lich. Auch zwischen den 4- und 8-Stunden-Werten der Konzentration 10^{-3} ist kein statistisch sicherbarer Unterschied vorhanden ($p\chi^2 \geqslant 0{,}05$; berechnet wie oben angegeben). Das bedeutet, dass DTPA unter diesen Versuchsbedingungen keine Erhöhung von Chromosomenaberrationsraten induziert.

Therapeutisch ist die in Anwendung kommende Konzentration von 10^{-3} bereits an der Grenze der Verträglichkeit. Um so mehr ist der Befund interessant, dass nicht nur diese Konzentration, sondern auch diejenige von $10^{-2}M$ keine Aberrationen hervorzurufen vermag.

Aus diesen Ergebnissen – wie aus denen nach DFOA- und PA-Behandlung[4] – ist zu schliessen, dass ein Metallionenentzug aus den Zellen, und damit unter Umständen auch aus der Chromosomenstruktur, nicht zur Erhöhung der Chromosomenbruchrate zu führen braucht. Der in der vorliegenden Untersuchung verwendete Zellklon hat eine Generationszeit von 15–16 h und dabei eine G_2-Phase von 4–5 h[6]. Demnach sind in den Versuchen mit 4-Stunden-Behandlung praktisch nur G_2-Zellen ausgewertet worden. Weitere Versuche mit anderen Zellzyklusstadien sind wünschenswert, zumal eine mit den Zellzyklusstadien korrelierbare Verteilungsänderung von Metallionen in Zellen nachgewiesen wurde[7]. Sollten ausserdem in vivo Untersuchungen mit Knochenmarkszellen und Lymphozyten die in vitro Befunde mit DTPA bestätigen, dann könnten beim praktischen Einsatz genetische Bedenken entkräftet werden[8].

Summary. The influence of DTPA on the chromosome aberration rate of Chinese hamster cells in culture was studied. No increase of the aberration rate was observed after treatment with 10^{-2} and $10^{-3}M$ concentrations.

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4. Februar 1972.

[6] H. G. MILTENBURGER, Strahlentherapie *138*, 5 (1969).
[7] E. ROBBINS und T. PEDERSON, Proc. natn. Acad. Sci. *66*, 1244 (1970).
[8] Mit Unterstützung der Deutschen Forschungsgemeinschaft.

Muntjac Chromosomes: A New Karyotype for *Muntiacus muntjak*

The evolutionary history of the primitive muntjac deer (Muntiacinae) and karyotypes of two species of the genus *Muntiacus* have been described[1]. The taxonomy of *Muntiacus* is not complex, only 5 species being listed by ELLERMAN and MORRISON-SCOTT[2]. This study is concerned with *Muntiacus muntjak*, commonly called Indian muntjac, of which there are 8 subspecies listed[2].

Previous chromosome analyses on *M. muntjak*[1] were performed on offspring of stock captured in Assam. These animals are considered, on the basis of geographical range, to be *M. muntjak vaginalis*. The diploid number of chromosomes is 7 in the male and 6 in the female; both sexes carry an *X* to autosome translocation.

Chromosome analysis has now been done on a female muntjac captured near Kuala Lumpur, Malaysia, and considered on the basis of geographic range to be *Muntiacus muntjak muntjak*. Preparations were made from a fibroblast culture grown from skin explants cultured in McCoy's 5A (modified) medium enriched with 20% fetal calf serum. This animal has a diploid number of 8 (Figure 1) with an *X* to autosome translocation confirmed by the use of autoradiography. A diploid number of 9 would be expected in the male of this subspecies. A karyotype of *M. muntjak vaginalis* shows in Figure 2. In *M. muntjak muntjak* the No. 1 pair of large metacentrics found in *M. m. vaginalis* is replaced by a pair of large submetacentrics and a pair of acrocentrics. The *X* chromosome, exclusive of the autosome to which it is fused, equals $9.17 \pm 0.86\%$ by weight of the haploid complement, as determined by the photo cutout method[3]. This value is similar to that of the Indian animal reported previously to be 9.3%[1].

DNA values have been determined on the female from Malaysia and on 1 male *M. m. vaginalis*. Determinations were made on 35 Feulgen stained fibroblasts and compared to 35 human lymphocytes analyzed simultaneously as controls. Measurements were made with a Deeley Integrating Microdensitometer. DNA value for the *M. muntjak vaginalis* was 0.724 ± 0.012, for the *M. muntjak muntjak* was 0.948 ± 0.029 and for two specimens of *M. reevesi* was 0.894 ± 0.033 of the human value.

Karyotype evolution and chromosome homology are intriguing problems in the muntjacs. The Chinese or Reeve's muntjac (*M. reevesi*) has a diploid number of 46 and all the autosomes are acrocentric[4]. Neither evolution of the karyotype of *M. muntjak* from that of *M. reevesi*, or vice versa, nor the karyotype of a common ancestor can be easily imagined. Transition of karyotypes from that

[1] D. H. WURSTER and K. BENIRSCHKE, Science *168*, 1364 (1970).
[2] J. R. ELLERMAN and T. C. S. MORRISON-SCOTT, *Checklist of Palaearctic and Indian Mammals* (Tonbridge, Kent, England 1951).
[3] D. H. WURSTER, J. R. SNAPPER, K. BENIRSCHKE, Cytogenetics *10*, 153 (1971).
[4] D. H. WURSTER and K. BENIRSCHKE, Cytologia *32*, 273 (1967).

Fig. 1. Karyotype of *Muntiacus muntjak muntjak*. ×1600.

of *M. reevesi* to that of *M. muntjak* through repeated fusions and inversions would entail considerable loss of DNA. The figure of 0.724 of the human DNA value for the *M. muntjak* with $2n = 6/7$ indicates that such a loss may have taken place. On the other hand, one would then expect a figure of somewhat more than 0.724, but considerably less than the given figure of 0.948 for the *M. muntjak* with $2n = 8$. These data on DNA values do not support conclusions concerning the path of karyotype evolution, but do offer a basis for speculation.

Figure 3 shows the same karyotype of *M. muntjak muntjak* as shown in Figure 1 but with pair No. 1 superimposed on pair No. 3 to depict the possible evolution of the karyotype of *M. muntjak vaginalis* from that of *M. muntjak muntjak*. This pathway supposes breakage and subsequent fusion of pairs 1 and 3. This would have involved some chromatin loss and appears to be a feasible pathway. Homology of the chromosomes of the 2 animals cannot be ascertained, however, and the *X* chromosome appears to be translocated to a different autosome in each case. In *M. muntjak vaginalis* the autosome involved often displays a marked secondary constriction about a third of the distance from the centromere. This autosome is equal in length by actual measurement, to half of the No. 1 chromosome. In *M. muntjak muntjak* the autosome fused with the *X* is relatively shorter and does not display the secondary constriction. A similar constriction appears in the No. 3 pair. It is thus possible that in transitioning from the karyotype of *M. muntjak muntjak* to that of *M. muntjak vaginalis* the *X* chromosome translocated onto the No. 3 pair and the autosome which had borne the *X* chromosome translocated onto the No. 1 pair. This transition seems more probable, but would have involved less DNA loss than the hypothesis pictured in Figure 3 and is not confirmed by the DNA figures. Transition of the karyotype from that of *M. muntjak vaginalis* to that of *M. muntjak muntjak* would have involved chromosomal fission, and the attainment of additional centromeres and DNA. This is improbable. A fourth alternative would be the separate evolution of the karyotype of each from a common predecessor, possibly *M. reevesi*.

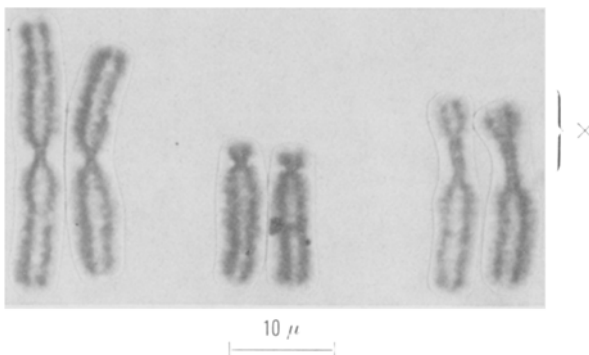

Fig. 2. Karyotype of *Muntjacus muntjak vaginalis*. ×1600.

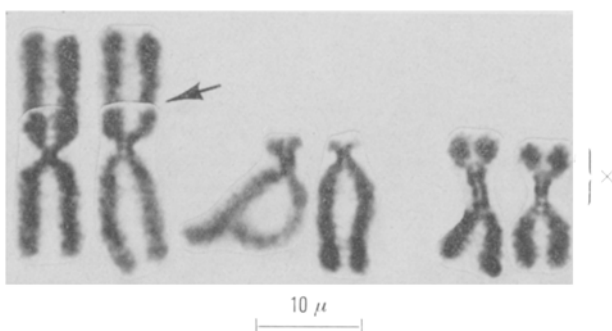

Fig. 3. Karyotype of *Muntiacus muntjak muntjak* with pair No. 1 superimposed on pair No. 3 with junction at arrow. Thus pair No. 1 becomes similar in Figures 2 and 3, but note difference in realative size of the *X*/autosome element in each. ×1600.

The karyotype differences between these subspecies are pronounced enough that one would predict synaptic incompatibility in meiotic division of a hybrid offspring, thus conferring sterility on this individual. Although specimens of *M. muntjak muntjak* are difficult to obtain, confirmation of a diploid number of 8 for this subspecies is essential, and hybridization studies of the two subspecies would be invaluable. If this karyotype is indeed characteristic of this subspecies, then it is possible that a taxonomic revision should be considered and that either subsp. *muntjak* or subsp. *vaginalis* should receive full species status.

Zusammenfassung. Es gibt bemerkenswerte Unterschiede der Karyotypen von *Muntiacus muntjak vaginalis* und *M. m. muntjak*. Jeder hat einen unterschiedlichen DNA-Wert, aber beide Werte sind niedriger als diejenigen des Menschen. Die Karyotypen-Evolution ist nicht abgeklärt, aber die Befunde zeigen, dass eine taxonomische Revision notwendig ist.

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On Dicentric Aberration Yields in 50-MeV Proton-Irradiated Human Peripheral Lymphocytes

In space, it is known that protons constitute the major component of ionizing radiation. It has been pointed out by a number of authors[1–3] that radiation biology problems posed by space flights require, in the first place: studies on detrimental effects of protons and heavy ions of various energies; studies on combined effects of these particles and other flight factors; development of effective physical, biological, and pharmacological means of protection; development of appropriate methods for physical and 'biological' dosimetry of ionizing radiations, with a view