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Infection Experiments in Man and Other Mammalian Hosts with Sparganum Stage of Oriental Diphyllobothrids.

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The Sparganum larva of a diphyllobothrid (psaudophyllidean) cestode was first recovered from man in 1882 by Patrick Manson, who obtained a dozen of these ligulate worms from the perirenal fat of an Amoyese. The same year Scheube obtained similar material from a Japanese subject. Following these early cases numerous additional human infections were described from Japan and French Indo-China, the latter being almost if not entirely from the orbit. A few human cases have also been reported from Australia. These larvae have been consistently designated as *"Sparganum mansoni"*, after their discoverer. Meanwhile larvae indistinguishable from those recovered from the human host have been obtained from numerous vertebrates in the Orient, including frogs, snakes, birds and mammals. These, too, have commonly been referred to as *"Sparganum mansoni"*, although experimental feedings to dogs and cats of the larvae from human cases in Japan (Okumura's[1] material) have shown that the adult worms belong to 2 previously described species, *Diphyllobothrium decipiens* and *D. cordatum*, while similar experiments in French Indo-China (Joyeux and Houdemer[2]) have produced adults of another species which these investigators have described as *"Diphyllobothrium mansoni"*.

During a period of more than 8 years the writer has collected adult diphyllobothrids from naturally infected dogs and cats and their wild relatives in China and has had placed in his hands for study a complete worm of the generic group from the intestine of a native Chinese in Shanghai. These Chinese worms have been diagnosed as belonging to the following species: *Diphyllobothrium cordatum* (Leuckart, 1863), Stiles and Hassall, 1926, (dog, Peking and Amoy); *D. mansoni* (Cobbold, 1883), Joyeux, 1927, (cat, Canton, Foochow, Peking); *D. decipiens* (Diesing, 1850), Chandler, 1925, (cat, wild-cat, leopard, Peking); *D. ranarum* (Gastaldi, 1854), Meggitt, 1925, (cat, Peking); and *D. houghtoni* n. sp., (man, Shanghai; cat, Peking; dog, Wuchang). The writer has also found heavy sparganum infections in frogs, snakes and several

[1] Okumura, T., *Kitasato Arch. Exp. Med.*, 1919, iii, 190.

[2] Joyeux, Ch., and Houdemer, E., *Ann. Parasitologie*, 1928, vi, 27.

species of mammals, from representative areas in North, Central and South China. Since these larvae were indistinguishable from one another, feeding experiments have been undertaken to determine the adult species to which the larvae belong and also to find out what mammalian hosts are susceptible to intestinal infection with these spargana. The larvae were fed each in a small gelatin capsule and the feces of the animal examined systematically for *Diphyllobothrium* eggs. In a susceptible host these appeared from 2 to 3 weeks after the feeding but in negative individuals search was continued for 3 months. In non-human members of the series the animal was autopsied within 3 months or less. The results of these experiments are set down in Table I.

TABLE I.
Showing the results of feeding Oriental spargana to mammals.

Sparganum	Host	Mammal submitted to infection	Result	Species of adult worm
A	*Rana esculenta*	cat	positive	*Diphyllobothrium mansoni*
A	*Rana esculenta*	man	negative	
B	*Microhyla sowerbyi*	cat	positive	*D. decipiens*
B	*Microhyla sowerbyi*	man	negative	
C	*Canis procyonides*	cat	positive	*D. ranarum*
C	*Canis procyonides*	man	negative	
D	*Erinaceus dealbatus*	cat	positive	*D. erinacei*
D	*Erinaceus dealbatus*	dog	positive	*D. erinacei*
D	*Erinaceus dealbatus*	rabbit	negative	
D	*Erinaceus dealbatus*	man	negative	

Examination of the data shows consistently that in the 4 species diagnosed man is in no instance a susceptible host, although cats (and dogs) are infectable. Furthermore, in no member of the series was there any evidence that the spargana worked their way through the intestinal wall of the mammal and developed a somatic sparganosis.

During the course of investigating diphyllobothrid infections in Foochow, China, 2 cases of human sparganosis were discovered by Dr. Horace E. Campbell. In the one instance the infection was in an abscessed thumb, while in the other it was associated with an ulcerated wrist. Eight larvae were said to have been removed from the former infection and 10 larvae from the latter. In both cases, as in others in the locality, the patients had applied "split" frogs to the abscessed members, and since these frogs are almost always infected with the sparganum, it seems highly probable that they were the source of the infection. This evidence corresponds to that secured by Joyeux and Houdemer (1925) from patients suffering

from ocular sparganosis in French Indo-China, where a like custom is practiced to "relieve" severe conjunctivitis. To test out the assumption that any sparganum will infect the orbit the writer applied spargana of *D. erinacei,* freshly obtained from the hedgehog in Peking, to the conjunctiva of a dog, and was able to observe the invasion of the larvae through the conjunctival membrane and the development in this animal of a severe inflammatory process, which continued for several days, when the dog was sacrificed. Other experiments in susceptible hosts such as the dog indicated that the spargana when introduced aseptically into the thigh muscles were able to multiply asexually over a period of several months. In rabbits in which a similar experiment was performed no increase was observed although the original number of worms was recovered after 5 months.

These series of experiments show definitely that there are several species of spargana in China, just as in other parts of the Orient, that the cat and the dog and their wild relatives are the natural hosts of the adult worms, and that man, except in the case of *Diphyllobothrium houghtoni,* is not subject to infection with the adult worm. Furthermore, the natural hosts of the spargana are a wide variety of vertebrates, which presumably become infected from ingesting the infected first intermediate host of the worms (Cyclops). Although the evidence is not conclusive it favors the view that human sparganosis results from applying frogs infected with these spargana to inflamed and ulcerated areas of the body.

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Vitamin A and B Content of Canned Sweet Potatoes.

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Although sweet potatoes are an important constituent of American dietaries, information regarding their vitamin content is almost entirely lacking. With but the one exception,[1] dealing with vitamin C, no reference was found to any work on the vitamin content of this food.

The sweet potatoes used in these experiments were a yellow variety which were commercially canned in southern Louisiana, pur-

[1] Peck, E. C., *China Med. J.,* 1924, xxxviii, 125.