Table 1 *Average thickness of different tissues of fronds in two Rajasthan ferns* (μ)

	A. prolifera	*D. cochleata*
Locality	Sitabari	Mt. Abu
Cuticle	0.86 ± 0.046	0.67 ± 0.031
Upper epidermis	22.22 ± 0.332	26.21 ± 0.216
Palisade	181.8 ± 0.658	155.39 ± 0.569
Lower epidermis	19.91 ± 0.365	23.45 ± 0.481
Upper + lower epidermis	42.13 ± 1.611	49.66 ± 1.008
Total thickness of pinna	224.79 ± 1.484	205.72 ± 1.045

cuticle and palisade leading to overall pinna thinness (205.72 ± 1.045 μ) is better adapted to humid situations at Mt. Abu where organic humus rather exaggerates the prevailing humidity. The present study reveals that although different genera were used for the investigation, the overall dimensional changes in cuticle, epidermis, palisade and pinna are indicative of physiological adaptations of the Rajasthan ferns to their respective habitats.

Financial assistance by UGC, New Delhi is gratefully acknowledged.

8 December 1986

1. Bhardwaja, T. N., Yadav, A. K. and Gena, C. B., *J. Bombay. Nat. Hist. Soc.*, 1978, **75,** 533.
2. Bhardwaja, T. N., Gena, C. B., Takker, T., Kaur, R. and Wadhwani, C., *J. Bombay. Nat. Hist. Soc.*, 1981, **78,** 639.
3. Bhatt, J. G. and Andal, R., *Proc. Indian Acad. Sci. (Plant Sci.)*, 1979, **B88,** 451.
4. Magitt, M. and Magitt, E., *Bot. Centr.*, 1930, **17,** 223.
5. Shields, L. M., *Bot. Rev.*, 1950, **16,** 399.

CONSTITUTIVE HETEROCHROMATIN IN THE PALM SQUIRREL, *FUNAMBULUS PALMARUM* LINN (MAMMALIA—RODENTIA)

N. V. ASWATHANARAYANA and
S. KRISHNA RAO
Department of Zoology, University of Mysore, Manasagangotri, Mysore 570 006, India.

THE genus *Funambulus* includes 5 species viz *F. pennanti*, *F. tristriatus*, *F. palmarum*, *F. sublineatus* and *F. lyardi*. All the species are distributed in peninsular India and Sri Lanka except *F. pennanti* which is confined to North India[1]. Some karyological data are available for *F. pennanti*, *F. tristriatus* and *F. palmarum*[2–9]. In this communication, G- and C- banding of the chromosomes of *F.p. palmarum* are presented for the first time for the genus *Funambulus* and the karyotypes of the known species are compared.

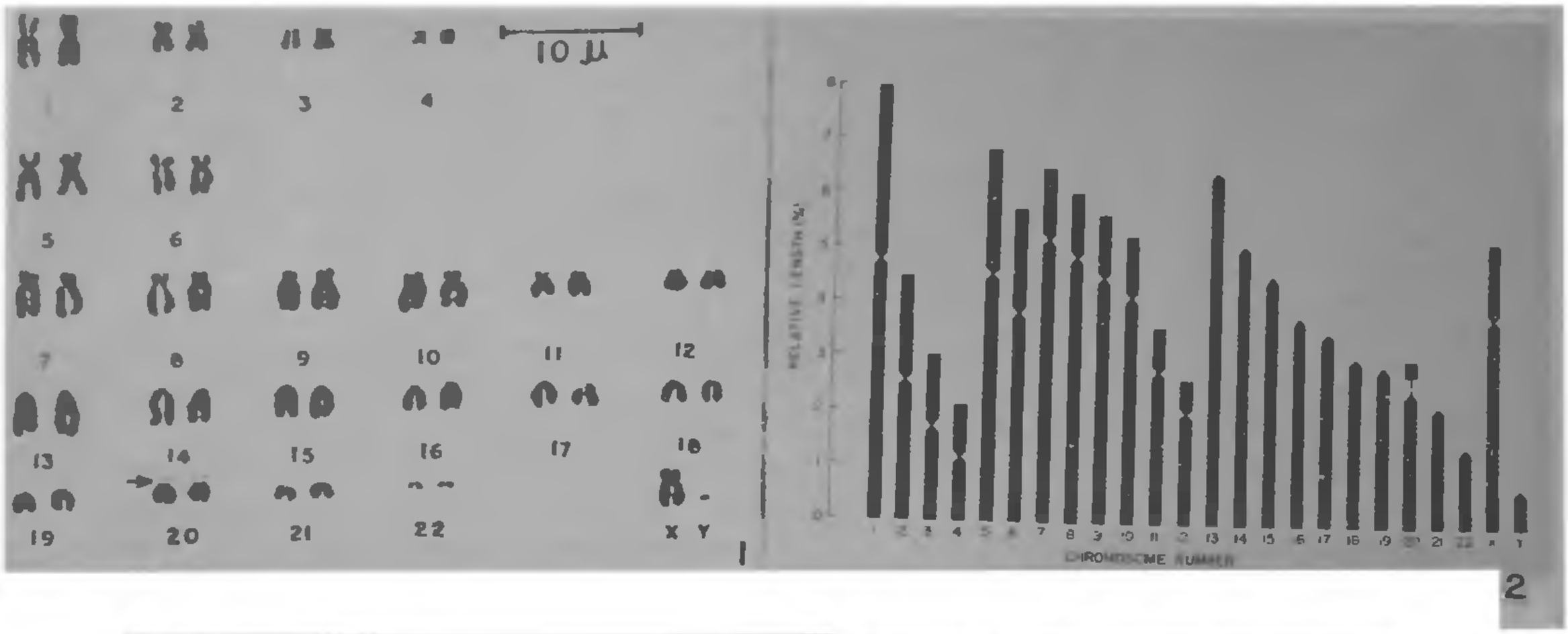
In this study 12 males and 12 females caught in the environs of the University campus and the outskirts of Mysore (S.W. India) have been used. Bone marrow and spleen were utilized for chromosome preparations applying air-dry method. The technique of Sumner *et al*[10] for G- banding and Sumner's method[11] with a slight modification for C- banding were applied.

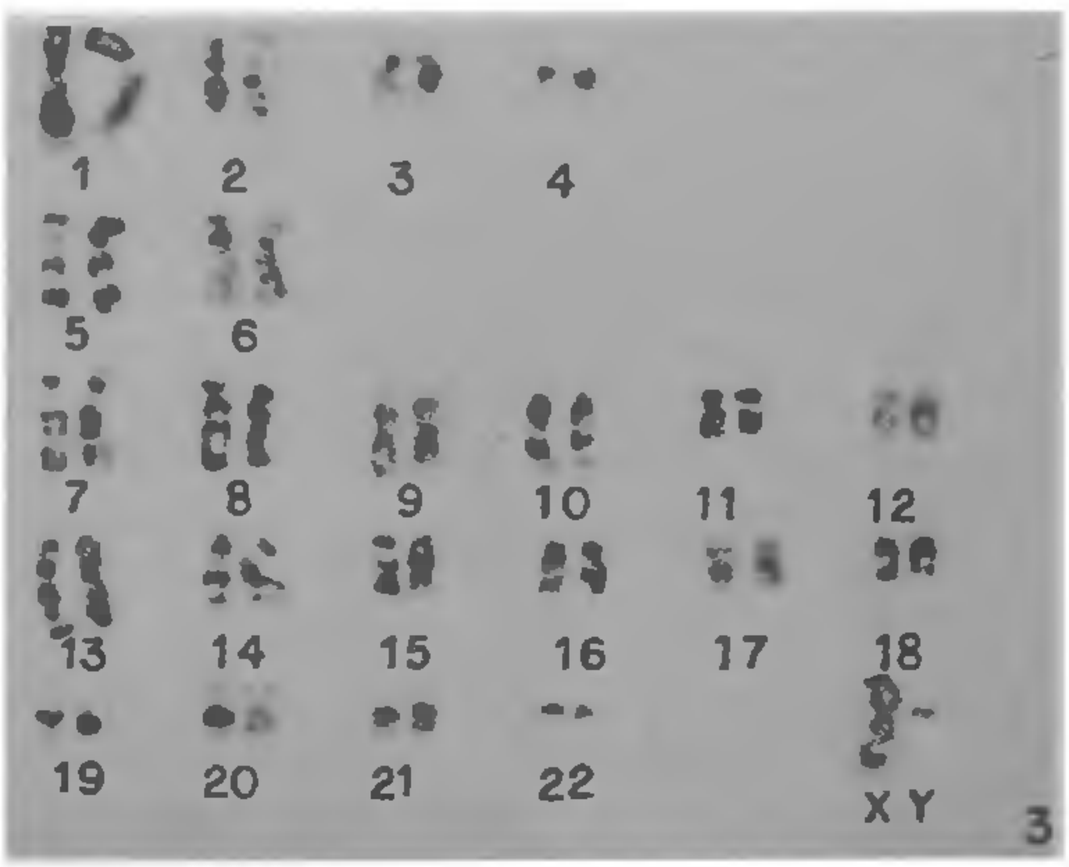
All the specimens showed a diploid chromosome number of 46 with an autosomal fundamental number (FN) of 68. The karyotype has 4 pairs of metacentric, 2 pairs of submetacentric, 6 pairs of subacrocentric and 10 pairs of acrocentric chromosomes in graded series. A pair of acrocentrics bear small 'satellites'. The *X* chromosome is submetacentric measuring 5.2% of the haploid genome while the *Y* chromosome is the smallest acrocentric (0.6%) whose identification is unequivocal (figures 1 and 2).

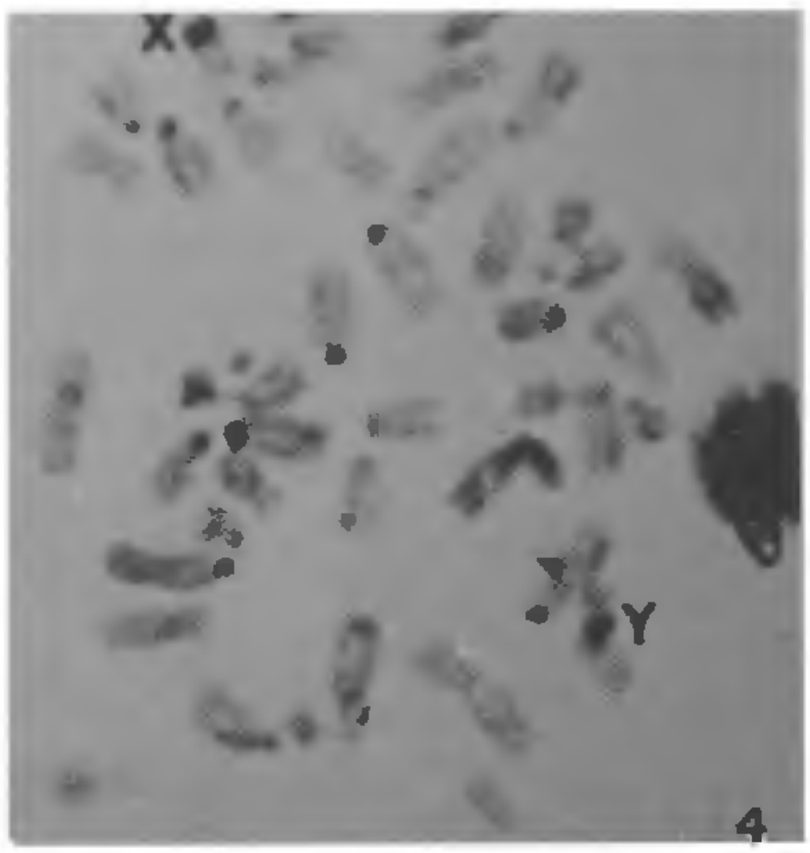
Distinct G- bands are observed in all the chromosomes except in the *Y* chromosome which has a uniform light staining. In the *X* chromosome each arm consists of 2 dark and 2 faint bands. The number of clear bands varies from 1–5 (figure 3). The dark centromeric bands are in 12 acrocentric chromosomes while the bands are light in 4 subacrocentric chromosomes. The rest of the autosomes are devoid of C–bands. In the *X* chromosome the distal region of the long arm is C–positive. The acrocentric *Y* chromosome is almost entirely heterochromatic (figure 4).

The chromosome banding is an essential tool in any cytogenetic studies. Both G- and C- bandings are described for the first time in *F.p. palmarum* of this genus and these are very much wanting in other species for comparison.

The karyotype of *F.p. palmarum* described earlier[8] is essentially similar to the present karyotype except for the submetacentric nature of the *Y* chromosome and for a few structural changes in the autosomes. However, the present karyotype is similar in all the individuals analyzed, hence this is considered as the 'standard' karyotype. But the karyotype of *F.p. bellaricus* (from Pune; S.W







Figures 1–4. **1.** Male karyotype of *Funambulus palmarum*. Note the 'satellites' in one autosomal pair (arrow) and minute *Y* chromosome; **2.** Idiogram of the male karyotype; **3.** G- banded karyotype, showing clear bands except in the *Y* chromosome; **4.** C- banded metaphase. Note the difference in the staining intensity and absence of bands in some autosomes. The distal portion of the long arm of the *X* and the entire *Y* chromosome are C- positive.

India) has a diploid number of 54 consisting of 16 biarmed (4m, 12sa) and 36 acrocentric chromosomes with $FN = 68$ resembling the karyotype of the 5 striped squirrel, *F. pennanti*[2–6]. This subspecies differs from the other species of *Funambulus* in possessing a large subacrocentric *Y* chromosome and absence of the SAT-chromosomes.

Though the karyotype of *F. tristriatus*[1] resembles the present karyotype, some autosomes exhibit structural deviations. It is reported to have 13 biarmed pairs (meta-/submetacentric) inclusive of a 'satellited' submetacentric pair and 9 acrocentric pairs of chromosomes ($FN = 70$). The variation appears to be due to pericentric inversions. Both *F. pennanti* and *F.p. bellaricus* have a high diploid number ($2n = 54$) and larger number of acrocentric chromosomes. The repatterning of their karyotypes might be due to centric fissions.

The occurrence of the smallest acrocentric *Y* chromosome and a pair of SAT-chromosomes in all the karyologically known species are useful features in the phylogeny of the genus *Funambulus*. However, all the karyological features of the other species of *Funambulus* are essential to draw a definite conclusion.

One of the authors (SKR) thanks UGC, New Delhi for a fellowship.

18 July 1986; Revised 20 December 1986

1. Ellerman, J. R. and Morrison-Scott, T. C. S., *Checklist of Palaeartic and Indian mammals 1758–1946*, British Museum (Natural history), London, 1966, p. 456, 2nd edn.
2. Rao, S. R. V. and Sharda, *Cytogenetics*, 1964, **3**, 342.
3. Chopra, V. L. and Pai, R. A., *Nature (London)*, 1965, **207**, 1110.
4. Seshadri, C., Rao, S. R. V. and Shah, V. C., *Chromosomes Today*, 1969, **2**, 148.
5. Sharma, V. K., Rao, S. R. V. and Shah, V. C., *Indian J. Exp. Biol.* 1970, **8**, 249.
6. Srivastava, M. D. L. and Bhatnagar, V. S., *Mamm. Chrom. Newsl.*, 1971, **12**, 51.
7. Rao, S. R. V., Lakhotia, S. C. and Jhanwar, S. C., *Proc. Indian Nat. Sci. Acad.*, 1972, **38**, 8.
8. Satya-Prakash, K. L. and Aswathanarayana, N. V., *Curr. Sci.*, 1973, **42**, 284.
9. Ghaskadbi, S. and Indurkar, A. K., *Experientia*, 1982, **38**, 558.
10. Sumner, A. T., Evans, H. J. and Buckland, R. A., Nature (London), *New Biol.*, 1971, **31**, 232.
11. Sumner, A. T., *Exp. Cell Res.*, 1972, **75**, 304.

HYPER OR HYPOPROTEINEMIA DUE TO HELMINTHIASIS IN POULTRY

P. C. SEKHAR*, U. C. MOHAN† and S. S. SIMHA

Department of Zoology, Osmania University, Hyderabad 500 007, India.

** Department of Zoology, Dr B. R. Ambedkar College, Hyderabad 500 044, India.*

† Pathology Laboratory, SC Railway Hospital, Lalaguda, Hyderabad 500 017, India.

AVIAN diseases, like certain viral, bacterial and protozoan infections were observed to affect the serum proteins and their fractions. Squibb *et al*[1] reported hyperproteinemia in diseases like coryza and cholera and hypoproteinemia due to Newcastle disease. Rajendran *et al*[2] observed hyperproteinemia, due to increase in both the albumin and globulin levels, in visceral lymphomatosis and fowl pox and because of the fall in both albumin and globulin levels, hypoproteinemia, in caecal coccidiosis and erythroleucosis. In Ranikhet disease, the depletion in albumins was compensated by increase in globulins and hence the total protein level did not alter[2]. The present report is an attempt to elucidate the effect of various gastro-intestinal helminthic infections (field cases) on the total protein, albumin and globulin levels and albumin to globulin (A/G) ratio in the domestic fowl, *Gallus domesticus*.

The blood and viscera (intestine along with its associated glands) of 167 cockerels and 149 pullets, including both healthy (uninfected) and helminth-infected (natural infection) fowls, were examined. The birds were between 3 and 4 months in age and weighed 450–800 g. The birds were sacrificed and about 5 ml of the blood was collected from each bird, from the jugular vein, into empty vials. The viscera from each bird was collected in separate polythene bags. The coagulated blood was centrifuged for 5–10 min at 3000 rpm to separate the serum. From each of the serum samples, the total protein[3] and albumin[4] levels were estimated. Making use of these data, the globulin level and the A/G ratio were calculated.

The intestines were thoroughly examined for the presence of helminthic worms. The different types of helminths that infected the fowl were the tape worms, *Raillietina tetragona*, *R. echinobothrida*, *R. cesticillus*, *Cotugnia digonopora*, *Choanotaenia infundibulum*, *Hymenolepis carioca* and the round worm, *Ascaridia galli*. The worm infestation was categorized into 4 types i.e. single, double, triple and quadruple infections, after taking into account the number of different species of worms involved in infecting the same fowl[5].

The values of total protein, albumin and globulin levels and A/G ratio in cockerels and pullets are given in tables 1 and 2 respectively.

In healthy fowls:

The results indicate a slightly higher level of total proteins in pullets than in cockerels. This was due to the increase in both albumin and globulin fractions, but the rise was more marked in globulins and hence a drop in the A/G ratio of the pullet. The total protein levels obtained in cockerels and pullets were more or less in complete agreement with earlier findings[6–10]. The values of albumin and globulin levels were in closer agreement with those of Perk *et al*[7]. The values of A/G ratio obtained in cockerels and pullets in the present study are considerably higher than those reported by earlier investigators[2,7,11,12]