

PHAGE RECOMBINATION

1946– HERSHEY & DELBRÜCK



Max Delbrück
(1906 - 1981)

Alfred D. Hershey
(1908 - 1997)

- Hershey and Delbrück independently discovered that different strains of phages can exchange or combine genetic material while in the same host cell.
- The mechanism of recombination remained unclear, but they speculated that recombination via “mating” took place after the multiplication of phage within the cell.

LYSOGENY

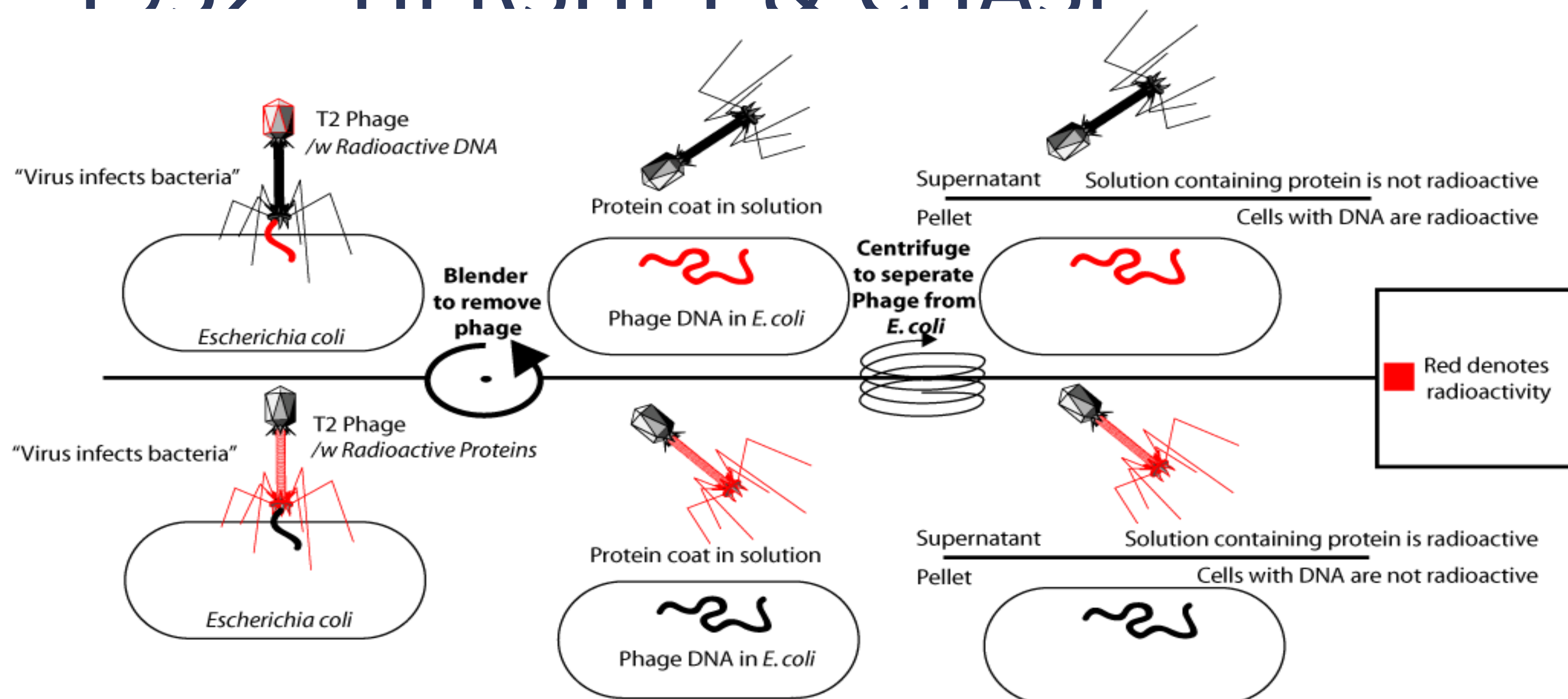
1950 – LWOFF & GUTMAN

- Lwoff and Gutman found that lysogenic phage are passed through generations of bacteria. No free phage were present inside lysogenic daughter cells, but sensitive bacterial strains were lysed when daughter cells were grown with the sensitive strains, showing that bacteria carry a non-infective phage structure.



DNA AS THE GENETIC MATERIAL

1952– HERSHEY & CHASE

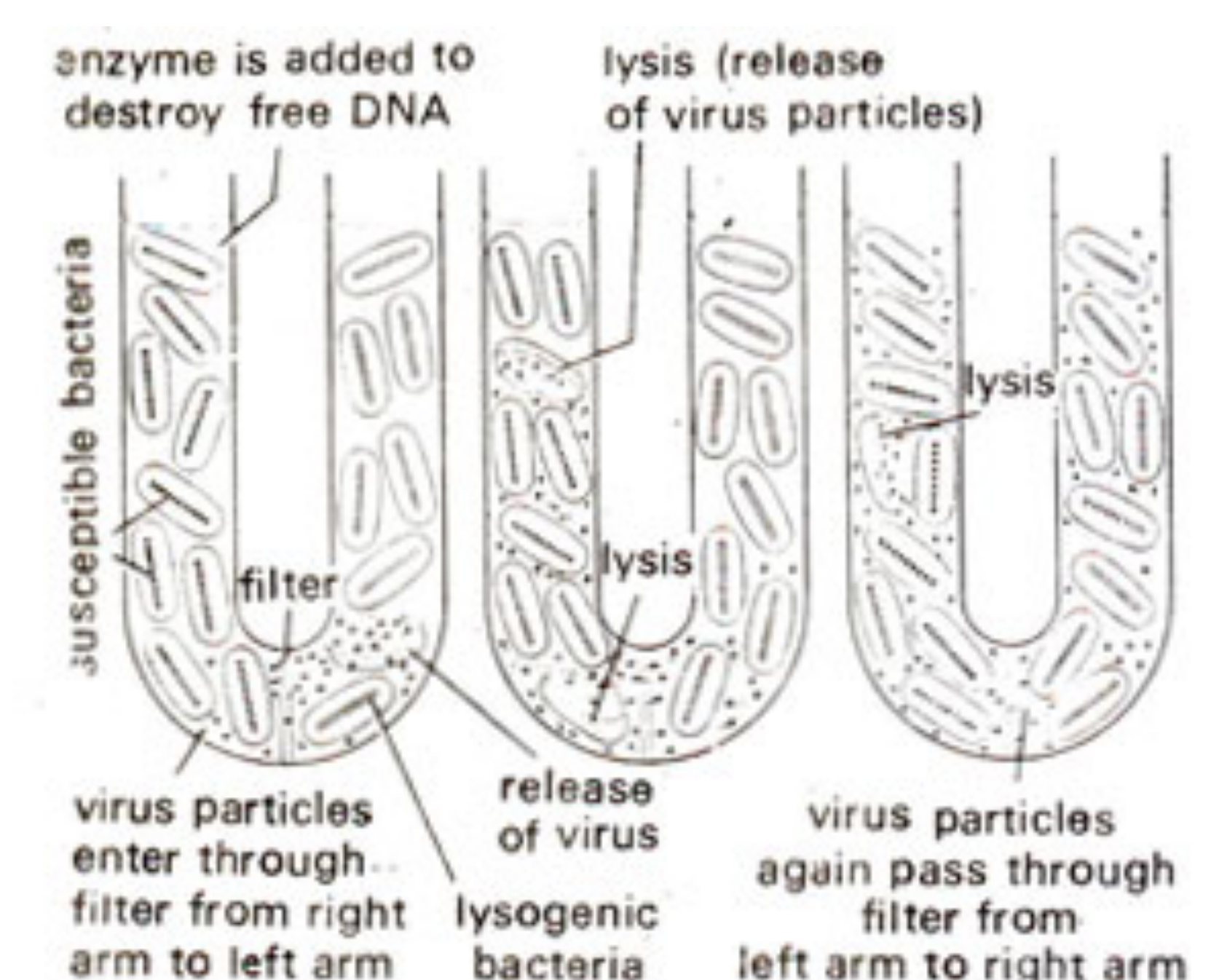


- Radiolabeled DNA and protein were used to demonstrate that viral nucleic acids and proteins have independent functions in phage.
- Hershey won the 1969 Nobel Prize along with Luria and Delbrück for their work on phage

TRANSDUCTION

1952 – ZINDER & LEDERBERG

- Transduction was discovered using a U-tube experiment where lysogenic bacteria containing a phage and bacteria susceptible to the phage were separated by a filter. Genetic material was transferred from the susceptible strain to the lysogenic strain, demonstrating that phage are vehicles for bacterial gene transfer.



Other Important Papers:

- Freeman 1951 – Phage contribute to bacterial virulence
- Luria 1952 – Bacterial hosts can influence the ability of a phage to infect other bacteria
- Franklin 1955 – Tobacco Mosaic Virus (TMV) rods are all the same length
 - First to speculate that phage are hollow and that TMV was a single strand RNA virus

1956 - 1965

Savannah Sanchez & Sophie Nguyen

The History of Phage Research

Benzer's deletion map of rII

1955-1959 – Seymour Benzer

- First evidence that the gene is not an indivisible entity, as previously believed, and that genes are linear.
- Showed that recombination occurred within bacteriophage T4 using rII mutants, resulting in characterization of the rII region and the mapping of over 2400 mutations.
- Proved that mutations are distributed across a single gene and allowed for him to propose distinct classes of mutations.
- His work provided novel techniques and a model system for many molecular and phage biologist, such as Francis Crick and Alan Campbell.

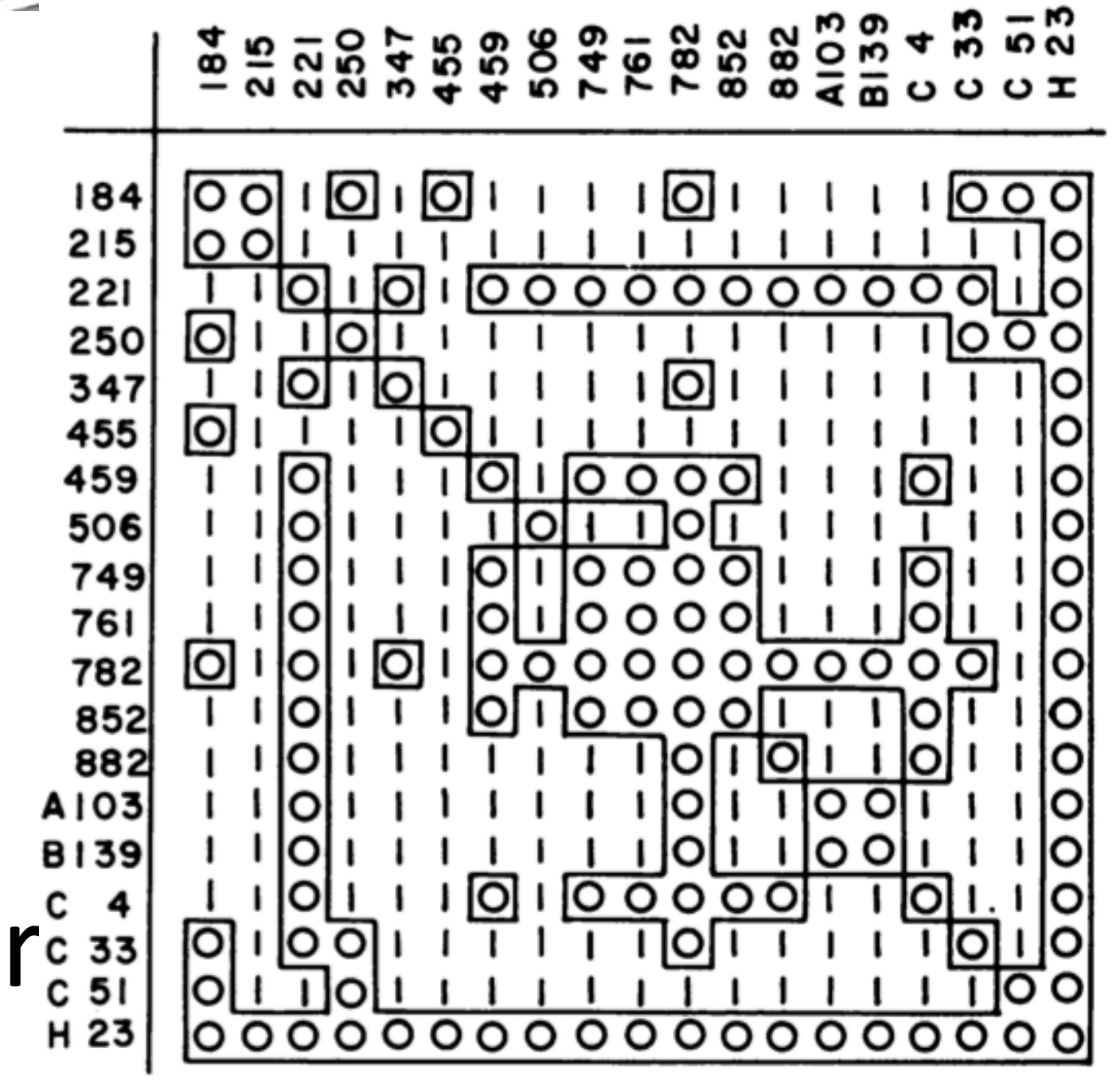
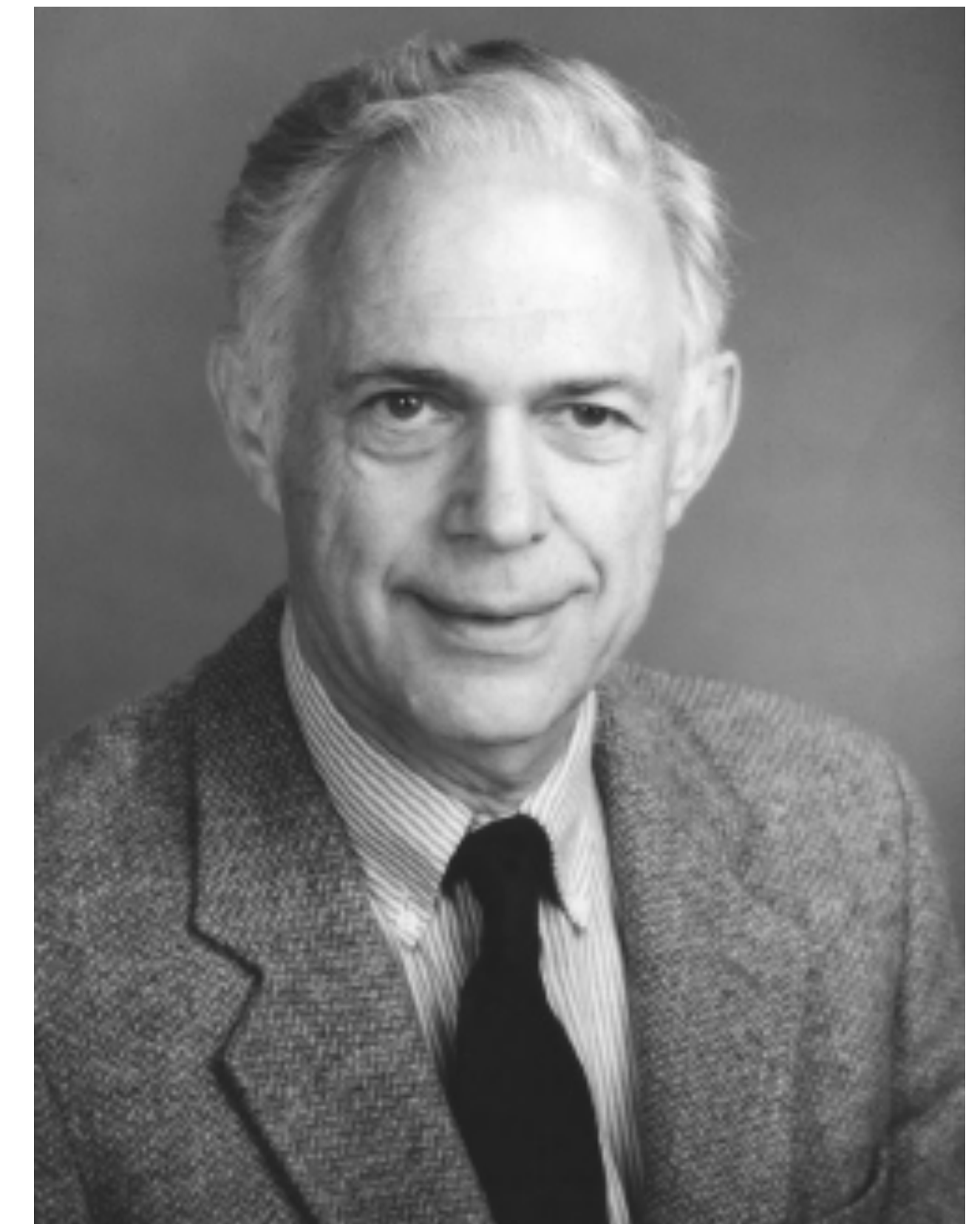


Fig. 4.—Recombination matrix for 19 rII mutants of phage T4, arranged in arbitrary order.

The "Campbell Model" of virus insertion

1962 – Allan Campbell

- Phage assume a circular intracellular form and become linearly integrated into the chromosomal DNA through a recombination event
- Provided conceptual basis for retroviral integration and lead to first detailed information on plasmid biology.
- Traditional view was that prophage were not incorporated into the bacterial chromosome but instead synapsed due to homology (Jacob & Wollman).



The LHT classification of viruses

1962 – Lwoff, Horne, and Tournier

- Proposed the first virus classification scheme where viruses are grouped according to *their* properties, not the cells they infect.
- Four characteristics were to be used for the classification of all viruses: (1) Nature of the nucleic acid in the virion; (2) Symmetry of the protein shell; (3) Presence or absence of a lipid membrane; (4) Dimensions of the virion and capsid

