

conditional-lethal phage mutations were found in it, genes that affected several aspects of Mu behaviour were later identified, e.g. *kil*, *arm*, *cim*, *gam/sot* and *lig*, not all of which are necessarily separate genes. So this region is labelled SE (for semi-essential), rather than NE (for non-essential). The product of the *kil* gene apparently kills the host cell during lytic Mu growth by affecting cell wall synthesis. However, another gene, *lys*, to the right of SE is necessary (or responsible) for lysis of the infected cell, by a mechanism not yet understood. Two conclusions drawn from this chapter are: first, SE proteins are involved in many facets of the Mu cycle, including integration, replication and lysis; and second, SE proteins include a number of novel enzymes, involved directly or indirectly with DNA replication, whose biochemical properties will be of great interest at both the practical and the conceptual level.

Mystery also still attaches to the *mom* gene of Mu, which codes for a DNA modification system. This modification is dispensable for phage growth and is not a methylation, but a novel type, regulated by a complex interaction without precedence in prokaryotes. The Mom function allows the phage to overcome host-controlled restriction/modification systems with G(+) phage in *E. coli*, but appears to be not expressed, or ineffective, during growth of G(-) phage in other bacteria. Clearly much remains to be elucidated in this system.

The chapter on Mu as a genetic tool describes a large number of Mu derivatives which have actual or prospective uses in DNA manipulation. These are generally designed to make use of the transpositional abilities of Mu carrying deletions which leave the two ends and the A early gene but not usually B, and not the Kil function operative. A selectable gene to make transfer more easily recognized, such as Ap, Cm, Kn or Tc is incorporated into many of them; and some contain a *lac* fusion segment, the *lux* gene or a truncated *nptI*. All have the thermo-inducible cts62 Mu repressor mutation. In addition there are several broad host-range plasmids, mostly RP4, with a mutant Mu, a mini-Mu or even a mini-D108 insertion (D108 is a phage with very close homology to Mu – 90% by heteroduplex analysis). Many possible applications of these plasmids are suggested, and a number have already been tried out: the reader who wants to use them will have to study this chapter carefully, look up the references, and then see which tricks can be persuaded to work efficiently. pULB113, which is RP4 carrying a mini-Mu of 7.5 kb, is the most promising for picking up DNA from one bacterial species and transferring it to another: the chromosomal DNA is sandwiched between two mini-Mu DNAs lying in the same orientation within RP4. This plasmid is said to be able to pick up about 250 kbp of DNA, or two genes separated by about 3.5 minutes on the *E. coli* map. All this Mu technology will, of course, have to compete with the continuing advances in techniques

based on Lambda, multicopy plasmids, etc., and we must wait to see which techniques win out.

With this book, Mu and Mu-workers have come of age – a ripe old age of 25 years! *Phage Mu*, I am glad to report, is an excellent book, very readable and full of information and surprises; and it undoubtedly meets an important need. The price is rather high for a comparatively slim volume, and I think a cheaper 'paperback' edition would enable it to be much more widely read.

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Visual Display Terminals and Workers' Health. WHO Offset Publication No. 99. Geneva. World Health Organization 1987. 206 pages. Paper. Sw.Fr. 32, US \$19.20. ISBN 92 4 170099 8.

Molecular geneticists are becoming increasingly glued to their Visual Display Terminals (VDTs) as they search for meaning and homologies in the wealth of new DNA sequences pouring into the Gene Banks. So they may begin to wonder whether long hours of this occupation are good for their health. This is a question of world-wide interest, since millions of workers over the globe are daily involved with VDTs, and much literature has appeared on their experiences, including a number of claims of health problems. WHO therefore set up an expert committee in 1985 to assess these reports, and the book under review is the result. The WHO Regional Office for Europe has also organized a scientific review, in view of the particular concern expressed in Europe, which is being prepared by I. A. Marriott and M. A. Studily.

The WHO book gives a critical review of about 300 publications and makes recommendations on the basis of their findings. A summary of their main conclusions will, I hope, encourage scientific libraries to obtain copies of the book and Departmental Safety Officers to think more ergonomically. In fact the book is relevant to University Administrative and Arts Departments also.

(1) *Eye and visual problems*. Eye discomfort was found to be a common problem, but there was no definite evidence of permanent eye damage. Such discomfort is considered largely avoidable if proper attention is given to the design of equipment, work environment and work practices.

(2) *Musculoskeletal disorders*. These are common-place in VDU work, and injury from repeated stress to the musculoskeletal system is possible; but further research on this syndrome is needed. Application of ergonomic principles to the workplace and conditions should reduce such health problems.

(3) *Stress-related disorders*. It is very difficult to distinguish between the role of the VDT system and other factors, such as job design and organization, in causing these disorders, as one might expect; but

abnormal levels of stress-related disorders were not evident among VDT workers.

(4) *Skin disorders.* A number of VDT workers complained of skin disorders, which were mostly non-specific facial skin rashes and aggravation of rosacea (a facial condition marked by flushing, red coloration and acne-like appearance of the skin). One Swedish VDT operator had elastosis solaris (premature ageing of the skin), which was recognized by a worker's compensation board as a work-related disease. Further research on skin disorders is considered essential.

(5) *Adverse reproductive outcomes.* Reports of clusters of spontaneous abortions among VDT operators, or of congenital defects in their children, have caused widespread concern. The Committee found no evidence of a link between the use of VDTs and adverse effects on pregnancy, but recommend avoiding excessive discomfort and fatigue for a pregnant woman using a VDT. A number of studies are still in progress and should lead to a more definite conclusion.

These often tentative or provisional conclusions are based on detailed discussion of the reported data on each possible effect. The published reports are frequently less than convincing, but they at least make clear the problems of collecting adequate and unbiased data. One or two examples will serve as illustration.

Photosensitive epilepsy. Cases of grand mal seizures in people watching television have been recorded, and about 1 in 5000 of the population are said to be at risk (but whether these persons were sensitive to the radiation or to the exciting nature of the programme is not discussed). Only a few isolated cases of seizures while working with VDTs have been reported. In a test series a VDU with a short-persistence phosphor failed to cause epileptiform activity in photosensitive subjects, while black-and-white television caused many positive reactions.

Adverse reproductive outcomes. Several clusters of unusually high miscarriage or birth defect rates among pregnant VDT operators have been reported for groups in Canada and the USA. Examples for spontaneous abortions (number of abortions/number of pregnant women) are: 7/12, 7/15, 7/13, 10/19, 3/7 and 4/7. These figures look very impressive, but such clusters appear to have been publicized because they were so high; and statistical analysis has shown that small samples with these ratios could occur frequently enough by chance, in view of the overall rate of spontaneous abortion. Thirteen much larger studies, containing data with various defects, are discussed in detail in the book, and lead the authors to the conclusion that 'the currently available data fail to provide any evidence for a link between adverse reproductive outcome and VDT work'.

Other sections of this book discuss ergonomic problems and the design of the workplace, apparatus, lighting, etc., types and strengths of radiation from VDUs, possible effects of humidity level, extent to which different types of VDT work will involve watching the screen, and so on. All these aspects of the general problem are well presented and this will help the reader to make a reasonable assessment of likely future risks. My overall impression is that the main problems for the VDT user, if he or she does not have any specific sensitivities or eye problems, will arise from bad ergonomic design – leading to awkward postures and movements causing neck, shoulder, back or arm stiffness or headaches. Ill-designed lighting may also cause eye strain. These problems are much more likely to be realized and under control in large offices than in laboratories.

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