SYMPOSIUM ON GENETICS OF BACTERIA AND VIRUSES. John Curtin School of Medical Research, Australian National University, Canberra, A.C.T. August 19, 1957.

The permanent buildings of the John Curtin School have just been completed and occupied, and the symposium represented the first function to be held in these quarters.

PAPERS PRESENTED:

1. INTRODUCTORY REMARKS AND DISCUSSION.-- Prof. J. Lederberg, Dept. of Medical Genetics, University of Wisconsin.
2. GENETICS OF PSEUDOMONAS AERUGINOSA.-- Dr. Bruce Holloway, Dept. Bacteriology, Melbourne Univ.
3. GENETICS OF INFLUENZA VIRUS. -- Sir MacFarlane Burnet, Director, Walter and Eliza Hall Institute of Medical Research, Melbourne.
4. LYSOGENICITY AND PROPHAGE-LINKED TRANSDUCTION IN ESCHERICHIA COLI. — Dr. Esther M. Lederberg, Dept. of Genetics, University of Wisconsin.
5. GENETICS OF VACCINIA VIRUSES. - Prof. Frank Fenner, Dept. of Microbiology, Australian National University.
6. GENETICS OF TOMATO SPOTTED WILT VIRUS. Dr. R. J. Best, Dept. of Agric. Chemistry, Adelaide University.

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1. INTRODUCTORY REMARKS. A number of systems of genetic recombination have been discovered in various bacteria during the past several years. In Escherichia coli, a sexual mating process has been found, by which large blocks of genetic material are transferred from one cell to another in intimate contact. Systems of genetic exchange in which only hereditary fragments are exchanged have been termed "transduction". The leading example, the transformation of pneumococcal types, was first discovered in 1928 by F. Griffith, and other workers have subsequently shown that purified preparations of deoxyribonucleic acid carry the genetic specificity. Another mode of transduction, in which bacteriophage particles carry random bits of genetic information, presumably as deoxyribonucleic acid, was reported for Salmonella serotypes in 1952. It may well be the basis for the distribution of various antigens in manifold combinations among these types in nature. ~~Still another type of transduction, in which genetic markers are linked to prophage has been described in E. coli.~~

GENETICS OF PSEUDOMONAS. Recent findings indicate that the recombinational system of this bacterial genus is similar to sexuality in E. coli in the following respects: mating type specificity, loss of some genetic markers during the cycle, and stimulation of mating by ultraviolet light. A number of lysogenic strains have been found, but their inheritance in crosses is still obscure. This is the first bacterial species after E. coli in which sexual recombination has been delineated.

LYSOGENICITY AND TRANSDUCTION. In E. coli, K-12, the phage "lambda" is carried by certain so-called lysogenic strains. The ability to produce this phage is inherited as a bacterial marker in bacterial crosses. Since the lysogenic bacteria do not contain infective phage, but only produce it as a random event, or in response to mutagenic treatments, it is considered to be carrying an Anlage of the phage, called a prophage (Lwoff). The genetic experiments show that lambda-prophage is part of the bacterial chromosome, linked to a cluster of genes for galactose-fermentation.

Free lambda particles occasionally carry with them the linked genes for galactose-fermentation, hence can transduce these factors, but with low efficiency, about 10^{-6} per phage particle. The transmission of these genes is analogous in many respects to the transmission of the prophage itself to sensitive bacteria. Therefore, lysogenization, or the establishment of a prophage, via infection, in a sensitive host is a category of transduction, and the virus is in all essential respects part of the hereditary makeup of the cell. No fundamental feature remains by which we can strictly distinguish between a virus and other genes, though we emphasize the infective transmission of a virus, in contrast to the hereditary transmission of other genes in most instances.

INFLUENZA VIRUS. Dr. Burnet and his colleagues have studied the genetics of influenza over many years, as reviewed in this account. Under certain conditions of mixed infection (in chick chorioallantoic membranes, principally de-embryonated eggs) with well marked strains, the following types of interaction are found: 1) phenotypic mixing, in which particles of a given genetic type are coated with a mosaic of outer antigen, presumably during their emergence from the infected cells. These particles

can therefore be neutralized by antiserum against either one of the parental strains; 2) heterozygotes: these are single particles which carry the hereditary content of each parental strain, and therefore give rise to mixed infections; 3) recombinants: these are pure-line particles which receive part of their genetic content from one, part from the other parent. The paucity of independently inherited markers has limited the detailed genetic analysis of recombination. Particular attention has been given to the inheritance of virulence for chick embryos. Crosses between highly and a-virulent strains give recombinant progeny of a range of virulent types, as a rule considerable less virulent than the virulent parent. The available data do not enable a decision whether this "redistribution of virulence" depends on an ordinary polygenic determination, as in many quantitative traits in higher organisms, or on the quantitative assortment of a special reduplicated virulence factor, as has also been proposed. Special interest attaches to these studies, not only as a pioneer treatment of an animal virus, but also because influenza contains ribonucleic acid, in contrast to the deoxyribonucleic acid basis of the heredity of all other biolofical material so far genetically studied.

POX VIRUSES. This group offers special advantages for genetic study, as pure lines can be isolated with the help of single countable pocks on egg membranes. A number of strains of vaccinia (and of mouse pox) have been examined, and found to differ in a variety of usable characteristics, such as pock morphology and heat resistance and virulence, but not in serologic reactions. A few distinctive recombinants have been found in mixed infections, in preliminary experiments to date.

TOMATO SPOTTED WILT VIRUS. Very little work has been done so far on the genetics of plant viruses, partly because of the difficulties of controlled mixed infection and isolation of pure lines. A few instances of probable recombination between distinctive strains of this virus were described.

These reports indicate that we are approaching the practical experimental control of virus characteristics through controlled breeding, but that much more fundamental information is still needed.

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