(Diptera: Culicidae): a re-examination. J. Med. Ent. 12:459–63.
Polovodova, V. P. 1949. The determination of the physiological age of female *Anopheles* by the number of gonotrophic cycles completed. Medskaya Parazit. 18:352–55 (In Russian).
Scholl, P. J. and G. R. DeFoliart. 1978. The influences of seasonal sex ratio on the number of annual generations of *Aedes triseriatus*. Ann. Entomol. Soc. Am. 71:677–79.
Sinsko, M. J. and G. B. Craig, Jr. 1979. Dynamics of an isolated population of *Aedes triseriatus* (Diptera: Culicidae). I. Population size. J. Med. Entomol. 15(2):89–98.

WHITE-EYE, A MUTANT IN THE MOSQUITO *ERETMAPODITES QUINQUEVITTATUS* THEOBALD[1]

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ABSTRACT. A recessive mutant is described in *Eretmapodites quinquevittatus*. The mutant, white-eye (*w*), exhibits complete penetrance and uniform expressivity. It can be determined in the larvae, pupae, and adults of both males and females. Experimental cross data indicate that *w* segregates independently of sex (*m*), and that *w* is epistatic to red-eye (*re*).

INTRODUCTION

White eye appears to be a common eye color mutant in many of the species of mosquitoes where genetic studies have been carried out. It has been found in *Anopheles pharoensis, Anopheles gambiae* and *Anopheles quadrimaculatus* (Kitzmiller and Mason 1967), *Anopheles stephensi* (Aslamkhan 1973 and Sharma *et al.* 1977), *Culex pipiens* (Gilchrist and Haldane 1947 and Laven 1967), *Culex tarsalis* (Barr and Myers 1966), *Culex tritaeniorhynchus* (Baker 1969), *Aedes aegypti* (Bhalla 1968) and *Aedes cooki* (Wade 1977). White eye is sex-linked for all these species except *Cx. tarsalis* where it appears to be autosomal and *An. stephensi* where the mutant colorless-eye (a white eye) described by Sharma *et al.* (1977) is autosomal. Thus the white eye mutant reported for *Eretmapodites quinquevittatus* in the present study is at least the third white-eyed mutant that segregates independently of sex to be described in mosquitoes.

MATERIALS AND METHODS

The mutant white-eye (*w*) was first isolated in 1976 by the second author. Several white-eyed male and female pupae were isolated from the EQ-MIXED strain of *Er. quinquevittatus*. The resulting adults were crossed and their progeny inbred to establish a pure-breeding white-eye strain which was designated EQ-W. Two other strains of *Er. quinquevittatus*, EQ-PURE with normal eye phenotype and EQ-RE/GL homozygous for the red-eye mutant (*re*) (Hartberg and Johnston 1977), were also used in this investigation. All of the strains used were selected from the colonies maintained at the Mosquito Genetics Laboratory, Georgia Southern College.

Rearing methods used were generally similar to those described by Hartberg and Gerberg (1971) for rearing *Er. quinquevittatus*. Rearing was in an insectary

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room with a temperature of 27 ± 2°C and ambient RH. Larvae were fed on a suspension of liver powder and adults were provided with dry sugar cubes. After laying their autogenous egg batch (Hartberg and Gerberg 1971), females took a blood meal from an anesthetized mouse before laying further egg batches. All experimental crosses were conducted in cages made from gallon-size cylindrical cardboard containers. Between 20–50 pairs of mosquitoes were mass-mated per cross.

RESULTS AND DISCUSSION

DESCRIPTION. The normal eye color of *Er. quinquevittatus* is brownish-black. In the mutant white-eye (*w*) the eye color is white. The white-eye takes on a greyish tinge with age. Both the ocelli and compound eyes are affected, and the character can be determined in the larvae and pupae, as well as in the adults. Both males and females are affected. Penetrance is complete and expression uniform. F_1 progeny from reciprocal crosses between EQ-PURE and EQ-W were normal, indicating that *w* is recessive.

LINKAGE. Table 1 gives the data obtained from testcrosses between F_1 males and Eq-W (white-eye) females to test for linkage between *w* and the sex locus, *m* (Hartberg and Johnston 1977). The detection of linkage, together with an examination of the concomitant segregation ratios, is easily carried out by means of a chi-square (X^2) analysis (Bailey 1961). Such an analysis of X^2 for the testcross progeny data is given in Table 2. The data indicate that *w* is segregating independently of sex. We recognize that there

Table 1. Segregation of white-eye (*w*) and sex (*m*) in progeny from testcrosses of EQ-W females X F_1 males.

Trial No.	Testcross Female		Testcross Male	Female Progeny *w*	Female Progeny +	Male Progeny *w*	Male Progeny +
1	EQ-W	X	F_1(EQ-W X EQ-PURE)*	102	119	109	120
2	EQ-W	X	F_1(EQ-W X EQ-PURE)	94	118	104	110
3	EQ-W	X	F_1(EQ-W X EQ-PURE)	113	130	125	128
			Totals	309	367	338	358
4	EQ-W	X	F_1(EQ-PURE X EQ-W)	143	190	139	155
5	EQ-W	X	F_1(EQ-PURE X EQ-W)	116	117	126	125
6	EQ-W	X	F_1(EQ-PURE X EQ-W)	167	171	143	139
			Totals	426	478	408	419

* Female of P_1 cross is listed first in parentheses.

Table 2. Analysis of X^2 for data in Table 1.

Trial No.	Segregation *w*, + X^2	DF*	P	Segregation *m*, *M* X^2	DF	P	Joint Segregation X^2	DF	P	Totals X^2	DF	P
1	1.74	1	>0.10	0.14	1	>0.70	0.08	1	>0.70	1.96	3	>0.50
2	2.11	1	>0.10	0.01	1	>0.90	0.76	1	>0.30	2.89	3	>0.30
3	0.81	1	>0.10	0.20	1	>0.50	0.40	1	>0.50	1.40	3	>0.70
4	6.33	1	<0.05	2.43	1	>0.10	1.53	1	>0.20	10.29	3	<0.05
5	0	1	1.0	0.67	1	>0.30	0.01	1	>0.90	0.68	3	>0.80
6	0	1	1.0	5.06	1	<0.05	0.10	1	>0.70	5.16	3	>0.10

* Degrees of Freedom.

Table 3. Segregation of white-eye (*w*) and red-eye (*re*) in F_2 progeny from EQ-W females X EQ-RE/GL males.

Phenotype	F_2 Females	F_2 Males	Totals
+	351	201	552
re	19	145	164
w	112	103	215
Totals:	482	449	931

is a remote possibility that *w* and *m* are linked but widely separated. Additional genetic markers will need to be found before the question can be fully clarified.

EPISTASIS. Table 3 gives the data obtained from the F_2 progeny of a cross between EQ-W females and EQ-RE/GL males to test for *w* being epistatic to *re* (red-eye) (Hartberg and Johnston 1977). The data fit the expected 9:3:4 ratio ($X^2 = 3.52$; $P > 0.10$) that should be obtained if *w* is epistatic to *re*.

References Cited

Aslamkhan, M. 1973. Formal genetics of the malaria mosquito, *Anopheles stephensi*. Proc. Int. Cong. Trop. Med. Malariol., 9th, Athens, 1, 246–247.

Bailey, N. T. J. 1961. Introduction to the Mathematical Theory of Genetic Linkage. London: Oxford University Press. 298 pp.

Baker, R. H. 1969. White-eye, a female sterile and sex-linked mutant of *Culex tritaeniorhynchus*. Mosquito News 29:571–573.

Barr, A. R. and C. M. Myers. 1966. Two spontaneous mutants of *Culex tarsalis*. Proc. Entomol. Soc. Wash. 68:49–52.

Bhalla, S. C. 1968. White-eye, a new sex-linked mutant of *Aedes aegypti*. Mosquito News 28:380–385.

Gilchrist, B. M. and J. B. S. Haldane. 1947. Sex linkage and sex determination in a mosquito, *Culex molestus*. Hereditas 33:175–190.

Hartberg, W. K. and E. J. Gerberg. 1971. Laboratory colonization of *Aedes simpsoni* (Theobald) and *Eretmapodites quinquevittatus* Theobald. Bull. Wld. Hlth. Organ. 45:850–852.

Hartberg, W. K. and K. W. Johnston. 1977. Red-eye, a sex-linked mutant in the mosquito *Eretmapodites quinquevittatus* Theobald. Mosquito News 37:725–728.

Kitzmiller, J. B. and G. F. Mason. 1967. Formal genetics in anophelines. In *Genetics of Insect Vectors of Disease*, edited by J. W. Wright and R. Pal, pp. 3–15. Amsterdam: Elsevier.

Laven, H. 1967. Formal genetics of *Culex pipiens*. In *Genetics of Insect Vectors of Disease*, edited by J. W. Wright and R. Pal, pp. 17–65, Amsterdam: Elsevier.

Sharma, V. P., T. R. Mani, T. Adak and M. A. Ansari. 1977. Colorless-eye, a recessive autosomal mutant of *Anopheles stephensi*. Mosquito News 37:667–669.

Wade, J. O. 1977. The genetics of white-eye, a sex-linked mutant of *Aedes* (*Stegomyia*) *cooki* Belkin. Ann. Trop. Med. Parasit. 71:483–485.