these cells survive for at least 23 days (from the twelfth day of incubation to the fourteenth day of postembryonic life). The present report does not offer evidence for the activity of the recipient's own lymphoid cells in the elaboration of anti-O agglutinins.

It is quite possible that the thymus cells are potentially capable of producing antibodies, and the results presented here support the idea that this organ interferes directly with immune reactions. Earlier studies from this laboratory demonstrated that the chicken thymus participates in the development of experimental allergic thyroiditis and parathyroiditis[11], contains plasma cells and germinal centres[12], induced a state of immunological tolerance to skin homograft[9,13], and shows specifically fluorescing antibody-producing cells following hyperimmunization with a soluble antigen[6]. We also described the ability of the thymus to induce a graft-versus-host reaction when implanted on the ectodermal layer of the chorioallantoic membrane of 12-day-old embryos[9,13], a finding which was recently confirmed by GOOD and his associates[14]. These facts, in conjunction with the present findings, may provide a solid basis for the belief that the thymus cells are directly involved in the realization of immune responses. It seems reasonable to assume that the thymus plays at least an auxiliary antibody-synthesizing role which may become more pronounced under certain experimental circumstances[15].

Zusammenfassung. Bei Thymus- und Milzimplantation auf die chorioalantoide Membran von Kückenembryonen, die mit humanen O-Erythrozyten immunisiert wurden, wird O-Hämagglutinin erzeugt. Die Bursa ist nicht in der Lage, adoptive Antikörper zu bilden.

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The Adaptive Significance of Blood Potassium and Hemoglobin Types in Sheep

EVANS[1] classified sheep into 2 types on the basis of the concentration of potassium in whole blood; the type which had a concentration of potassium of approximately 35m-equiv/l blood was designated HK and the other type which had a relatively low concentration of potassium (approximately 13m-equiv/l blood) was designated LK. Sheep have also been classified into 3 types, namely A, B and AB, based on the electrophoretic mobilities of their hemoglobins[2,3]. Both these characters are inherited as simple mendelian alleles[3,4]. An association between hemoglobin A (Hb A) and HK type has been suggested[5]. In southern Britain the Hb B gene is more common in lowland breeds whereas the Hb A gene predominates in mountain and hill breeds. Hemoglobin A has been found to be more common in northern Europe and northern Britain and relatively uncommon in North Africa, the Middle East and in India[6].

There are a few reports dealing with potassium types and their association with some physiological characters in Indian sheep[7–11]. GHOSH, EYAL and EVANS[12] have studied both hemoglobin types and potassium types in some indigenous breeds of Rajasthan. The report by these workers appears to be the only one in the literature dealing with both these physiological characters – which are thought to have an adaptive significance[5] – in Indian sheep. The present study was undertaken to determine (1) the gene frequencies for hemoglobin and potassium types in 2 breeds of Indian sheep (Bikaneri and Mandia) and in crossbred sheep (Corriedale × Bikaneri) and (2) to discover whether there was any association between hemoglobin types and either of the potassium types.

Adult Bikaneri (52), Mandia (30) and Crossbred (34) ewes were used (numbers indicate size of respective flocks). They were maintained at Mathura which is situated close to the arid state of Rajasthan in India. Potassium concentration in the blood was determined using a Beckman spectrophotometer, and hemoglobin type by paper electrophoresis in a Carl Zeiss Jena apparatus.

It is evident from the Table that although the 3 breeds under investigation differed in the gene frequencies for hemoglobin and potassium types, the Hb B and HK genes predominated in all the 3 breeds. The Mandia breed had the highest gene frequency for Hb B and HK. Regression analysis using an IBM 1620 computer showed no significant correlation between gene frequencies for Hb B and HK (data used were from the present work and that of GHOSH et al.[12]). However, it is seen from the Table that in all 3 flocks, the frequencies for the Hb B and HK genes were both quite high. These findings are contrary to those of EVANS et al.[5] who found that there was a correlation

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Per cent distribution and gene frequencies of blood potassium and hemoglobin types in the 3 sheep breeds

(A) Per cent distribution

Breed	Potassium types		Hemoglobin types		
	HK	LK	A	B	AB
Bikaneri	57.70	42.30	5.77	69.23	25.00
Mandia	66.66	33.33	0.00	93.33	6.66
Crossbred	58.82	41.18	2.94	79.41	17.65

(B) Gene frequencies

Breed	Potassium types		Hemoglobin types	
	HK	LK	A	B
Bikaneri	0.76	0.24	0.19	0.81
Mandia	0.82	0.18	0.03	0.97
Crossbred	0.77	0.23	0.12	0.88

between the gene frequencies for Hb A and HK in 33 different British breeds of sheep, and also that Hb A and HK appeared to be more common in breeds indigenous to mountain areas in Britain. The difference in these findings may be due to a different mode of adaptation to different environmental conditions. EVANS[13] and TANEJA[10] suggested that LK sheep are better adapted to arid zone conditions because of their lower water consumption. However, the very fact that results obtained by GHOSH et al.[12] and TANEJA and GHOSH[7] as well as the findings of the present study indicate a marked preponderance of HK type animals in the relatively drier parts of India, would clearly point to the comparative suitability of such animals for these tracts. Because sheep of Hb B and HK types are much more common in India and the Middle East than sheep of Hb A (and AB) and LK types, it is suggested that the Hb B and HK genotypes confer an adaptive advantage in these areas and the animals which have these genotypes thrive best. The results of TANEJA et al.[8] support this hypothesis[14].

Résumé. On a effectué la numération globulaire et déterminé la concentration du potassium dans le sang de 2 races de moutons de l'Inde et dans celui des croisements de Corriedale et de Bikaneri. La prépondérance des types Hb B et HK indique que ce sont ces individus qui s'adaptent le mieux aux zones arides de l'Inde.

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Cytological Evidence Suggestive of Crossing Over Within the Mammalian *X* Chromosome

In 1966, GALTON[1] proposed that the mammalian sex chromosomes originated from an unbalanced translocation between the members of a homologous pair of autosomes and thus produced 2 chromosomes of unequal size that are now known as *X* and *Y*. If the hypothesis is correct, the *X* chromosome should contain a large duplication.

The morphology of the *X* chromosome in testicular preparations from 4 male squirrel monkeys (*Saimiri boliviensis*), 6 male rhesus monkeys (*Macaca mulatta*), 1 male dwarf galago (*Galago demidovii*), and 1 male tarsier (*Tarsius syrichta*) suggests that chiasmata occur within the mammalian *X* chromosome (Figure).

Testicular preparations were made in the usual manner[2] but with oversquashing of the material, which produced faintly stained preparations, that, in many cases, reveal the structure of the sex chromosomes in the sex vesicle. At least 500 cells/animal were examined and a mean of 50 cells/animal photographed. The *X* chromosome is always identifiable during prophase I: it is heterochromatic; it appears close to *Y*, which is also heterochromatic; and it is the only chromosome in which chiasmata are visible at pachytene, when the autosomes still show a rod-like shape. The characteristic configuration of the *X* chromosome can be clearly seen in almost 100% of the cells in *Saimiri* and in about 20% of the cells in the other species; the remaining cells show the typical, darkly stained sex vesicle in which the structure of the sex chromosomes is not visible.

The size and morphology of the *X* chromosome suggest that it is bent at a median point; the 2 strands of the chromosome are often visible. In *S. boliviensis* and *M. mulatta*, the only species studied about which adequate information on the mitotic chromosomes is available, the *X* chromosome is the size of the longer autosomes. Nevertheless, during pachytene *X* is only about half the size of the longer autosomal bivalents; at diplotene, it is still bent at a median point in most cells.

The morphology of the *X* chromosome suggests that crossing over takes place within it. In about 50% of the cells in which the configuration of *X* is visible, actual exchanges can be seen (Figures a and b). There is now evidence[3] that when an autosome translocates into its homologous, the resulting chromosome can still undergo crossing over during meiosis. In some specimens of the rodent *Sigmodon minimus*[3], 2 acrocentric chromosomes have undergone centric fusion; meiotic studies prove

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