We are indebted to Dr. Alexis Carrel, of the Rockefeller Institute, for valuable suggestions as to operative technique, and to the Carnegie Institution of Washington for material assistance through a grant to the senior author.

W. E. CASTLE,
JOHN C. PHILLIPS
FOREST HILLS, BOSTON, MASS.,
August 11, 1909

THE PECULIAR INHERITANCE OF PINK EYES AMONG COLORED MICE[1]

READERS of SCIENCE are well acquainted with the fact that color-inheritance in mice presents many difficult problems. To one of these problems we are hopeful that we have found a solution. Mice occur in the same fundamental color-varieties as guinea-pigs, most of which are found also among rabbits.[2] These color varieties occur in two series, one the usual or intense series, the other a dilute or pale series. Bateson (1909) considers the pale series a quantitative modification merely of the intense series, but there are some reasons for regarding it as a qualitative modification. But whichever it may prove to be, the dilution is demonstrably interchangeable from one color variety to another, so that it may conveniently be treated as due to an independent factor.

Mice are peculiar in that they possess another series of color varieties, or really two other series, as we shall try to show, not found in mammals generally.

In this series the eye is apparently pink, but in reality, as Miss Durham has shown, it is very slightly black or brown pigmented. Further, black or brown pigments of the coat, if present, are pale in pink-eyed mice.

We find, however, that the paleness of the pigments in such cases is not commonly due to the same factor as the paleness of coat in the dilute series having dark eyes, but to a different factor which may or may not be associated with the dilution factor and which we regard as a *quantitative* modification of the pigmentation, while the dilution may be regarded as a *qualitative* modification of it.

We recognize, accordingly, four series of color varieties among mice, two dark-eyed and two pink-eyed. Dark-eyed and pink-eyed may each occur in an intense series and in a dilute series. The reason that they have not been recognized sooner is that the intense pink-eyed animal is really less heavily pigmented than the dilute dark-eyed animal of the same color-type, and so *all* pink-eyed animals have been considered *dilute*. But that such is not the case is shown by the following experiment. If a pink-eyed gray (intense) animal is mated with a dark-eyed pale cinnamon (dilute) the young are all both dark-eyed and intense; namely, the color of wild house-mice (gray).

Now if such grays are bred together they produce: (1) grays (both intense and dark-eyed); (2) blue-grays (dilute and dark-eyed); (3) pink-eyed grays (intense but with reduced amount of pigment), and (4) pink-eyed pale-grays (dilute and with reduced amount of pigment). Manifestly this is a case of Mendelian dihybridism, in which the pigmentation has been modified in two different ways. Each modification affects the fundamental color-factor, *C*, and may be transmitted through albinos, or from one color variety to another. For convenience of reference we place in a table the names of the four series of color-varieties which we recognize. Most of these have already been identified but there is still uncertainty about a few of them. In the table p. means pink-eyed as well as "paucity" of black or brown pigment in the coat.

The albinos being wholly unpigmented are indistinguishable in the several series except by breeding tests.

A specific experiment illustrative of the foregoing account, though involving a greater number of factors, is the following.

[1] Contributions from the Laboratory of Genetics, Bussey Institution, Harvard University, No. 2.

[2] See SCIENCE, January 25, 1907; August 30, 1907; August 21, 1908.

[3] The coat looks to the unaided eye very similar to that of the dark-eyed pale cinnamon.

[4] This variety has a coat much less heavily pigmented than the dark-eyed blue, but if crossed with cream it produces black and gray young, not blue and blue-gray.

Series 1 Dark-eyed Intense	Series 2 Dark-eyed Dilute	Series 3 Pink-eyed Intense	Series 4 Pink-eyed Dilute
Gray	Blue-gray	p. Gray[3]	p. Pale gray
Black	Blue	p. Blue[4]	p. Pale blue
Cinnamon	Pale cinnamon	p. Cinnamon	p. Pale cinnamon
Chocolate	Pale chocolate	p. Lilac	p. Pale lilac
Yellow	Cream	p. Yellow	p. Cream
Albino	Albino	Albino	Albino

A *dilute* dark-eyed cinnamon ♀ 682 was mated with a *pink-eyed* gray ♂ 691. From this mating fifteen young were obtained, all *intense* dark-eyed grays (like the wild house-mouse).

From these grays, when bred together, there have been obtained up to the present time fifteen young of at least six different color varieties distributed as shown below. On the hypothesis, which we have advanced, the expected number of varieties is eight; their expected frequencies in a total of sixty-four young are also shown below. It is not surprising that, in so small a number of young as fifteen, two of the smallest of the expected classes should be unrepresented, but it is not yet certain that they are unrepresented, since the visible difference between p. cinnamons and p. grays is probably so slight that breeding tests may be required to differentiate the two classes.

	Dark-eyed				Pink-eyed			
	gray (intense)	blue gray (dilute)	cinnamon (intense)	pale cinnamon (dilute)	p. gray (intense)	p. pale gray (dilute)	p. cinnamon (intense)	p. pale cinnamon (dilute)
Expected	27	9	9	3	9	3	3	1
Actual	4	3	2	1	4?	1?	?	?

The cross is evidently one involving three independent Mendelian factors, viz., (1) black *vs.* brown pigmentation; (2) intense *vs.* dilute pigmentation; and (3) dark-eyed *vs.* pink-eyed (or, as we should prefer to call it, the full amount of pigment *vs.* a reduced amount).

The known Mendelian factors concerned in the color variation of mice now number nine. They are:

1. *C,* the general *color* factor, the basis of all pigment in the skin and coat; its three modifications follow next.

2. *d,* the *dilution* factor.

3. *s,* the factor which causes *spotting* with white.

4. *p,* the *pink-eye* (or *paucity*) factor; next follow the three specific color factors and their two modifiers.

5. *Y,* the *yellow* factor.

6. *Br,* the *brown* or chocolate factor.

7. *B,* the *black* factor.

8. *R,* the *restriction* factor, which when present restricts black and brown pigments to the eye and leaves the coat yellow.

9. *A,* the *agouti* factor which operates by excluding black and brown pigments from particular parts of the hair, thus producing the ticked gray or cinnamon coat.

An explanation of the symbols chosen to express these factors will be given elsewhere. Grateful acknowledgment is made of assistance rendered by the Carnegie Institution of Washington through a grant to the senior author.

W. E. Castle,
C. C. Little

Forest Hills, Boston, Mass.,
August 11, 1909

THE FORTIETH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY. III

Division of Physical and Inorganic Chemists

Charles H. Herty, chairman

Wilder D. Bancroft, secretary

On the Volumetric Estimation of Uranium and Vanadium: Edward DeMille Campbell and Chas. E. Griffin.

A brief review of the methods previously published is given. Experiments show that vanadium may be satisfactorily determined by reduction with sulphur dioxide and titration with permanganate and vanadium and uranium together may