The histology of the tissues processed showed no significant abnormalities. In particular, mammary tissues were normal.

For this experiment the basic supposition was that an important factor in tissue susceptibility is the maintenance of an adequate concentration of the carcinogen in contact with the target tissue. However, the results have indicated that neither labelled carcinogen nor a labelled metabolite was localized in the mammary tissues.

The sites of localization suggest that the carcinogen was absorbed by the stomach and intestines and, by the normal pattern of metabolism through liver and kidney, was excreted in urine and fæces.

A. L. GOODALL
MAUREEN H. MCINTYRE
J. S. KENNEDY

University Departments of Surgery and Pathology,
Royal Infirmary, Glasgow.

[1] Prohaska, J. van, Brunschwig, A., and Wilson, H., *Arch. Surg.* (Chicago), **38**, 328 (1939).
[2] Orr, J. W., *J. Path. Bact.*, **55**, 483 (1943).
[3] Shay, H., Aegerter, E. A., Gruenstein, M., and Komarov, S. A., *J. Nat. Cancer Inst.*, **10**, 255 (1949).
[4] Huggins, C., Briziarelli, G., and Sutton, jun., H., *J. Exp. Med.*, **109**, 25 (1959).
[5] Dao, T. L., and Sunderland, H., *J. Nat. Cancer Inst.*, **23**, 567 (1959).

RADIOBIOLOGY

Effect of Chlorination of Drinking Water on Mortality after Whole-body X-irradiation

IN the course of investigations of X-irradiation of mice, we noted during the past year large variations in the LD_{100}/30 days under identical conditions of radiation. We have tried a number of antibiotics and found, finally, in chlorination of the drinking water an efficient means of controlling these variations.

The mice (inbred strains *C57BL/6*, *AK*, *CBA*, *C+*), 12–14 weeks old, were exposed to a single dose of X-rays from a General Electric 'Maxitron 300' (200–300 kV, 20 m.amp, half-value layer 1 mm copper, dose rate 50–100 r./min, target distance 50 cm). Dosimetry was carried out with a Philips dosimeter type No. 37.470. Mortality was recorded twice daily. Chlortetracyclin (4 mg/g food[1]) or 'Nitrofurazone' (*n*-5-nitrofurfurylidino-3-amino-2-oxyazolidone, kindly given by Socophy, Brussels) (100 mg in 1·8 l. drinking water) was administered for 15 days after exposure. Automatic chlorination of the tap water was provided by a Wallace–Tiernan metering pump (Wallace–Tiernan, Gunzburg, Germany) connected to a closed supply of sodium hypochloride. The concentration of chlorine in the drinking water as determined by iodometric titration was 10 p.p.m. immediately and about 5 p.p.m. 3 days later. Thus, with a semi-weekly change of the drinking water, efficient concentration of chlorine can be maintained.

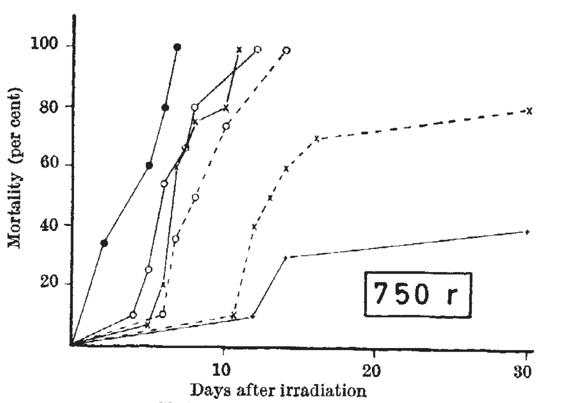

Fig. 1. ●—●, 10 *CBA* (10–62); ○—○, 20 *C57BL*(12–61); ○ - - ○, 10 *C57BL* + nitrofurazone (12–61); ×—×, 20 *C+*(8–62); × - - ×, 10 *C+* + chlortetracycline (8–62); + — +, 21 *C57BL* (1–63)

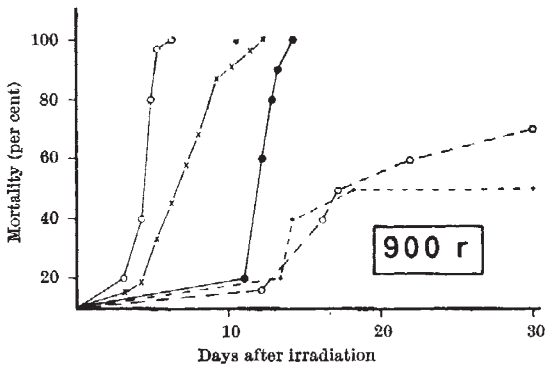

Fig. 2. ●—●, 10 *AK* (8–62); ○—○, 12 *C57BL* (10–62), ○ - - ○, 10 *C57BL* (1–63), × — ×, 22 *C+* (3–62); + - - +, 10 *CBA* (1–63)

Infection probably accounted for the very high mortality which we observed, in 1962, for different mouse strains after total-body irradiation (Figs. 1 and 2) since bacteriological examination of heart blood revealed *Pseudomonas* or *Proteus* bacteria.

Antibiotics in food or in drinking water afford some protection mainly by lengthening the life-span or, in some cases, by lowering the lethality; the results were, however, not constant and the procedure was cumbersome for large experimental series.

Chlorination of the drinking water alone results in an increase of the LD_{100} to 975 r. for *C57BL* and 1,050 r. for *CBA* at an average survival time of 15 days.

Similar observations were made in irradiated rats. Whereas before chlorination, all rats irradiated with 900 r. died within a week, only 80 per cent of the irradiated animals died within 30 days when the drinking water was chlorinated.

A. SASSEN
G. MATTELIN
F. KENNES
J. R. MAISIN

Department of Radiobiology,
Centre d'Étude de l'Énergie Nucléaire,
Mol, Belgium.

[1] Van Bekkum, D., and Vos, O., *Intern. J. Rad. Biol.*, **3**, 173 (1961).

Absorbed Dose Calibration of an Ion Chamber

SINCE 1953 the official unit for the absorbed dose of X- and other ionizing radiation received by biological material has been the rad, defined as " . . . the energy imparted to matter by ionizing particles per unit mass of irradiated material at the place of interest . . . ", 1 rad being 100 ergs/gm (ref. 1). Use of the roentgen was not approved for quantum energies above 3 MeV. Nevertheless, absorbed doses of megavoltage X-rays are usually estimated by instruments calibrated in roentgens using ionization chambers. This method is indirect and involves three uncertainties: (1) the proper value of W, the mean energy per ion pair in air; (2) the value of the stopping power ratio for the wall to the gas (this includes the polarization correction at high energies); (3) the correction for attenuation of the radiation in the wall.

In order to overcome these difficulties several workers have measured the absorbed dose in materials of low atomic number by calorimetric methods, and have compared the energy absorption with ionization[2–4], with the response of a chemical dosimeter[5,6] or with the darkening of transparent plastic[7]. However, in the comparisons of energy absorption with ionization, no single technique has been used over a wide range of energies. Also the methods used involved troublesome corrections for attenuation of the radiation in chamber walls and calorimeter baffles and for scattering by the chamber stem.