

The Panama Strains of Human Strongyloides.

ERNEST CARROLL FAUST.

*From the Gorgas Memorial Laboratory and from the Parasitology Laboratory,
Department of Tropical Medicine, Tulane University.*

The studies of Grassi,¹ Perroncito² and particularly those of Leuckhart³ demonstrated that there were 2 different strains of the human Strongyloides, *S. stercoralis*, the one consisting entirely of a parasitic generation and the other having both a parasitic and a

¹ Grassi, G. B., *Rend. Inst. Lomb. sci. e. lett. Rendic.*, Milano, 2 ser., 1879, 12, 228.

² Perroncito, E., *Atti Accad. Lincei*, Ser. 3, 1879-1880, 1, 381.

³ Leuckart, R., *Gesellsch. d. Wissensch. Math. phys. Klasse*. Leipzig, 1882, 84, 85.

Proc. Soc. Exp. Biol. Med. 28 (3): 253-55, 1930

free-living generation in its life cycle. Leichtenstern⁴ believed that the organism in warm climates utilized only the indirect development, while those in cooler regions utilized only direct development. This hypothesis, however, has been proved fallacious by the work of Darling,⁵ Sandground,⁶ Nishigori⁷ and others.

Darling's series consisted of cultures from 23 infected persons in Panama, residents of the tropics for many years. Of these cultures 5 proved to be purely indirect in their development, 7 were direct only and 11 were combined strains.

During the summer of 1930 the writer studied 1662 native patients in the Santo Tomas Hospital, Panama, of whom 348 were positive for *Strongyloides stercoralis*. Of this series 276 were each examined 3 or more times. Twenty-nine of these (10.5%) were of clinical importance. From the entire series 27 cases of heavy infection, in which no hookworm infestation was present, were selected for culture. These cultures consisted of active larvae, which had been richly concentrated by the centrifuge method, planted on animal charcoal in sterile Petri dishes, and allowed to develop at room temperature (26-36°C.). Each culture was examined daily for a period of from 3 to 9 weeks. The results of this study indicate that 2 of the infections were purely of the indirect type, 13 were direct only, 7 were of a direct type in which dwarf filariform larvae were present in the freshly passed feces, and 5 were combination of these types. The term *hyperinfective strain* is proposed for the type in which dwarf (unfed) filariform larvae are passed in the feces, since there is considerable evidence that this is the strain which is responsible for hyperinfection of the host.

In 5 cases second cultures were made from the same individuals and in every instance these were similar to the original strains. In the indirect type filariform larvae of the free-living generation had developed as early as the sixth day of culture; by the fifteenth day the strain had completely died out. In the unmodified direct type the rhabditiform larvae of the parasitic generation grew rapidly, became ensheathed between the fourth and sixth day, and continued as active organisms up to 9 weeks, without exsheathing or metamorphosing. In the pure hyperinfective type the feces usually showed both unfed rhabditiform larvae of the parasitic generation

⁴ Leichtenstern, O., *Deutsche Med. Wochenschr.*, 1898, 8; *Arbeit. aus d. k. Gesundheitsamte*, 1905, 22, 309.

⁵ Darling, S. T., *J. Exp. Med.*, 1911, 14, 1.

⁶ Sandground, J. H., *Am. J. Hyg.*, 1926, 6, 337.

⁷ Nishigori, M., *Taiwan Igakkai Zasshi*, 1928, No. 276. (Japanese text with English abstract.)

and dwarf (unfed) filariform larvae of the same generation. In a few days the former always metamorphosed into the latter, without feeding, and in 6 to 12 days after the culture was started they had died out. In mixed types the indirect and the hyperinfective strains died out between the sixth and the fourteenth day and the active ensheathed rhabditiform larvae of the direct type survived.

This study confirms the work of Darling, Sandground and Nishigori. Furthermore, it substantiates Nishigori's observations on the correlation between filariform larvae in the freshly passed stool and chronic clinical cases in tropical countries. On the basis of the consistent metamorphosis of the larvae without feeding, from the rhabditiform to the filariform stage, frequently before evacuation of the diarrheic stool, there is adequate evidence to designate them as a separate strain, for which the term hyperinfective strain is proposed. These observations indicate that the viability of these respective strains is directly associated with the nourishment which is taken, primarily in the rhabditiform stage of the parasitic generation.