mid-15th century (9). The region has not been occupied by agricultural Indians in historic time. During the last 500 years a climatic shift, possibly involving summer monsoon rainfall, may have left the area unsuitable for corn cultivation (10).

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**References and Notes**

1. P. C. Mangelsdorf, *Science* **128**, 1313 (1958).
2. P. S. Martin, J. B. Rinaldo, E. Bluhm, H. C. Cutler, R. Granger, *Fieldiana Anthropol.* **40** (1952).
3. The Cienega site diagram will be included in a study of pollen stratigraphy and postglacial environments in Arizona now in preparation. We acknowledge support of the National Science Foundation (grants No. G4803 and G10692).
4. E. W. Haury, *Am. Antiquity* **23**, 1 (1957).
5. J. B. Wheat, *Mem. Soc. Am. Archaeology* **10**, 190 (1955).
6. P. C. Mangelsdorf, R. S. MacNeish, W. C. Galinat, "Archaeological evidence on the diffusion and evolution of maize in northeastern Mexico," *Botan. Museum Leaflets, Harvard University* **17**, 125, (1956); P. C. Mangelsdorf and R. H. Lister, *ibid.*, 151.
7. E. S. Barghoorn, M. K. Wolfe, K. H. Clisby, *ibid.* **16**, 229 (1954).
8. E. B. Kurtz, J. L. Liverman, H. Tucker, *Bull. Torrey Botan. Club* **87** (1960).
9. E. W. Haury, "Evidence at Point of Pines for a prehistoric migration from northern Arizona," in *Migrations in New World Culture History*, R. H. Thompson, Ed., Univ. of Arizona Social Science Bull. No. 27 (1958).
10. We acknowledge the assistance of E. W. Haury, E. B. Kurtz, and P. C. Mangelsdorf. This report is contribution No. 31 of the Program in Geochronology, University of Arizona; and contribution to Point of Pines Archaeology, No. 14.

2 March 1960

## Environmental Factors Influencing Progeny Yields in Drosophila

*Abstract.* Progeny counts in *Drosophila melanogaster* were found to be correlated with barometric pressures. Addition of a sublethal chemical to the culture produced a higher correlation coefficient, whereas growth of the culture in an electric field reduced the correlation well below the level of significance. The electric field appeared to have a protective action.

Three variations in environmental conditions were found to influence progeny yields in cultures of *Drosophila melanogaster*. The factors studied were growth in an electric field, chemicals introduced into the media, and diurnal variations in barometric pressure. We believe that the effect of the electric field is a new finding. Atmospheric pressure effects on progeny yields also appear not to have been previously reported. A. F. Brown (1), however, has shown a relationship between barometric pressure and a cyclic pattern in the metabolic rates of various organisms.

In the initial phases of the studies, the flies were examined for external mutant effects of phenotypic variations. After several generations had been produced without observed changes, the data were re-examined in terms of variations in progeny yields. All of the cultures in a given generation series were prepared and examined in the same manner, thus allowing a direct comparative analysis. Simple crosses were made (at 22°C) with wild type and a white eye mutant. A banana culture medium was used (2) with 0.1-percent mold inhibitor (3). Three adult pairs were left in the culture 7 to 9 days, and counting was continued until 22 days after the initial mating date.

Immediately preceding an anticipated low barometric pressure in October, 1959, wild type cultures were started almost daily, extending through the "low" period and into November, 1959, or until higher pressures occurred. The total number of flies that emerged during the first 6 days of hatching are plotted as the broken line in Fig. 1. The barometric pressure on the mating date is shown as the solid line. With increasing barometric pressure there is an increase in the progeny yield. These curves have similar contours and although the peaks and valleys do not exactly coincide, there are similarities.

The relationships were also critically analyzed with a statistical correlation coefficient ($r$) for ungrouped data, given by Freund (4) as

$$r = \frac{n\Sigma F_t P - (\Sigma F_t)(\Sigma P)}{[n\Sigma F_t^2 - (\Sigma F_t)^2]^{\frac{1}{2}}\ [n\Sigma P^2 - (\Sigma P)^2]^{\frac{1}{2}}} \quad (1)$$

where $F_t$ represents the total number of flies per filial generation, $n$ represents the total number of generations, and $P$ represents the barometric pressure. These data are considered to be significant at the 95-percent confidence level if

$$r > \pm 1.96 \,/\, (n-1)^{\frac{1}{2}}.$$

The $r$ value for the seventeen $F_1$ generations shown in Fig. 1 was 0.51. These data are significant at the 95-percent confidence level.

Repeated filial generation crosses with the same wild type cultures also disclosed similarities between the contours of the progeny curves and barometric pressure. A total of 25 control cultures extending over an 8-month period gave an $r$ value of 0.48, significant at the 95-percent confidence level. A greater degree of correlation was obtained by taking an average of three daily barometric pressure readings over the 72-hour period covering the day before, of, and after the initial mating of each generation.

A more pronounced correlation was

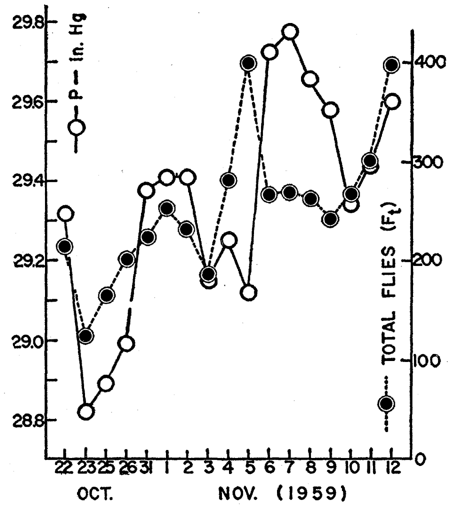


Fig. 1. Variation in wild type progeny with barometric pressure ($P$ represents pressure on date of mating).

obtained by adding a sublethal chemical to the culture media. The material used was protocatechuic acid (3,4-dihydroxybenzoic acid), and the amount tolerated was about 0.5 percent by weight. Marked variations were observed in the progeny yields. In some cases a sequence of generation matings was suddenly terminated because of very low counts: one or two flies and occasionally none.

The progeny yields of 11 successive generations of two different cultures exposed to the protocatechuic acid are shown in Fig. 2. The barometric pressure values are averages of the 72-hour

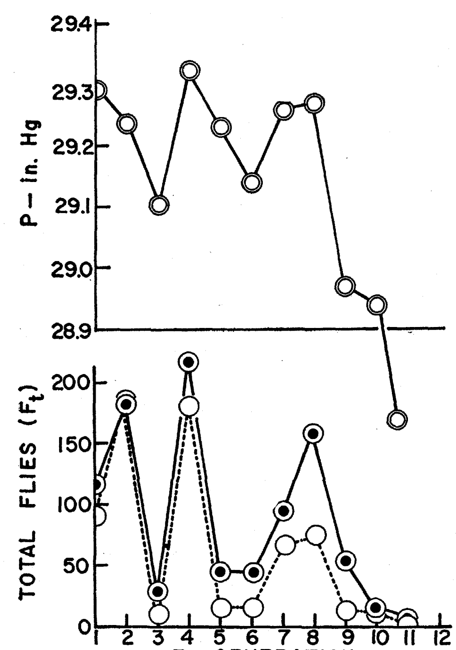


Fig. 2. Protocatechuic acid added to white eye mutant (broken line) and mutant × wild type (solid line) cultures ($P$ is average pressure for 72-hour period).

period mentioned above. The initial mating in one case was with the white eye mutant and in the other case a white eye crossed with wild. It was interesting to note that these mutant crosses survived and successfully reproduced, with the chemical added, whereas wild fly cultures generally died out in one or two generations. This was true regardless of changes in the barometric pressure. In fact it was very difficult to obtain an $F_1$ from wild flies with the added protocatechuic acid. The coefficient of correlation for the white eye mutant is 0.67, and for the mutant × wild type cross, 0.76; both curves are significant at the 95-percent confidence level.

Placing the cultures in an electric field appeared to have a different effect on the progeny yield. The culture bottles were 11.5 cm high, and 4.8 cm in diameter. Semicircular electrodes were formed from copper sheeting (0.05 cm thick) and mounted on 0.5 cm thick plexiglass bases. The electrodes were 8 inches high and contacted diametrically opposite sides of the bottles. The separation at the sides of the copper plates was 2.5 cm. A $12 \times 10^3$ volt potential was applied across the electrodes with a power supply with full-wave rectification. Because of the shape of the electrodes and the inserted bottle, it was difficult to determine the exact field strength inside the bottles; however, by making some simplifying assumptions, the electrostatic field strength was estimated to be $7 \times 10^2$ coul.

The progeny yields of cultures in the electric field were, on the average, higher, and the effect of barometric pressure was considerably reduced. A coefficient of correlation of 0.08 was obtained between barometric pressure and 16 consecutive wild type generations, in the electric field. The barometric pressure values were again averaged over the 72-hour interval. The electric field appears to provide a certain amount of protection and reduces the variations found outside the field.

There is one possible explanation for this electric field effect; however, this is mostly conjecture on our part. It was felt that perhaps the barometric pressure variation is really reflecting another unknown factor. This factor might be connected with variations in the terrestrial electric fields at high altitudes, which are known to affect our general weather patterns (*5*), and which might also influence the progeny yields. Flies in the electric field are, in a sense, protected or shielded from external fluctuations. It is suggested that it might be interesting and profitable to study the reactions of more complex organisms with induced carcinogenic growths, in the electric field. Humphrey and Seal (*6*) have recently shown the effects of an external electric field on the growth of tumors in mice. We are continuing our studies on the comparison of flies grown in various environments.

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**References and Notes**

1. F. A. Brown, Jr., *Science* **130**, 1535 (1959).
2. M. Demerec and F. P. Kaufmann, *Drosophila Guide* (Carnegie Institution of Washington, Washington, D.C., 1957), p. 7.
3. Flies and mold inhibitor were obtained from Carolina Biological Supply Company, Elon College, N.C.
4. J. E. Freund, *Modern Elementary Statistics* (Prentice-Hall, Englewood Cliffs, N.J., 1952), p. 265.
5. H. Odishaw, *Science* **128**, 1599 (1958).
6. C. E. Humphrey and E. H. Seal, *ibid.*, **130**, 388 (1959).

7 March 1960

## Observations on the Behavior of the Porpoise Delphinus delphis

*Abstract.* Common porpoises have been observed in January, in the area of the Hudson Canyon, feeding on fish that escaped an otter trawl. An echo-sounder also recorded, in one instance, a descent of a porpoise to a depth of 200 feet in less than 2 minutes.

On the afternoon of 2 February 1959, we had an opportunity to observe two porpoises (*Delphinus delphis* Linnaeus) feeding on fish escaping from a trawl net, and to record them at depth on an Edo echo-sounder (Navy designation AN/UQN-1B; apex of sound beam about 30° between the half-power points). The observations were made aboard the R/V *Albatross III* (cruise 126, station 10-6, lat. 39°48′ N, long. 72°28′ W, depth of water 200 feet, surface temperature 45.9°F) in the area of the Hudson Canyon. At this season in these waters the observation of this species is, in itself, worthy of note.

Immediately following the haul back of the otter trawl, two porpoises appeared and began to feed on specimens of red hake (*Urophycis chuss* Walbaum) and scup (*Stenotomus versicolor* Mitchill) that had escaped from the net. These fish were disabled and were floating belly up as a result of their air bladders being decompressed. The porpoises were circling about at the surface and usually passed by each fish at least once before turning and picking it up.

The porpoises did not appear to be the least bit alarmed by the boat or the many people moving around on deck. They passed within a few feet of the boat several times.

Both porpoises disappeared for short intervals, at which times distinctive echo sounding records were obtained. These tracings are unique in our experience; we feel, without doubt, that they represent echoes from the porpoises (see Fig. 1). Both porpoises once descended together to the bottom, a depth of 200 feet, in about 2 minutes, and returned to the surface in less time than that. One of them dived to about 150 feet shortly thereafter and stayed at that general depth for a short period before returning to the surface.

It is not uncommon for either marine biologists or commercial fishermen to observe sharks feeding on fish that have

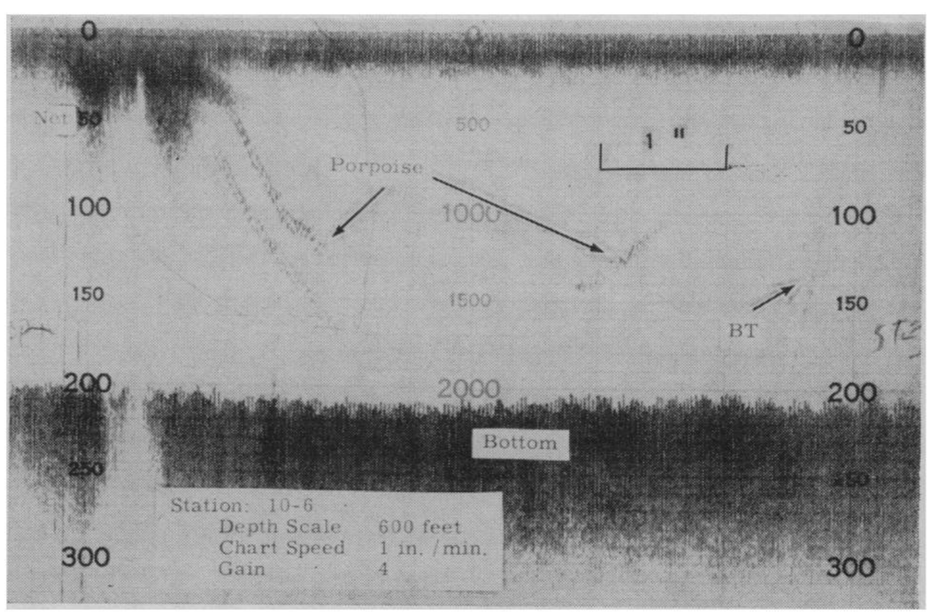


Fig. 1. Portion of echo-sounder chart showing echoes from common porpoises and from bathythermograph (BT). The vessel was hove to at the time this record was made.