pothesized process reflects the characteristics of audio analgesia observed in clinic and laboratory. Moreover, in a recent letter, Mountcastle reports that he has found, in the posterior group nuclei of the thalamus and in the cerebral cortex, pain-evoked neural activity that is suppressed by acoustic stimulation (*7*).

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2. We use the word *analgesia* here in the sense of the dictionary definition, "insensibility to pain," which we interpret as "condition in which perceived pain is eliminated or significantly reduced, without implications concerning mechanism."
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18 March 1960

Arizona's Oldest Cornfield

Abstract. Flood-plain alluvium at the Cienega site, San Carlos Indian Reservation, central Arizona, contains two preceramic and one ceramic cultural horizon. Pollen of *Zea mays* appears in each, substantiating previous early records of agriculture in the American Southwest. Prehistoric cultivation extended through at least 2000 years, ending in the late 15th century.

The earliest southwestern record of corn (*Zea*), dated at about 5600 years ago, comes from Bat Cave, New Mexico (*1*). Confirmation of early agriculture associated with the preceramic Cochise culture appeared in Tularosa and Cordova caves, New Mexico (*2*). Pollen analysis of flood-plain sediment enables us to extend the record of Cochise cultivation into an adjacent part of Arizona and to locate a probable prehistoric cornfield.

While excavating the Cienega Creek site in Arizona, Haury collected sediment samples which we have used to construct a pollen profile (*3*). *Zea* appeared in 15 of 19 levels, a total of 42 pollen grains (Table 1). The locality lies along the Cienega Creek about 4 miles southeast of the University of Arizona Archaeological Field School on the San Carlos Indian Reservation, Graham County. Here at about 6200 feet elevation a natural meadow of grasses and forbs, locally with cattail and sedge, is surrounded by upland forest of ponderosa pine, pinyon, juniper, and oak. Stream erosion during historic time cut into alluvial deposits of the meadow, exposing prehistoric remains.

Traces of human activity (hearths, cremations, shallow wells, and artifacts) can be assigned to three periods: to Chiricahua and San Pedro stages of the Cochise culture, and to Mogollon-Pueblo occupation, roughly dated at A.D. 1000 (*4*).

Radiocarbon dates of various strata led to discordant results. University of Arizona determinations of bed D-1 (roughly equivalent to level 245 to 260 in Table 1) average about 4200 years before the present and exceed by 1700 years Michigan dates of the same material. On the basis of cultural chronology, Haury considered the former more reasonable. Regardless of age, pollen analysis provides an effective monitor of *Zea* cultivation. It supports the archeologist's suspicion that prior to the rise of a ceramic tradition corn was in general use throughout the Southwest (*5*), as it was in northern Mexico (*6*).

Admittedly, fossil Maydeae pollen is not identified quite as conclusively as are cobs or kernels. We base our determination on the absence of any similar large native grass pollen in the modern pollen rain trapped in cattle tank sediments in the study area (N = 22,000); and on size-frequency measurements of grass pollen in three fossil strata compared with the size of alleged *Zea* plotted as a histogram on the same abscissa (Fig. 1). The largest native grass encountered in our count was 48 μ long with a pore diameter of 10 μ.

Compared with other Maydeae (*7*) the great size range of our measurements (55 to 104 μ total length, 11 to 17.6 μ diameter of annulus) and low average axis-annulus ratio ($\bar{X}$ = 5.7, N = 35) suggests a mixed population. For two reasons we hesitate to make such a claim, that is, that some of this pollen is derived from *Tripsacum* or teosinte. First, these are unknown from the local archeological record; second, experimental evidence shows that pollen size in *Zea* is highly susceptible to environmental control (*8*). A third possible explanation for high variability in Point of Pine *Zea* pollen is poor preservation in alluvial sediment with attendant breakage, folding, shrinkage, and stretching.

Although it appears that corn was cultivated along the Cienega Creek for at least 2000 years, the archeological record at Point of Pines reveals population decline and abandonment by the

Table 1. Corn at the Cienega Creek site. N = estimated total number of pollen grains scanned for *Zea* at each level.

Depth (cm)	*Zea*		
	Pollen grains (No.)	Frequency (%)	N
	Mogollon		
20	1	0.03	3500
45	1	0.18	560
65	1	0.13	760
80	1	0.74	136
	Cochise culture—Preceramic San Pedro		
110	0		1900
125	0		1520
145	4	0.03	14900
165	0		1820
175	1	0.03	3400
195	3	0.07	4420
210	2	0.15	1300
225	3	0.23	1320
235	1	0.07	1390
	Cochise culture—Preceramic Chiricahua		
245	7	0.47	1500
250	7	0.22	3200
260	1	0.03	3200
270	6	0.14	4400
280	3	0.04	6900
Totals	42	0.07 (av.)	56126

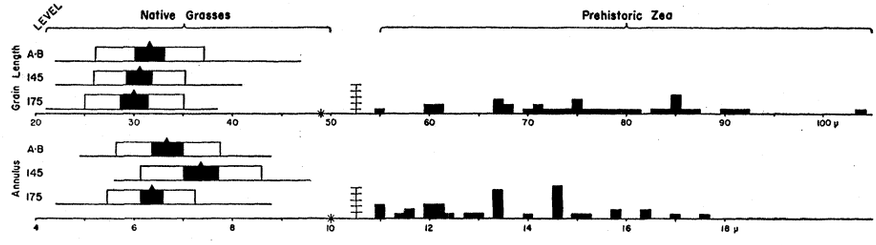

Fig. 1. Size frequency of grasses and *Zea* from the Cienega site. Mean, range, standard deviation (white bar), and twice standard error of mean on either side of the mean (black bar) represent three different populations of fossil grass pollen (N = 50 in each). The largest grass measured during analysis of the Cienega site profile is shown by an asterisk. Grains with total length equal to or exceeding 60 μ, or with annulus equal to or exceeding 11 μ in diameter, are considered Maydeae (*Zea*). Their measurements are plotted as a histogram on the same abscissa as the native grass populations.

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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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

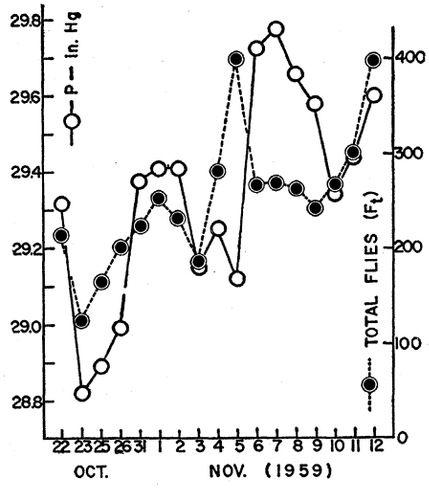

Fig. 1. Variation in wild type progeny with barometric pressure (P represents pressure on date of mating).

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

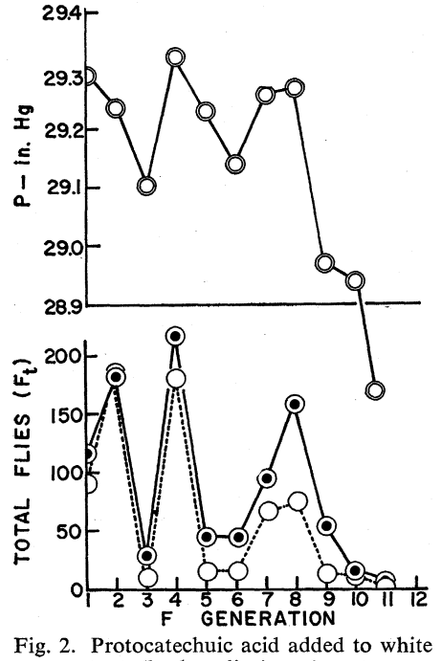

Fig. 2. Protocatechuic acid added to white eye mutant (broken line) and mutant × wild type (solid line) cultures (P is average pressure for 72-hour period).