no growth ; and of these, seven only were suitable for this type of research, showing less than $10^{-7}$ mutants capable of growth on minimal medium. Mixtures of $10^{8}$–$10^{9}$ cells of each of these strains with the same number of cells of various *K* 12 substrains were plated on minimal medium, while these strains and *K* 12 substrains were also plated separately in the same conditions as controls of back-mutation. The cells had been obtained from 18-hr. old agar cultures, and were washed two or three times with saline ; the minimal medium employed was the same as that described by Lederberg[2].

In such experiments one danger is that the unknown growth factor requirements of the new *coli* strains tested may be partly the same as those in *K* 12 substrains. If, then, they are due to the same genes, no recombination can be observed. To make this a remote chance, at least two *K* 12 strains showing different requirements were used : 58–161, which is devoid of biotin and methionine, and *W* 583, which is devoid of threonine, leucine and aneurin.

Of the seven strains which gave reliable controls, only one consistently gave prototrophs in numbers sufficient to demonstrate recombination. This strain apparently showing recombination with *coli K* 12 is *Escherichia coli* strain 123 of the National Collection of Type Cultures, and is labelled as var. *acidi lactici*. It is a strain of relatively poor and slow growth in nutrient agar or broth. Its growth requirements are complex and not yet fully elucidated. Plated on minimal medium, 123 gives either no growth at all, or very few tiny colonies difficult to subculture, at a rate less than $10^{-9}$. Plating a mixture of 123 with *K* 12 substrains one obtains prototrophs at a rate, according to conditions, of $10^{-6}$–$10^{-8}$ (that is, the ratio of number of prototrophs to number of cells of either parental type plated).

That the appearance of prototrophs is due to recombination and not to increased back-mutation rate to prototrophism on either side is shown by testing for recombination for other character differences in the parental strain. For example, crossing 123, which ferments lactose ($Lac^+$), galactose, maltose and arabinose, and is sensitive to viruses 1 and 5, with *K* 12–*W* 705, which does not ferment these four sugars and is resistant to viruses $T_1$ and $T_5$, one gets prototrophs which ferment galactose, maltose and arabinose, but in respect of the other two characters show the following distribution of phenotypes :

| $Lac^+ V_1^s$ | $Lac^- V_1^s$ | $Lac^- V_1^r$ | $Lac^+ V_1^r$ |
|---|---|---|---|
| 202 | 6 | 7 | 0 |

Strain 123 shows the same recombination-rate with 58–161 as with 58–161 *Hfr*, which is a newly described[3] derivative of 58–161 with a high frequency of recombination.

A fuller genetical analysis of the new strain is in progress.

We are indebted to Dr. J. Lederberg for his generosity in supplying so many of the *K* 12 substrains he has established.

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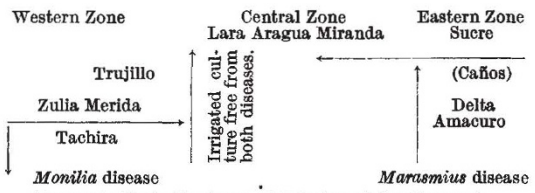
July 26.

[1] Lederberg, J., and Tatum, E. L., *Nature*, **158**, 558 (1946).
[2] Lederberg, J., *Genetics*, **32**, 505 (1947).
[3] Cavalli, L. L., 100th Meeting of the Genetical Society, Cambridge, 1949.

## Geographic Distribution of the Great Epidemic Cacao Diseases of Venezuela

A thorough survey of cacao disease of Venezuela has confirmed and/or ascertained an interesting situation in regard to the most dangerous, epidemic, cryptogamic diseases of New World's cacao : 'witch broom', caused by *Marasmius perniciosus* Stahel and 'watery pod' disease, caused by *Monilia Roreri* Ciferri. The situation can be better understood from the following diagram showing the relative geographical position of cacao zones in Venezuela :




(Arrows indicate the trend of diffusion of the diseases.)

Intercrossing of geographical, distributive areas of both diseases is prevented by the 'diaphragm' of cacao culture under irrigation of the State of Aragua, at the centre of the Republic, producing the best Venezuelan forastero[1], almost a Criollo type of cacao. Ecological conditions of cacao culture in this region, on the coastal, semi-arid belt of the Caribbean Sea, are opposite to the natural environment of the cacao tree ; but this species grows well, provided there is a sufficient amount of irrigation water and good shade. The same ecological environment appears to be unfavourable to the establishment of both diseases.

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Ciferri, R., *Nature*, **163**, 953 (1949).

## A Curious Habit of Dragon-flies

Some twenty-five years ago, while working in the garden, I noticed that a dragon-fly kept alighting on the handle of a wheel-barrow which I was using. During its absence I was preparing to shift the barrow, and had my hands on the handles when the insect returned ; after slight hesitation, it settled on my hand immediately over the spot where it had previously rested. Waiting until it had departed on another flight, I placed a piece of sacking completely over the barrow, and when the dragon-fly returned, it alighted in exactly the same position on the covered handle.

Since then I have made a large number of tests under various conditions, and have found that dragon-flies seem to be guided, not by the appearance of their resting-place, but entirely by its position. If the object on which they have been in the habit of resting is moved, say, two feet, the dragon-flies will usually not find it, but will settle on the nearest object to the original position.

This habit seems to be common to all the larger species, both the long- and the short-bodied types, and may throw some light on the nature of their vision, though I am not prepared to suggest what this may be.

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