high metabolic levels of hypothalamus. Nevertheless these observations are in complete agreement with those performed by SAITO et al.[8], in which it was demonstrated that FSH releasing factor appears in the peripheral blood of hypophysectomized rats, probably as a consequence of an increased synthesis of this hypothalamic factor, and that this peripheral FSH releasing factor activity disappears after castration of hypophysectomized animals. If changes in the oxidative metabolism of hypothalamus are considered as representative of modifications in the synthesis of the releasing factors, these experiments could help explain the decrease in the oxygen uptake of the anterior and posterior hypothalamus which was observed in hypophysectomized rats after gonadectomy.

Since the only difference between hypophysectomized-castrated and hypophysectomized rats is that in the latter some androgen secretion remains, it can be postulated that the absence of the depressor effect of gonadotrophins is not solely responsible for the increase in the metabolic activity of hypothalamus; the presence of some androgenic activity is also necessary for this increase. Whether or not this finding is concerned with the fact that the presence of testes is necessary for the increase of FSH releasing factor in hypophysectomized rats remains to be studied.

Resumen. Los resultados obtenidos han indicado que el incremento del consumo de oxígeno en el hipotálamo anterior y posterior de los animales hipofisectomizados desaparece si estos animales son castrados simultaneamente con la hipofisectomía. Se discute la importancia de la presencia del testículo en la elevación de la actividad metabólica del hipotálamo luego de la hipofisectomía.

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The Karyotype of the Black Rat (*Rattus rattus* L.). Another Population with a 38-Chromosomes Complement

Following the classical observations of numerous authors[1–4], the diploid number of the black rat (*Rattus rattus* L.) is now fixed at $2n = 42$. This diploid number has also been confirmed recently by YOSHIDA et al.[5], for black rats of 2 Japanese populations, and by YONG[6] in the Malayan *Rattus rattus diardii* (Jentink). Both these recent observations were carried out by employing the bone marrow technique, which allows an excellent characterization of the morphology of the karyotype. The results of all these observations indicate, for *Rattus rattus*, a diploid number that is unmistakably fixed at $2n = 42$. In fact, this is the diploid number given for this species in the latest critical list of the diploid numbers of the eutherian mammals[7].

However, in a number of this periodical there is a report by BIANCHI et al.[8] on 2 South American populations of *Rattus rattus* showing a chromosome-complement of $2n = 38$. This fact has prompted us to publish our past observations, which were merely a preliminary report by two of us[9], on the discovery of a similar chromosome complement in an Italian population of *Rattus rattus*.

In the course of an investigation involving studies on the indigenous populations of the small Italian islands[10], we had the opportunity of studying, from the cytotaxonomic point of view, the populations of *Rattus rattus alexandrinus* Geoffroy of the islands of Giglio and Giannutri (southern Tuscan archipelago). The karyotype of the black rats captured here is constantly characterized by a diploid number of $2n = 38$.

A study was made of the chromosomes of 13 specimens from Giglio and 7 from Giannutri, using both the method of primary cultures of splenic fibroblasts and that of bone marrow. In order to check whether the karyotype anomaly was limited to the island area, we studied the populations of *Rattus rattus* of the Argentario promontory, which is connected to the mainland by 2 natural dunes and an artificial dam (see map shown in Figure 3), and of the inland area of the Tuscan Maremma. Also in these cases (14 specimens studied) the karyotype was constantly found to be characterized by $2n = 38$.

Also in our case, as in that reported by BIANCHI et al.[8], the decrease in the diploid number may be imputed to 2 Robertsonian[11] translocations, in a homozygous condition, which have produced 2 pairs of large metacentric autosomes from 4 pairs of acrocentric chromosomes. The pairs of acrocentric autosomes involved in this Robertsonian process would appear to be the same in the 2 populations (Italian and South American), at least as far as may be seen from a comparison between our figures and those published by BIANCHI et al.[8]. A precise karyometric assessment will provide more reliable information in this respect, and we are now in process of working on our karyometric data.

The interest of this report goes well beyond a mere confirmation of a strange diploid number. In fact, we find ourselves in the position of having to justify data in

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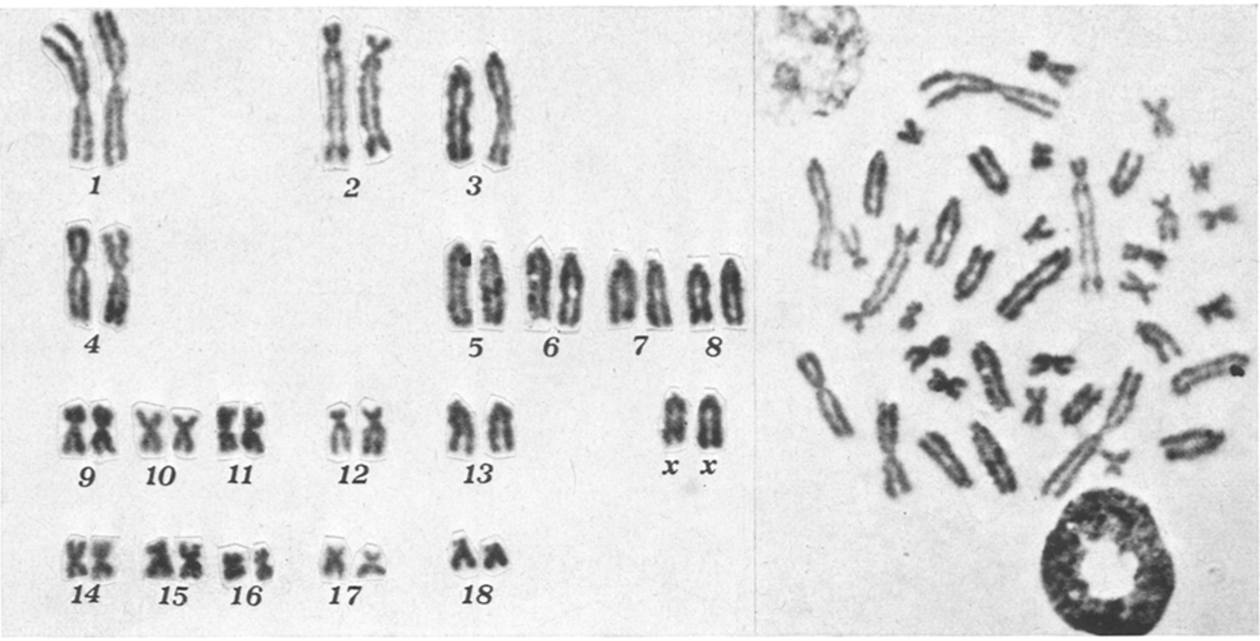

Fig. 1. Karyotype of female black rat (*Rattus rattus* L.), from Giannutri island.

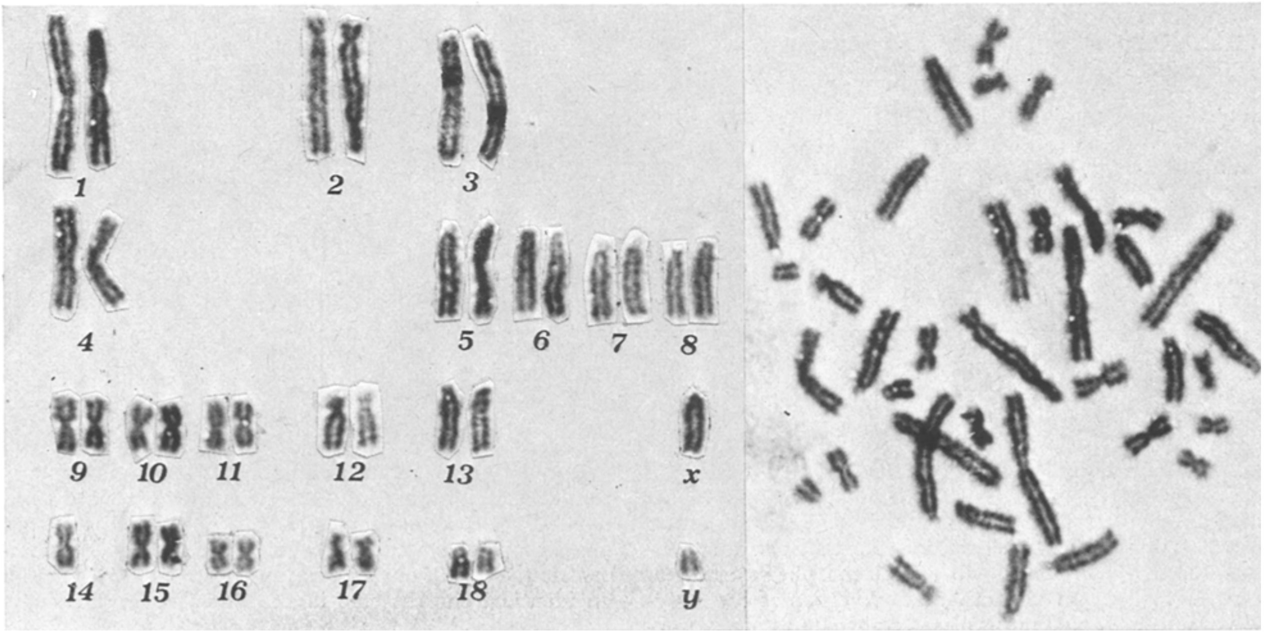

Fig. 2. Karyotype of male black rat from the inland of Tuscany.

apparent contrast to other: the morphological identity of the karyotype, up to now considered anomalous, in 2 black rat populations so sharply separated (Mediterranean Europe and South America), contrast with the plentiful evidence of the widespread existence of a diploid number $2n = 42$. There is therefore no other possibility but to advance the theory of a chromosome polymorphism within the species *Rattus rattus*. On the other hand, chromosome polymorphism must not be considered to be a rare phenomenon among rodents; vide, for example, among the numerous works on the subject, those of MATTHEY on *Acomis*[12], and *Leggada*[13], those of VORONTSOV et al.[14] on *Ellobius* and those of WARHMAN et al.[15] on *Spalax*.

We must not forget the early observations carried out by PINCUS[16] and by CROSS[17], who, in studying the North American populations of *Rattus rattus*, had established a diploid number of $2n = 40$! It should also be borne in mind

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Authors	Large autosomes		Small autosomes				
	Metacentrics	Submetacentrics	Metacentrics	Submetacentrics	Acrocentric autosomes	$2n$	aFN
Yoshida et al.[5]	–	(1)[a]	7	–	13	42	54[b]
Yong[6]	–	–	7	2	11	42	58
Bianchi et al.[8]	2	1	7	1	7	38	58
Present observations	2	1	6	2	7	38	58

$2n$, diploid number; aFN, autosomal fundamental number. [a] The largest pair of autosomes in part of the individuals is heteromorphic (one telocentric, the other subtelocentric). [b] Autosomal fundamental number is calculated in the homozygous situation of the largest pair of autosomes considered as acrocentrics.

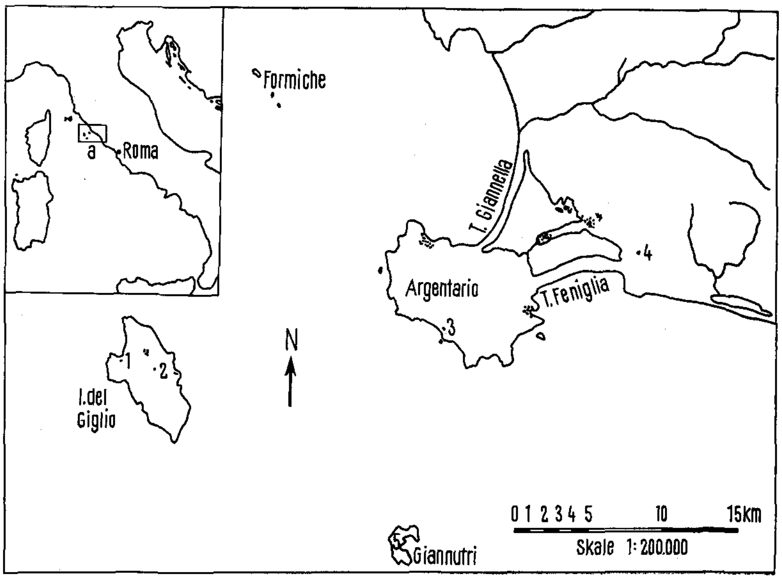

Fig. 3. Map of the area where the animals were collected; numbers mark the sites where the captures were carried out.

that Pincus maintained the presence, in this 40-chromosome karyotype, of a pair of large metacentric autosomes. It is very probable that a new and more accurate examination of the karyology of the North American populations of *Rattus rattus* will reveal the phenomenon of centric fusion. On the other hand, chromosome polymorphism in *Rattus rattus* already appears as a considerably complex phenomenon, merely from a comparison between the karyological observations so far available (see Table).

A first consideration is suggested by the large submetacentric autosome (No. 2 of our karyotype). It is also present in the karyotype supplied by Bianchi et al.[8] but not in that reported by Yong[6]. In the karyotype of the Japanese populations studied by Yoshida et al.[5], this chromosome is in a particular condition, since it is observed in a heterozygous situation in a heteromorphic pair only in a limited percentage of the population. The mechanism of chromosome transformation capable of producing this change is that of pericentric inversion. Other pericentric inversions must be invoked in order to explain the differences that exist in the different karyotypes, with regard to the number and form of the small metacentric and submetacentric autosomes (see Table).

The karyotype of the population that we studied and that relative to the South American black rats are those most alike; however, in the karyotype of the rats of our population, one small autosome is markedly submetacentric (No. 12 of our karyogram) and is not matched by an identical chromosome in the karyotype supplied by Bianchi et al.[8].

The study of the polymorphism of *Rattus rattus* therefore appears highly promising, especially considering the ubiquitous distribution of this species, and the fact that both Robertsonian translocations and non-Robertsonian changes seem to be involved in this chromosome polymorphism. We have planned a wide-scale investigation of the European and Mediterranean populations and some material has already been collected.

One last consideration is suggested by the apparent identity of the pairs of acrocentric autosomes involved in the Robertsonian fusion in 2 such widely separated populations (Italy and South America). Two hypotheses may be advanced: (1) that centric fusion has occurred between the same pairs of autosomes independently in the 2 separate populations, which would show that particular chromosome areas possessed a readiness to fuse, in relation to the presence to structurally homologous areas; or

(2) that the 2 populations are interconnected by the same system that is responsible for the ubiquitous diffusion of the species, which is that associated with the black rat's condition as man's commensal. It is not improbable that some rats of Mediterranean Europe may even have reached America with . . . Christopher Columbus!

Riassunto. In una popolazione italiana di *Rattus rattus* L. è stato messo in evidenza un cariotipo a 38 cromosomi; la differenza nel numero diploide rispetto a quanto noto per altre popolazioni della stessa specie è dovuta a due fusioni centriche in condizione omozigote. Il confronto con i cariotipi forniti da altri autori per la specie *Rattus rattus* ci fa proporre anche per questa specie di Roditori la presenza di un fenomeno di polimorfismo cromosomico.

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Chromosome Polymorphism in Deer Mouse Siblings (*Peromyscus maniculatus*)

Earlier chromosome studies demonstrated an unusual chromosome polymorphism both within and between subspecific members of *Peromyscus maniculatus*[1–4]. Although multiple balanced chromosome translocations have not been completely ruled out, most authors favor the explanation of pericentric inversions as probably representing the basic mechanism for the chromosome polymorphism. However, these inversions may be complemented in some animals by variation due to the matings of animals with different karyotypes. The present study indicates that sibling offspring of the same parents also demonstrate this chromosome polymorphism.

Materials and methods. The animals used for this study are from a colony of *Peromyscus maniculatus* maintained at the University of Washington; the animals in the colony have resulted from free interbreeding among members of the pure subspecies *Peromyscus maniculatus rubidis*, *Peromyscus maniculatus gambelli*, and *Peromyscus maniculatus sonoriensis* over a period of several years. A total of 14 offspring from multiple matings between 2 of these colony animals had successful chromosome analysis. The routine chromosome studies on these animals utilized the microtechnique for culturing leukocytes from whole-blood as previously described[5].

Results. For ready comparison between animals, the chromosomes are placed into 3 groups as previously described: (A) large submetacentric chromosomes; (B) acrocentric chromosomes; and (C) small submetacentric and metacentric chromosomes[3]. Within each group the chromosomes are arranged in decreasing size. Examination of the representative karyotypes in Figures 1, 2 and 3 suggests that a number of the chromosomes can be paired on the basis of size and morphology, while others cannot. Since the acrocentric chromosomes are most readily distinguished, the primary comparisons among the animals are based upon the acrocentric number, as summarized for the 14 siblings in the Table. The father of these animals had 15 acrocentric chromosomes and 10 large submetacentric chromosomes. The studies on the mother were unsuccessful.

The number of acrocentric chromosomes varies from 12–15 in the females and 14–16 in the males (see Table). The number of the large metacentric chromosomes in Group A appears to vary from 9–11. Since the chromosome number was constant at 48 in all animals examined, the relative proportion of the chromosomes in each group will vary if the chromosome complement within one group, such as the B (acrocentrics), varies. However, because of the difficulty in establishing where the A group ends and the C group begins in some instances, no specific conclusions were attempted for these groups. The sex chromosomes could not be specifically identified in all animals and therefore are not marked in the figures.

Discussion. The findings in the present study confirm a constant diploid chromosome number of 48 for *Peromyscus maniculatus*. The results also indicate that the previously described chromosome polymorphism can be seen among closely related animals (siblings). While some differences between animals of different sexes can be attributed to the sex chromosomes, the full extent of the chromosome variance between male and female as well as the differences within each sex cannot be attributed to this explanation.

These results do not give a further insight into the possible etiology of the observed chromosome polymorphism, although they are consistent with the above-mentioned pericentric inversion possibility. If the chromosome studies had been successful on both parents of these animals, it might have been possible to determine that the chromosome differences among the animals could be

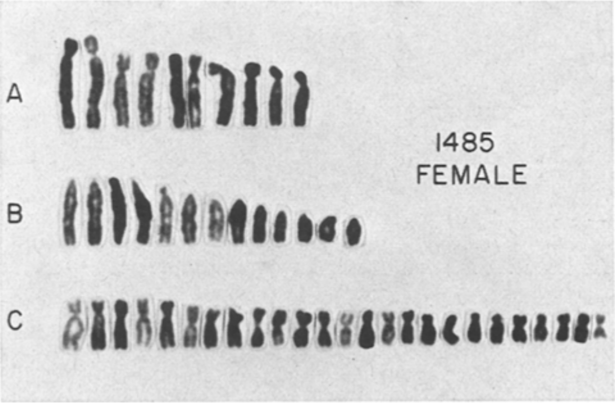

Fig. 1. Animal 1485 is female and has 13 acrocentric chromosomes (B Group). On the basis of size alone the distinction between the smallest A Group chromosome and largest C Group chromosome is not clear, but on comparison with other animals they seem to fit best as illustrated.

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