present distribution is most significant. Such is the recently discovered flora of the Pleistocene Brea deposits at Carpinteria, Santa Barbara County, California.

This flora as now known represents a forest assemblage dominated by coniferous trees with a heavy undergrowth of shrubs and herbs. Following is a list of fossil plants thus far found in the deposit:

Pinus radiata Don.
Pinus muricata D. Don.
Cupressus goveniana Gord.
Arceuthobium, sp.
Chorizanthe, sp.
Platanus, sp.
Amelanchier, sp.
Arctostaphylos, 3 species.
Numerous other small elements not yet identified.

Two hundred miles northward there exists to-day a relict flora limited to the coastal slopes in the vicinity of Monterey Bay. Small groves occur northward and southward over a total distance of about fifty miles. This forest flora is dominated by the Monterey Pine (*Pinus radiata* Don.) and has associated with it the Bishop Pine (*Pinus muricata* Don.), the Monterey Cypress (*Cupressus macrocarpa*), and the Gowen Cypress (*G. goveniana* Gord.). The ground cover of this forest is composed largely of shrubs of Manzanita (*Arctostaphylos*) and California lilac (*Ceanothus*), there being several species of each. Aside from these there are many other less common shrubs and a host of herbaceous plants. It is this forest flora that existed in Pleistocene time in the vicinity of Carpinteria, practically as it exists to-day on the slopes back of Monterey Bay.

The preservation of the fossil material is particularly fine and the completeness of the specimens is unique. The conifers are all represented by wood, leaves, ovulate and staminate strobile; the mistletoe is represented by twigs, scale-leaves, staminate and pistillate flowers, and fruits; the Manzanitas by wood, leaves, flowers and fruits. Particularly noteworthy are the flowers of Amelanchier and of the Manzanitas, in which minutest details as to pubescence, surface markings and stamen peculiarities are plainly discernible. Epidermal layers of leaves show remarkable structure of tissue and stomata. Sections of much of the wood show mycelial threads of parasitic fungi as well as the borings and remains of beetles. The threads of fungi, preserved and stained by petroleum, stand out in striking contrast to the tissues of the wood.

The absence of Ceanothus in the fossil deposits is noteworthy, as it occupies such an important position in the living forest. However, further excavation is expected to bring to light other species and it is reasonable to suppose that Ceanothus may be among them.

In comparing the flora with that of the other tar deposits of California it is significant to note that there is but one species in common with each of them. *Pinus muricata* is found also at Rancho La Brea and one species of Arctostaphylos occurs in the McKittrick deposit. The La Brea flora contains a Cypress specifically distinct from that at Carpinteria. It is associated with elements indicating a drier habitat such as *Juniperus* sp., *Quercus agrifolia* Nee, *Celtis* sp. and other elements of a similar nature. The La Brea flora appears to be ecologically comparable to the openly wooded hills of the inner California Coast Ranges, whereas the Carpinteria flora is obviously coastal. The McKittrick flora has not yet been studied but in all probability is of the inland type.

From the fact that all the fossil plants from Carpinteria are identical or similar to species now living in California it seems proper to refer this flora to the Pleistocene. The assemblage indicates a climatic change in the region since Pleistocene time involving a lessening of the rainfall, an increase in the evaporation rate, and a considerable lessening of the amount of summer fog.

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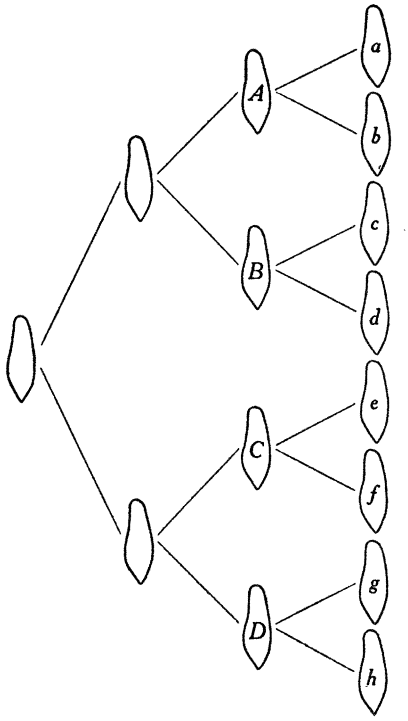
SPECIAL ARTICLES

THE AXIAL GRADIENT IN PARAMECIUM

IN work on the effect of crowding in *Paramecium caudatum* it was noticed that individuals from the same parent, under identical conditions, divided at different rates. Further, it was found that in the isolated fission products of animals which had divided in the morning the anterior piece had a more rapid rate, but in those isolated in the evening after division, the posterior piece divided first. This suggested a temperature effect. To test this the exact time of division of fission products was recorded for three filial generations at three temperature ranges; in fifteen cases at 26 to 30 degrees, in fourteen cases at 18 to 22 degrees, and in twelve cases at 13 to 17 degrees Centigrade. The experimental animals were transferred from room temperature, 18 to 22 degrees, to the high or low temperature for the period of the experiment. Constant attention was required in the experiments, for approximately forty-eight hours at highest temperature and over seventy-two hours at

low temperature, in the effort to obtain the exact time of division of all the progeny and to identify the fission products at the time of division and to reisolate them to the fourth generation.

In the division of the first filial generation at 26 to 30 degrees, the anterior cell always divided before the posterior; at 13 to 17 degrees, the posterior piece always divided first; and at 18 to 22 degrees the relative rate varied. The following table gives the distribution of cells having the highest and lowest rates at the high and low temperatures (see diagram).



Temperature		26–30°		13–17°
	Piece	per cent.	Piece	per cent.
	a	79.9	h	91.6
Highest rate.....	e	13.3	d	8.3
	c	6.7		
	h	93.3	c	41.6
	f	6.7	a	33.3
Lowest rate.....			e	16.7
			g	8.3

In the third generation at high temperatures, the "a" piece had the most rapid rate in 79.9 per cent. of the cases and in the other 20.1 per cent. it came second, while the "e" piece, which is the anterior piece of the posterior cell produced in the second generation, had the highest rate in 13.3 per cent. of the cases. The "h" piece under these conditions had the lowest rate in 93.3 per cent. and the "f" piece in 6.7 per cent. of the cases.

At the low temperature range, 13 to 17 degrees, there is a marked reversal. The "h" piece divided most rapidly in 91.6 per cent. of the cases and in all other cases the "d" cell had the most rapid division rate, but there was considerable variation with respect to which pieces showed the lowest rate; "a" pieces were lowest in 33.3 per cent.; "c", in 41.6 per cent., "e", in 16.7 per cent., and "g", in 8.33 per cent. Here there is indicated a possibility of acclimatization or recovery in the anterior pieces, since in the preceding division the "A" piece had the lowest rate in 74.9 per cent., and the "C" piece in 25.1 per cent.

At the intermediate temperature range, 18 to 22 degrees, there was no noticeable order of division.

These results suggest an interpretation in terms of Child's gradient theory. The axial gradient in Paramecium has been indicated by various methods, but the evidence from cell lineage presented here is of particular significance since there is less uniformity in cytolysis along the axis of Paramecium than with any other ciliate thus far examined.[1] It has been shown for some forms, *e. g.*, Planaria, that a rise in temperature up to a certain point accelerates the more active levels to a greater degree than the less active. In view of these facts it may be suggested that the sudden rise of temperature accelerates, and the lowering of temperature retards physiological activity to a greater extent in the anterior than in the posterior region of the body. Some of the data suggest that if the cultures were kept at the different temperatures for a longer time, acclimatization would obliterate the differences in division rate.

At the intermediate temperature the anterior end is neither inhibited nor accelerated sufficiently to show either a more or less rapid rate of division consistently. Apparently there may be an inheritance of the relative regional metabolic rates of the original animal in the fission products at least to the third filial generation.

The differential rate of division of progeny of a single individual may account for some of the difficulties involved in obtaining consistent results in experimental work on Paramecium.[2]

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[1] Child, C. M., and Deviney, Ezda, 1926. "Contributions to the Physiology of Paramecium caudatum." *Jour. Exp. Zool.*, Vol. 43, p. 257.

[2] I am indebted to Professor W. C. Allee, of the Department of Zoology, and to Dr. Marie A. Hinrichs, of the Department of Physiology, for suggestions during the progress of this work.