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Genetics 453

Evolutionary Genetics

Population Genetics

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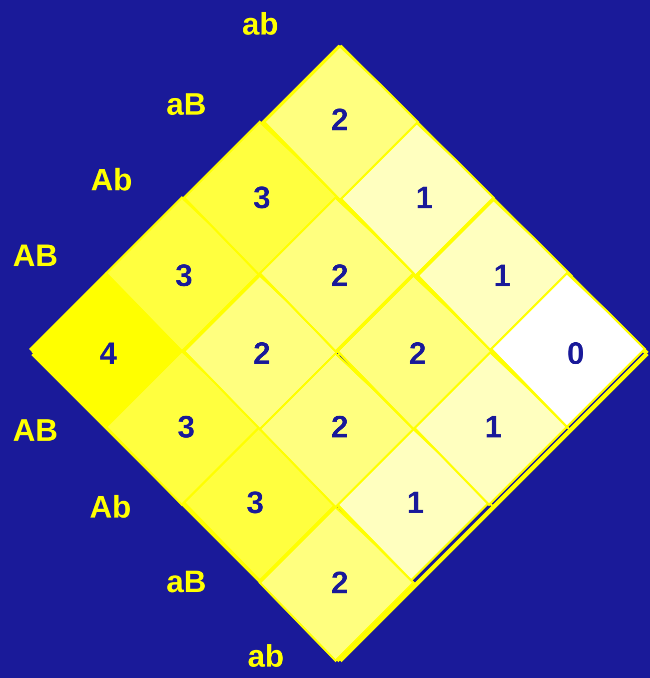
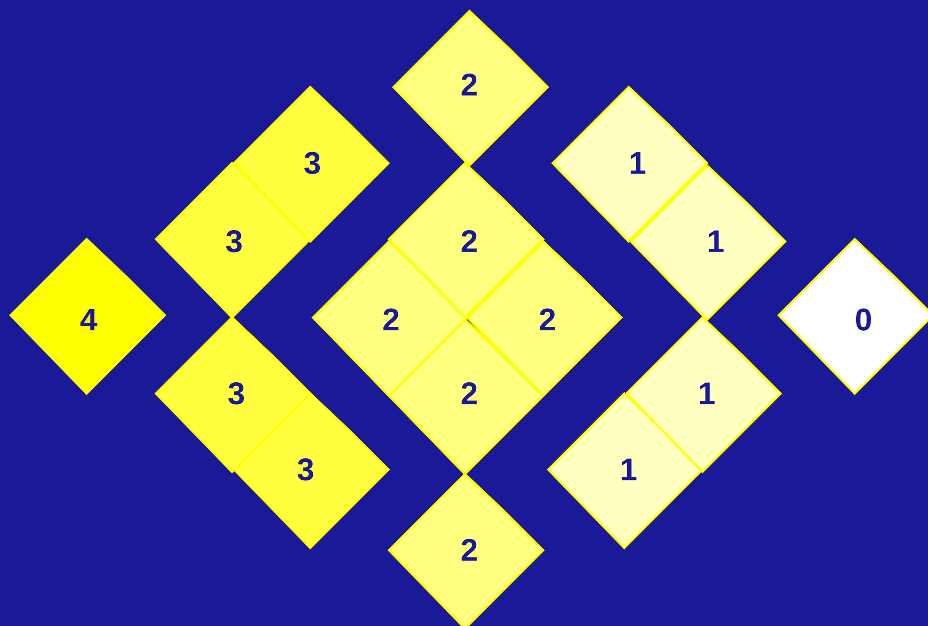
A random−mating population with two genes having 2 alleles each, at equal frequencies, symmetrically affecting a quantitative character

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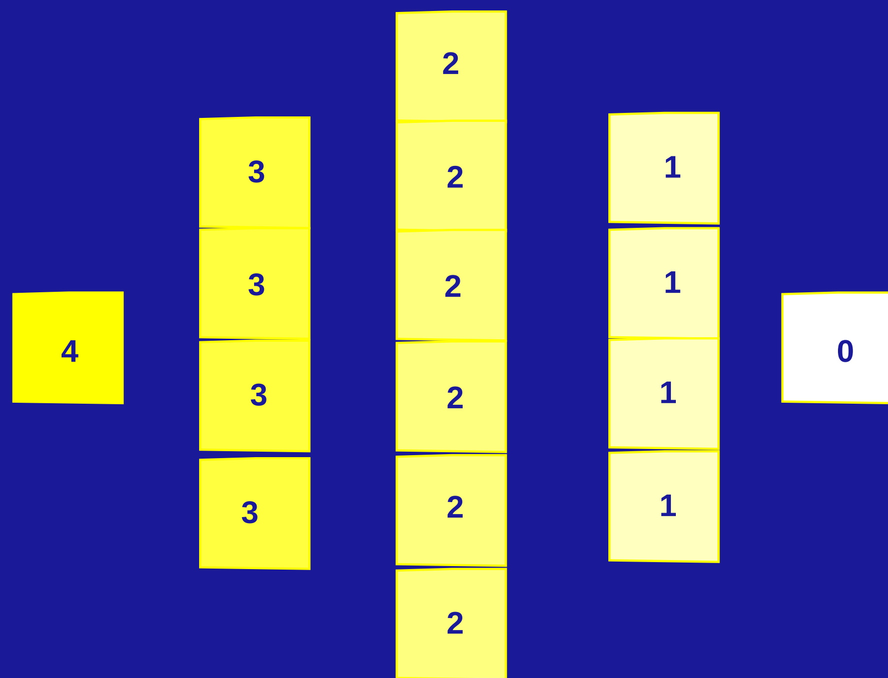
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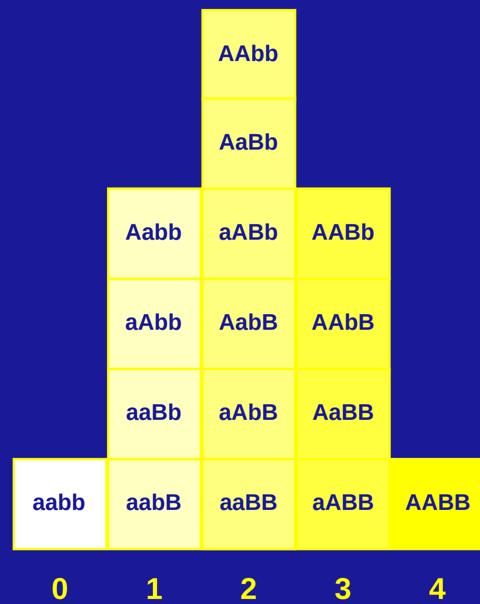
The distribution of the genotypes and the quantitative character before artificial selection



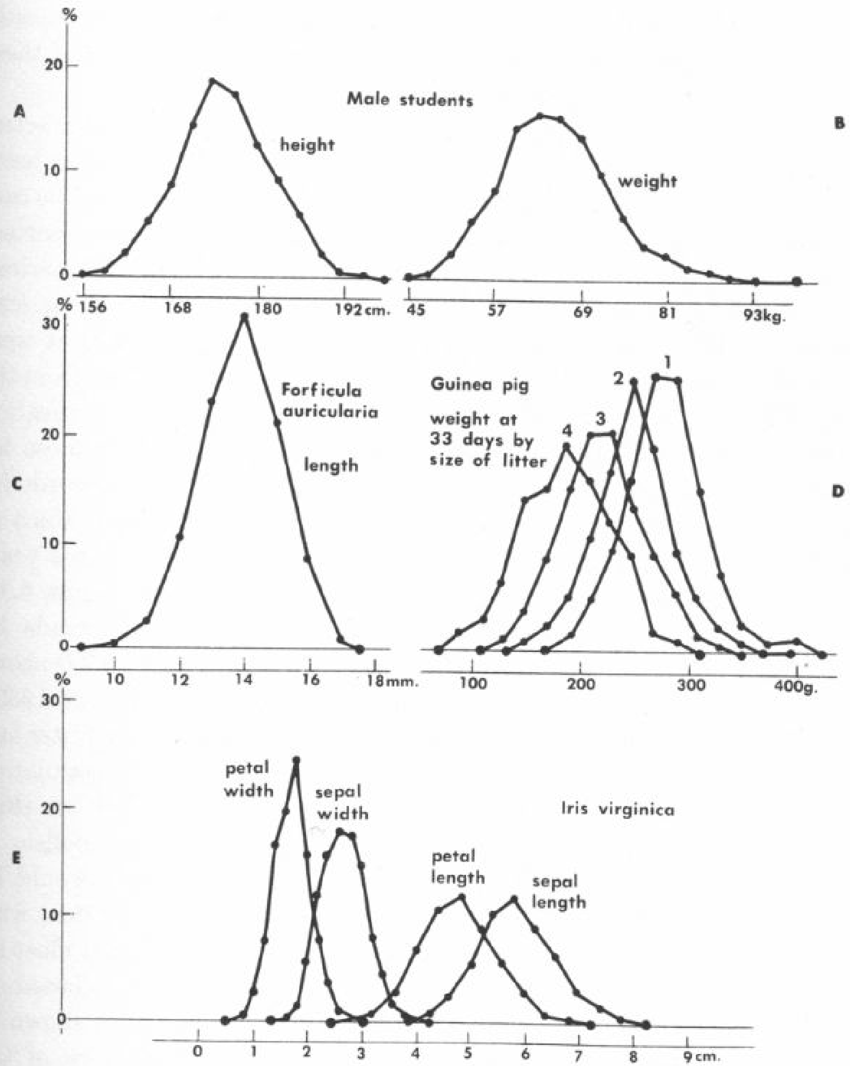


FIG. 6.2. Some unimodal distributions of sizes. Numbers of individuals. *A*, *B* 1,000 male students; *C*, 1,519 *Forficula*; *D*, 80, 382, 530, and 205 guinea pigs in litters of 4, 3, 2 and 1 respectively; *E*, 1,584 ± flowers of *Iris virginica*. (From data: *A* and *B*, Castle 1916*a*; *C*, Diakonov 1925; *D*, Wright and Eaton 1929; *E*, Anderson 1928.)

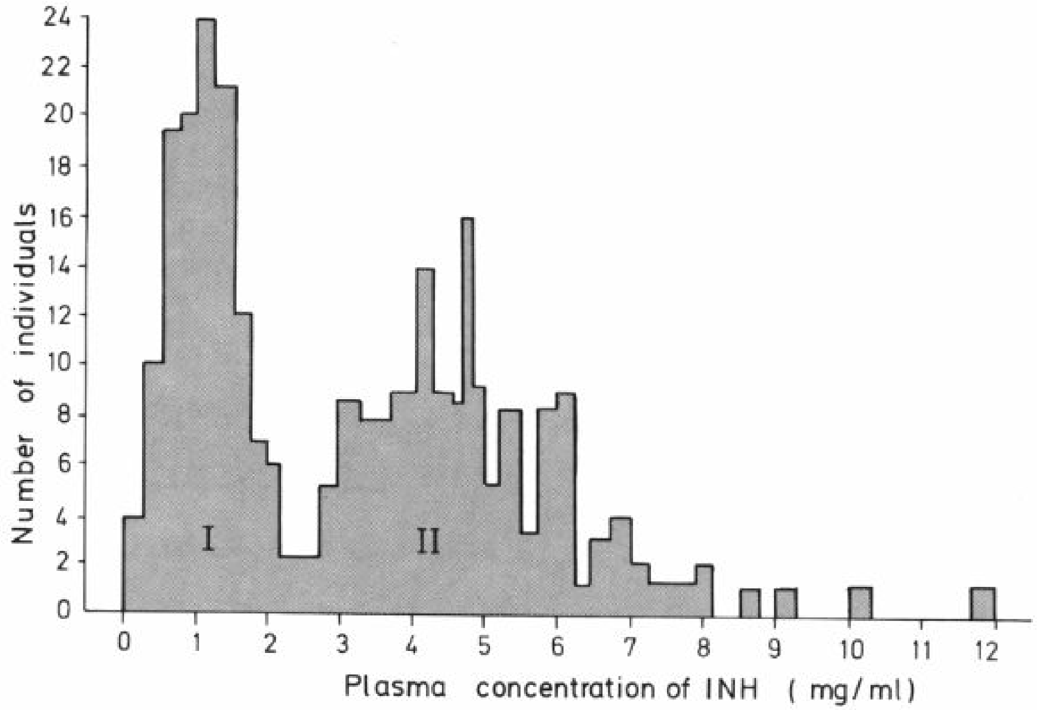


Fig. 3.49. Plasma concentration of isoniazid (*INH*) in 267 members of 53 families; bimodal distribution. The antimode is between 2–3 mg% (adapted from: Evans et al., 1960 [117])

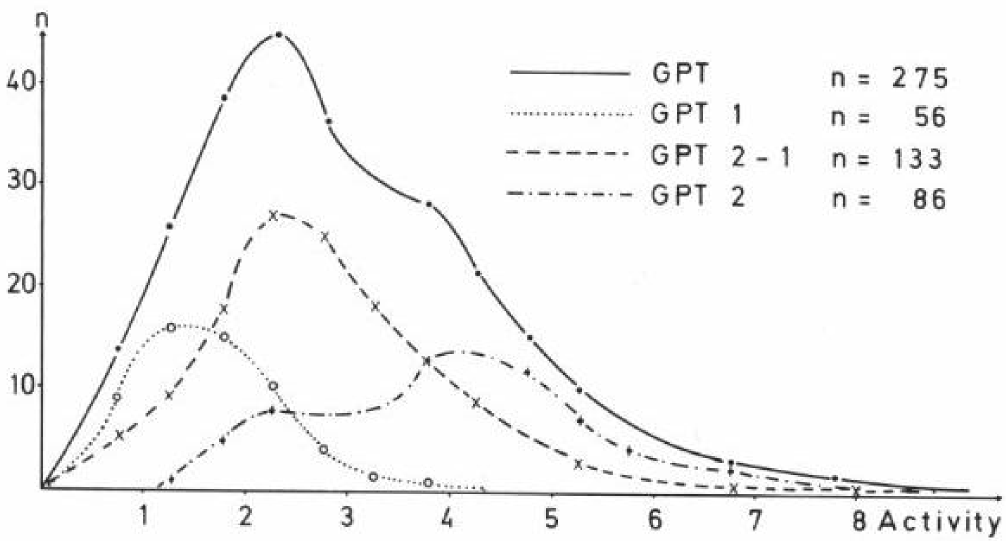


Fig. 3.51. Distribution of enzyme activities for three GPT genotypes, almost combining to a somewhat skewed normal distribution (data from Becker, P.E. (ed.), 1976 [*6*])

The distributions after artificial selection which saves only those individuals at or above 2

Before selection

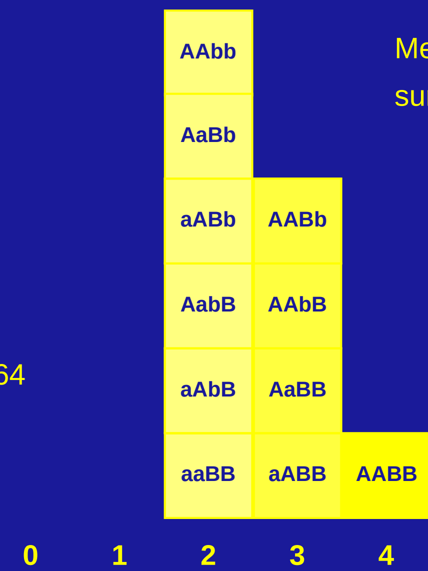
frequency of A = 0.5

frequency of B = 0.5

After selection:

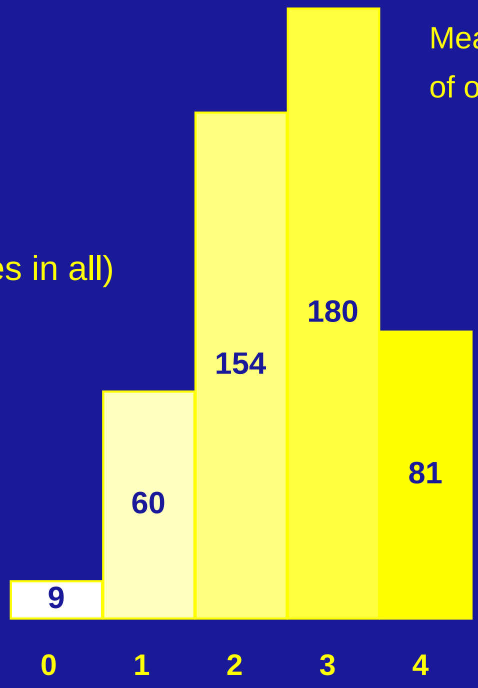
frequency of A = 14/22 = 0.6364

frequency of B = 14/22 = 0.6364



Mean phenotype of survivors = 2.545

In fact, the offspring will have this distribution:



(484 copies in all)

Mean phenotype of offspring = 2.545

Heritability

(assuming genes are additive and environments are independent)

Variance of a character = V_T

$$V_T = V_A + V_D + V_E$$

Environmental variance

Dominance variance

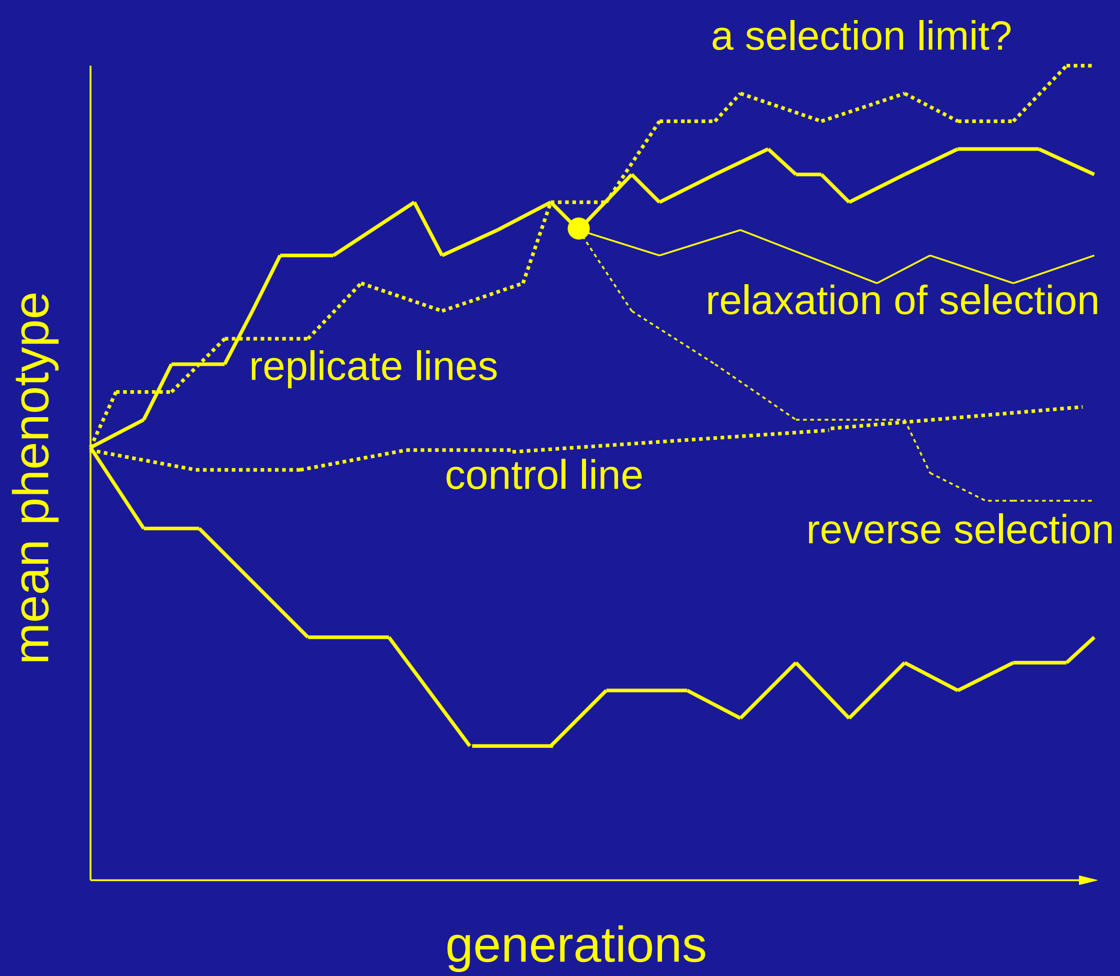
Additive genetic variance

Total variance

$$\text{heritability} = h^2 = \frac{V_A}{V_T}$$

heritability in effect measures the fraction of variations that are passed on to the next generation, undisrupted by Mendelian segregation

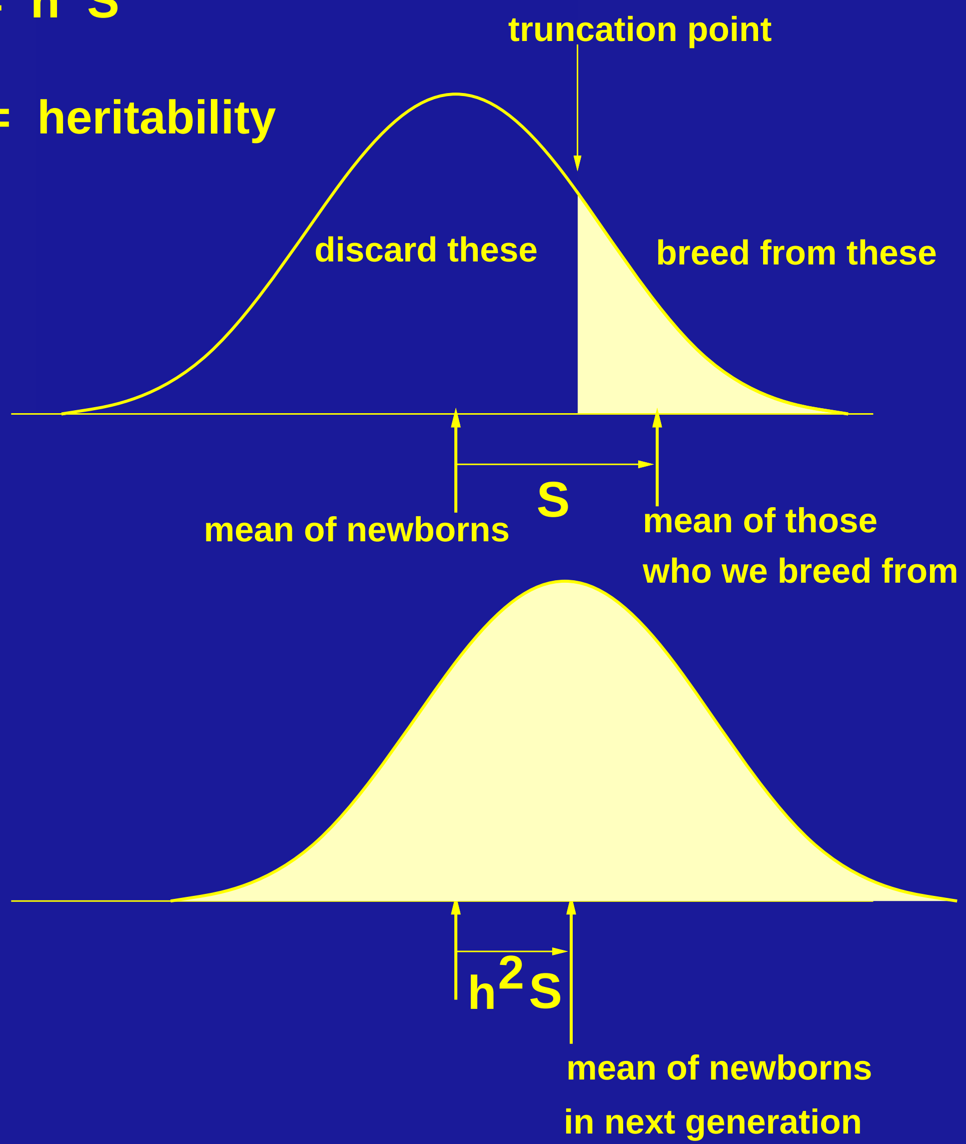
Some features of artificial selection experiments



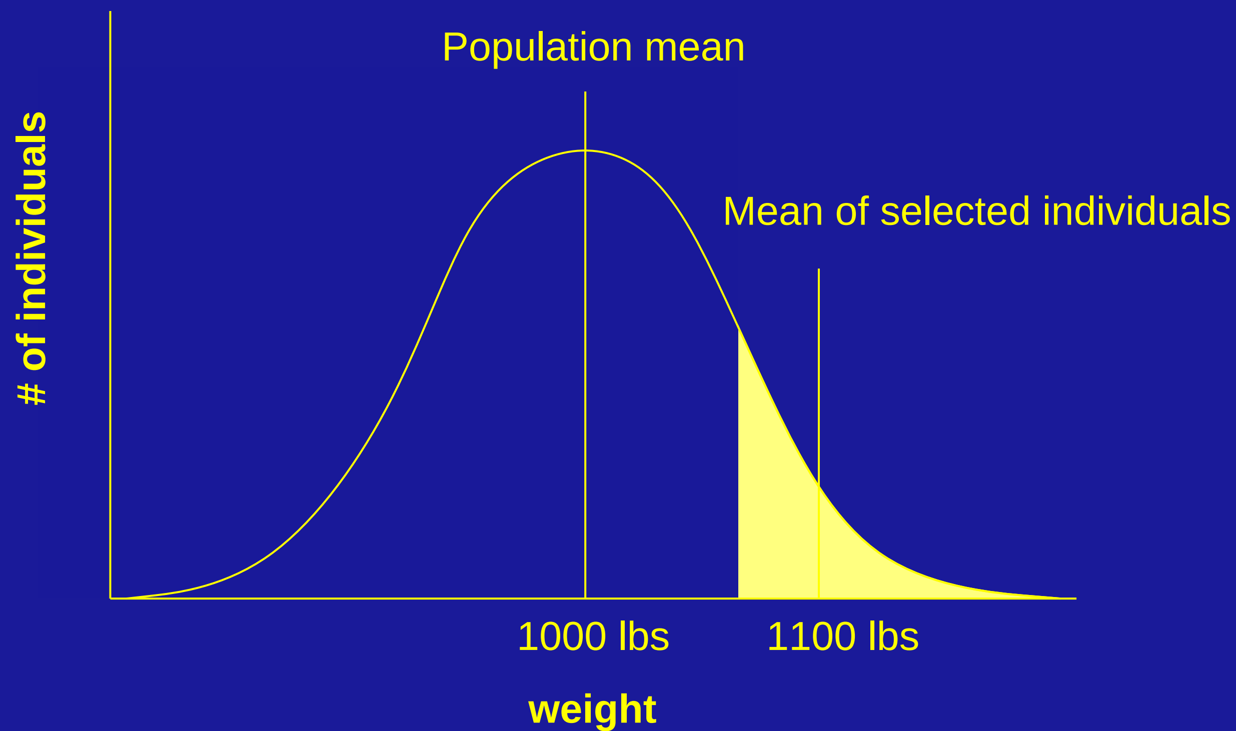
Response to artificial selection

$R = h^2 S$

h^2 = heritability



Response to artificial selection



If heritability = 0.4

S = selection differential

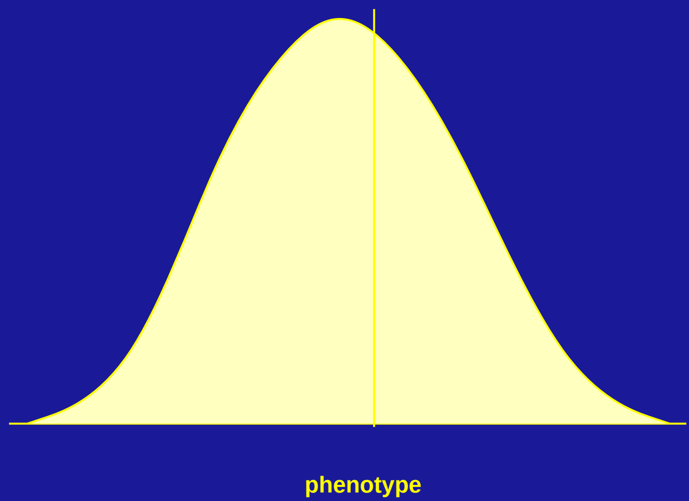
= mean of selected individuals − population mean = 100 lbs

R = gain

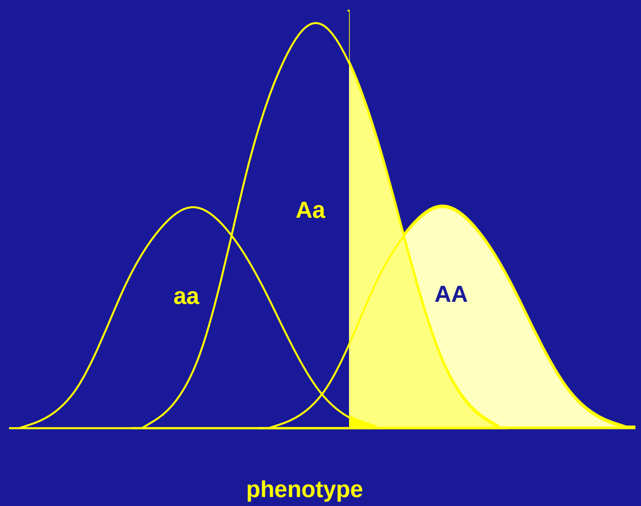
= $h^2 S$ = 40 lbs

This is the expected gain in one generation

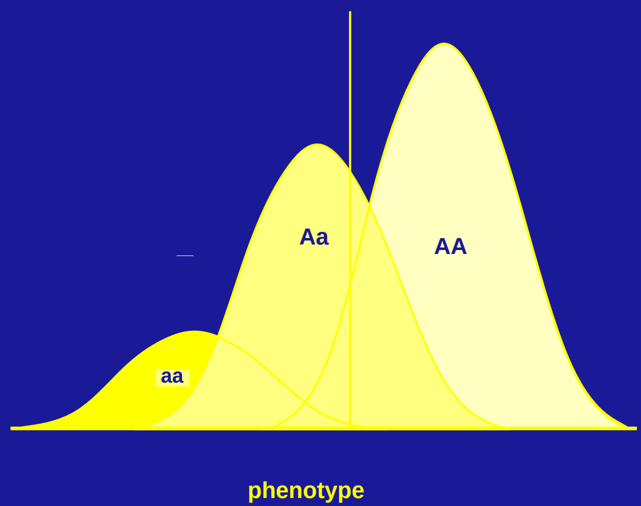
With a larger number of loci, focussing just on one locus



With a larger number of loci, focussing just on one locus



The distribution of offspring at this locus



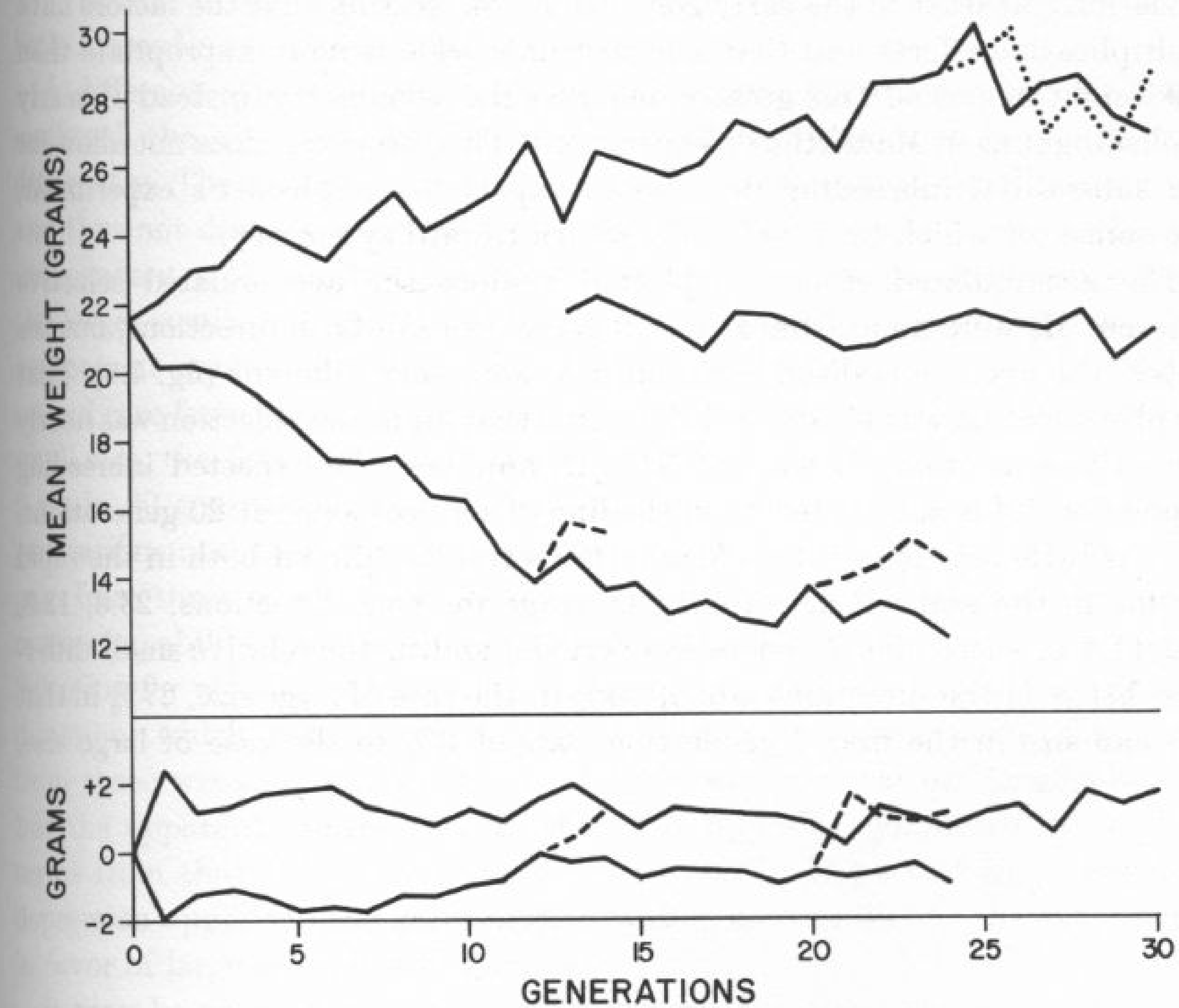


FIG. 7.5. Courses of selection of mice for high or low weight at six weeks in com parison with controls. Effects are shown of late relaxation (*dotted lines*) in the high line and of reverse selection (*broken lines*) at two times in the low line Standard deviations are shown below. Redrawn from Falconer (1955, fig. 1), ©

frequencies in mice of Falconer and Bloom.

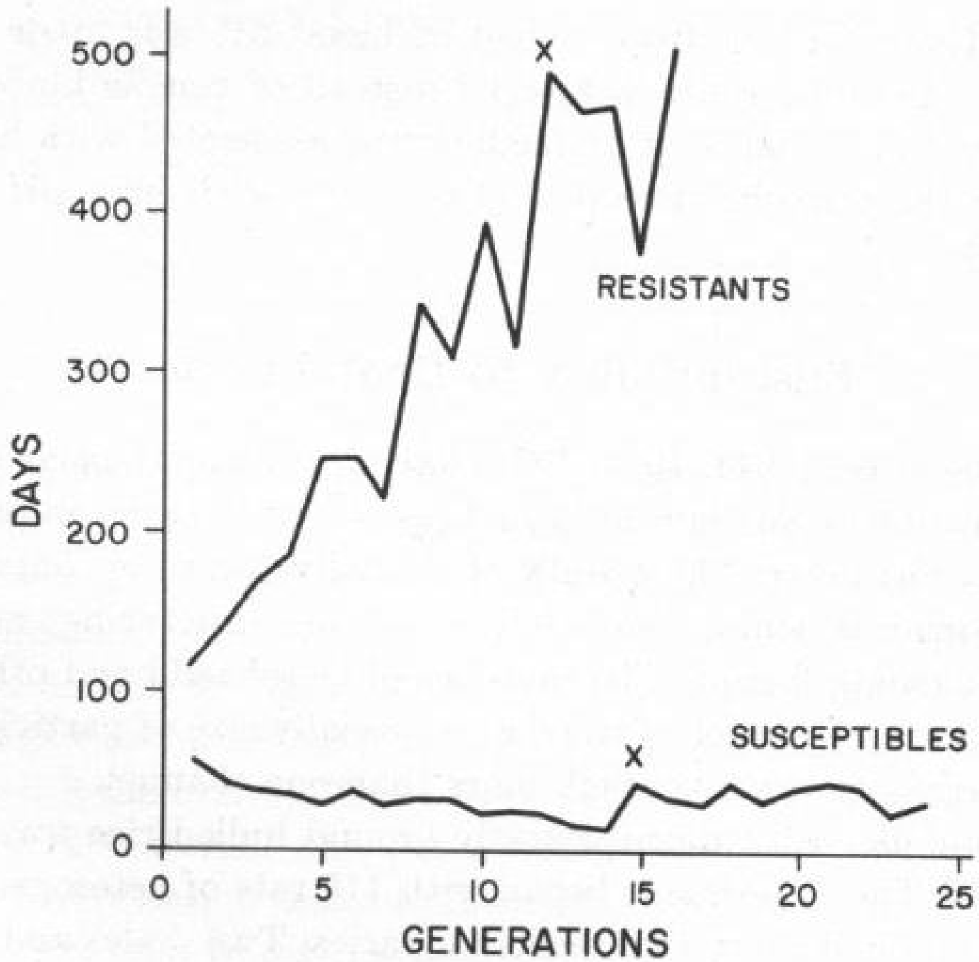


FIG. 7.11. Average number of days from exposure of rats to a cariogenic diet to recognition of caries, under selection for resistance or for susceptibility. The crosses indicate the time after change to a less cariogenic diet. Reprinted, by permission, from Hunt, Hoppert and Rosen (1955). © 1955 by the American Association for the Advancement of Science.

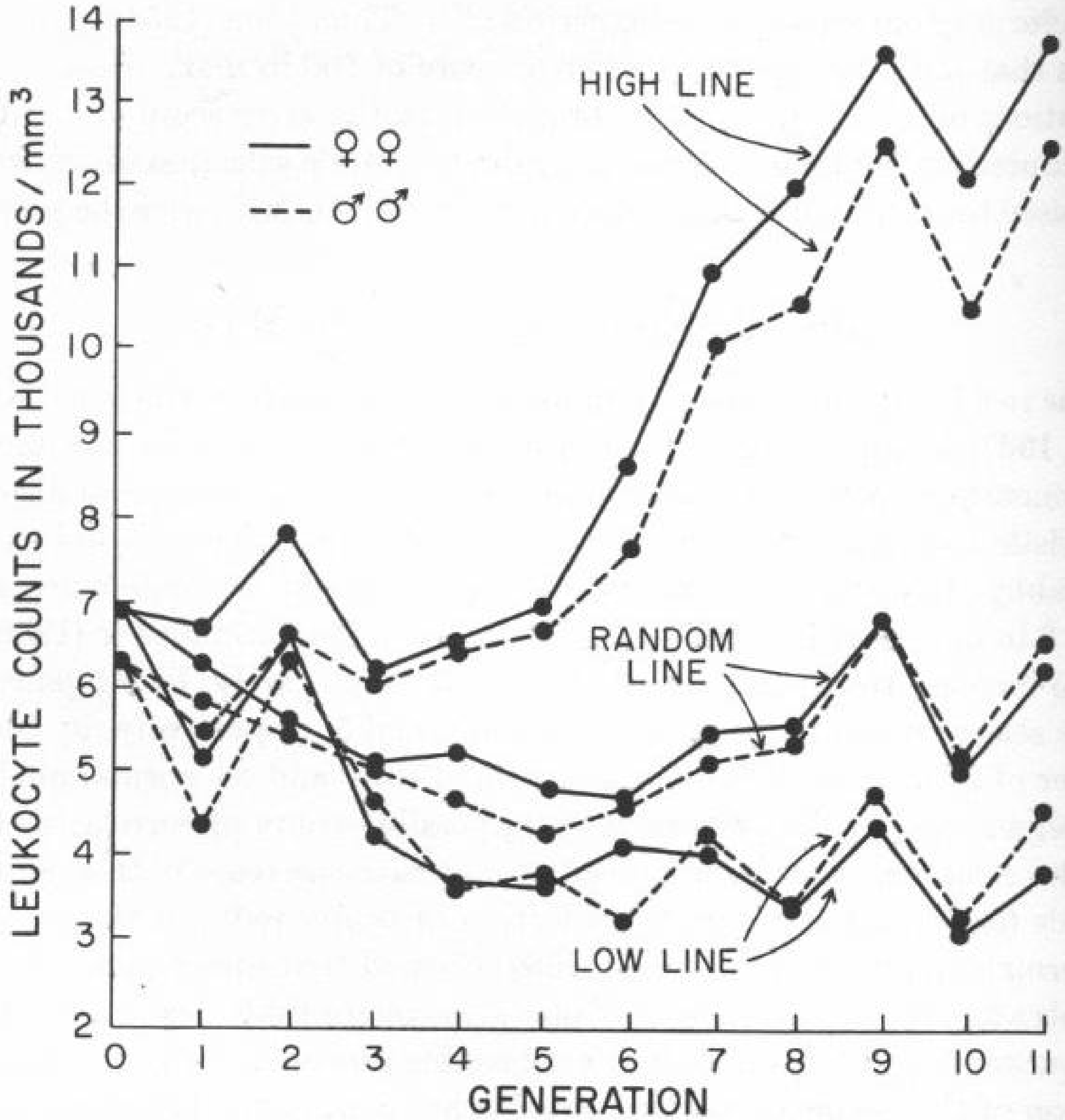


FIG. 7.12. Courses of change of leukocyte counts, in mice selected for resistance or for susceptibility, over 11 generations. From Chai (1966).

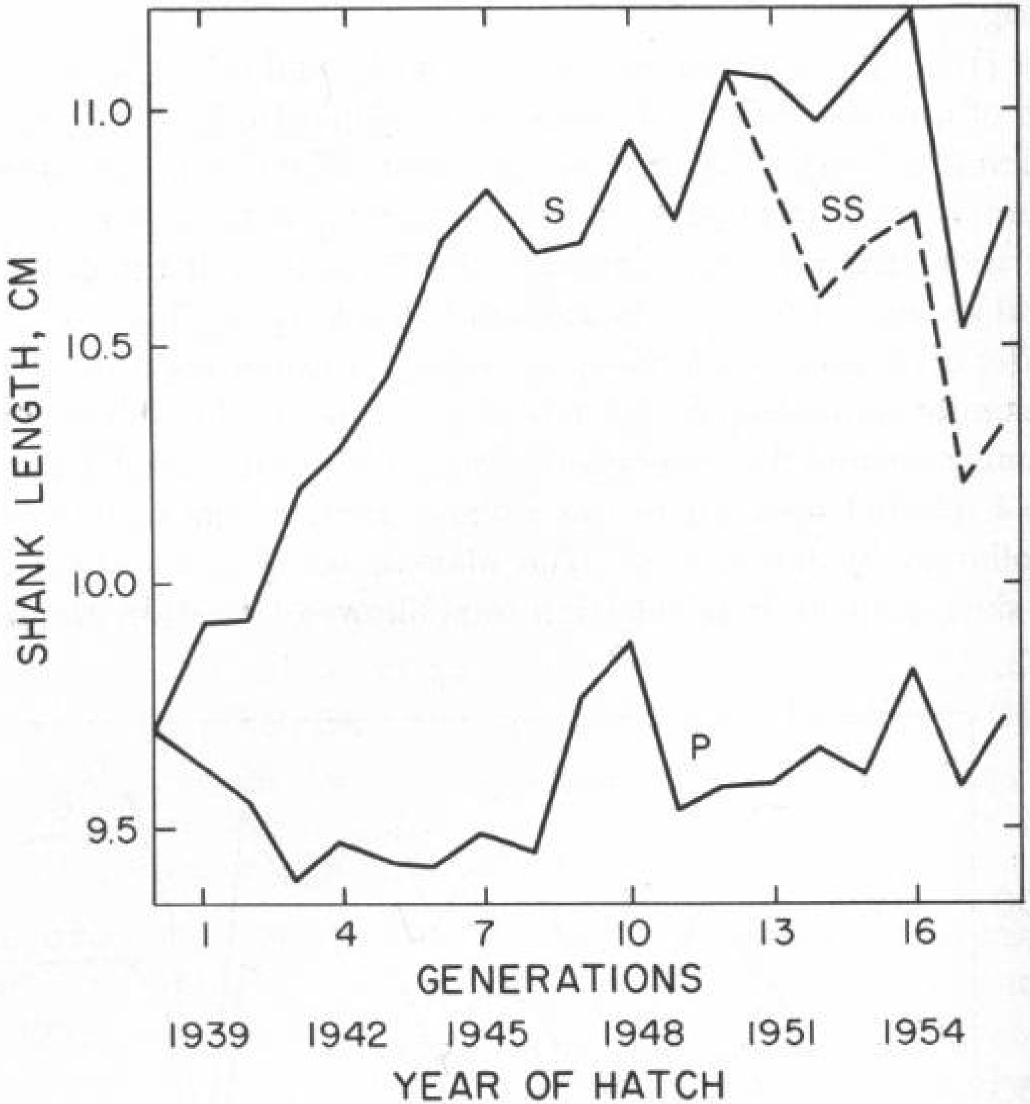


FIG. 7.15. Courses of selection (S) of White Leghorn fowls for increased shank length and suspension of selection (SS) in comparison with controls (*P*). Redrawn from Lerner (1958, fig. 4.10); used with permission.

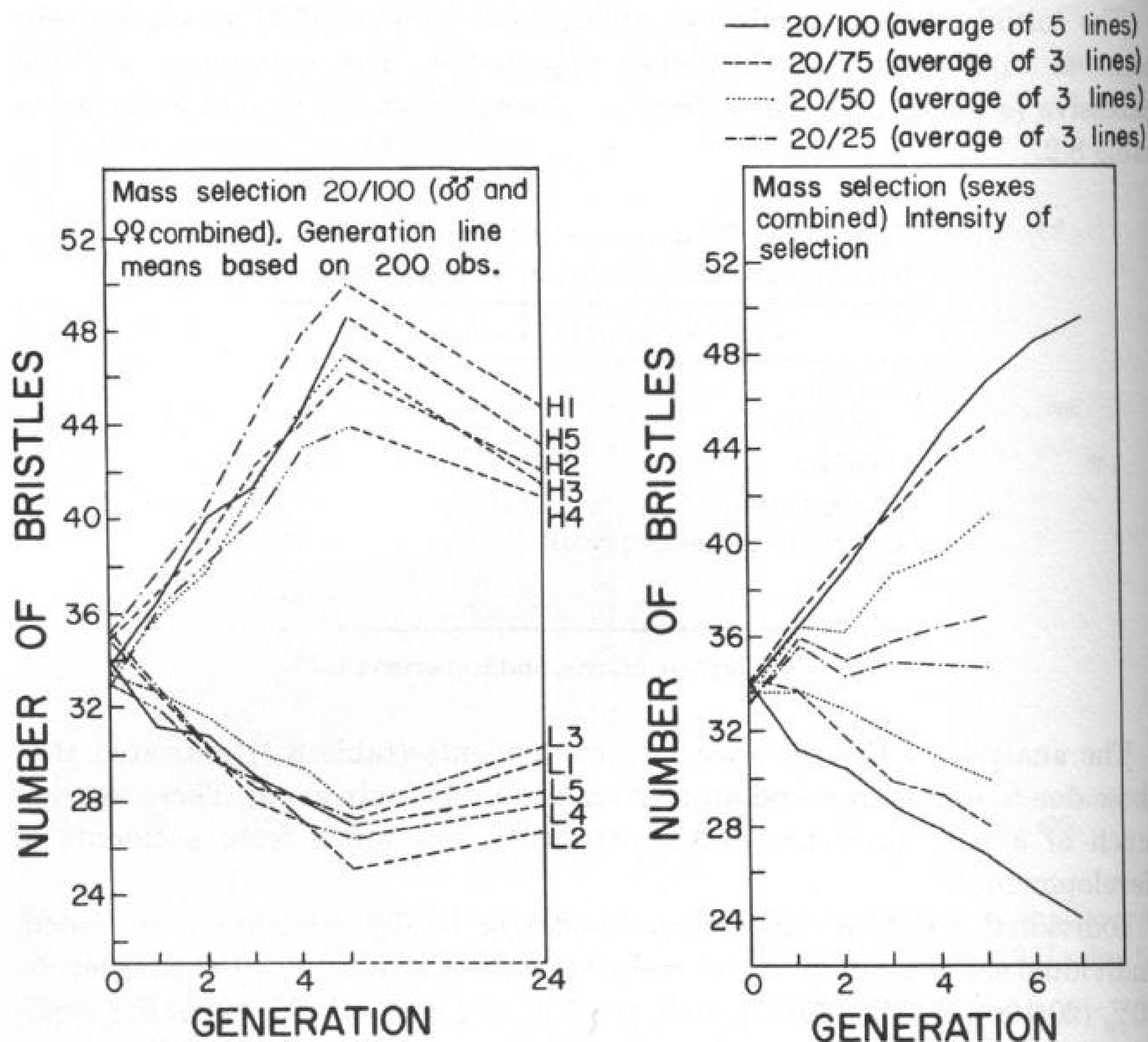


FIG. 8.4. Courses of selection for number of abdominal chaetae in five lines of *D. melanogaster*, in each direction, followed by 19 generations of relaxation (*left*). Courses of selection (high and low) at different intensities (*right*). Redrawn from

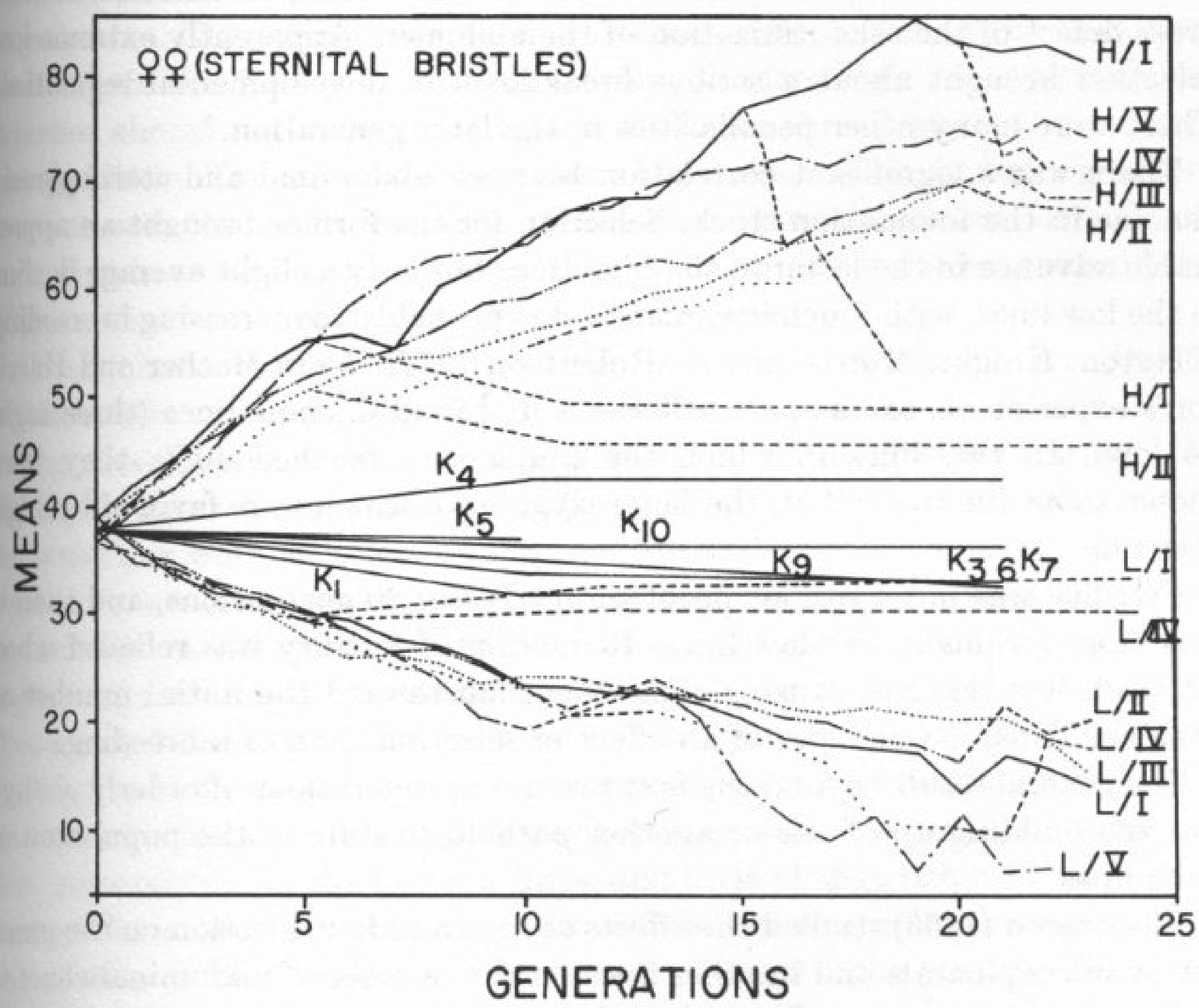


FIG. 8.6. Courses of selection, high, H; low, L; in five lines each, for number of abdominal chaetae (sternital bristles) in females of *D. melanogaster*, continuing the selection of figure 8.4. The effects of relaxation are shown by broken lines. The courses in a number of unselected lines, *K*, are also shown. Redrawn from

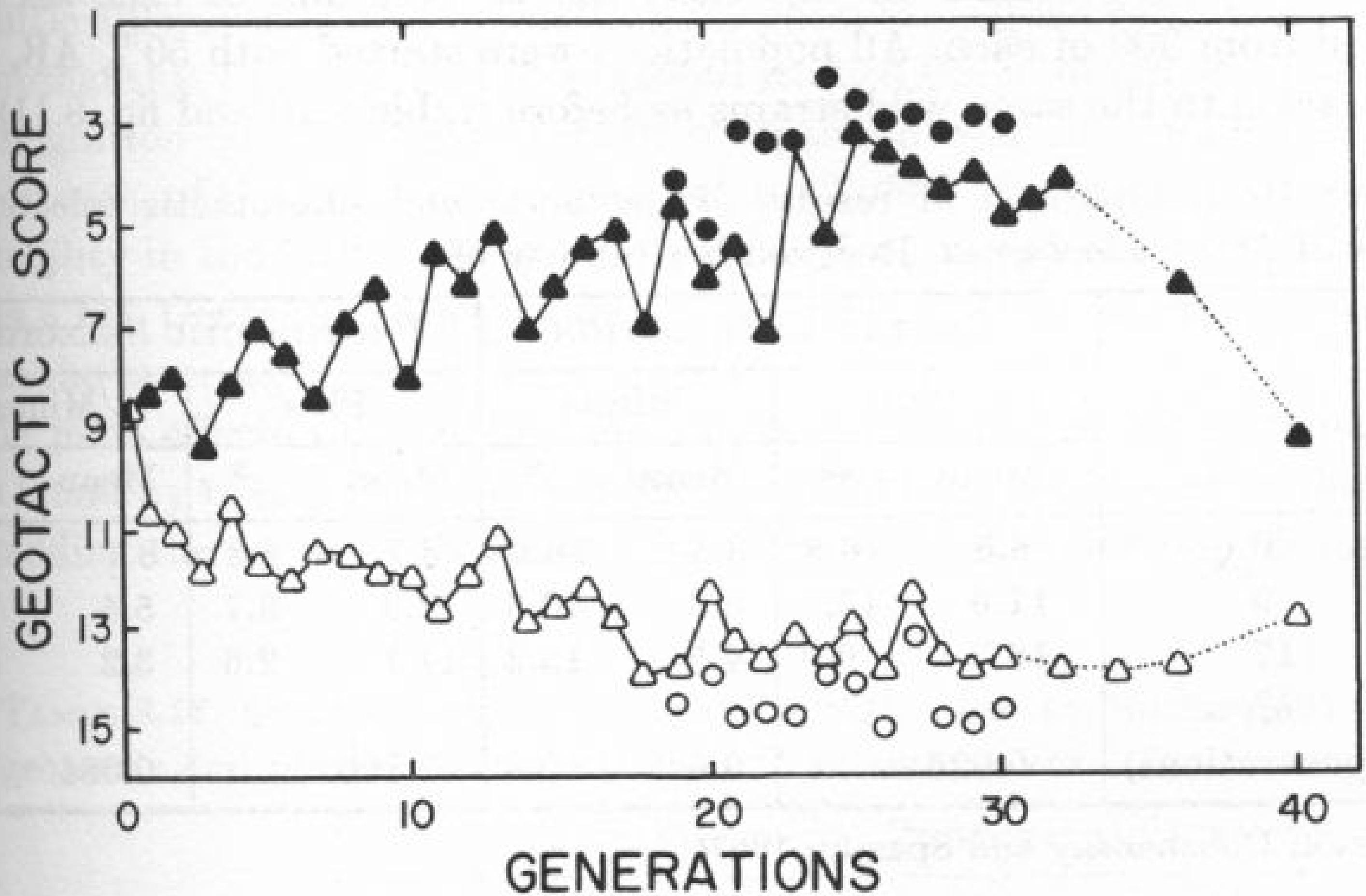


FIG. 8.10. Courses of selection in each direction for geotaxis in *D. pseudoobscura*. Mean scores of retests of 100 "best" flies (*solid circles*, minus; *open circles*, plus). Relaxation of selection, *dotted lines*. Reprinted, by permission, from Dobzhansky and Spassky (1969).

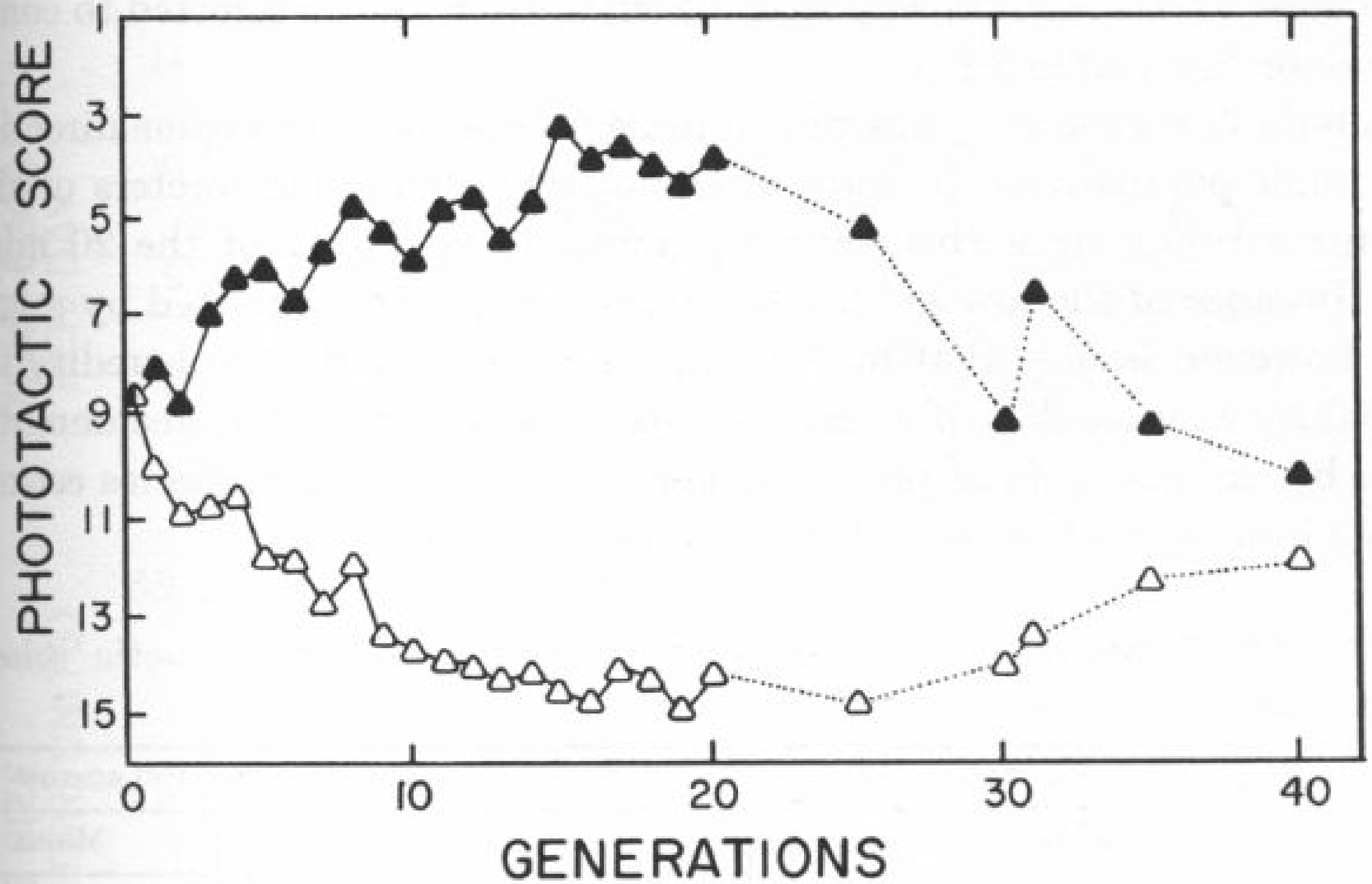


FIG. 8.11. Courses of selection (*solid triangles*, minus; *open triangles*, plus) in each direction for phototaxis in *D. pseudoobscura*. Relaxation of selection, *dotted lines*. Reprinted, by permission, from Dobzhansky and Spassky (1969).

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- Linux (operating system)
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- Idraw (drawing program to modify plots and draw figures)
- Adobe Acrobat Reader (to display the PDF in full-screen mode)

(except that we had to use Microsoft Windows to project this as the X server I have in Linux is not too great)