

REVIEW

WELLS, H. S.: (1931.) Observations on the blood-sucking activities of the hookworm. *Jour. Parasitology*, 17: 167.

The writer cites Grassi, Leichtenstern, and Perroncito as sources of the observation that *Ancylostoma duodenale* withdraws much more blood than is necessary for its food requirement, that the red cells are practically unchanged after passage through the worm, and that therefore the plasma must be the main source of nourishment. Wells induced anesthesia in dogs harboring *Ancylostoma caninum* by intravenous injection of sodium barbital, 0.35 g. per kilo of weight in 10 per cent aqueous solution. A loop of intestine was now clamped off by a special clamp invented by the author with an oblong opening inside the periphery through which the intestine might be viewed microscopically. This intestinal loop was now resected and the tied-off stumps dropped back into the abdominal cavity but the mesentery through which an intact blood supply could be vouchsafed to the resected loop was preserved. The resected intestinal loop was now opened longitudinally and over it and the anesthetized and living dog the attached worms could be microscopically examined and seen sucking blood. If there were no living worms in this particular loop, other loops were opened and their contained worms were transferred to the loop under the microscope where they readily took hold of the mucous membrane and promptly began sucking blood. The rate of the sucking movements of the esophagus were usually very rapid, from 120 to 250 per minute, but the relative periods of inactivity and feeding seemed to be irregular. The droplet of blood was also regularly and explosively emitted unchanged from the anus. The frequency of emission of droplets varied considerably, intervals between emission changing from a fraction of a second to fifteen minutes or more. By sucking up the caudal extremity of the worm into a long fine pipette, an ejected drop could be diluted to 1 cc., mixed, and the corpuscles counted.

In this manner it was calculated that each droplet amounted to 0.25 cu. mm. of blood. In a female worm, in 24 hours, it was also calculated that 0.84 cubic centimeter can be lost. With 1,000 worms this would amount to about 420 cc., admitting that Leichtenstern was correct in assuming that the male was not a blood-sucker.

But as the author has named the reviewer of this paper as one

of those, with Looss, who considered that blood was not the normal food of the hookworm, it will not be amiss to add that Leichtenstern himself makes it clear that it is the young hookworm which produces the greatest number of ecchymoses in the intestinal mucous membrane and that these young worms, actively changing their feeding ground, set up bleeding in proportion to their activity, this being greatest at pairing time which comes but every three to six months and probably lasts but a few days⁽¹⁾. In this connection it will be interesting to also recall the fact that Loeb and Smith demonstrated an anti-coagulant in the cephalic gland of the hookworm.⁽²⁾

In the interim, when the worm quiets down in one place, any blood that is still inevitably lost—and practically all investigators recognize that loss of blood plays a part in producing the anemia, even the Porto Rico Anemia Commission, especially considering the formidable curved teeth of the genus *Ancylostoma*—seems too small to be the sole cause of the anemia.*

Leichtenstern⁽³⁾ is surprised at the small number of worms found in certain miners with uncinariasis but in explanation thereof he speaks of not only individual resistance to loss of blood but to the power of a toxin (hypothetical, of course), showing that he himself did not consider blood-sucking the only source of miners' anemia.

Leichtenstern often found living and sucking worms filled with blood at autopsy. Their death of the host does not seem to cause a prompt cessation of blood-sucking as we might deduce from Wells' paper. The writer has seen one case, in all probability one of necatoriasis, although it was only later that Gutiérrez Igaravidez demonstrated the presence of *Ancylostoma duodenale* in Porto Rico which, indeed, it might have been, with every worm alive still at autopsy, and filled with blood. In addition, the intestinal contents were bloody and the feces dark with blood. But such cases must be rarely for long, as this was the only instance in over a dozen autopsies, and follow massive infestations within a month or six weeks, causing serious acute anemia. In the rest, the worms contained no macroscopic evidence of blood and were of a grayish-white color, *and still alive*.

Wells' paper is not only interesting, his experiments well-planned and ingenious, and his exposition clear and convincing, but this investigator has added something definite to our scientific conception

* To call the worm a blood-sucker implies that blood is its chief, its normal food and, also by implication, to add that the anemia is entirely due to blood loss, an opinion which not only we, but many other observers do not share. Nevertheless, massive infestation at coffee-picking time in Porto Rico frequently brought within a month or more severe acute anemia, probably largely due to blood loss and to this extent the writer is believed to be correct.

of the disease ankylostomiasis. Nevertheless, more for the medical public than for the author himself, the reviewer wishes to caution against jumping at the conclusion that the *modus operandi* of the anemia of uncinariasis is settled by these experiments. It is far from proved that the same obtains with a worm, *Necator americanus*, whose buccal armature is weaker and less incisive, and it is still less evident, in view of all that has gone before, that the anemia of uncinariasis is due chiefly to loss of blood. It is believed that after so many years of increasing familiarity with this disease we are still very distant from the point where we can say that we know the mechanism of the anemia of uncinariasis.—Bailey K. Ashford.

- (1) Leichtenstern O.: (1887). Einiges über Ankylostomum duodenale. Deutsche med. Wochenschr., Leipzig und Berlin, **13**: 565, 594, 620, 645, 669, 691, 712.
- (2) Loeb, L. and Smith, A. J.: (1904) The presence of a substance inhibiting the coagulation of the blood in ankylostomiasis. Proc. Path. Soc., Phila. n. s., **7**: 173.
- (3) Leichtenstern, O.: (1899) Zur Ankylostoma Anämie. Deutsche med. Wochenschr. Berlin, **25**: 41.