of x-rays. These observations lead to the assumption that 2 different mechanisms are responsible for the atheromatosis.

MEASUREMENT OF BLOOD FLOW IN THE MOUSE TAIL AFTER IRRADIATION. J. de Ruiter and L. M. van Putten, Radiobiological Institute TNO, Rijswijk.

The measurement of the local clearance rate after subcutaneous injection of $^{133}$Xe and $^{51}$Cr-EDTA provided a way to obtain information on blood flow and capillary diffusion capacity (CDC) in the mouse tail. These studies were performed under normal resting conditions and after the induction of maximal blood flow. A decrease in blood flow and CDC was observed about a year after tail irradiation with a single dose of 3000 rad x-rays. This decrease was most significant under maximal blood flow conditions. The dose effect curves for single doses when measured at 14–17 months after irradiation showed a decrease in blood flow up to 2500 rad whereas following doses higher than 2500 rad, an increase in blood flow was observed. The same phenomenon was observed with the CDC but it was less pronounced. Studies of blood flow and CDC after fractionated irradiations demonstrated no significantly different curves, if the doses were expressed in rets. This indicates that the Ellis formula is a satisfactory predictor of fractionation effects on later functional blood vessel damage. A full description of this study has been published (Radiat. Res., 1975, 61, 427).

TIME–DOSE RELATIONSHIPS FOR SPINAL CORD DAMAGE. A. J. van der Kogel, Radiobiological Institute TNO, Rijswijk.

The development of paralysis has been studied after local irradiation of the rat spinal cord with 300 kV x-rays in single, fractionated and protected regimens.

An iso-effect curve of the logarithm of the tolerance dose as a function of the logarithm of the number of fractions has a slope of about 0.45. The effect of longer time intervals between subsequent fractions (5 fractions/28 days, 10 fractions/31 days) on the total dose tolerated by the spinal cord is almost negligible compared with the influence of the number of fractions. These results indicate that intracellular repair of radiation damage is a very prominent phenomenon, in contrast with repopulation. This is in agreement with the very low rate of cell proliferation in the central nervous system.

With respect to radiotherapy, these experiments suggest that a high tolerance dose of the spinal cord is obtained through the use of a large number of fractions but that an increase of the overall time has little effect.

DIFFERENT RADIOSENSITIVITY OF CHINESE HAMSTER FIBROBLASTS FOR CHROMATID BREAKS IN G$_2$/PROPHASE. DEPENDENCE ON LET. G. Mindeker, I. Riehle, L. Cabeza and H. Fritz-Niggl, Strahlenbiologisches Institut der Universität Zürich.

Irradiated G$_2$/prophase cells (200 kVp photons, 29 MV photons and 15 MV electrons) were selected by means of $^{3}$H-TdR pulse labelling technique and analysed for chromatid aberrations in the first metaphase. The frequency of aberrations varied with time the cells remained in culture after irradiation. Dose–effect curves for the three types of irradiation were measured at the most sensitive fixation time after irradiation (1 h) with 5, 12, 25, 50 and 100 rad. Electrons and photons showed different effects depending on the dose; 200 kVp and 29 MV photons showed the same effect, electrons were less effective. The results are in good agreement with earlier investigations (H. Fritz-Niggl and H. R. Schinz, Strahlentherapie, 1962, 118, 503).

INFLUENCE OF CORYNEBACTERIUM PARVUM AND OF ANTI-LYMPHOCYTE SERUM (ALS) ON BONE MARROW TRANSPLANTATION IN SMALL RODENTS. D. Jovanovic, A.-M. Cuvelier and D. Bemelman, Laboratoire de Radiobiologie, Institut du Cancer, U.C.L., Leuven.

The modifying action of horse anti-rat lymphocyte serum (ALS) and of Corynebacterium parvum on bone marrow transplants was examined in allogeneic and xenogeneic host donor combinations. Bone marrow aplasia was induced either by supralethal doses of y-irradiation or myleran.

In myleran treated rats the survival of allogeneic transplant was prolonged for 5 days by the repeated administration of ALS in 2
conditions: the ALS had to be administered simultaneously or before the allogeneic bone marrow and continued regularly, and it was ineffective if administered after the bone marrow or if administration was discontinued. Corynebacterium parvum enhanced rejection of the xenogeneic bone marrow and neoplastic cells.

These experiments were performed as part of the Cooperative Research Programme of the European Late Effects Project Group and was partly supported by the European Commission.

BCG IMMUNOTHERAPY: ITS INTEREST IN ASSOCIATION WITH RADIOThERAPY IN THE TREATMENT OF LEWIS TUMOUR IN MICE. J. B. Dubois, B. Serrou and H. Pourquier, Centre Paul Lamarque, Hôpital St-Eloi, Montpellier.

Four groups of 6–8 week old male C57 Bl/6 × DBA2, F1 Lewis tumour transplanted mice were given a localized irradiation on the tumour (left leg), with a single dose of 60Co γ-ray (2100 rad) associated with intraperitoneal injections (1 mg) of BCG (lyophilized Pasteur Institute). In group I (5 mice) the BCG was injected 3 times every 3 days between the tumour transplantation and the irradiation. In group II (15 mice) the BCG was given on the 7th day for 5 mice, on the 4th and 7th days for 5 other mice and on the 1st, 4th and 7th days after the irradiation for the last 5 mice. In group III (15 mice) the BCG was given on the 15th and the 18th days for 5 mice, on the 7th, 9th, 12th, 15th and 18th days for 5 other mice and twice a week between the 1st and the 18th day after the irradiation for 5 mice. In group IV (15 mice) the BCG injection was given twice a week only on the 3rd week for 5 mice, on the 2nd and 3rd weeks for 5 other mice and on the 1st, 2nd and 3rd weeks after the irradiation for 5 other mice. There were 3 control groups: one with no treatment, the second one with only radiotherapy 8 days after the tumour transplantation and the last one with BCG therapy alone. Tumour growth was measured from the surface of the tumour, and the weight of the animal. When the animals were killed we measured the tumour weight, the tumour surface and the tumour volume. We also counted the lung metastases using a light microscope. The immune status was followed by the weight of the thymus and the spleen, and by the plaque forming cells test (PFC test). The results of the PFC test are expressed in PFC per spleen and in PFC/10^6 lymphocytes. They show a proportional increase with the number of BCG injections (P < 0.01) and cannot be related to the tumour evolution. The tumour weight, tumour surface and number of lung metastases are significantly decreased in the mice treated by radiotherapy and BCG as compared with controls (P < 0.01) but only if the BCG injections are begun the day after the irradiation. In all the groups in which the BCG treatment is started 4 days or more after the irradiation, there is no effect of BCG compared with radiotherapy alone control group (P > 0.3). This emphasizes the importance of the timing in such a radio-immunological associated treatment.

THE SUPERADDITIONAL EFFECTS OF X-RAYS AND ADOPITIVELY TRANSFERRED IMMUNITY ON MOUSE BP8 TUMOUR CELLS IN VIVO. J. McBurney and T. R. Munro, Nuclear Physics Laboratory and Nuffield Department of Clinical Medicine, University of Oxford.

A predetermined, weak level of immune response against BP8 mouse sarcoma cells grown as an ascites tumour in AKR mice can be produced by adoptive transfer of a standard number of peritoneal exudate cells from pre-immunized mice of the same strain. The lethal effect of the immune response on the tumour cells is analogous to that of a drug but, as it is mediated by living cells, it is more prolonged. The killing of the tumour cells has been monitored in vivo by pre-labelling them with 125I UdR and following the release and subsequent excretion of 125I that occurs when labelled cells are destroyed, by total-body counting of the mice. If the tumour cells are irradiated with either 200 or 600 rad before injection into immunized mice, the rate of cell killing is much greater than would be expected from the effect of either the x-radiation or the immune response on its own, implying that the 2 agents interact to produce a superadditive effect. This may be important when weakly antigenic tumours are treated by radiotherapy.