The nuclide-labeled microspheres supplied by the Nuclear Products Division of Minnesota Mining and Manufacturing Company had an average diameter of 50 ± 5 µm. 75 to 90 µC, or approximately 40,000–50,000 spheres, were injected into the left ventricle of each animal used in this study. The animals were sacrificed with intro-arterial barbiturate immediately after these procedures. The skin was dissected from the carcass, weighed, and incinerated at 500°F for 4 h. The ashes were examined for radioactivity with a Nuclear-Chicago automatic gamma well-counter. The gamma counter was calibrated with cesium standard and with small aliquots of labeled-microspheres. Isotopes of strontium (85-Sr) and iodine (131-I) were used in this study. Standard arithmetical methods were used to obtain total activity and specific activity for the skin.

Results and comments. The results obtained are presented in the Table. The total body weights of the monkeys ranged from 5.5 to 6.9 kg. The dissected skin weight was between 568 and 760 g. The cardiac output varied from 822 to 1150 ml per min. The blood flow in the total skin showed considerable variation between individual animals and ranged from 30 ml to 135 ml per min, which represents 3.6 and 12.6% of the total cardiac output. Despite the differences between animals, there was a good agreement between estimations of blood flow per g of skin. The skin is only 10% of the body weight, but the blood flow is about 7.0% of the total cardiac output.

Zusammenfassung. Die Durchblutung der Haut von Rhesus-Affen (*Macaca mulatta*) wurde mittels Verteilung radioaktiver Kügelchen gemessen und beträgt etwa 7% des HerzMinutenvolumens.

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Complete Development of *Ancylostoma ceylanicum* (Looss, 1911) in Golden Hamsters, *Mesocricetus auratus*

The importance of the small laboratory animal adapted strain of hookworm has long been realized, especially so from the experimental chemotherapeutic point of view. The work of Sen and Seth[1] with human hookworm *Necator americanus* in golden hamsters demonstrate that such a host-parasite system is possible. It is the first time that the complete development of a species of the genus *Ancylostoma* is reported in golden hamsters. The existence of *Ancylostoma ceylanicum* in dogs and cats has been reported by several workers[2–5]. Lane[6] reported for the first time man as a host of this parasite in India. Ever since then it has been reported in man from several parts of the world[5,7–9]. The controversy with regard to the identity of the 2 different species, *Ancylostoma ceylanicum* and *Ancylostoma braziliense* has been well thrashed out by Biocca[10] and later confirmed by other workers[11–14]. It is now evident that the reports available up to date about *A. braziliense* being found in man, in fact relates to *A. ceylanicum*[15–16]. The object of our investigations was to determine whether hamsters could be a suitable host for dog hookworms.

The infective larvae were obtained from 10–12-day-old faecal culture prepared from pooled faeces of dogs naturally infected with *A. canium* and *A. ceylanicum* maintained in the animal house by methods described by Sen et al.[17].

Two experiments were conducted with 3-month-old female hamsters. Infection was given per os with a specially designed feeding needle. In Experiment No. 1 a single dose of 1000 mixed infective larvae was given to a batch of 34 hamsters and in Experiment No. 2, the same dose of infective larvae was given to a batch of 10 hamsters repeatedly at weekly intervals till the ova were seen in pooled faeces.

In Experiment No. 1 where single dose infection was given 4 animals were necropsied on day 12. The parasites found were all male adults of *A. ceylanicum* like 1, 0, 1 and 3 with one animal without worms. On days 16, 17 and 18 faecal examination of pooled faeces was found negative for ova. On day 18, 10 animals were necropsied but no worms could be recovered. On day 20 the remaining 20 animals after negative faecal examination were necropsied and only from two of them 1 adult male and 1 female of *A. ceylanicum* respectively could be recovered.

In Experiment No. 2, we were interested to see only the complete development of any one of the species of worms by the presence of ova in faeces; none of the animals were necropsied at any stage of the experiment, until any were found to have died naturally.

Examination of pooled faeces for the presence of ova started regularly from day 16 after the first infective dose. 3 animals died on day 22. On necropsy no worms could be recovered from them. Infertile eggs were first seen on day

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Ancylostoma ceylanicum adults recovered from the small intestine of hamsters at different intervals, with varying infective doses in generations 1 and 2

Generation	Dose	Age of hamsters (months)	No. of animals	Sex	Serial No.	Duration of infection (days)	Died or killed	[a] Fecal examination	Worms recovered ♂	♀	Total
1	4000	2	1	♂	1	28	died	+	7	2	9
	5000	4	1	♀	2	23	died	+	7	7	14
2	1000	4	4	♀	3	39	died	+	1	3	4
		4		♀	4	49	died	+	7	5	12
		4		♀	5	60	died	—	0	1	1
		4		♀	6	77		+			
					6	110	killed	—	0	0	0
	2000	4	10	♀	7	20	died	+	2	3	5
		4		♀	8	20	died	+	2	1	3
		3		♀	9	22	died	+	1	4	5
		4		♀	10	23	died	+	18	35	53
		4		♀	11	33	died	+	1	2	3
		4		♀	12	36	killed	+	16	18	34
		3		♀	13	77	killed	—	0	1	1
		3		♀	14	111	killed	—	0	2	2
		3		♀	15	111	killed	—	0	1	1
		4		♀	16	113		+			
					16	181	killed	—	5	0	5
		3	4	♂	17	21	died	—	6	0	6
		3		♂	18	23	died	+	1	2	3
		3		♂	19	24	died	+	2	7	9
		3		♂	20	24	died	+	3	2	5
	4000	4	3	♀	21	34	died	+	9	5	14
		4		♀	22	76	killed	—	0	4	4
		4		♀	23	76	killed	—	0	1	1
	5000	3	2	♂	24	16	died	—	1	4	5
		3		♂	25	21	died	+	12	14	26
		4	2	♀	26	39	died	—	0	1	1
		4		♀	27	137		+			
					27	151	died	—	0	0	0

[a] Fecal examination of all animals were positive for ova on 17th day.

Photomicrographs of mouth parts and copulatory bursa of mature *Ancylostoma ceylanicum* from hamster.

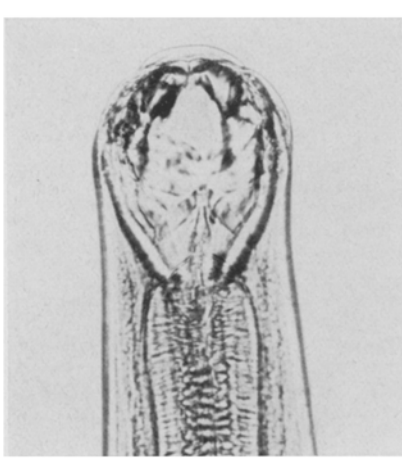

Fig. 1. Head end.

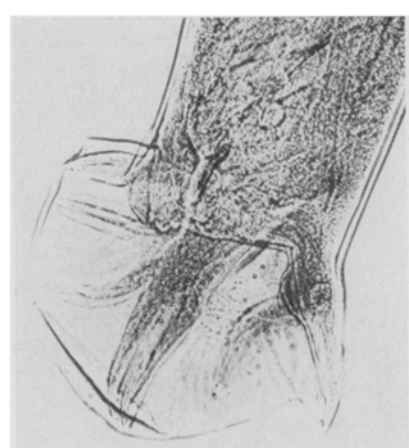

Fig. 2. Bursa of a male worm.

Fig. 3. Tail end of a female worm.

24 in the pooled faeces of the remaining 7 hamsters. Fertile eggs were seen on day 25 in the pooled faeces which was put to culture. It would seem probable that second dose of infective larvae from the pooled faeces of dogs contained a major ratio of *A. ceylanicum* lavae and hence the natural take in hamsters. Culture was made every day, up to day 28 when 3 out of the remaining 7 hamsters died. The worms recovered were 1 ♂, 2 ♀; 2 ♂, 2 ♀; 2 ♂, 1 ♀; respectively and they were identified as *Ancylostoma ceylanicum* (Figures 1–3). The remaining 4 hamsters were all negative for any ova or worms up to day 38 by which time they all died.

Larvae obtained from the faecal cultures from infected hamsters were infective for all age groups of hamsters in the subsequent generations with single dose infection. The adult male of the species measured 6–7.5 mm in length and 0.27–0.30 mm in width. The adult female of the species measured 6–9.2 mm in length and 0.30–0.43 mm in width. To show further that hamster and *A. ceylanicum* could develop to a satisfactory host-parasite system, results of hamster strain of *A. ceylanicum* in generation I and II (with single dose infection) are also summarized and incorporated in the Table. Incidentally, it may be mentioned here that a hamster strain *A. ceylanicum* is being maintained in this laboratory.

This communication gives only the results of a series of experiments and presents evidence that hamster is a suitable host for *A. ceylanicum*. A series of experiments are now being carried out to induce infection in golden hamsters with a pure strain of *A. ceylanicum* infection from dogs. The results would be published in due course[18].

Zusammenfassung. Es gelang, den Hakenwurm *Ancylostoma ceylanicum* an den Goldhamster zu adaptieren, was zur Vereinfachung chemotherapeutischer Versuche bei der Bekämpfung dieses tierischen und menschlichen Parasiten im Laboratorium beitrug.

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Effects of Some Tropical Diseases on the Urea Index

The urea index, defined as g urea/g creatinine determined in random urine samples, was introduced several years ago as a method of screening the protein intake of a human population[1]. It has been widely used in many nutrition surveys[2–7]. The theoretical basis of the index is that dietary proteins in excess of the daily requirement are deaminated by the liver and the resulting ammonia is converted to urea, which is excreted in the urine. Creatinine is the exclusive urinary metabolite of muscle creatine and is excreted in amounts proportional to the daily muscular activity. Dietary protein has no effect on urinary creatinine. Particularly in rural communities, daily creatinine excretion is relatively constant in an individual. While the absolute concentrations of urea and creatinine in a random urine sample vary with the recent water intake, the ratio of their concentrations is reasonably constant throughout the day and is a reflection of recent protein intake[1].

The index fails in starvation, when body protein is mobilized to provide energy and excessive urea is excreted. With this one exception, the index is believed to be a useful tool for surveys of the nutritional status of human populations.

Previous investigators have taken little or no account of endemic infectious diseases in the people they have studied. We felt that several widespread tropical diseases, known to influence intestinal absorption, liver metabolism, and kidney function, might well alter the formation or excretion of urea, creatinine or both. We have therefore studied individuals living in rural villages of northern Zambia where bilharziasis, malaria, and hookworm disease are endemic and largely untreated.

Individuals were given a general medical examination and samples of blood, urine and faeces were collected and

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Table I. Urea index for children under 13 years of age

Diagnosis	Sex	No.	Urea index (g urea/g creatinine) mean ± S.D.	*P* value
Healthy	♂	38	17.8 ± 6.6	–
Healthy	♀	36	18.6 ± 7.7	–
Bilharziasis	♂	24	13.1 ± 7.3	<0.02
Bilharziasis	♀	8	12.4 ± 6.5	<0.01
Malaria	♂	37	17.3 ± 8.9	N.S.
Malaria	♀	35	19.0 ± 6.5	N.S.
Hookworm disease	♂	23	20.9 ± 10.6	N.S.
Hookworm disease	♀	25	19.6 ± 9.7	N.S.