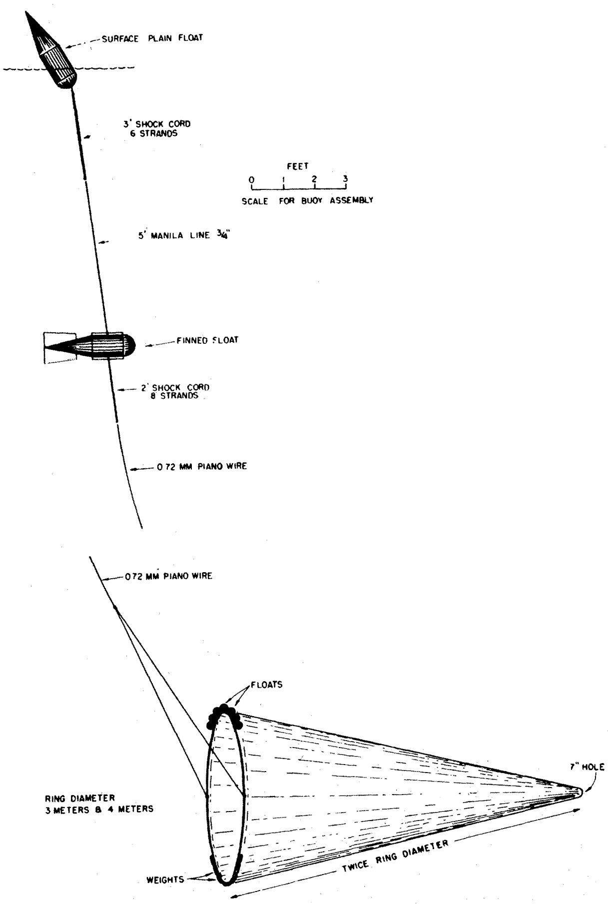

Fig. 2. Deep drag and buoy assembly used to measure the deep current.

The submerged east current was, thus, observed in a narrow zone near the equator, the speed of the axis exceeding 1 knot. It was separated from the Equatorial Countercurrent by water with a westward velocity component.

As mentioned in the opening paragraph, observations of the drift of long-line fishing gear have indicated the presence of the submerged current. The long line is a system of cotton lines suspended from buoys and floated freely in the water, the main mass of line lying, in these trials, in the lower part of the surface layer. This gear has been set very near the equator a number of times on various longitudes and, on several occasions, has moved eastward in spite of opposing southeast trade winds and seas at the surface, suggesting that the submerged current is prevalent near the equator in the central Pacific. Whether or not the current prevails in the eastern and western Pacific and in the Atlantic remains to be determined by further study.

In part, the dynamics of the current seem clear. The surface layer of warm water deepens westward, so that throughout this layer there is an eastward component of pressure-gradient force (*1*). Below the depth of influence of the southeast trade winds, water flows east in response to the pressure gradient. These considerations do not explain the narrowness of the current.

On this basis, the countercurrent at the equator can be expected to extend up to the sea surface when the wind stress is released or sufficiently diminished. Such an occurrence could explain reports of eastward drift of vessels close to the equator in the eastern Pacific and the Atlantic (*2*).

The countercurrent at the equator may, thus, occasionally be observed at the surface but is apparently more prevalent in the lower part of the surface layer and in the thermocline. For this reason the name "Equatorial Undercurrent" is proposed.

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Reciprocal Selection for Correlated Quantitative Characters in *Drosophila*[1,2]

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In recent years a number of mass-selection experiments directed at increasing, as well as decreasing, the magnitude of a given quantitative character have been reported (*1–4*). A constant feature of such experiments has been the occurrence of correlated changes in characters other than the one being selected. Three general hypotheses can account for these correlations: (*a*) unwitting selection for a genetically independent trait, physiologically essential to successful establishment of the main selected character; (*b*) linkage of genes responsible for the correlated characters; (*c*) pleiotropic effects of a single group of genes. The elimination of any one of these hypotheses is extremely difficult and is complicated by the fact that they are neither mutually exclusive nor necessarily collectively exhaustive.

One point of attack on the problem of correlated characters is to select separately for each of a pair of such characters (reciprocal selection) and study changes of both characters in both strains. Reeve and Robertson (*4*) were able to show a correlated response between wing length and thorax length on selection for either character, thus indicating a genetic general size factor. A similar genetic thorax length–wing length correlation was demonstrated in aphids (*5*).

Since early 1952, we have been selecting several strains of *Drosophila melanogaster* for resistance, as

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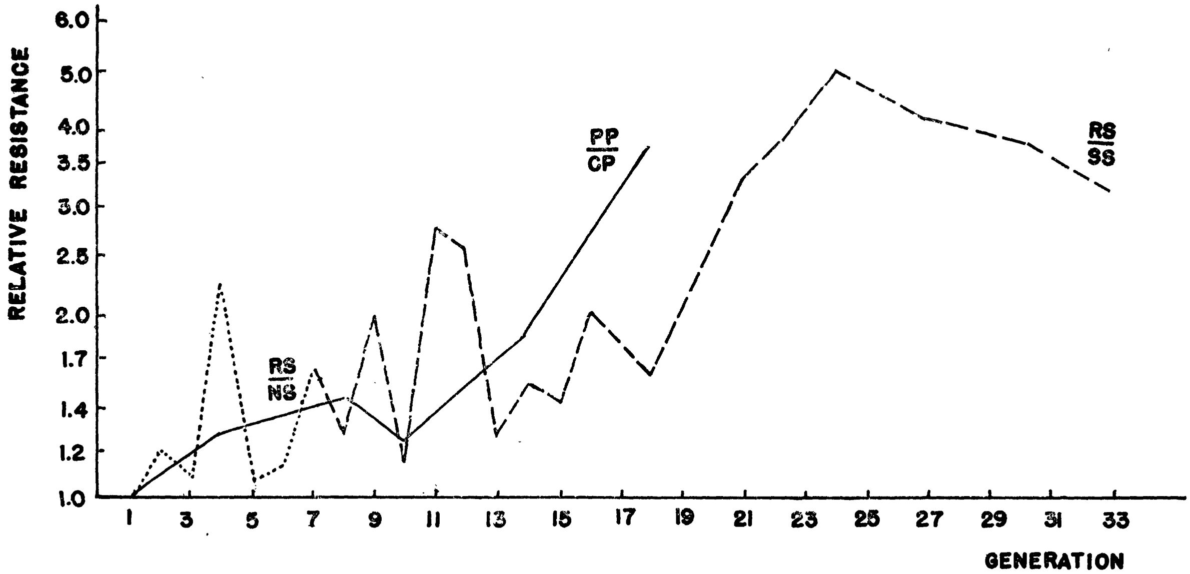

FIG. 1. Relative resistance of strains as results of selection for differences in DDT tolerance (broken line) and for differences in pupation site (solid line).

well as susceptibility, of larvae to DDT in the culture medium. This experiment is in its 34th generation at the time of writing. An analysis of changes in 21 physiological characters during selection will be published elsewhere. The flies are raised in 6-dram shell vials on corn meal-molasses-agar medium. Each vial contains 10 eggs obtained from a single mated pair. Optimally, the population for selection numbers 1000 flies per generation, which are thus descended from 100 mated pairs.

Effective population size is never lower than 20 pairs, so that inbreeding because of small population size is very slight. Three strains are considered here: the resistant (RS) strain, obtained by mating survivors from DDT poisoning; the control strain (NS), obtained by taking a random sample of each generation of offspring of the original stock (pooled Canton-S, Oregon-R-C, Sweden-C, and Urbana-S); and the susceptible (SS) strain, developed from sibs of poisoned flies starting with NS flies of generation 7.

The broken line in Fig. 1 depicts the progress of selection. The ordinate is graduated on a log scale and

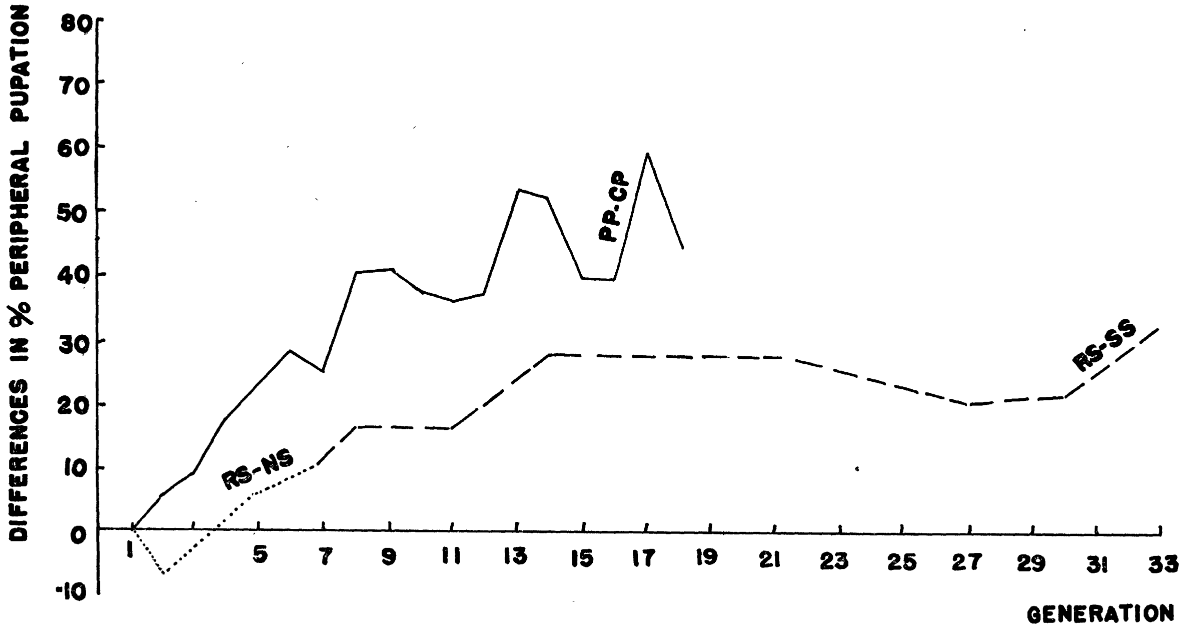

FIG. 2. Differences between strains in percentage of peripheral pupation as results of selection for differences in DDT tolerance (broken line) and for differences in pupation site (solid line).

represents relative resistance to DDT, computed as the ratio of the LD_{50} of the more resistant strain over that of the less resistant strain. Thus, it expresses how many times the RS strain is more resistant than the NS strain (dotted section; up to generation 7) or than the SS strain (dashed section; generations *8ff.*) As of generation 2, we find the RS strain more resistant. These differences persist and are statistically significant (P mostly < 0.01, never > 0.05). Violent fluctuations in relative resistance prior to generation 19 are probably due to crude methods of resistance assay. In spite of the fluctuations, the increase in relative resistance on continued selection is evident.

A curious behavior pattern was soon noted in the selected strains. The resistant strain tended to pupate at the margin of the medium, whereas the susceptible strain pupated largely in the medium away from the margin. This phenomenon occurred in nontoxic medium and has been quantified as percentage of peripheral pupation—that is, percentage of pupae at margin of medium or up the wall of the vial. In Fig. 2, the broken line expresses differences in percentage of peripheral pupation between the RS and the NS strains up to generation 7 (dotted section) and between the RS and SS strains as of generation 8 (dashed section). These differences are significant (P at least < 0.05, mostly < 0.01) beyond generation 5. Since the various strains were tested on the same batch of medium at the same time and handled alike, pupation site differences between them are not likely to be due to environmental factors, such as humidity. The concomitant increase on selection in differences for the two characters indicates the presence of genetic correlation between DDT resistance and pupation site.

To test this hypothesis, two new strains were selected for pupation-site differences, starting with newly pooled stock. Vials with a high percentage of peripheral pupation were chosen as parents for the peripherally pupating (PP) strain, and vials with a low percentage of peripheral pupation engendered the centrally pupating (CP) strain. Continued selection resulted in increasing and statistically highly significant differences in percentage of peripheral pupation between the two strains, as illustrated by the solid line of Fig. 2. These pupation site strains are now in the 19th generation of selection and their differences in percentage of peripheral pupation are considerably larger than those between the RS and SS strains. Assays of DDT resistance of the CP and PP strains (solid line, Fig. 1) reveal rapidly diverging, statistically significant levels of tolerance. At generation 18, the PP strain was 3.8 times as resistant as the CP strain. The hypothesis of genetic correlation between DDT resistance and peripherality in pupation site appears justified. Selection for one brings on the other.

The foregoing experiments in themselves are insufficient to discriminate between the three aforementioned hypotheses on character correlation. The maintenance of the correlation during reciprocal selection suggests linkage or pleiotropism rather than unconscious selection of a physiologically essential character. Experiments under way now, attempting to separate DDT resistance from peripheral pupation, plus planned genetic analysis, should evaluate the possibility of linkage. A number of experiments on the behavior and physiology of *Drosophila* larvae in toxic and nontoxic medium suggest that resistance as well as peripheral pupation are both measurable end-products of a physiological process, the threshold of which is raised or lowered during selection for either character. This would make the present correlation a case of spurious pleiotropism *sensu* Grüneberg (*6*).

It is evident that there is no perfect correlation between the two characters, since response of the correlated character lags behind that of the selected character. This suggests fixation of modifying genes for the selected trait, which tend to enhance the latter but not the correlated character.

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Diffusion Lines in Silver Chromate Gelatin

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In 1943, the formation of radial lines occurring when silver nitrate diffuses into a layer of chromate gelatin exposed to mercury vapor was described (*1*). These lines are so close together that they form a diffraction grating, and the appearance of bright diffraction colors makes the phenomenon conspicuous to the naked eye. By passing a beam of light through the plate, a diffraction spectrum can be produced on a screen. Microscopic examination reveals the lines, which seem to be located in or near the surface of the gel and whose distance from one another varies somewhat in different experiments. The maximum density so far observed is 600 lines/mm.

The fundamentally new feature of these lines as compared with Liesegang Rings and, indeed, all rhythmical structures is their radial orientation. Whereas rhythmical structures always extend in a direction normal to that of the generating movement (diffusion, progressing crystallization, and so forth), the present line pattern is running in the direction of the diffusion. The formation of Liesegang Rings is adequately explained by the theories of Ostwald (*2, 3*) and Chatterji and Dhar (*4*); an explanation of the origin of the radial lines, for which I propose to use the term *radii,* is still lacking. A further study of the phenomenon therefore seemed worth while.

In the first experiments, the gelatin layer was exposed to zinc sheets previously moistened with a solu-