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Infection Experiments in Monkeys with Human, Macaque and Ateles Strains of Strongyloides.

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Species of *Strongyloides* occur naturally in several primates. Those which have come under the observation of the writer have been in man, *Simia troglodytes*, *Pithecus rhesus*, *Ateles geoffroyi*, *Cebus capuchinus imitator*, and *Saimiri örstedii örstedii*. In man the infection occurs in 6.3% of the hospital and free-clinic patients in New Orleans and in 20% of the hospital and village population of Panama. Over a period of 2 years a colony of 12 rhesus monkeys in New Orleans has had an infection of 87.5%. Of 6 red spider monkeys from Panama 4 (66.6%) were positive, and of 3 capuchin monkeys and 15 marmosets one each was infected with *Strongyloides*. In man cultural studies made on material from cases observed by the writer showed both direct and indirect types with a preponderance of the direct type. All of the other strains studied have been consistently indirect in their mode of development.

Morphologically it is difficult to differentiate these primate strains, although they can be readily distinguished from the *Strongyloides* of the dog, the rat and the sheep. It has seemed desirable, therefore, to test certain of these strains by cross-infection experiments. For this purpose human, macaque and red spider strains, which had been studied over a period of several weeks, were selected. Six monkeys were inoculated by applying the inoculum to the abdominal skin for 30 minutes. Red spider monkeys (one each) were inoculated with about 10,000 f_2 larvae (1) of an autochthonous strain, (2) of a human direct strain and (3) of a *rhesus* strain. Rhesus monkeys (one each) were inoculated with about 10,000 f_2 larvae (1) of an autochthonous strain, (2) of a direct human strain and (3) of a red spider strain. A preliminary experiment had shown that the inoculum was equally viable, whether the larvae were washed free of the culture medium or not.

The red spider monkeys within an hour or two after inoculation showed evidence of an intense pruritus at the site of inoculation. This was followed for 2 or 3 days by a lupous dermatitis with moderate erythema. After 4 or 5 days the skin became normal

again. On the second day after inoculation there was a severe croupous bronchitis without temperature, which was observed for a period of approximately 24 hours and then rapidly receded. In the animal inoculated with the autochthonous strain eggs were first recovered from the feces 18 days after inoculation. The animal lived 34 days after eggs were first recovered; at autopsy strongyloidiasis was determined to be the cause of death. In the case inoculated with the human strain the early symptoms were comparable to those of the autochthonous strain, but the incubation period was 22 days. Eggs in large numbers were recovered for 2 weeks, after which time the infection became greatly reduced and stools became consistently negative (direct examination and culture) from the 45th day after inoculation. *Hatched larvae* of this human strain were never obtained from freshly passed feces. The *rhesus* strain apparently never became implanted in the intestinal mucosa of the red spider monkey, since daily stool examinations from the time of inoculation for a period of 2 months were consistently negative.

The rhesus monkeys inoculated with the autochthonous and human strains showed a moderate pruritus but no gross dermatitis or erythema, and had no apparent bronchial involvement. However, in the case of inoculation of this host with the red spider strain of *Strongyloides* there was a profound erythema at the site of inoculation which was first noticed 24 hours after inoculation and became progressively more intense up to the fourth day, when lupous patches were also conspicuous. There were never any open lesions. After the seventh day the skin became rapidly normal again. On the third and fourth days after inoculation there was a slight bronchitis, which had disappeared on the fifth day. Intestinal infection in the rhesus monkey was apparently never effected with the red spider and human strains. Up to 2 months after inoculation the stools remained consistently negative. In the autochthonous strain eggs were first recovered on the twenty-fifth day after inoculation and from that time were found daily.

The evidence obtained from this series of experiments points to the conclusion that the *rhesus* and *red-spider* strains of *Strongyloides* are physiologically different species: they are easily inoculable into their natural hosts from which they were obtained, but they are unable to establish intestinal infections in the reciprocal hosts, although there is some evidence that they migrate through the tissues of the inappropriate host. The human strain can be established but is not able to maintain itself in the red spider monkey; in the rhesus monkey it appears to be completely abortive.