The Occurrence of Mitotic Irregularities During a Normal Epithelial Proliferation

In earlier investigations, the author studied the mitotic rate[1] and the degeneration rate[2] during the epithelial differentiation in the müllerian part of the mouse vaginal anlage and in the cervix. The curves showing the degeneration rate distribution within the region studied have the same general appearance as those showing the mitotic rate distribution, the peak of each of the curves being localized in the same region. One explanation for this parallelism might be the appearance of irregular mitoses and this paper reports the results of a search for any mitotic irregularities that may occur.

The material consists of 2- and 3-day-old albino mice of a stock maintained at the Anatomical Institute for several years. The anterior parts of the vaginal anlage and the uterine cervix were dissected out and placed on slides. Some drops of fixative (acetic acid, *N*-hydrochloric acid, distilled water; 6:1:3) were added. The tissue was cut into small fragments and left for fixing for 5 min under a Petri dish. Staining took place in acetic orcein for 3 min under a cover glass. Finally, the preparations were squashed and the cover glass was framed with Kroenig cement.

Only anaphases were studied and only those of a probable epithelial origin. In all, 470 anaphases from 20 preparations were studied. Among these, 23 (4.9%) were deviating and could be classified as irregular anaphases. The irregularities seen were of the following types: chromosome bridges[3], free or attached chromosomes or chromosomal fragments between the 2 chromosome groups in the anaphase[4], vagabonding chromosomes[1], and highly disturbed mitoses including several bridges in the same mitosis[5].

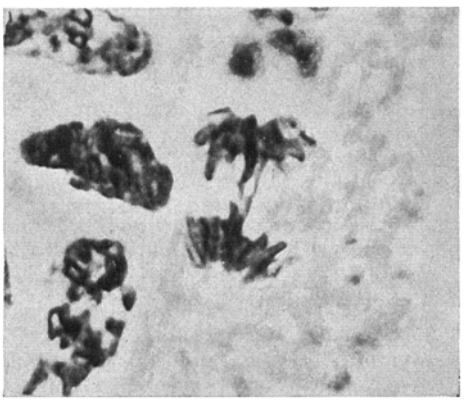

Fig. 1. Example of an anaphase with a chromosome bridge. Photographed in phase contrast.

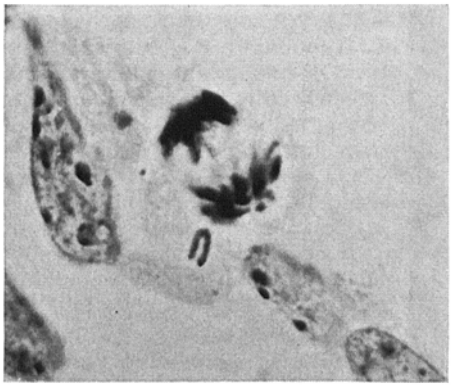

Fig. 2. Anaphase with a vagabonding chromosome.

Only definitely irregular mitoses are included in this investigation. It may well be that small disturbances escaped notice. This exerts a negative influence on the figure (4.9%) given for deviating anaphases. On the other hand, the irregular anaphases probably linger for some time[6]. This tends to increase the frequency figure. The value given for the number of irregular mitoses must thus be considered highly approximate.

Normal adult and embryonic tissues in situ are characterized by stability in their diploid chromosome number and chromosome structure[4,5,7,8] with the exception of polyploidy in some tissues[3,9,10] and possible aneuploidy in the human endometrium[11]. In the latter tissue abnormal mitoses have been seen[12]. In this connection it is interesting to note the selective degeneration of young cells in the mouse uterine epithelium[13]. Aneuploidy is not seen in a rapidly growing tissue, such as regenerating liver[8,10], but irregular anaphases have been described[14]. This indicates a degeneration of cells with, or resulting from, irregular mitoses.

There are strong reasons[5,15] for regarding the irregular mitoses in the cervico-vaginal epithelium in mice as contributing to the degeneration in the same epithelium[2]. The mitotic rate and the degeneration rate in the uterovaginal anlage have maxima in the same region[1], which may indicate a random appearance of abnormal mitoses in a rapidly proliferating tissue. Part of the degeneration may be an expression of a strong negative selection of eventually surviving cells with small deviations in the genotype. Also during the development of the neural epithelium in chicken embryos, anaphasic chromosome bridges occur (frequency: 10% of the anaphases) in a very vivid proliferating tissue parallel to a degeneration process[6,16].

Zusammenfassung. Es werden insbesondere atypische Mitosen im cervico-vaginalen Epithel der Maus untersucht. Diese stehen offenbar mit einer gleichzeitigen starken Gewebsdegeneration in Verbindung.

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