

PRELIMINARY STUDIES ON THE EFFECTS OF CADMIUM CHLORIDE ON THE MEIOTIC CHROMOSOMES

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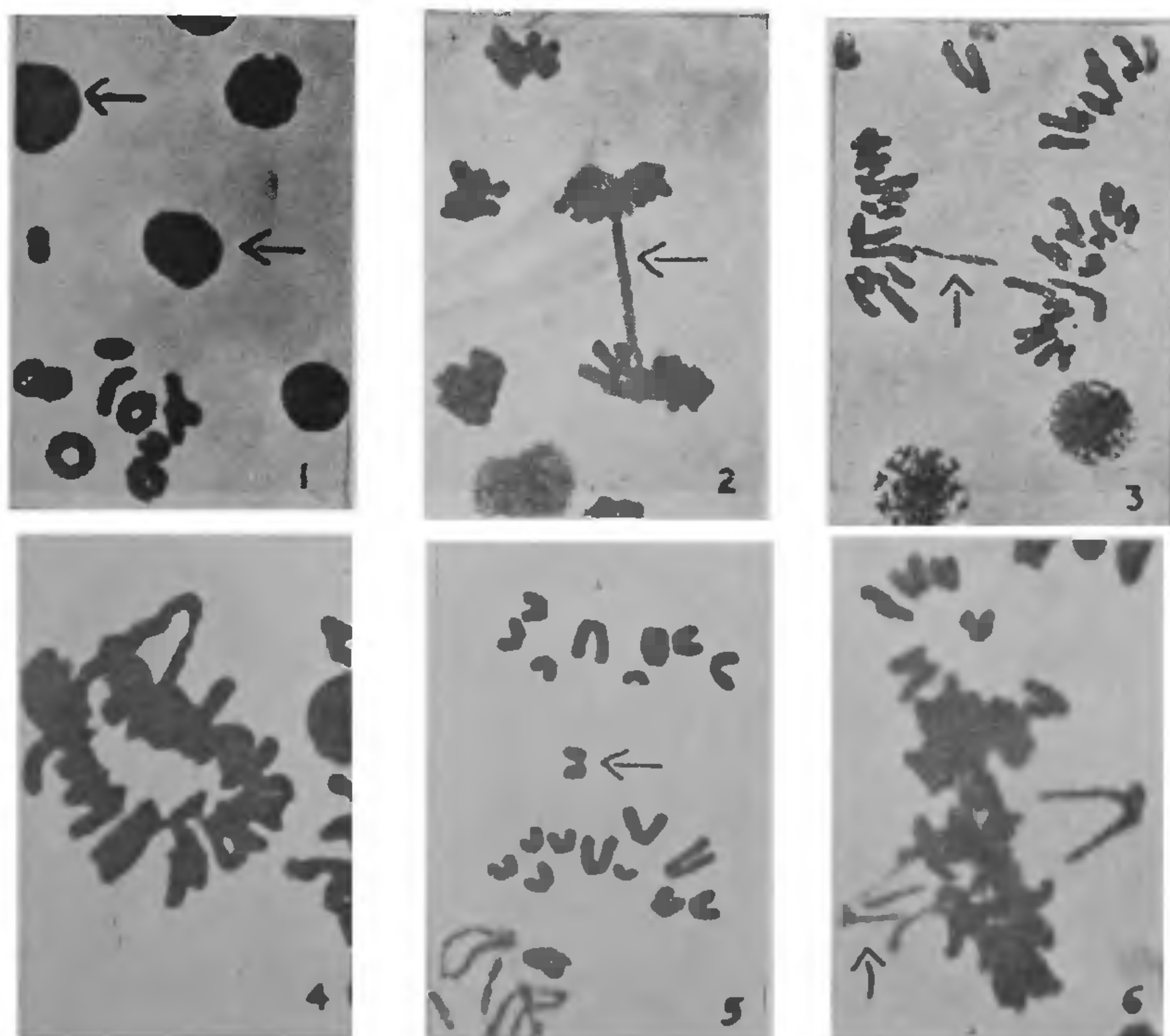
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EXPERIMENTALLY it has been convincingly shown by many workers that the dreadful pollutant cadmium and its compounds cause harmful effects in mammals and man. Eventhough a lot of work has been done on the histological, histochemical, histophysiological, pathological and toxicological aspects of cadmium on mammalian tissues¹, very little work has been done on the effects of cadmium salts on the chromosomes. So, the present study deals with the effects of Cadimium chloride on male meiotic chromosomes of the grasshopper *Poekilocerus pictus* (Acrididae: Orthoptera).

Males of *Poekilocerus pictus* collected from the environs of Manasa Gangotri, Mysore (India) formed the material for the present study. The animals were

injected with 0.05 ml. of 0.001%, 0.01% and 0.05% aqueous cadmium chloride solution abdominally and the animals survived upto 24 days, 18 days, and 10 days, respectively, for the above three concentrations. Testes Squash chromosomal preparations were made and stained in Heidenhain's Iron Hematoxylin.

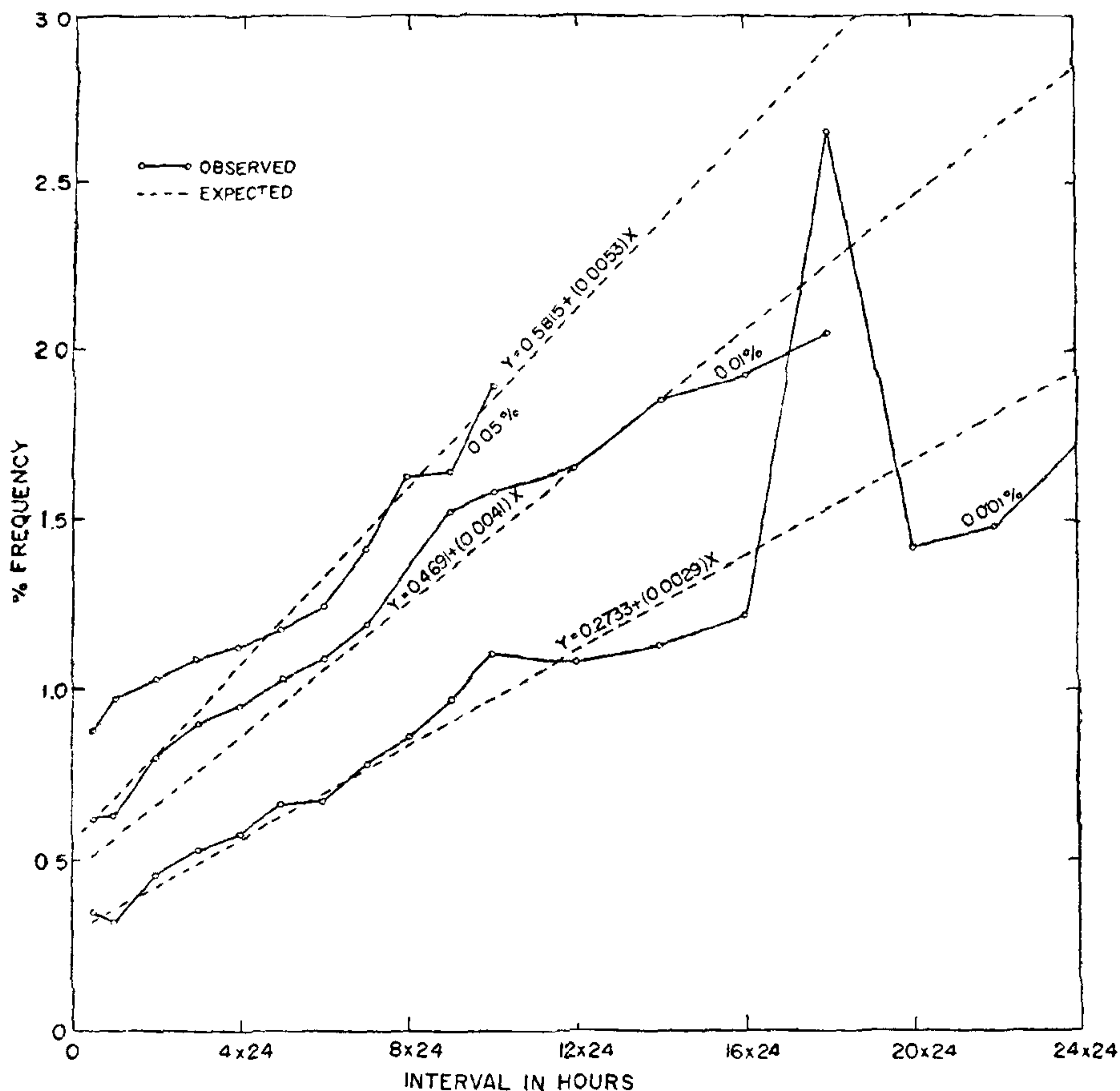
The qualitative analysis has revealed the presence of different types of chromosomal aberrations, such as, stickiness and clumping (Fig. 1), pseudobridge formation at anaphase-I (Fig. 2) and at anaphase-II (Fig. 3), tetraploidy at metaphase-II (Fig. 4), lagging of chromosomes at anaphase-I (Fig. 5) and despiralization of metaphase-II chromosomes (Fig. 6).



FIGS. 1-6. Fig. 1. Diakinesis-extreme clumping (arrows). Fig. 2. Anaphase-I-rope-like pseudobridge (arrow). Fig. 3. Anaphase-II-tetraploidy with pseudo bridge (arrow). Fig. 4. Metaphase-II-tetraploidy with stickiness. Fig. 5. Anaphase-I-lagging (arrow). Fig. 6. Metaphase-II-tetraploidy with despiralization (arrow).

Several chromosome aberrations have been observed² in the cultured human leukocytes after treatment with Cadmium sulfide at a concentration of 6.2×10^{-2} $\mu\text{g/ml}$ of culture fluid. Induction of sticky chromosomes by Cadmium chloride has been reported as early as 1950³. Stickiness is a pathological manifestation. The biochemical investigations^{4,5} on the effects of Cadmium chloride on DNA in rat and mouse testes showed that there was a decrease in the nucleic acid content. It has been suggested⁶ that the depolymerization of nucleic acids is responsible for the production of stickiness. The electron microscopic studies⁷ on the Ethidium bromide induced stickiness have

shown that the chromosome stickiness is caused due to the entanglement of the chromatin fibers between unrelated chromosomes. The present observations have shown that the stickiness is more a morphological and mechanical manifestation. Formation of pseudo-bridges is one of the direct expression of stickiness. The present investigations have shown that pseudo-bridges are formed due to the terminal stickiness. With regard to the metaphase-II despiralization, it is the considered opinion of the authors that the chemical acts on the coiling system of the chromosomes. The metaphase-II tetraploidy appears to have been formed due to the failure of cytokinesis. Generally lagging



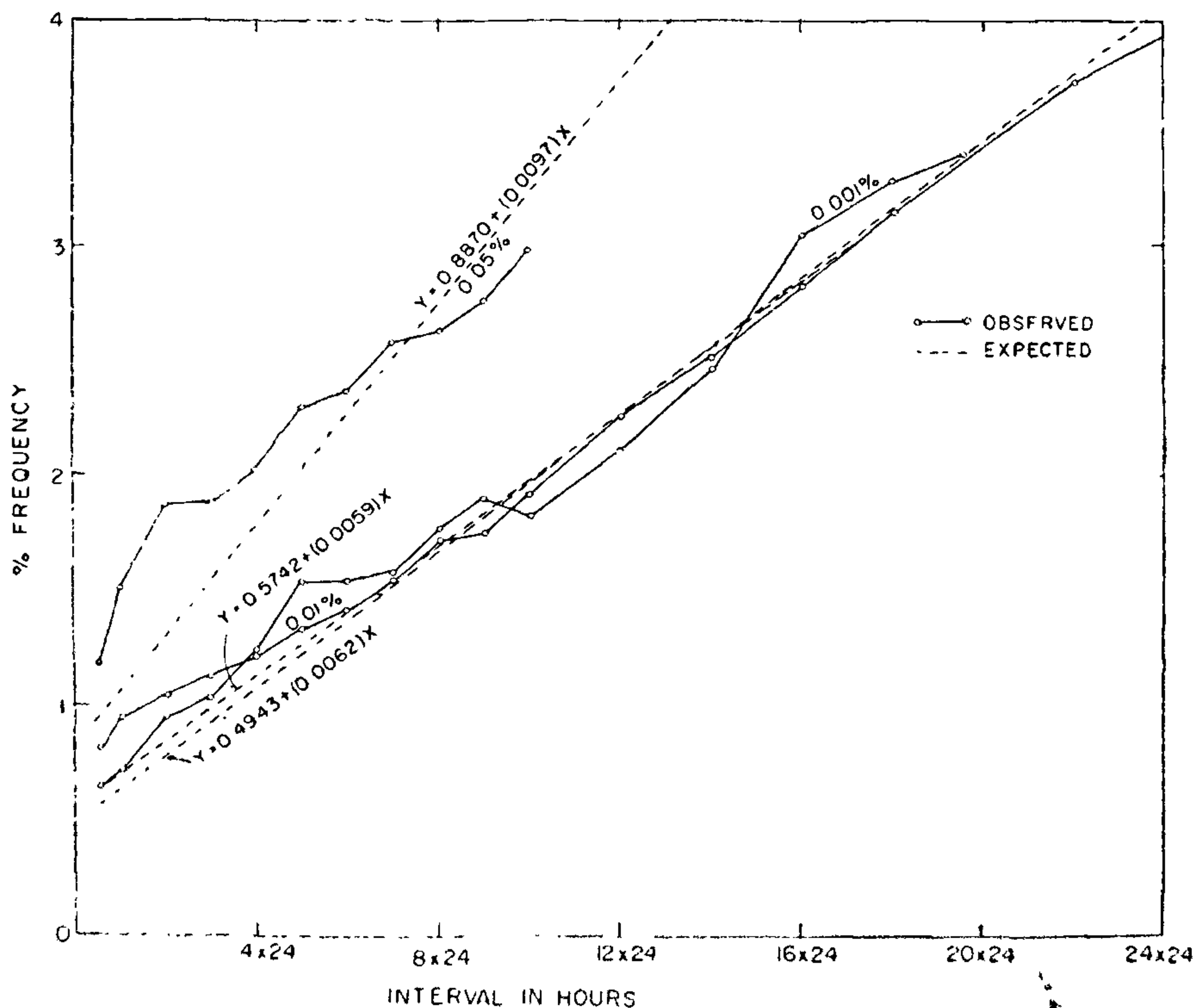
TIME-YIELD RELATIONSHIP OF PSEUDOBRIDGES AT ANAPHASE I STAGE

FIG. 7

of chromosomes is encountered in the natural populations of Acridids at a very low frequency. The present observations on the occurrence of laggards to a high degree induced by the pollutant have led the authors to believe that the laggards encountered at anaphase-I are the outcome of the delayed terminalization of interstitial chiasma but not either due to the defective centromeric activity or malfunctioning of the spindle fibers, because, it is proved by the fact that the laggards have not been observed in the anaphase-II stages.

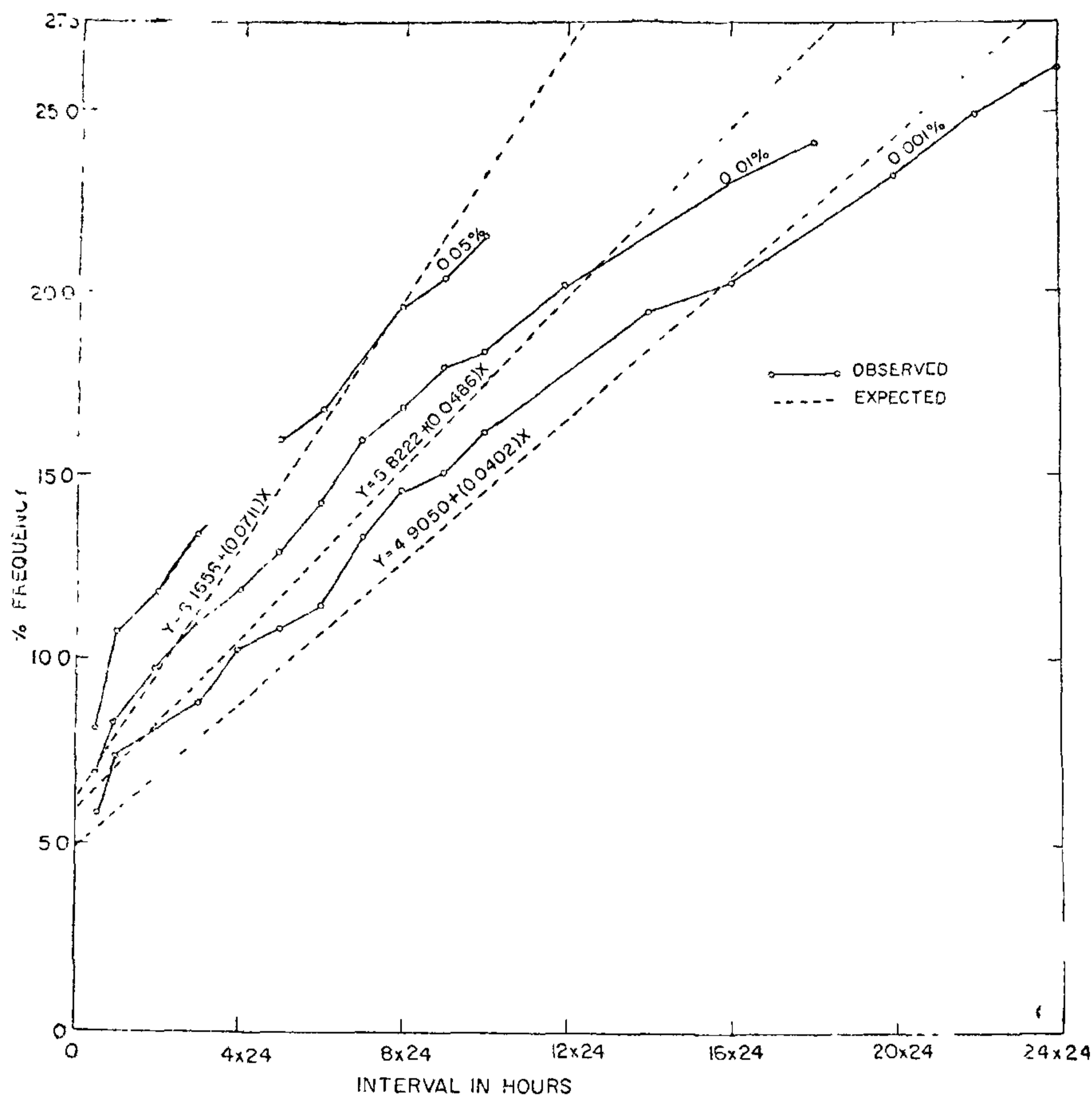
The quantitative analysis of the different chromosomal aberrations induced by cadmium chloride with regard to the time-yield and dose-yield relationships of the anomalies have been studied. The data on these lines have been depicted in Figs. 7, 8 and 9. The present observations have shown that there is a direct correlation between the frequencies of pseudo-

bridges at anaphase-I and anaphase-II and the time interval. Maximum number of pseudobridges have been obtained at 24 days, 18 days and 10 days for 0.001%, 0.01% and 0.05% doses, respectively. Only in the case of 0.001% dose the frequency of anaphase-I pseudobridges gradually increases upto 18 days and then declines. In all the doses of treatment, the percentage frequency of anaphase-II pseudobridges is more than the anaphase-I pseudobridges. The percentage frequency of pseudobridges increases with the increase in dose from 0.001% to 0.01% to 0.05%. The metaphase-II cells are the most susceptible ones for the chemical damage. There is a positive correlation of the cells showing the polyploids with respect to the time and dose, that is, there is an increase in the frequency of polyploids with the increase in the duration of post-interval treatment and with the increase in dose.



TIME-YIELD RELATIONSHIP OF PSEUDOBRIDGES AT ANAPHASE II STAGE

Fig. 8



TIME-YIELD RELATIONSHIP OF POLYPLOIDY AT METAPHASE II STAGE

FIG. 9

The biometrical analysis with regard to the straight lines of the form $Y = ax + b$ have been fitted to the data on the timeyield relationships by the method of least squares for pseudobridges at anaphase-I, anaphase-II and the metaphase-II polyploids. The high degree of correlation between the observed and the expected values in all the cases indicates that the factor time is linearly related to the yield of anomalies ($r = 0.8$ to 0.9). In calculating the dose-yield relationships no straight lines could be fitted because of the large number of variables that are present in the three different doses. The details of these studies are being worked out.

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