Continued

Wild-type and mutant stocks other than R *mutants. For explanation of symbols and initials, see text*

Stock name	Finder	Origin	Female fertility	Allele to
ga-561	GBS	X ray	f	....
ga-2949	SS	Spontaneous	f	....
mh-131	GBS	X ray	f	....
mh-333	SB	Spont. from *pe*-333	f	....
mh-493 (*to*^{mz})	PWW	Spontaneous	f	....
mh-511	GBS	X ray	f	....
mf-306	SC	X ray	f	....
or-123 (*or*)	GBS	X ray	f	....
oy-2	SB	Spont. from *st*-213	f	....
oy-553 (*tl*$^{oy\text{-}b}$)	PWW	Spontaneous	lf	*tl*-627
pap-344	SC	X ray	f	*tl*-627
pe-100	SC	X ray	f	*tl*-627
pe-343	SC	X ray	f	....
pe-365	SC	X ray	f	....
pl-311 (*pl*)	PWW	Spont. from +/*ti*-277	f	....
rep-818	SC	X ray	.	....
rep-839	SC	X ray	.	....
rdh	SS	Spontaneous	lf	....
rdh-5 (*rh*)	MK	Slow neutrons	f	....
rdh-212	GBS	X ray	f	....
rdh-591	GBS	X ray	fs	....
rdh-810 (*to*^{mo})	MK	Slow neutrons	f	*ga*-493
st-1	GBS	Spont. from *cop*-221	f	....
st-5219 (*ga*$^{st\text{-}b}$)	MK	Fast neutrons	f	*ga*
st-152	SC	X ray	f	....
st-221	GBS	X ray	f	*st*-318
st-318 (*st-d*)	MK	Slow neutrons	f	....
st-473 (*st-c*)	PWW	Spontaneous	f	....
tl-100	SC	X ray	f	*tl*-627
tl-627 (*tl*)	MK	Fast neutrons	f	....
tl-l (*l*)	DB	Spont. from *pe*-100	lethal	....
Section IV: Morphological mutants				
bar-211	GBS	X ray	fs	....
bt	SS	X ray	fs	....
be-1	SS	Spont. from *ga*	fs	....
cl-131	GBS	X ray	fs	....
dkg-121	KR	X ray	fs	....
ele	SS	Spont. from *st*-DR *vg*	fs	....
fx-331	GBS	X ray	fs	....
gl	BM	Spontaneous	lf	....
hb-441	GBS	X ray	fs	....
mm-251	GBS	X ray	fs	....
mcl-121	GBS	X ray	f	....
pro	SS	Spont. from *dkg*-121	fs	....
rev-421	GBS	X ray	lf	....
sw-561	GBS	X ray	fs	....
se-14	SS	Spont. from X rayed stock	fs	....

TABLE 1—Continued

Wild-type and mutant stocks other than R *mutants. For explanation of symbols and initials, see text*

Stock name	Finder	Origin	Female fertility	Allele to
se-121	SC	X ray	fs	....
stp-1	SS	Spontaneous	fs	....
stp-211	GBS	X ray	f	....
stp-361	GBS	X ray	fs	....
tw	SS	Spont. from *cl*-131	fs	....
unf-441	GBS	X ray	fs	....
vg	RPK	X ray	fs	....
wa-362	GBS	X ray	fs	....

Table 2 includes the genes which have arisen by mutation in the *R* region of linkage group I. Each mutant gene is characterized by an eye color determined by a change in one or more of four factors,—*O*, *S*, *M*, and *P*, and, in the case of deleterious genes, by a change to female sterility, *fsa* in factor *A*, *fsb* in factor *B*, or by a change in one (or more) of the numerous *X* factors. These last produce male sterility, *msx*, near-sterility, *nsx*, and complete, *lx*, or partial, *slx*, inviability. With the exception of the semilethals, *slx*, the *X*-factor changes cannot conveniently be tested against each other for homology except by use of polyploidy (WHITING 1960a).

Tests for homology are made by combining two genes and noting the character of the compound produced. Because the mutations are for the most part recessive, the compounds are wild type unless the factors involved are homologous. This applies both to the color and to the deleterious changes.

Extant *R* genes are designated by an abbreviation for the eye color—oyster-white, *oy* (colorless); tinged, *ti* (very pale peach); peach *pe*; apricot, *ap* (sometimes more intense and redder than *pe*); orange, *or* (more brillant and more intense than *ap*); tomato, *to* (dull dilute red, lacking dark pigment); scarlet, *st* (intense red with small dark fleck); vermilion, *vm* (similar to *st* but dark fleck more pronounced); red, *rd* (dull intense red); dahlia, *da* (darker than *rd*); mahogany, *mh* (darker than *da*); reddish, *rdh* (grading to +); each followed by a three-digit number, or, in the case of six found before 1952, by the initials of the finder.

A factor for nonreciprocal cross-incompatibility, probably cytoplasmic, has been found in various laboratory stocks. This factor is carried in one strain of *ti*-277 (SAUL 1961) and in *st*-940. The incompatible strain of *pe*-333 (SAUL 1961) has been lost.

The scarlet lethals are carried with *oy*-DR or with *pe*-333 but for some as indicated a balanced stock is maintained with *oy*-423. The oyster lethals are carried with *st*-DR, but this is replaced by the female-steriles, *fsa*, 689, 829, or 858, to give balanced stocks. These *st-fsa* genes, as also *oy*-423, make good balanced stocks with *da-fsb*-442. The *oy*-805 which formerly had to be run (with *st*-DR and *da*-GF) as a Merry-Go-Round (WHITING and CASPARI 1957) because it is double

recessive for color factors, *O* and *S*, can now be run with *da*-845, factor *M*, with which it gives a complementary effect.

Instability in factor *O* occurring in a pedigree in which factor *S* remains constantly *st* traces back to *ti*-277 males crossed with WH wild-type females. Inbred stock of unstable-*O.st*, mutant genes are maintained and also of unstable-*O* with wild-type *S* from diverse sources, Unst-*O*.+ (WHITING 1960b).

Stocks of *R* mutants from X-rayed wild-type males crossed to untreated peach, *pe*-333, females, are maintained (CASPARI 1958).

TABLE 2

R *mutant stocks. For explanation of symbols, initials, and factor notation, see text*

Designation	*O*	*S*	*M*	*P*	*A*	*B*	*X*	Finder	Origin, compound carried, lethal incidence
st-DR	+	*st*	+	+	+	+	+	DTR	X-rayed + ♀
oy-DR	*oy*	+	+	+	+	+	+	DTR	X-rayed + ♀
vm-MK	+	*vm*	+	+	+	+	+	MK	X-rayed + ♀, also with *oy*-825
da-GF	*da*	+	+	+	+	+	+	GF	X-rayed + ♀
oy-NH2	*oy*	*st*	+	+	+	+	+	NH	X-rayed *st*-DR ♀
oy-250	*oy*	*st*	+	+	+	+	+	PWW	Unst-*O.st*, also with *da*-817
ti-277	*ti*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
or-305	*or*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
st-313	*da*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
pe-333	*pe*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
or-336	*or*	*st*	+	+	+	+	+	PWW	Unst-*O.st* with *bk*-849
oy-423	*oy*	*st*	+	+	*fsa*	+	+	MEG	X-rayed *st*-DR ♀, with *da*-442
st-426	*da*	*st*	+	+	+	+	+	MEG	X-rayed *da*-DF ♀ with *pu*
mh-441	*mh*	+	+	+	+	+	+	GBS	X-rayed + ♂
da-442	+	+	+	*da*	+	*fsb*	+	GBS	X-rayed + ♂, with *oy*-423
st-445	+	*st*	+	+	+	+	+	PWW	Unst-*O.st*
st-474	+	*st*	+	+	+	+	*lx*	PWW	Spont. from +; egg lethal; with *pe*-333
mh-605	+	*mh*	+	+	+	+	+	DTR	X-rayed + ♀
st-689	+	*st*	+	+	*fsa*	+	+	DTR	X-rayed + ♀, with *oy*-840 and *oy*-828
st-798	*da*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
st-799	*to*	*st*	+	+	+	+	+	PWW	Unst-*O.st*
oy-801	*oy*	+	+	+	+	+	*lx*	SBC	X-rayed + ♂, pupal lethal with *st*-DR
oy-802	*oy*	+	+	+	+	+	*lx*	SBC	X-rayed + ♂, egg lethal with *st*-DR
oy-803	*oy*	+	+	+	+	+	*lx*	SBC	X-rayed + ♂, with *st*-858 larval lethal
oy-804	*oy*	+	+	+	+	+	*lx*	SBC	X-rayed + ♂, egg lethal with *st*-829
oy-805	*oy*	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, with *da*-442 egg lethal
or-806	+	*st*	*da*	+	+	+	+	SBC	X-rayed *da*-846 ♀, with *oy*-826
st-808	+	*st*	+	+	+	+	*slx*	SBC	X-rayed + ♂, with *pe*-333
vm-809	+	*vm*	+	+	+	*fsb*	*lx*	SBC	X-rayed + ♂, with *oy*-DR; lethal at eclosion

TABLE 2—Continued

R *mutant stocks. For explanation of symbols, initials, and factor notation, see text*

Designation	*O*	*S*	*M*	*P*	*A*	*B*	*X*	Finder	Origin, compound carried, lethal incidence
st-811	+	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, with *oy*-423; late pupal lethal
st-812	+	*st*	+	+	*fsa*	+	*lx*	SBC	X-rayed + ♂, egg lethal with *pe*-333
st-813	+	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, late pupal lethal with *oy*-DR
st-814	+	*st*	+	+	+	+	*msx*	SBC	X-rayed + ♂, with *oy*-DR
oy-816	*oy*	+	+	+	+	+	*msx*	SBC	X-rayed + ♂, with *st*-689
da-817	+	*da*	+	+	*fsa*	+	*lx*	SBC	X-rayed + ♂, egg lethal with *oy*-250
mh-819	*mh*	+	+	+	+	+	+	SBC	X-rayed + ♂, with *oy*-423
st-821	+	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, with *ap*-837; egg lethal
st-823	+	*st*	+	+	*fsa*	+	*lx*	SBC	X-rayed + ♂, egg lethal; see *Polyploids* in text
st-824	+	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, egg lethal with *oy*-DR
oy-825	*oy*	+	*da*	+	+	+	+	SBC	X-rayed *da*-846
oy-826	*oy*	+	*da*	+	+	+	+	SBC	X-rayed *da* 846 with *or*-806
oy-828	*oy*	+	+	+	+	+	*lx*	SBC	X-rayed + ♂, with *st*-689; egg lethal
st-829	+	*st*	+	+	*fsa*	+	+	SBC	X-rayed + ♂, with *oy*-804
st-830	+	*st*	+	+	+	+	*lx*	SBC	X-rayed + ♂, late pupal lethal, with *oy*-DR
st-831	+	*st*	+	+	*fsa*	+	*lx*	SBC	X-rayed + ♂, egg lethal with *oy*-DR
rd-833	*rd*	+	+	+	+	+	+	PWW	Unst-*O*, in *ap*-837
st-834	+	*st*	+	+	+	+	*slx*	SBC	X-rayed + ♂, with *oy*-DR
mh-835	+	*mh*	+	+	*fsa*	+	*lx*	SBC	X-rayed + ♂, with *pe*-333 late pupal lethal
ap-837	*ap*	+	+	+	+	+	+	SBC	X-rayed *da*-GF ♀; with *st*-821
da-838	*rdh*	+	*da*	+	+	+	+	SBC	X-rayed + ♂, with *oy*-250
oy-840	*oy*	+	+	+	+	+	*nsx*	SBC	X-rayed + ♂, with *st*-689
st-841	+	*st*	+	+	+	+	*nsx*	SBC	X-rayed + ♂, with *oy*-423 *pu*; balanced, no crossovers
da-844	*da*	+	+	+	+	+	+	PWW	Unst-*O*, with *oy*-DR
da-845	+	+	*da*	+	+	+	+	GBS	(=5101 GBS) X-rayed + ♂
da-846	+	+	*da*	+	+	+	+	MK	fast neutrons, + ♀
oy-847	*oy*	*vm*	+	+	+	+	+	SBC	X-rayed *vm*-MK ♀
oy-848	*oy*	*mh*	+	+	+	+	+	SBC	X-rayed *mh*-605 ♀, with *st*-DR
st-855	+	*st*	+	+	+	+	*lx*	class	gamma rays + ♂, with *oy*-847 egg lethal
st-856	+	*st*	+	+	+	+	*lx*	class	gamma rays + ♂, with *oy*-DR egg lethal
st-858	+	*st*	+	+	*fsa*	+	+	GBS	(=311 GBS) X-rayed + ♂ with *oy*-803
st-859	+	*st*	+	+	*fsa*	+	*lx*	PWW	X-rayed + ♂, egg lethal with *pe*-333

TABLE 3

Stocks containing combinations of mutant genes. If two genes interact in eye-color formation, the phenotype is listed after the combination of genes

Stock	Interaction (eye color)
be-1, *ga*	....
bk-113, *or*-305	white
bk-211, *or*-305	white
bk-362, *ga*-531	gray
bk-362, *or*-305	white
bk-362, *pe*-333, *pu*	white
bk-423, *or*-305	white
bk-423, *pu*-333	white
bk-424, *or*-305	white
bk-441, *or*-305	white
bk-451, *or*-305	white
bk-571, *or*-305	white
bk-576, *da*-GF	"ebony", dark gray
bk-576, *st*-5219	white
bk-577, *or*-305	white
bk-577, *pu*	....
oy-DR, *gl*, *pu*	...
pe-333 *pu*/*pe*-333 *gl*	...
pu, *gl*	..
st-DR, *ga*-531	orange
st-426, *pu*	....
st-473, *pu*-416	....
tl-l/*pe*-100 × *pe*-100	....

Table 3 includes combination stocks which have been found useful in teaching and research. Genes included in these combinations are listed and described in earlier tables.

Polyploids: In addition to the stocks listed in the tables, the stock center carries two polyploid stocks. The polyploidy is recognized by the complementary effect of *R* genes. Polyploidy-850, *po*-850, a spontaneous mutation, appeared as triploid female 731.42 PWW (WHITING 1960a). Two stocks are carried: (1) *st*-DR/*oy*-DR/*oy*-DR and (2) *st*-823/*oy*-DR/*oy*-DR. The gene *st*-823 has, besides recessive deleterious factors *fsa* and *lx*, dominants for female semisterility, *Ss*, and for restriction of fertilization, *Rf* (WHITING 1962).

In Figure 1, the 52 loci which have been tested for linkage are shown as associated in five linkage groups. It is not known whether these groups represent the five chromosomes in each Mormoniella genome. The loci are placed in correct order within each group, where such ordering has been established with reasonable confidence. Most loci of unknown location within a linkage group are represented by mutations which also restrict recombination; a few are not placed because insufficient tests have been made.

SUMMARY

Wild-type and mutant types of *Mormoniella vitripennis* which are maintained

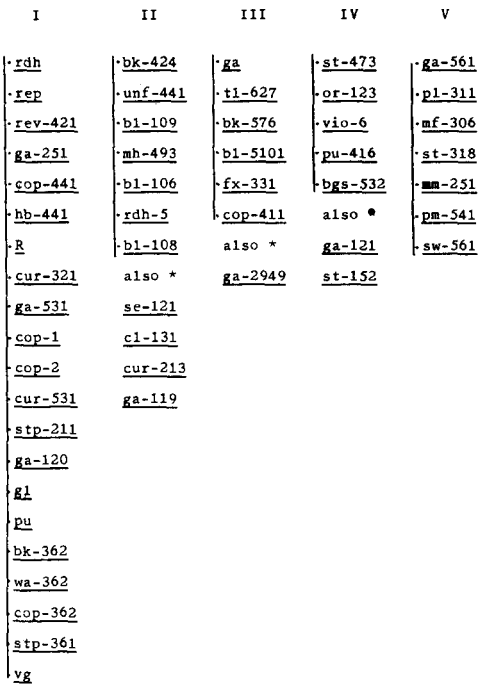

FIGURE 1.—Linkage groups of Mormoniella. Orders of loci within each group are tentative. The symbol * designates loci of unknown position within the linkage groups.

at a National Science Foundation stock center at Dartmouth College are described and listed, and a preliminary indication of their association in linkage groups is provided.

LITERATURE CITED

CASPARI, S. B., 1958 An X-ray sperm-dose-action curve for mutations at a single locus in Mormoniella. Radiation Res. **8**: 273–283.

MAERZ, A., and M. R. PAUL, 1950 *A Dictionary of Color*. 2nd Ed. McGraw-Hill, New York.

SAUL, G. B., 1961 An analysis of non-reciprocal cross incompatibility in *Mormoniella vitripennis* (Walker). Z. Vererb. **92**: 28–33.

SAUL, G. B., and M. KAYHART, 1956 Mutants and linkage in Mormoniella. Genetics **41**: 930–937. (Walker) Z. Vererb. **92**: 28–33.

WHITING, P. W., 1955 A parasitic wasp and its host for genetics instruction and for biology courses. Carolina Tips **18** (4): 13–16. (Carolina Biological Supply Company, Burlington, North Carolina). —— 1960a Polyploidy in Mormoniella. Genetics **45**: 949–970. —— 1960b Unstable-*O R*-locus mutations in Mormoniella. Proc. Penn. Acad. Sci. **34**: 243–249. —— 1962 *R*-locus factor homologies in Mormoniella. Genetics **47**: 921–936.

WHITING, P. W., and S. B. CASPARI, 1957 Mormoniella Merry-Go-Rounds. J. Heredity **48**: 31–35.