The Specific Locus of Prophage ϕ80 on the K12 Chromosome

Among the numerous temperate phages isolated by Jacob (1955)[1], all the UV-inducible prophages (82, λ, 434, 381, 21, 424, 466) were linearly arranged on the Gal-R segment of the Hayes *Hfr* strain[2]. On the other hand, none of the non-inducible prophages was located on the Gal-R segment but rather on other regions.

A study was made of whether the UV-inducible prophage ϕ80 is located on the Gal-R segment of the K-12 chromosome. The genetic behaviour of the lysogenic character in cross experiments with $F^+(\phi80)^-$ and $F^-(\phi80)^+$ was first studied. In the cross experiment illustrated in Table 1, it was found that the ϕ80-lysogenic character segregates among recombinants. ϕ80 prophage is weakly linked to Lac being located on the M (Methionine) marker side. This result suggests that the prophage ϕ80 is also usually found on the Gal-R segment where are the loci of Jacob's UV-inducible prophages.

Table 1. The Segregation of Characters (Lac and ly for ϕ80) in the Recombinant between W3637 ($F^+T^+L^-M^-Lac^+$, $\phi80^-$, λ^-, S^s $\phi80^r$) × Y70 ($F^-T^-L^-B_1^-M^+$, Lac^-, $\phi80^+$, λ^-, S^r, $\phi80^r$) on Minimal Agar Plates Supplemented by Streptomycin.

	$Lac^-(\phi80)^+$	$Lac^+(\phi80)^+$	$Lac^+(\phi80)^-$	$Lac^-(\phi80)^-$
number	194	29	68	9
%	64.7	9.7	22.7	3.0

To test whether the prophage ϕ80-locus is on the Gal-R segment of the K12 chromosome corresponding to the λ-locus, the following cross experiments (Table 2) were made on minimal agar plates containing galactose (1%) as the sole carbon source. In the Table, values represents the percentage of $(ly)^-$ and $(ly)^+$ in the total *gal*+ recombinants. It also shows the grade of linkage of the prophage ϕ80-locus to the *gal* marker. Therefore, the ϕ80 prophage occupies a specific site which is distinct from the site of the prophage λ. It may be located near to the prophage 381 or 21 isolated by Jacob.

Table 2. The Grade of Linked Transfer of $(ly)^-$ with Gal^+ from the Hayes Hfr Strain to F^- Bacteria

	Hfr $(ly)^- \times 3102$ $(\lambda)^-$ $(Gal_2^+B_1^-\lambda^r)$ $(Gal_2^-\lambda^r)$	Hfr $(ly)^- \times 3102$ $(\phi80)^+$ $(Gal_2^+B_1^-\phi80^r)$ $(Gal_2^-\phi80^r)$
$(ly)^-$	24	91
$(ly)^-$	76	9

It has been reported that clusters of genes, including *tryp* (Pardee *et al.*, 1959)[3], were located round this prophage locus. Therefore the linkage between the *tryp*- and ϕ80-loci had to be checked.

As shown in Table 3, it seems that the *tryp*- and ϕ80-loci are so closely linked that the segregation of two loci are not observed.

Table 3. The Grade of Linked Transfer of $(ly)^-$ and $Tryp^+$ with Gal^+ on the Cross of Hayes Hfr $(ly)^-(Gal^+, tryp^+, S^s, B_1{}^-)\times F^-4627\ (\phi 80)^+\ (Gal^-, tryp^-, S^r, B_1{}^+)$

$gal^+\ S^r\ B_1{}^+$ recombinants					crossing over value %
$(\phi 80)^+$		$(\phi 80)^-$		total	
$tryp^+$	$tryp^-$	$tryp^+$	$tryp^-$		
0 (0%)	284 (91%)	28 (9%)	0 (0%)	312 (100%)	0

In strains of *E. coli* K12 the relationship between closely linked loci is traceable by joint transduction (or co-transduction) of Pl kc (Lennox, 1955,[4] Jacob, 1956). The possibility that the transfer of lysogeny and nonlysogeny is accompanied by *tryp*-transduction by Pl kc was tested as follows:

1) $(ly)^-$ *tryp*$^+$ ——$\times$ $(\phi 80)^+$ *tryp*$^-/\lambda/\phi 80$
2) $(\phi 80)^+$ *tryp*$^+$ ——$\times$ $(ly)^-$ *tryp*$^-$ $/\lambda/\phi 80$

Joint transduction was not observed. This result is not yet understood.

Nevertheless, these cross experiments clearly show that the *tryp* gene cluster and the ϕ80 prophage locus are closely linked. Therefore if the specific transduction of *gal*-genes is mainly due to the close linkage between λ and the *gal*-locus, the transduction of the *tryp* marker mediated by the ϕ80 phage should be also expected.

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AIZO MATSUSHIRO

Department of Parasitology,
The Research Institute for Microbial Diseases,
Osaka University, Osaka

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