Autosome composition of the Malayan house shrew, *Suncus murinus*

2n	Autosomes[a]					NA[b]	No. of karyotypic classes
	m_t	m	sm	sa	a		
40	0	6	2	6	24	52	1
39	1	6	2	6	22	52	2
38	2	6	2	6	20	52	3
37	3	6	2	6	18	52	2
36	4	6	2	6	16	52	1

[a] m_t, 'translocation' metacentric; m, metacentric; sm, submetacentric; sa, subacrocentric (= subtelocentric); a, acrocentric. [b] NA, total number of autosome arms. It is assumed that only 2 types of 'translocation' metacentric are involved.

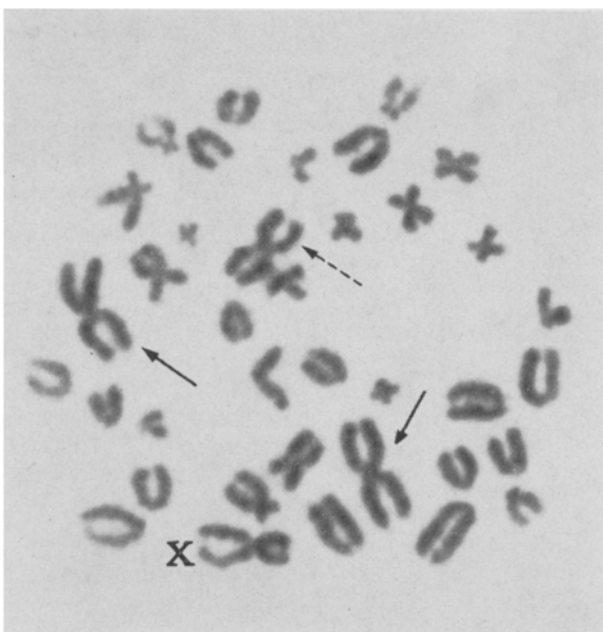

Fig. 3. Chromosomes at metaphase in a bone marrow cell from *Suncus murinus* male trapped at Kuala Lumpur with $2n = 37$. This shrew was homozygous for the longest 'translocation' metacentric (arrowed) but heterozygous for the other element (broken arrow).

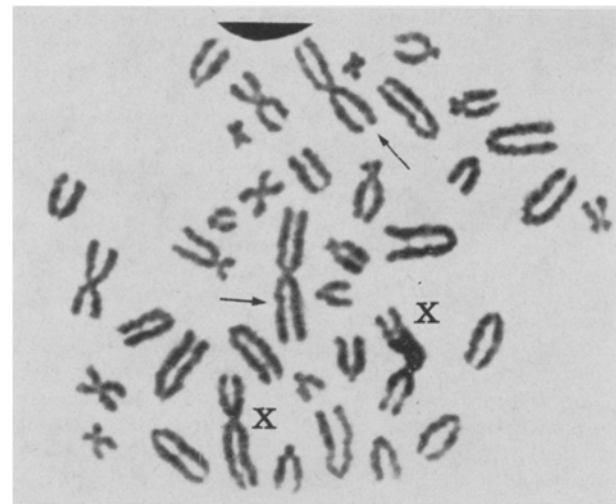

Fig. 4. Chromosomes at metaphase in a bone marrow cell from *Suncus murinus* female trapped at Ipoh with $2n = 38$. This shrew was heterozygous for both the 'translocation' elements (arrowed).

murinus is more extensive than the present finding could only be answered when more specimens have been examined. It is, however, certain that $2n = 40$ forms one end of the spectrum; the present lower limit is $2n = 36$.

Based on the existing data and assuming that only 2 kinds of 'translocation' metacentric are involved, there should exist 9 karyotypic classes viz. 1 each for 36 and 40 chromosome types, 2 each for 37 and 39 chromosome types, and 3 for 38 chromosome type (Table). These karyotypic classes can be positively identified as the largest metacentric element is longer than the *X*-chromosome while the other large metacentric element is shorter. The $2n = 36$ and 37 karyotypic classes and 2 of the 3 $2n = 38$ karyotypic class are described in this report. The third $2n = 38$ karyotypic class is represented in Figure 1 of ref.[8] while the two $2n = 39$ karyotypic classes are represented in Figures 2 and 4 of ref.[8] and the $2n = 40$ karyotypic class represented by Figure 3 of ref.[8]. Hence all the 9 karyotypic classes based on the 2 'translocation' elements have been found in the Malayan *Suncus murinus*. Further studies – meiotic, population, etc. – are being conducted to seek an answer to some of the questions posed by the extensive karyotypic variation in this animal[15].

Zusammenfassung. Zwei neue Chromosomen ($2n = 36$ und 37; früher 38, 39 und 40) wurden in der malayischen Spitzmaus *Suncus murinus* gefunden und als numerische Variationen der Robertsonschen Translokation zugeschrieben. Es wird angenommen, dass es sich um zwei Arten von «Translokation» handelt, die metazentrisch mitwirkten und woraus die Produktion 9 karyotypischer Klassen resultiert.

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[15] I thank Mr TEH KOK LENG for technical and Miss KUAN LAI WAH for clerical assistance.

Structural Correspondence Between Nucleolus- and Sphere-Organizing Regions of the Lampbrush Chromosomes and Secondary Constrictions of the Mitotic Chromosomes[1]

In two previous works, a definitive description has been given of the karyotype of the lampbrush chromosomes[2] and that of the mitotic chromosomes[3] of the Italian alpine newt *Triturus alpestris apuanus* (Bonaparte, 1839). The former is diagrammatically represented in the form of maps arranged in decreasing order on the basis of the relative lengths[4], showing the centromeres (vertical arrows), the regions in which there is greater preference for the formation of cha ismata (horizontal brackets), the nucleolus-organizing regions (white circles) and the sphere-organiz-

ing regions (black circles). The maps also show the main loops and the other landmarks described in another work[4] (Figure 1).

The mitotic karyotype is given here diagrammatically in the form of an idiogram of the haploid set, in which the individual elements have been arranged in a series that respects their correspondence with the relative lampbrush chromosomes, and in which are also indicated all the heterochromatic regions (Figure 2).

Comparative examination between lampbrush chromosomes and mitotic chromosomes reveals, first and foremost, that the nucleolus-organizing regions present on lampbrush chromosomes VIII and X correspond to the heterochromatic tracts of mitotic chromosomes VIII and X, present in the median and subterminal positions respectively: for this reason, these tracts have been indicated on the idiogram by the letters (no). Moreover, it is also found that the sphere-organizing regions present on lampbrush chromosomes I, II, IV and IX correspond to heterochromatic tracts of the respective mitotic chromosomes I, II, IV and IX, which, for this reason, have been indicated on the idiogram by the letters (s). It appears more difficult, at the present moment, to trace a correspondence between particular landmarks of the lampbrush chromosomes and the heterochromatic tracts, subterminal of elements I and VI and proximal of all the elements. However, for these last, it may be pointed out that at the two sides of the centromere the lampbrush chromosomes present the densest alignment of landmark loops.

The relationship between secondary constrictions and the nucleolus-organizing regions is a very interesting confirmation of what had already been envisaged from the very first observations on the chromosomal origin of the nucleoli in vegetable and animal material[5,6] and had also

[1] With financial support by C.N.R., Rome.

[2] I. Nardi, M. Ragghianti and G. Mancino, Experientia, in press.

[3] M. Ragghianti, I. Nardi and G. Mancino, Experientia, in press.

[4] G. Mancino and G. Barsacchi, Caryologia *18*, 637 (1965).

[5] B. McClintock, Z. Zellforsch. *21*, 294 (1934).

[6] W. H. Dearing, J. Morph. *56*, 157 (1934).

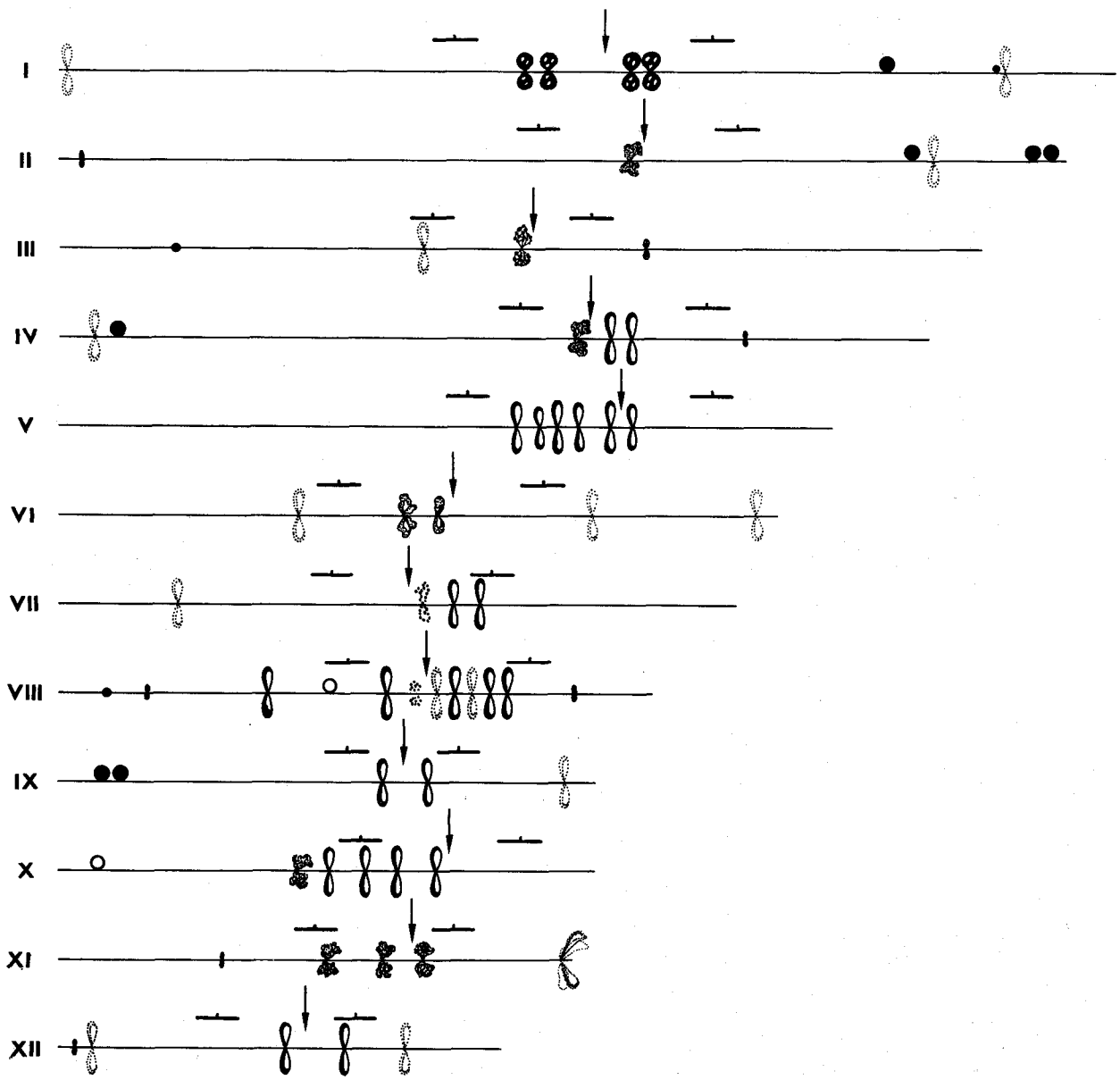

Fig. 1. Maps of the 12 lampbrush chromosomes of *T. alpestris apuanus*.

been verified in other species of urodele Amphibians[7,8]. The structural relationship between secondary constrictions and sphere-organizing regions, already demonstrated in *T. viridescens*[7] and discarded in the axolotl[9], assumes a particular importance on account of certain implications of a genetic and functional order: in fact, the spheres are organites present exclusively in the germinal vesicle of the oocytes, where they form at specific chromosomal sites, later being released into the nuclear sap. Thus, the nucleus of the oocytes of Amphibians contains hundreds of multiple nucleoli and a smaller number of free spheres. Unlike the nucleoli, however, the spheres do not incorporate H^3-uridine, at least in medium and large-sized oocytes, and reveal high protein metabolism[10]. The inserted spheres are among the last landmarks of the lampbrush chromosomes to dissa ppear in oocytes in the pre-ovulatory period[11] and may be replaced by loops when maturation is induced by gonadotropic hormones or by in vitro incubation of oocytes with progesterone[12]. An important indication regarding the structural and functional difference between the heterochromatin connected with the formation of the nucleoli and that connected with the formation of the spheres also appears clearly from the results of RNA/DNA molecular hybridization on cytological preparations of lampbrush chromosomes: the segment of the sphere is seen to be intensely labelled, together with the centromere DNA and that of the telomeres, when use is made of radioactive RNA transcribed by DNA deprived of the fractions containing cistrons coding for rRNA; so that also at the level of the sphere-organizing regions a repetitive DNA would be present[13]. It remains to determine the precise significance of these organites in the oocytes, also on account of the fact that in certain urodeles – e.g. in *Triturus marmoratus* – neither inserted spheres nor spheres free in the nuclear sap have been noted[14].

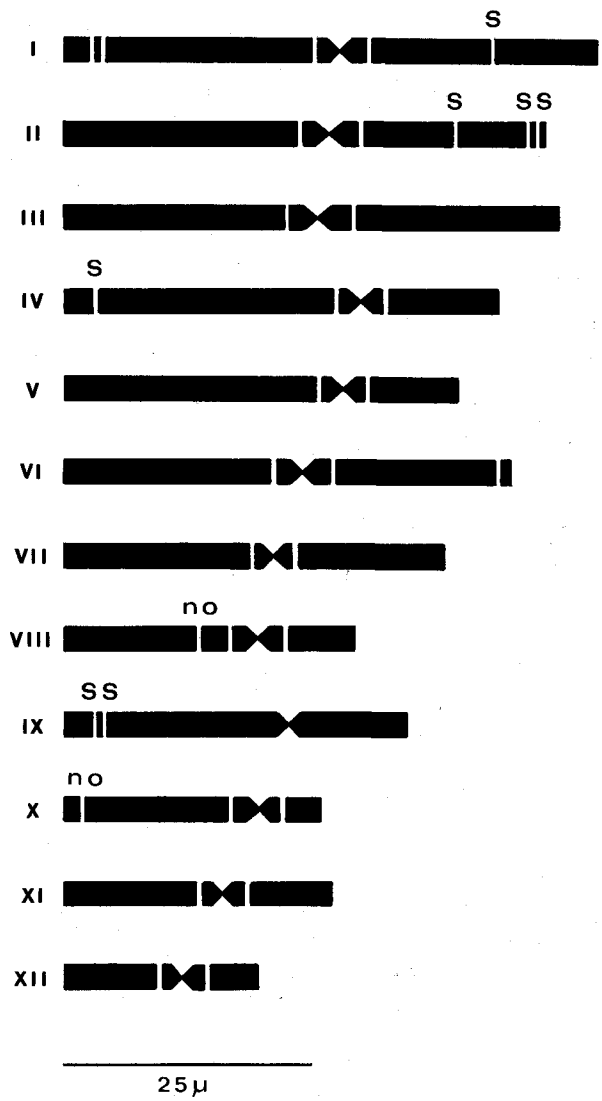

Fig. 2. Idiogram of the 12 mitotic chromosomes of the haploid set. Further explanation in the text.

Riassunto. Le regioni nucleolo-e sfera-organizzatrici dei «lampbrush chromosomes» di *Triturus alpestris apuanus* corrispondono a costrizioni secondarie presenti sui rispettivi cromosomi mitotici. Questo dato ripropone l'interesse per lo studio dell'origine e del significato delle sfere negli ovociti in accrescimento.

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Istituto di Zoologia e Anatomia Comparata dell'Università, Via Volta 4, Pisa (Italy), 28 September 1971.

[7] J. G. GALL, J. Morph. *94*, 283 (1954).
[8] G. BARSACCHI, L. BUSSOTTI and G. MANCINO, Chromosoma *31*, 255 (1970).
[9] H. G. CALLAN, J. Cell Sci. *1*, 85 (1966).
[10] G. MANCINO, G. BARSACCHI and I. NARDI, Atti Accad. naz. Lincei *44*, 102 (1968).
[11] G. MANCINO and G. BARSACCHI, Boll. Soc. tosc. Sci. nat., Mem. B, *73*, 113 (1966).
[12] G. BARSACCHI, Boll. Zool. *38* (1971), in press.
[13] G. BARSACCHI, Boll. Zool. *37*, 474 (1970).
[14] I. NARDI, M. RAGGHIANTI and G. MANCINO, Chromosoma, in press.

Completion of the Morphology of the Lampbrush Chromosomes of the Italian Alpine Newt *Triturus alpestris apuanus* Bonaparte[1]

The lampbrush chromosomes of the Italian alpine newt *Triturus alpestris apuanus* (Bonaparte, 1839) have already been the subject of a previous karyological study which concluded with the presentation of the first chromosome maps of the species[2]. To that work is now added this new contribution, which completes the morphology of the individual elements with the identification of all the fundamental landmarks – such as the centromeres, the nucleolus-organizing regions and the sphere-organizing regions – that were partly or completely lacking in the previous description (Figure 1).

The centromeres (indicated with arrows) have been identified on each element: they appear as enlarged chromomeres, generally devoid of loops, situated between the 2 regions where there is a preference for chiasmata to form. The nucleolus-organizing regions (*no*) have been identified on the mid-region of chromosomes VIII and on the left subterminal position of chromosomes X. They can be

[1] With financial support by C.N.R., Rome.
[2] G. MANCINO and G. BARSACCHI, Caryologia *18*, 637 (1965).