The dose-dependence of sister chromatid exchanges induced by 3 hydrocarbons, in the in vivo bone marrow test with Chinese Hamsters[1]

U. Bayer and T. Bauknecht

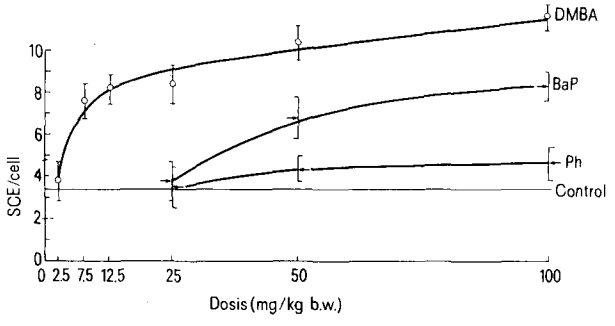
Forstbotanisches Institut der Universität, Bertoldstrasse 17, D–7800 Freiburg im Breisgau, and Institut für Humangenetik und Anthropologie der Universität, Albertstrasse 11, D–7800 Freiburg im Breisgau (Federal Republic of Germany, BRD), 16 June 1976

Summary. In accordance with their carcinogenic effects, 7,12-dimethylbenzanthracene and 3,4-benzo(a)pyrene induce sister chromatid exchanges in the bone marrow of Chinese Hamsters in vivo. Phenanthrene is inactive. A dose dependence of induced sister-chromatid exchanges can be shown.

Recent publications show that mutagenic substances induce not only chromosome aberrations but also sister chromatid exchanges. Differential staining of sister chromatid exchanges (SCE) was so far restricted to cultured cells[2–6].

Recently methods were developed to demonstrate the induction of SCE in vivo, i.e. in the bone marrow cells of treated animals[7]. With this new technique of Vogel and Bauknecht, the dose-dependence of SCE induced by 3 polycyclic hydrocarbons was examined: 7,12-dimethylbenzanthracene (DMBA); 3,4-benzo(a)pyrene (BaP) and phenanthrene (Ph).

Male Chinese Hamsters, 8–20 weeks old, received one dose either of 2.5, 7.5, 12.5, 25, 50 or 100 mg DMBA/kg b.w. or of 25, 50 or 100 mg BaP/kg b.w. or of 25, 50 or 100 mg/Ph/kg b.w. All 3 hydrocarbons were dissolved in Tricapryline, using a homogenizer for better solution. $2^1/_2$ h before fixation, 10 mg Colchicine/kg b.w. was given. The animals were sacrificed 24 h after the treatment with hydrocarbons, and 28 h after the first injection with BUdR. In the controls, untreated animals or animals treated with the pure solvent, the mean number of SCE/cell was 3.2 ± 1.2 and 3.4 ± 1.4 respectively. Compared with induced breaks and interchanges, the number of SCE per cell is much higher. Therefore much fewer cells need to be counted than in the case of chromosome aberrations. We found 50 cells adequate to get reliable results with hydrocarbons.



Dose response curve of sister chromatid exchanges induced by DMBA (top curve), BaP (middle curve), and Ph (bottom curve) in bone marrow cells of Chinese Hamsters. The horizontal line represents the control level (3.4). Abscissa: Dose (mg/kg b.w.). Ordinate: Mean number of sister chromatid exchanges ± standard deviation (vertical lines). Each point of the curves represents a sample of 50 cells from 2 animals.

The figure shows the dose-response curves obtained so far. DMBA, the most active compound, as well as BaP, show a non-linear increase of SCE. This may also be the case with Ph, but the number of SCE induced is not significant. The dose curve of DMBA is based on 6 different concentrations. A significant increase is obtained with 7.5 mg/kg b.w.; obviously no, or a very low, threshold value exists. The 3-point-curve of BaP rises from about 25 mg/kg b.w. with a significant increase between 25 and 50 mg/kg b.w. Here a distinct threshold value seems to exist. The increase of SCE induced by Ph is not significant with a dose of 100 mg/kg b.w.

3 main conclusions can be drawn from the results:
1. The induction of SCE corresponds to the results obtained from chromosome aberrations (unpublished).
2. It reflects the sequence of carcinogenic effects by the 3 hydrocarbons with DMBA as the most active compound.
3. The SCE test is much more sensitive than the induction of chromosome aberrations. A significant increase of SCE can be observed with concentrations much lower than those which are necessary to induce chromosome aberrations. The test may be used as a quick method to screen for the induction of chromosome aberrations and to examine the existence of a threshold value.

1 Work carried out under Contract No. 022–74–1-ENVD of the E. G. Environmental Research Programme and the Bundesministerium für Forschung und Technologie (Nr. MT 420).

2 H. Kato, Exp. Cell Res. *85*, 239 (1974).
3 B. Beek and G. Obe, Humangenetik *29*, 127 (1975).
4 E. Solomon and M. Bobrow, Mut. Res. *30*, 273 (1975).
5 P. Perry and H. J. Evans, Nature *258*, 121 (1975).
6 S. A. Latt, Proc. Nat. Acad. Sci. *71*, 3162 (1974).
7 W. Vogel and T. Bauknecht, Nature *260*, 448 (1976).

Mouse sex vesicle. C-band and pairing at the light and electron microscope[1]

Maria Luiza Beçak, Sylvia M. Carneiro and W. Beçak[2]

Serviço de Genética, Instituto Butantan, C. Postal 65, São Paulo (Brazil), 23 June 1976

Summary. C banded mouse pachytene chromosomes were studied with the light and electron microscopes by the whole mount technique. The X and Y chromosomes show pairing by the long, by the short or by both long and short arms. Assuming Lyon's hypothesis, the latter suggests that the Y segment transferred to the X is intercalar. With the light microscope, a negative image of the synaptonemal complex is evidenced.

Chromatin free synaptonemal complexes (S.C.) resulted from water spreading of mouse pachytene nuclei pretreated with saline solution[3]. In this paper we report C banding of the same material at the electron and light microscopes after some modifications in the technique described.

[1] This work was supported by grants of the Brazilian Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Fundo Especial de Despesas do Instituto Butantan (FEDIB).

[2] We acknowledge Dr N. Leon for his editorial suggestions.

[3] M. L. Beçak, W. Beçak and S. M. Carneiro, Experientia *31*, 1020 (1975).