

A CASE OF SKIN INFECTION WITH ANKYLOSTOMA.

BY A. E. BOYCOTT, M.A., M.D.

(*From the Lister Institute of Preventive Medicine.*)

IN view of a previous failure¹ to produce a skin infection with *Ankylostoma*, it seems worth while to put on record the present successful case. Dr J. B. Leathes very kindly offered himself as the subject of experiment. It is important to note that he has never, either before or during the course of the experiment, had anything to do with any *Ankylostoma* material except that deliberately applied to his person for the purpose of this experiment, nor has he been to any infected place or even worked in the part of the Institute where the cultures of *Ankylostoma* larvae have been kept. On March 21st a small quantity of water containing encapsuled larvae of *A. duodenale*, hatched artificially from infected faeces from Cornwall, and 13 days old, was applied to the forearm. After five minutes the arm was bandaged up and left for two hours, at the end of which time the wrappings were removed and the arm thoroughly cleansed. The purpose of the experiment and the precautions necessary were fully appreciated by the subject, and there is no doubt that there was not the slightest possibility of a mouth infection.

A definite eosinophilia was found on April 17 (27 days). Eggs were looked for on May 4 and May 6 without success, but on May 10 (50 days) a few eggs were found. Thymol (40 grains) was given on May 13 (53 days), but on May 22 one or two eggs were still present. On May 27 (67 days), 90 grains of thymol were taken in three 30-gram doses, and on June 6 a single egg was found with some difficulty. This failure to effect complete cure immediately after infection is possibly due to the varying times taken by different larvae to reach the intestine.

¹ This *Journal*, vol. iv. 1904, p. 89.

The symptoms observed were slight, though definite. The morning after the application of the larvae half-a-dozen small roundish patches of erythema were present in the treated area; these were not raised and faded completely on pressure. They made no further progress and in a few days had completely disappeared. Itching was felt for the first time a few hours after the larvae had been washed off the arm and continued for about a fortnight. Symptoms of "dyspepsia," hardly amounting to more than epigastric discomfort, were noticed after about fourteen days, and lasted till thymol was taken; after this they diminished, but were still present to some extent. The subject of the experiment is normally altogether a stranger to such symptoms, which seem to be just the same as those previously experienced by the writer after infection¹, to which they are doubtless due. Somewhat indefinite symptoms of bronchial catarrh were present from the second week onwards. No anaemia was produced.

The blood, and more especially the differential leucocyte count, was examined from time to time. The chief results are given in the following table:

Days after infection	Haemoglobin per cent.	Leucocytes per cub. mm.	Lymphocytes	Intermediate	Large hyaline	Neutrophile	Eosinophile	Mast-cells
0			20.0	12.4	4.6	61.0	2.0	0 ²
14			9.8	14.0	5.2	62.2	7.4	1.4
21			29.0	5.0	3.4	58.2	3.0	1.4
27	102	8000	8.4	17.6	6.0	53.2	14.4	0.4
43			13.2	7.8	5.4	60.0	13.4	0.2
44	105	7000	19.6	8.0	3.6	48.0	20.8	0
48			12.8	9.6	2.4	38.8	35.6	0.8
50		Eggs found						
51			15.6	3.4	0.6	52.0	28.0	0.4
52	98	10600	10.8	5.2	3.2	35.2	44.8	0.8
53		Thymol grains 40						
55	102	8100	19.6	5.4	2.0	40.0	31.0	2.0
64	96	8800	19.2	2.8	2.0	54.4	21.6	0
67		Thymol grains 90						
69	100	7800	24.4	5.6	2.0	46.0	20.8	1.2
72		7100	13.6	11.6	1.6	56.0	17.2	0
95			21.6	4.0	3.2	47.2	22.8	1.2

It will be seen from this that a definite eosinophilia was found 27 days after infection and 23 days before eggs appeared in the stool.

¹ This *Journal*, vol. iv. 1904, p. 463; see also C. A. Smith, *Journ. American Med. Association*, vol. XLIII. 1904, p. 592.

² Mast-cells were constantly present, though not always found in the leucocytes enumerated. The counts were all made at about the same time of day, fasting.

The eosinophilia subsequently rose to a very high figure (45 p.c.), subsiding somewhat after treatment. The total leucocytes were once observed to exceed 10,000, but even at the height of the eosinophilia there was no marked leucocytosis. Such increase as there was is fully accounted for by the increase of eosinophiles alone.

The following curves compare the time-relations of the eosinophilia in the present case and in the case of mouth infection which has been already dealt with¹. The rise is rather earlier in the latter, but taking into consideration the fact that a slight increase of eosinophiles was present at the time of infection, there does not appear to be any necessarily significant difference in the two cases. The worm evidently begins to produce the substance to which the eosinophiles react at the

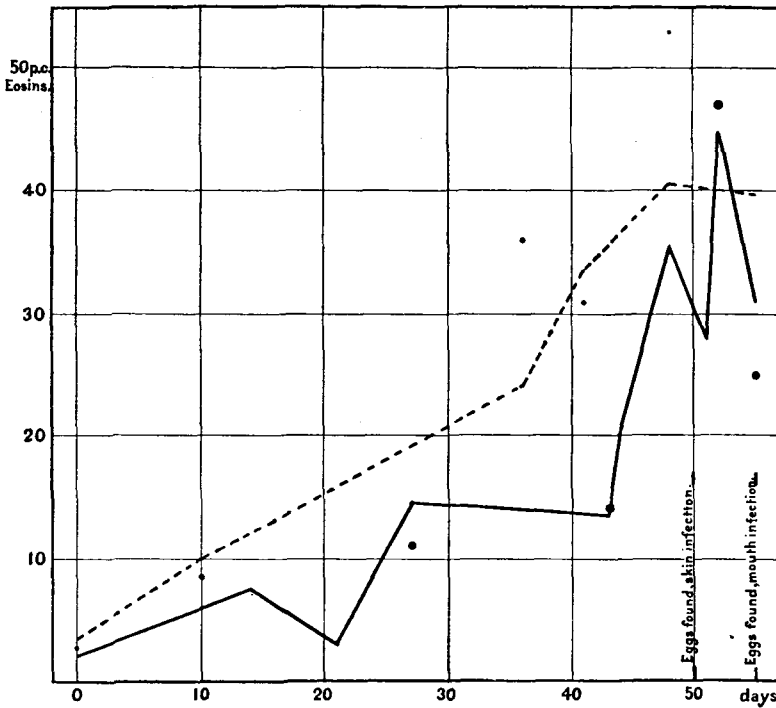


Fig. 1. The ordinates represent percentage of eosinophiles, the abscissae days. The continuous line is the skin, the dotted line the mouth infection. The separate points give the absolute eosinophiles where these were determined.

¹ *This Journal*, vol. iv. 1904, p. 462.

stage in its development which is reached 14 to 21 days after its entry into the body¹.

During the last eighteen months a number of important observations have been made on the skin infection in ankylostomiasis. Looss², working with *A. caninum* and dogs, has completed his demonstration by showing that the larvae leave the neighbourhood of the skin in the blood stream, pass through the right heart and are arrested in the lungs, whence they travel up the trachea and down the oesophagus to the intestine. These results have been fully confirmed by Schaudinn³, who, using *A. duodenale* and monkeys (*Inuus*), found larvae in the blood of the right heart and in the lungs a short time after infection, and adult worms in the intestine from a previous application of larvae to the skin. C. A. Smith⁴ has brought about skin infection in man with *A. americanum*; he found eggs in 45 days. This period, as well as that of 50 days found in the present experiment, is much shorter than that previously found by Looss (71 days), and by Pieri (71 days), and is so little different from that observed in mouth infections that any emphasis which has previously been laid on the difference seems to be hardly valid. With *A. caninum* and dogs, Lambinet⁵ has shown that eggs appear in the stool in just the same time (20 days) whether the larvae are swallowed, or applied to, or injected under, the skin. Herman⁶ has also successfully infected himself by the application of larvae to the skin.

The clinical aspects of the skin eruptions and their essential connection with the disease have been fully described by C. A. Smith⁷ in the United States ("ground itch"), and by Ashford, King, and Igaravidez⁸ in Porto Rico ("mazamorra"). The natives in the latter

¹ The eosinophilia is extraordinarily persistent. A man who while infected showed 17-19 p.c. still has 11 p.c. though it is more than 30 months since treatment was commenced and fully 20 months since he was restored to health and his stools found to be free from ova on repeated examinations.

² Communicated on behalf of Prof. Looss by Prof. Elliot Smith to the meeting of the British Medical Association at Oxford; see abstract in *The Mining Journal*, Aug. 6, 1904, p. 138.

³ *Deutsche med. Wochenschr.* 1904, p. 1338.

⁴ *Journ. Amer. Med. Assoc.* vol. XLIII. 1904, p. 592.

⁵ *Bull. de l'Acad. Roy. de Méd. de Belgique*, Jan. 28, 1905. F. Smith, *Journ. Roy. Army Med. Corps*, vol. iv. 1905, p. 335, and H. Liefmann, *Zeitschr. für Hygiene*, vol. L. 1905, p. 349, have also recorded successful skin infections in dogs with *A. caninum*.

⁶ *Acad. Roy. de Méd. de Belgique*, procès-verbal, Jan. 28, 1905, p. 8.

⁷ *Journ. American Med. Association*, Sept. 19, 1903.

⁸ *Report on Anaemia in Porto Rico*, San Juan, 1904. This valuable report shows

place have long recognised the aetiological connection between mazamorra and anaemia, just as in Cornwall the miners knew that dyspnoea followed "New sump bunches." There is an older account of ankylostomiasis which is of especial value and interest in this connection¹. The author, after a careful review of the epidemiology of the miners' anaemia of the French coal-field, concluded at the time of writing that the anaemia is due to products of the distillation of heated coal. No suggestion had then been made of a parasitic origin. He describes however certain skin affections as an essential part of the disease, which are obviously identical with those seen in Cornwall. They were celebrated in the topical songs of the period and consisted of: "(1) a papular-vesicular-pustular eruption, very painful, called *ampoules*, affecting the hands and feet, and, in a more generalised form, the parts of the body coming in contact with the mine-water and coal-dust. (2) An urticaria, called *gourmes*, forming red indurated swellings up to the size of a bean, extending into the subcutaneous tissue. Each lump lasts 2 or 3 days, and there are successive crops². They affect parts which have been in contact with wet coal and appear 12 to 24 hours after contact. When the urticarial nodules are numerous, they are accompanied by severe bronchial catarrh (*catarrhe des gourmes*)." This last observation is of great interest in view of the recent demonstration that the lungs form a temporary lodgement for the larvae on their way from the skin to the bowel. Skin symptoms do not appear to have been noticed in the Belgian and Westphalian coal-mines.

in a striking manner the fearful havoc which *Ankylostoma* can play in a bare-footed and untreated population. A large proportion of the natives seem to have less than 50 p.c. haemoglobin.

¹ A. Manouvriez, *De l'anémie des mineurs, dite d'Anzin*, Valenciennes, 1878. See also *De l'anémie ankylostomiasique des mineurs*, Valenciennes, 1904.

² It has been previously pointed out (*This Journal*, vol. III. 1903, p. 109), that attacks of urticaria, like the general pruritus, may also occur long after the patient is removed from any possibility of fresh infection. See also *Journ. Roy. Army Med. Corps*, vol. IV. 1905, p. 652.