differentiation into spores may be triggered by events which lead to the over-all decrease in rate of protein synthesis.

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[1] Kjeldgaard, N. O., and Kurland, C. G., *J. Mol. Biol.*, **6**, 341 (1963).
[2] Doi, R. H., and Igarashi, R. T., *J. Bact.*, **87**, 323 (1964).
[3] Gierer, A., and Schramm, G., *Nature*, **177**, 702 (1956).
[4] Mandell, J. D., and Hershey, A. D., *Anal. Biochem.*, **1**, 66 (1960).

GENETICS

Transferrin Variation in Kangaroos

Inherited variation in the electrophoretic mobility of the serum protein transferrin (siderophilin) has been established for a number of mammalian species[1–12] and for doves[13]. In other mammals[14,15], several colubrid snakes and one amphibian species, variants exist[16] and, although family data are not yet available, it is probable that they are also genetically determined. This communication reports the discovery of inherited variation in the transferrin of an Australian marsupial, *Megaleia rufa* (= *Macropus rufus*), commonly known as the red kangaroo.

Samples of serum or, in a few cases, heparinized plasma were subjected to electrophoresis in starch-gels under essentially the same conditions as those described by Smithies[17], with the exception that platinum electrodes were used at both terminals in a solution of 0·75 M boric acid and 0·125 sodium hydroxide. To several runs, 2–5 μc. iron-59 as ferric citrate were added to the serum. An autoradiograph was made by placing one-half of the gel in a thin sealed polyvinyl chloride bag and leaving it in contact with a 'Kodirex No-Screen' X-ray plate at − 30° C for 24–36 h. The other half was stained with amido black 10*B* (Gurr). Two transferrin patterns were observed. The first type possesses three iron-binding bands, the second four; in both types the fastest and slowest bands are very faint.

The family data are shown in Table 1. Some of them are in the form of mother–offspring combinations. The certainty with which one can ascribe the parentage of a young marsupial to the female in whose pouch it is found should be further exploited in the genetical investigation of this and other marsupial species. It is proposed that the difference between the two types is controlled by a single gene pair, Tf^1 and Tf^2. The first pattern is that of the homozygote $Tf^1\ Tf^1$, the second that of the heterozygote $Tf^1\ Tf^2$. Each allele determines three bands in a starch gel. The heterozygote on this basis possesses six kinds of transferrin, two pairs of which have identical mobilities in the electrophoretic system employed here. The expected phenotype of the postulated $Tf^2\ Tf^2$ homozygote is shown in Fig. 1. Attempts are being made to produce an animal of this genotype by mating captive heterozygous animals. The failure to discover it so far is attributable to its low frequency in the two series examined.

One sample, of 22 individuals, was from a very restricted area on Mount Murchison station near Wilcannia, New South Wales, and had a frequency of $Tf^2 = 0{\cdot}04$ (95 per cent confidence limits = 0·01 − 0·18).

Table 1. Family Data on Transferrin Variation in the Red Kangaroo

Parents		Offspring	
Female	Male	$Tf^1\ Tf^1$	$Tf^1\ Tf^2$
$Tf^1\ Tf^1$	?	7	0
$Tf^1\ Tf^2$	?	2	1
$Tf^1\ Tf^2$	$Tf^1\ Tf^1$	0	1
$Tf^1\ Tf^1$	$Tf^1\ Tf^2$	1	1
$Tf^1\ Tf^1$	$Tf^1\ Tf^1$	9	0

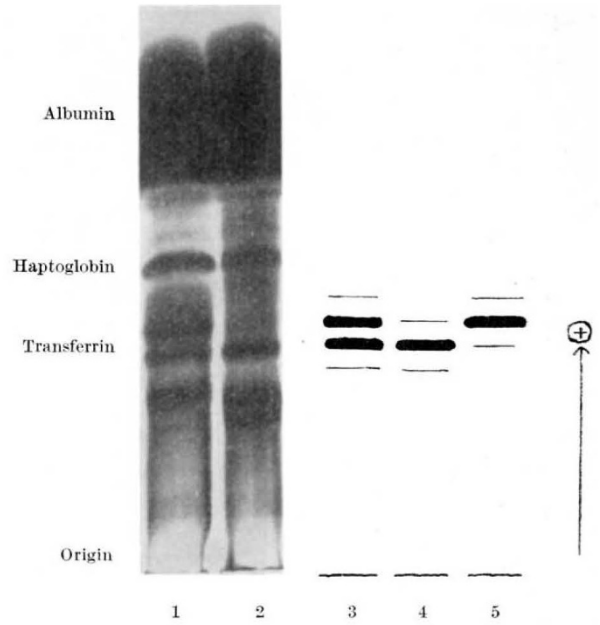

Fig. 1. 1, 2, Starch gel stained with amido black showing transferrin variants in the red kangaroo. 3, 4, Diagram of autoradiograph showing positions of iron-binding bands in 1 and 2 respectively. 5, Expected pattern of the iron-binding bands in the postulated $Tf^2\ Tf^2$ homozygote

A series of 34 individuals kept in captivity at the C.S.I.R.O. Division of Wildlife Research, Canberra, also had a frequency of $Tf^2 = 0{\cdot}04$ (95 per cent confidence limits = 0·004 − 0·11). These came from various widely separated areas of New South Wales and South Australia; in some cases, the point of capture was unknown. Data from the offspring of these animals are included in Table 1.

In the calculation of gene frequencies and confidence limits Cotterman's method of weighting[18] has been used to allow for the inclusion of related individuals. The 95 per cent confidence limits have been obtained using Steven's "Table for the Limits of the Expectation for Binomial and Poisson Distributions"[19].

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[1] Smithies, O., *Nature*, **180**, 1482 (1957).
[2] Ashton, G. C., *Nature*, **180**, 917 (1957).
[3] Hickman, C. G., and Smithies, O., *Proc. Gen. Soc. Canad.*, **2**, 39 (1957).
[4] Ashton, G. C., *Nature*, **182**, 1101 (1958) and unpublished results.
[5] Ashton, G. C., *J. Agric. Sci.*, **34**, 321 (1960).
[6] Kristjannson, F. K., *Science*, **121**, 1681 (1960).
[7] Ashton, G. C., and Braden, A. W. H., *Austral. J. Biol. Sci.*, **14**, 248 (1961).
[8] Cohen, B. L., *Genet. Res.*, **1**, 431 (1960).
[9] Shreffler, D. C., *Proc. U.S. Nat. Acad. Sci.*, **46**, 1378 (1960).
[10] Goodman, M., and Riopelle, A. J., *Nature*, **197**, 261 (1963).
[11] Buettner-Janusch, J., Twichell, J. B., Wong, B. Y-S., and Wagnenen, B. van, *Nature*, **192**, 948 (1961).
[12] Gahne, B., and Rendel, J., *Nature*, **192**, 529 (1961).
[13] Mueller, J., Smithies, O., and Irwin M. R., *Genetics*, **47**, 1385 (1962).
[14] Ashton, G. C., *Nature*, **182**, 1029 (1958).
[15] Lowe, V. A. W., and McDougall, E. I., *Nature*, **192**, 983 (1961).
[16] Dessauer, H. C., Fox, W., and Hartwig, Q. L., *Comp. Biochem. and Physiol.*, **5**, 17 (1962).
[17] Smithies, O., *Biochem. J.*, **71**, 585 (1959).
[18] Cotterman, C. W., *Contrib. Lab. Vest. Biol. Mich. Univ.*, **33**, 1 (1947).
[19] Fisher, R. A., and Yates, F., *Statistical Tables for Biolog. Agric. and Med. Research Workers*, fifth ed., Table VIII (Oliver and Boyd, London, 1957).