Heredity (1982), **48** (2), 305–309 0018-067X/82/04540305$02.00

ROBERTSONIAN TRANSLOCATIONS IN *MUS MUSCULUS* FROM N.E. SCOTLAND AND ORKNEY

P. C. BROOKER

Department of Zoology, University College London, London, U.K.

Received 9.xi.81

1. Introduction

A centric fusion (Robertsonian translocation) was first observed in house mice in the AKR inbred strain (Léonard and Deknudt, 1967). Following this Gropp and co-workers (Gropp, Tettenborn and von Lehmann, 1970) reported Robertsonian translocations in wild caught mice from the Val di Poschiavo in Switzerland, which had seven pairs of metacentric chromosomes and eleven pairs of normal acrocentrics. Gropp and Capanna have since described four populations in the Rhaetion Alps, three in the central Appenines, and two in Sicily (Capanna, 1980; Gropp and Winking, 1981). In addition metacentric bearing mice have been found in India (Chakrabarti and Chakrabarti, 1977), Marion Island in the South African sub-Antarctic (Robinson, 1978), Yugoslavia (Dulić, 1978), Spain and southern Germany (Adolph and Klein, 1981). This communication confirms and expands the report of Adolph and Klein on Robertsonian bearing mice in Orkney and N.E. Scotland.

2. Materials and methods

Thirty-five mice from 20 locations in Caithness and Sutherland and 84 mice from five islands in Orkney were examined. The mice were live-trapped in or near buildings or hand caught at threshings (Berry, 1970).

Chromosome preparations were made from peripheral blood lymphocytes cultured *in vitro*. An adaptation of the method of Triman, Davisson and Roderick (1975) was used, with Concanavalin A as a mitogen. After ageing the slides for at least seven days, the slides were G-banded according to the method of Buckland, Evans and Sumner (1971).

3. Results

The karyotypes of mice from Caithness and Orkney are listed in tables 1 and 2. In addition 82 mice from six other locations in the United Kingdom were also examined: from Fair Isle (north of the Orkney group), the Isle of May (in the Firth of Forth) and four sites in England (N. Yorkshire, Norwich, London and Taunton). These were all found to have a normal karyotype of $2n = 40$.

Table 1 shows that mice in Caithness contain a mixture of karyotypes. In the furthest N.E. tip around John O'Groats (see fig. 1), all the mice studied were $2n = 32$. West and south from here the chromosome number increased until the normal complement of $2n = 40$ was found in the Sutherland towns of Helmsdale and Melvich. However in the central part of the area karyotypes differ sharply over very small distances. The extreme

TABLE 1

Karyotype analysis of mice from Caithness and Sutherland

Locality (see map)	Nos. of ♂	Nos. of ♀	2*n*	Translocations 6–13	9–12	4–10	11–17	10–14	4–8	1–11	8–17	8–14	15–17	3–8	8–15	3–16	17–18	11–14
Caithness 1	2	1	32	hom	hom	hom	hom											
Caithness 2	2	1	32	hom	hom	hom	hom											
Caithness 3	1		32	hom	hom	hom	hom											
Caithness 4		1	36	hom	hom													
Caithness 5	1		33	hom	hom			hom	het									
Caithness 6		1	32	hom	hom	hom	hom											
Caithness 6		4	34	hom	hom	hom												
Caithness 7		1	35	het	hom					het	het							
Caithness 8	1		32	hom	hom	hom	hom											
Caithness 9		1	36	hom	hom													
Caithness 9	1		32	hom	hom	het						hom	het					
Caithness 9		1	36	hom	hom													
Caithness 9	1		33	hom	hom	hom								het				
Caithness 10		1	32	hom	hom	hom	hom											
Caithness 11	1		34	hom	hom			hom										
Caithness 12	1		36	hom	hom													
Caithness 13		1	32	hom	hom	het									hom	het		
Caithness 14		1	36	hom	hom													
Caithness 15	1		35	hom	hom												het	
Caithness 16	1		32	hom	hom						hom							hom
Caithness 17 and 18	3	1	36	hom	hom													
Sutherland 1 and 2	3	1	40															

TABLE 2

Karyotypic analysis of mice from Orkney

Locality	No. mice	2n	Translocations 9–12	3–14	4–10	6–14
Eday	22	34	hom	hom	hom	
Westray	14	36	hom			hom
Steness (mainland)	12	40				
S. Ronaldsay	22	40				
Stromsay	14	40				

situation was three different karyotypes in four mice caught in the one house in Keiss on the east coast (sample no. 9).

4. DISCUSSION

The situation in Caithness seems to fit the pattern beginning to emerge from the study of mouse populations with Robertsonian translocations

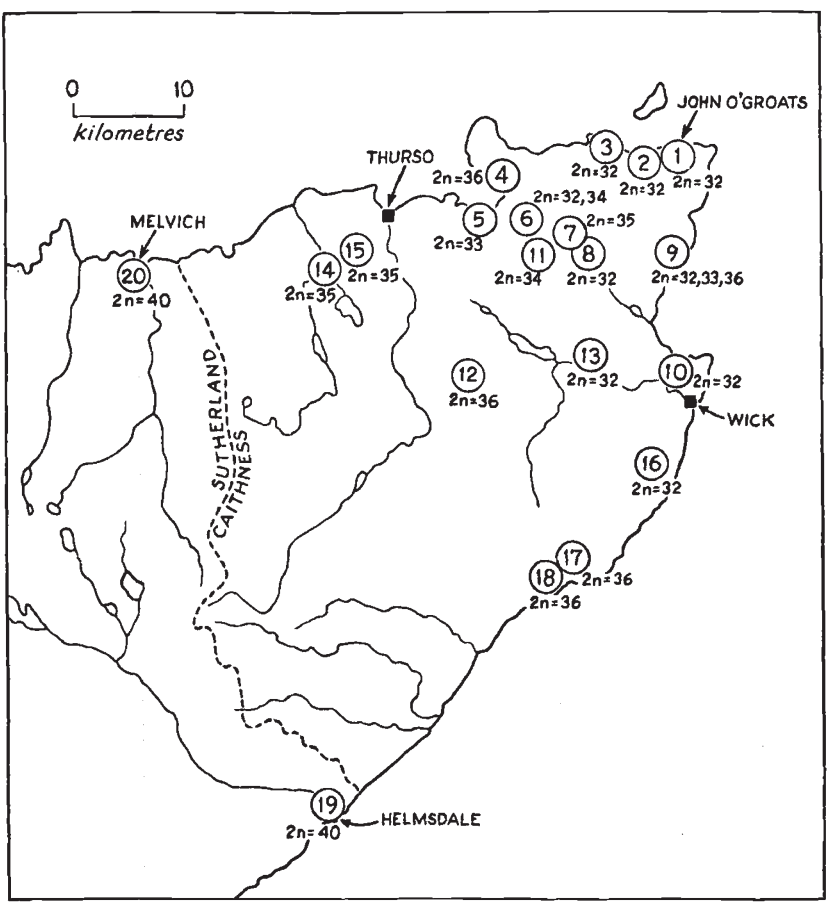

FIG. 1.—Map of Caithness showing collection sites and karyotype numbers.

elsewhere, that is of one or a few widespread associations in particular areas, together with other associations more restricted in distribution. In areas with metacentrics in both Italy and Germany, one to three associations occur in most mice with other associations present in more restricted localities. In Caithness Rb(9–12), Rb(6–13) were found in all mice; Rb(4–10) and Rb(11–17) were present in approximately one half and one third of the mice respectively. Eleven other associations were found in one or two mice only.

In Orkney, by contrast, the individual populations appear to be homogeneous. In the case of Eday the 22 mice tested came from three successive trappings, over an 18 month period from three different parts of the island. Adolph and Klein (1981) examined three mice from Eday and reported the same karyotype and associations. In every case the mice were homozygous for the three translocations shown in table 2. Likewise all the 14 mice tested from Westray were identical. Adolph and Klein also looked at mice from four other Orkney islands and found them all to be $2n = 40$.

Rb(9–12) has been found in all the Scottish "metacentric" mice so far examined. This translocation has not been reported from any other area, although it has occurred spontaneously in mice bred in the Genetics Department at Cambridge University from animals caught in Peru (M. E. Wallace, 1981, pers. comm.). It seems reasonable to assume that the Caithness and Orkney populations have a common ancestor and that they have diverged since.

There are two alternative theories as to why mice with Robertsonian translocations are present in northern Scotland. Either the original colonizers of the area carried them, or metacentric bearing animals have been introduced and have spread at the expense of "normal" mice. Capanna (1980) took the latter view for his Italian mice and suggested that the metacentric races represent the beginnings of speciation. White (1978) agreed with this interpretation and argued that this form of karyotypic change is an excellent sample of "stasipatric" speciation. Thaler, Bonhomme and Britton-Davidian (1981) on the other hand suggested that while these "chromosome races" may be termed semi-species, they are not on their way towards full speciation.

Cattanach and Moseley (1973) showed that gametic aneuploidy produced greatly reduced fertility in hybrids between metacentric bearing and normal mice. This could constitute the reproductive barrier necessary for speciation. However it would also make it very difficult for this type of mouse to spread. Therefore if the second theory is correct and metacentric bearing mice have spread at the expense of normal mice some advantage must accrue from the translocations.

Acknowledgements.—I should like to thank Mr A. J. Lee for drawing fig. 1 and Mrs A. E. Mitchell and Mr D. Franklin for photographic assistance. Professor R. J. Berry helped greatly in the preparation of this paper and with mouse collecting. I gratefully acknowledge the receipt of an N.E.R.C. studentship.

5. References

ADOLPH, S., AND KLEIN, J. 1981. Robertsonian variation in *Mus musculus* from central Europe, Spain and Scotland. *J. Hered.*, *72*, 219–221.

BERRY, R. J. 1970. The natural history of the house mouse. *Fld. Stud.*, *3*, 219–262.

BUCKLAND, R. A., EVANS, H. J., AND SUMNER, A. T. 1971. Identifying mouse chromosomes with the ASG (Acetic-saline Giemsa) technique. *Expl. Cell Res.*, *69*, 231–236.

CAPANNA, E. 1980. Chromosomal re-arrangement and speciation in progress in *Mus musculus*. *Fol. zool.*, *29*, 43–57.

CATTANACH, B. M., AND MOSELEY, H. 1973. Nondisjunction and reduced fertility caused by the tobacco mouse metacentric chromosomes. *Cytogenet. Cell Genet.*, *12*, 264–287.

CHAKRABARTI, S., AND CHAKRABARTI, A. 1977. Spontaneous Robertsonian fusion leading to karyotype variation in the house mouse—first report from Asia. *Experientia*, *33*, 175–177.

DULIĆ, B. 1978. Chromosomes of small mammals from south-western karstic regions of Yugoslavia. II. *Intern. Theriol. Congr. Brno* (1978) Abstr., *133*.

GROPP, A., TETTENBORN, U., AND VON LEHMANN, E. 1970. Chromosomenvariation vom Robertson'schen Typus bei der Tabakmus, *M. poschiavinus* und ihren Hybriden mit der Laboratoriumsmaus. *Cytogenet.*, *9*, 9–23.

GROPP, A., AND WINKING, H. 1981. Robertsonian translocations, cytology, meiosis, segregation patterns and biological consequences of heterozygosity. *Symp. zool. Soc. Lond.*, *47*, 141–181.

LÉONARD, A., AND DEKNUDT, G. H. 1967. A new marker for chromosome studies in the mouse. *Nature, Lond.*, *214*, 504–505.

ROBINSON, T. J. (1978). Preliminary report of a Robertsonian translocation in an isolated feral *Mus musculus* population. *Mamm. Chrom. Newsletter*, *19*, 84–85.

THALER, L., BONHOMME, F., AND BRITTON-DAVIDIAN, J. 1981. Processes of speciation and semi speciation in the house mouse. *Symp. zool. Soc. Lond.*, *47*, 27–41.

TRIMAN, K. L., DAVISSON, M. T., AND RODERICK, T. H. 1975. A method for preparing chromosomes from peripheral blood in the mouse. *Cytogenet. Cell Genet.*, *15*, 166–176.

WALLACE, M. E. 1981. Spontaneous occurrence of Rb(9–12) in Peru stocks. Pers. comm. *Mouse News Letter*, *64*, 49.

WHITE, M. J. D. 1978. Chain processes in chromosomal speciation. *Syst. Zool.*, *27*, 285–298.