virions and empty capsids. They have used double labelling and gel electrophoresis and also immunological methods to identify capsid material. They seem to have raised antisera which permit the discrimination of virus particles and capsids from 8S capsid subunits and unassembled capsid protein molecules and with these they have shown, first, that throughout infection there is only a small pool of unassembled major capsid protein and, second, that empty but assembled capsids may well be precursors of complete, intact virions; during pulse chase experiments using ^{3}H- or ^{14}C-lysine to label capsid protein label incorporated during a 15 min to 2 h pulse into empty shells can subsequently be chased into virions.

On the other hand, Ozer (*ibid.*, 41), who developed the useful density cushion centrifugation procedure which allows the separation and therefore assay of virions and empty capsids, has obtained evidence which indicates that some of the empty shells that accumulate in infected cells arise from the breakdown of intact virions. Most virions, however, must assemble directly, for not only do the empty shells seem to be precursors of intact virions but when cytosine arabinoside is added late in infection the rate of virion formation is halved but empty shells continue to accumulate at an unabated rate. It seems, therefore, that the maturation of polyoma virus particles, like the maturation of polio virus, involves the assembly of an empty capsid which is then filled with viral nucleic acid.

CANCER RESEARCH

Kinetic Studies

from a Correspondent

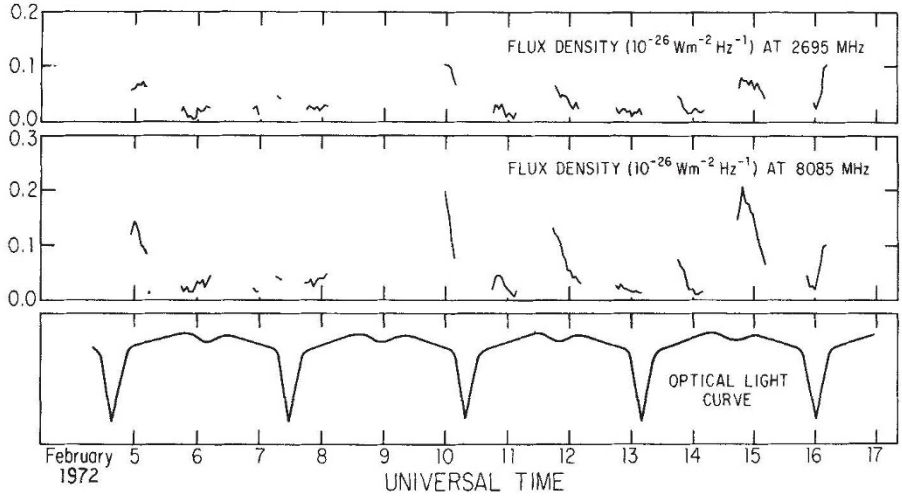
AT the eighth meeting in the series on the principles of experimental and clinical oncology at the British Museum (Natural History) on February 28, the topic for discussion was the growth rate and kinetics of tumours. The speakers were Dr G. G. Steel (Institute of Cancer Research)—an experimentalist inclined to mathematical models—and Professor L. G. Lajtha (Paterson Laboratories, Christie Hospital and Holt Radium Institute, Manchester)—a clinician similarly orientated.

Introducing his viewpoint Dr Steel promised to bear with the organizers and attempt to view the past with an eye on the future. Saddled with this intellectual divergence he first admitted that the lot of the kineticist studying tumours is not a happy one. Tumours are often heterogeneous in architecture, degree of necrosis and chromosomal phenotype and it is thus difficult to make a meaningful statement about such parameters as labelling index (with, for example, tritiated thymidine), cell cycle time and growth fraction. Aside from this technical difficulty it is also very likely that the stem cells of a tumour, from which regeneration occurs after treatment, and upon which the growth rate of a tumour is eventually dependent, are not estimated by the averaged measurements easily available to the kineticist. Ascites tumours with high replicability are, felt Dr Steel, toys for the experimentalist which, however neat and tidy in their kinetics, provide relatively little information for the clinician. He compared the doubling times of various commonly used transplanted animal tumours with those found in patients in the clinic and showed that the animal tumours grow much faster.

Developing this theme Dr Steel went on to show that some human tumours grow very slowly indeed and that labelling studies often indicate a high rate of cell loss from the tumour mass. In experimental tumours it has been possible to correlate high labelling indices with high curability but in the clinic Dr Steel said that such a correlation has not been proved. He concluded that mathematical models of tumour growth have so far not contributed much to knowledge of human tumours and he felt that in the future much more emphasis will have to be placed on characterization of the stem cell components of tumours.

Professor Lajtha defined kinetics as the movement of cells in time, number or functional capacity. Turning to leukaemia, the theme of his presentation, he put up a rough model of the three stem cell compartments in the haematopoietic system. The pluripotent stem cells are not recognizable, neither are the committed precursor cells. Recognizable precursors such as promyelocytes are the third category. Tumours can arise from any of the precursor types. It is difficult, however, to establish from which compartment a particular population of leukaemic cells was derived. In chronic myelogenous leukaemia, for example, it seems that there is a slight over-production of myeloid cells and that they are released into the periphery earlier than normal. In such cases the Ph' chromosome is an indication of genetic abnormality, but other cells which apparently behave normally seem to possess the same defect. In some acute leukaemias the abnormal cells at first seem to have a slow rate of synthesis and a very low labelling index compared with such normal cell populations as promyeloblasts.

Variations in Radio Stars β Lyrae and β Persei



ALTHOUGH only four radio stars with "normal" optical counterparts are known, these systems provide an important insight into astrophysical processes (see *Nature*, **235**, 247; 1972) and are now the subject of intensive study by several groups of radio astronomers. In next Monday's *Nature Physical Science* (March 20) R. M. Hjellming, C. M. Wade and E. Webster report observations of both β Lyrae and β Persei. Both systems have changed dramatically since their discovery (Wade and Hjellming, *Nature*, **235**, 270; 1972), β Lyrae having faded below the level of detectability and β Persei now showing irregular variations and flaring (see figure). There is no evidence of a correlation between this variability and the optical variations of the system. One of the radio flares—that of January 21–22 this year—has also been studied by V. A. Hughes and A. Woodsworth, and their observations are also reported in *Nature Physical Science* next week. The combined observations by the two teams cover 2.8 cm, 3.7 cm (8,085 MHz) and 11.1 cm (2,695 MHz) and represent the first observations of the decay of a radio flare of this kind at these frequencies.