phosphene appearing to flicker at one rate whatever the stimulus frequency: "a rapid flashing on and off, a little too quick for the flashes to be counted". Perhaps this is related to a genuinely central fluctuation in excitability, or intermittency, uncontaminated by the low-pass characteristics of the peripheral visual system. The feature of the phosphenes that was of most interest from a prosthetic point of view was that resolution (that is, distance between electrodes that gave rise to perceptibly different phosphenes) seemed to be potentially good enough to allow the projection of letters on to the visual cortex at rates that might allow the patient to read print or handwriting at speeds comparable with those of sighted people. It seems feasible that 200 positions per cortical hemisphere could be resolved easily, allowing the projection of four letters per "glance" from Brindley's estimate that 50 points are needed for each letter. In the device described, stimulation of the appropriate receiver is mostly determined by the location of the transmitter; a fast scan will be necessary for the rapid transmission of text, but it does at least seem feasible to transmit visual information directly to the central visual pathways of the recently blind.

Death from L-Canavanine

from our Cell Biology Correspondent

THREE years ago Schachtele and Rogers established that L-canavanine, like many other amino-acid analogues, kills bacteria. But canavanine death has two distinctive features. First, incorporation of the analogue into bacterial protein causes early and exponential cell death and irreversibly blocks RNA transcription from the bacterial genome and from infecting viral genomes. It also seemed that canavanine blocks initiation of DNA replication. In two papers in the current issue of the *Journal of Molecular Biology* the same workers (Schachtele and Rogers, **34**, 843; 1968, and Schachtele, Anderson and Rogers, ibid., 861) present evidence that canavanine death involves incorporation of the analogue into a membrane bound protein—probably the attachment site of the bacterial chromosome—and so interrupts the normal function and structure of the genome.

E. coli fed canavanine do not support the growth of *T* phages and no *T* phage *m*RNA or DNA is synthesized. Blockage of *T* phage replication is directly related to the incorporation of the analogue into bacterial protein. However, *in vitro* ribosomes and supernatant fractions from canavanine dead cells translate synthetic *m*RNAs and canavanine dead cells also metabolize glucose and make ATP. Perhaps more surprisingly the DNA dependent RNA polymerase activity of extracts of these cells is twice that of extracts from normal cells and furthermore the DNA extracted from the killed cells can act as template for RNA transcription *in vitro*. It appears that the killed cells have all the machinery needed for transcription and yet make no RNA. And no significant amounts of DNA are made. In canavanine killed cells DNA replication cannot be re-initiated. Schachtele and Rogers interpret all this as meaning that a protein (or proteins) in *E. coli* promote RNA transcription and DNA replication and if L-canavanine is substituted for L-arginine this protein(s) is inactivated and moreover cannot be displaced by newly made normal protein.

Where is this protein located in the *E. coli* cell? In their second paper Schachtele *et al.* present electron micrographs of canavanine dead cells. These show between two and eight electron dense bodies attached to the inner surface of the cell membrane and these contain, among other things, much of the canavanyl protein. The nuclear region is extensively disrupted. A canavanine-resistant mutant given the analogue also contains the dense bodies, but the nuclear region remains intact. In 1963, Jacob, Brenner and Cuzin proposed that the bacterial DNA is connected to the cell membrane and the binding to the membrane seems to be intimately associated with initiation of DNA replication. Since then Jacob and his collaborators have proposed that there are only a limited number of these attachment sites for the bacterial and for infecting DNA phage genomes. Schachtele *et al.* suggest that incorporation of canavanine into all these attachment proteins renders them inactive, preventing DNA replication and at the same time transcription. Canavanine may prove to be a useful tool for studying these sites.

Treatment of Tumours

from Correspondents

THE Second Symposium on Differential Sensitivity of Tumours and Normal Tissues took place at the Institute of Oncology and Radiology in Alma-Ata, Kazak SSR, on May 20–23. This was the second time that this institute had brought together a number of radiation therapists and radiation biologists to discuss the therapeutic aspects of radiation biology. The participants, of whom one-third were clinicians and the rest theoretical scientists, came from different therapy and research centres in the Soviet Union.

In his opening talk, a corresponding member of the Soviet Academy, A. M. Kusin, gave a review of the recent achievements of radiation biology which may have particular relevance for radiation therapy. The lectures and the discussion which followed concentrated around two main topics—the factors which determine the inherent radiosensitivity of the cells, and the agents which may influence these factors in such a way that the sensitivity of tumour cells increases and that of normal cells decreases.

Kabyiev and co-workers reported on tumour sensitization by using different polyphenols as specific sensitizing agents. By the use of antioxidants, Academician Emanuels and co-workers were successful in modifying the kinetic characteristics of tumour proliferation with specific radiosensitization as a main result. Many therapists discussed the effect of various fractionation schemes in connexion with high voltage therapy. Three years' clinical experience gathered at the Institute of Oncology and Radiology in Alma-Ata strongly suggested that, especially in general or local hypothermia, large dose fractions give the best protection to normal tissues, while the sensitivity of tumours (mostly oesophageal cancer) remains unchanged.

The proceedings of the symposium were summarized by Kuzin. It was generally agreed that a closer integration between the work of radiation therapists and radiation biologists is needed. Their combined work will provide a new scientific basis for the radiotherapy of neoplastic diseases which can be expected to improve the therapeutic results substantially. The papers