THE TUMBU FLY, *CORDYLOBIA ANTHROPOPHAGA* (BLANCHARD), IN SOUTHERN AFRICA*

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Cordylobia anthropophaga, the 'Tumbu fly' or 'skin maggot fly' is widespread over the Ethiopian region, i.e. Africa south of the Sahara, but it does not occur in any other zoogeographical region of the world. In West and Central Africa it is a very common pest; the larvae affect mainly humans, dogs and various kinds of rats, but they are also occasionally found in other wild and domesticated mammals.

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In the Union of South Africa this parasite has become of greater importance only in recent times. Drs. Annie Porter and Heymann,[1] who submitted a paper on this fly at a meeting of the Medical Association in Johannesburg on 19 December 1929, 30 years ago, said that 'in the Union of South Africa such cases are relatively uncommon'. They presented a case of a 9-months-old European girl who had contracted the infection during a short stay in the Bulawayo district, S. Rhodesia.

De Meillon and Gear,[2] in 1947, said that the Tumbu

fly was already very well known in the subtropical regions of Southern Africa, such as the Transvaal Lowveld, Natal and Zululand, but that for the first time specimens from human patients had been sent to the South African Institute for Medical Research from the Transvaal Highveld. There had apparently been a minor epidemic at Witbank, and several locally contracted infections had been found in the environs of Johannesburg, Pretoria, Springs and Lichtenburg.

Since then, we have received many more records of human infections with *Cordylobia* from Southern Africa, and de Meillon and Gear's assumption that the Tumbu fly has continuously enlarged its territory has proved to be true. The distribution of cases is shown in the map in Fig. 1, and in Table I, which includes the reliable† records known to me from our own cards and from the literature. It will be seen that human infection with *Cordylobia anthropophaga* has occurred widely in the Transvaal and the neighbouring part of the Orange Free State. It must be noted that when larvae extracted from humans are sent to us, it is not always certain that the infection has really been contracted in the district where the patient lives, even when he maintains that this is so. The larvae may stay in the human for quite a long time, longer than in their normal hosts, the rats, and the patient may have contracted the infection on a trip to the Lowveld or some other subtropical part of Southern Africa (see below). But for the practitioner this fact is not of such great importance as for the epidemiologist. The practitioner has to diagnose and to treat the infection wherever it appears in humans, and he should be acquainted with the aetiology and pathology of the disease.

TABLE I. RECORDS OF *CORDYLOBIA ANTHROPOPHAGA* (BLANCHARD) FROM SOUTHERN AFRICA

Locality and Date	*Stage*	*Host*
Ondongua, S.W. Africa. VI, 1934	L	*Tatera joanae* (=*T. afra*)
Outjo, S.W. Africa. III, 1953	L	man
Epukiro, S.W. Africa. III, 1950	L M F	?
Okahandja, S.W. Africa. III, 1951	L	man
Omitara, S.W. Africa	L	*Thallomys nigricauda* (=*Rattus paedulcus*)
Ondekaremba, S.W. Africa	L	*Tatera schinzi* (=*T. afra*)
Seronga (Ngamiland), Bechuanaland. VII 1949	M F	?
Shamva, S. Rhodesia	L	man
Bulawayo, S. Rhodesia	L	man
Messina, Transvaal	L	man
Pietersburg, Transvaal. I, 1941	L	dog
Letaba, Transvaal. I, 1915. XII, 1916	L	man, dog
Thabazimbi, Transvaal. IV, 1957	F	?
Nylstroom, Transvaal. III, 1957	L	man
Lydenburg, Transvaal. III, 1957	L	man
Rustenburg, Transvaal. XII, 1958	L	man
Koster, Transvaal. III, 1953	L	man
Pretoria, Transvaal (incl. Onderstepoort). I, 1915. XII, 1916. XII, 1939. I, 1944. X, 1948. I, 1949.	L	man, dog, guinea-pig
Witbank, Transvaal	L	man
Lichtenburg, Transvaal	L	man
Environs of Johannesburg (incl. Sandown, Bryanston, Springs, Yokeskei River). XI, 1909. III, 1949. III, 1953.	L	man
Klerksdorp, Transvaal. I, 1959	L	man
Stegi, Swaziland. I, 1951	L	man
Hoopstad, Orange Free State. II, 1955	L	man
Viljoenskroon, Orange Free State. II, 1953	L	man
Vredefort, Orange Free State. II, 1958	L	man
Harrismith, Orange Free State	L	man
Lourenço Marques, Mozambique. XII 1908	L	man
Durban, Natal	L	man

† Not all records in the literature are, of course, reliable. The late Mr. Bedford (1927), for instance, wrote that he had taken numerous adult flies of *C. anthropophaga* 'at the entrances of wart-hog burrows' in the Northern Transvaal and in Zululand. He also said that the larvae parasitize wart-hogs and ant-bears. Bedford had confused *C. anthropophaga* with *Auchmeromyia bequaerti* Roubaud, which is very common in these areas and the larvae of which live as blood-suckers on wart-hogs and ant-bears. These two hosts, however, have never been found infected with larvae of the true Tumbu fly.

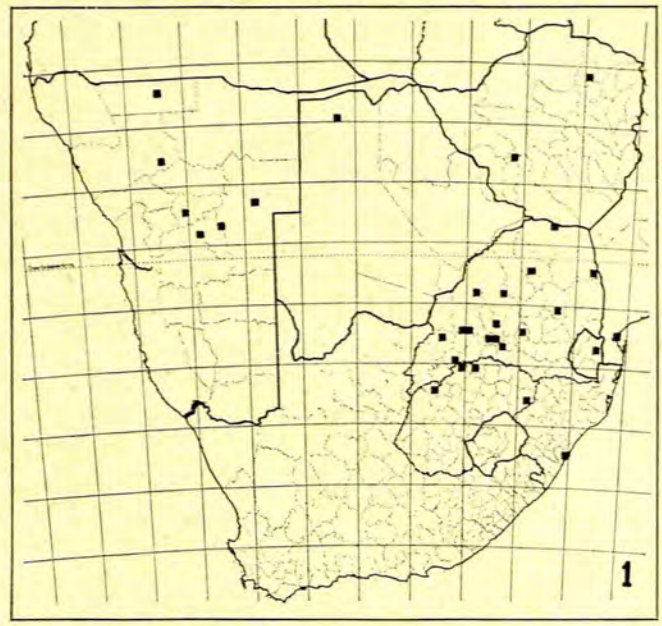

Fig. 1. Map of Southern Africa showing distribution of *Cordylobia anthropophaga.*

LIFE-HISTORY

The adult fly is rarely seen in nature, but it may be found in houses and huts, resting in dark places during the day-time. Males and females are very similar to each other, of yellow and dark-brown colouring, and measure 6–12 mm. in length. They become active in the late afternoon and in the early morning. At night they rest too, but may be attracted by artificial light.

The adult fly does not live parasitically, but feeds, like many other blowflies (fam.: Calliphoridae), on the juices of plants, for instance bananas, pine-apples and other fruits, and also on decomposing animal substances and on excreta. For oviposition, the female is especially attracted to dry sand which has been contaminated with urine or faeces. If the sand is still too moist, eggs are not laid there but are often deposited near by on a dry spot. Blacklock and Thompson[3] (1923), in their excellent study on *C. anthropophaga* in Sierra Leone, reported on an experiment in which wet sand had been provided for a mature female fly. She landed on it and protruded the ovipositor, 'but apparently found it too wet', flew off again and deposited about 100 eggs in a plug of pink cotton wool. This observation is important in respect of human cases, the flies being attracted to, and

stimulated for oviposition by, the soiled napkins of babies. They do not deposit their eggs on the wet clothes, but near by on the dry parts. If these napkins or other soiled clothes are not properly cleaned and ironed (they may appear quite clean to the human eye and nose), the flies may be attracted to them, for oviposition, in the same way as to dry contaminated sand. However, the flies will oviposit only in a shady place; if the clothes are hanging in the bright sunlight the flies will not deposit eggs, and any eggs that have been deposited previously or any young larvae will be killed immediately by the heat of the sun. I should add that the flies never deposit their eggs on the naked skin nor attach them to the hairs.

The stages in the life history are shown in Fig. 2. The female fly lives for only about a fortnight and during this time produces 300–500 eggs, which, as a rule, are deposited in two batches. The average length of the egg is 0·8 mm. At room temperature the larvae normally hatch on the 3rd day. They measure from 0·75 to 1 mm. The larvae remain in the situation in which they have hatched out, just below the surface of the sand, waiting for a host. If the surface of the sand is touched by any object, the larvae quickly crawl up. They adhere to grains of sand, by means of their posterior

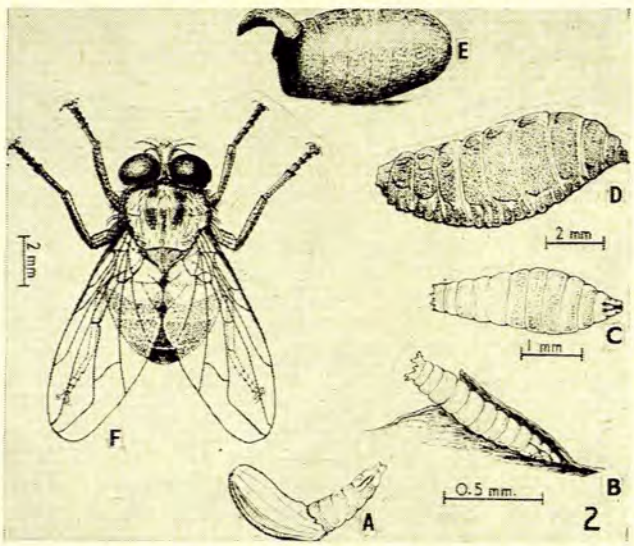

Fig. 2. Life cycle of the Tumbu fly, *Cordylobia anthropophaga* (Blanchard). A = larva hatching from egg. B = 1st larval stage. C = 2nd larval stage. D = 3rd larval stage. E = pupa. F = adult fly.

ends, raise their bodies into the air and wave about quite actively, seeking a host to which they can attach themselves. The same effect can be produced by bringing a container with hot water near the surface of the sand. The larvae remain alive in the sand for about 2 weeks; after this time they either die or become incapable of invading the host's skin.

Once a larva has succeeded in becoming attached to the skin, it immediately starts to penetrate. The time required for complete penetration depends on the thickness of the skin. On a rat or a guinea pig it takes from 25 seconds to about ½ hour. At the end of the process of invasion the larva is covered by a thin layer of skin; its last segment protrudes slightly from the aperture, but can be withdrawn when touched.

The 2nd larval stage arises as the result of a moult which occurs in the tissues of the host about the 3rd day after penetration. The larva then measures from 2·5 to 4 mm. and is quite different in shape. The 3rd and last moult, again in the tissues, takes place on the 5th or 6th day. The 3rd stage is again different from the 2nd, so that all three stages may easily be distinguished from one another. In a rat the larva reaches maturity about the 8th day, when it measures 13–15 mm. in length. Under normal conditions the larva then leaves its boil, drops to the ground, and pupates there within 24 hours. The puparium has a length of 6–12 mm. At room temperature the fly hatches after 10–11 days; at lower temperatures the pupal stage lasts longer.

Blacklock and Thompson found that in Sierra Leone the wet season is the season of prevalence of infections with *Cordylobia* larvae. The same is true for Southern Africa, as can be seen from Table I.

BEHAVIOUR IN MAN

Although the first larval stage of *Cordylobia anthropophaga* penetrates the skin of many mammals and even of birds, it does not follow that after establishment in the host-tissues development to maturity will take place. This is a matter of great significance and throws light on the question whether we are dealing with a suitable host or not. From this point of view, man must be listed as one of the unsuitable (or at least less suitable) hosts; he is, nevertheless, commonly attacked.

Blacklock and Thompson undertook some experiments with human volunteers. A larva measuring 0·9 mm. in length was placed on the back of a finger of an adult European. The larva moved quickly into a wrinkle and started to penetrate at once. No sensation was felt. Ten minutes later the larva was half concealed and first itching was felt. After another 10 minutes the larva was completely concealed in a tunnel. After 2 hours the itching became constant and a redness and swelling were visible around the larva. The next day a definite papula had been formed, but the irritation had ceased. By the second day the papula had grown larger, but no itching or other irritations were felt. Thereafter, the papula gradually disappeared without any itching or other discomfort. This experiment was repeated several times with other Europeans, and also with two Africans, with similar results. The French authors Roubaud and Bouet had previously had similar experiences in Senegal.

In all these cases the Europeans and Africans had a natural resistance or an acquired immunity (see below) which prevented further development of the larvae. There are several kinds of animals which react in the same way. But there are many cases, as we know from our own experiences in South Africa, in which the larvae succeed in continuing their development in the human skin. Blacklock and Thompson followed up the further development in several Europeans. As in the above-mentioned experiments, it was found that the larvae caused a slight itching or pricking at intervals in the first 2 days, symptoms which may easily be overlooked. The papulae continued to increase in size and became red, but the irritation ceased more or less completely for several days. Then the symptoms suddenly recurred with much greater severity, the pain increased and in some cases became so sharp as to interfere with sleep. At intervals the larvae became very active and could be seen retracting into the cavities and then pushing against the margins of the aperture

in order to increase their size. Serous fluid was exuded, the tissues had become indurated and the area around the aperture was deeply coloured. A tenderness existed on pressure. The lesion then resembled a boil. Even glandular enlargement was found to occur, as well as general symptoms like malaise and febrile reactions.

The development then became slow in the human volunteers, and in one case a 3rd-stage larva removed on the 15th day was found to measure only 9 mm. in length. In rats and guinea-pigs the larvae normally reach maturity on the 8th day, when they measure 13–15 mm.

In humans the larvae are usually noticed only when the 2nd or, more commonly, the early 3rd stage has been reached. The larva is then enlarging its aperture with considerable force and probably produces a lytic reaction on the tissues. A clear fluid comes from the cavity at intervals, sometimes stained with blood or with the faeces of the larva.

Nagel (1897) recorded that in East Africa he observed a larva in his skin for a period of 4 weeks. Evidently this larva also failed to complete its development.

These observations speak for the theory that man is an unsuitable host for *Cordylobia anthropophaga*, in that the parasite is not able to complete its development in man's skin. The larvae which I have received from humans have never been fully mature, but have at most reached the early 3rd stage. Of course, no patient would allow the larvae to continue their development after he had felt the first real pain or after the boil had reached an alarming size. Blacklock and Thompson followed up the infections of only a few volunteers, and it may be possible that there are humans in whom larvae may really reach maturity. I doubt it, and it will probably never happen in nature, but unless this is disproved on more volunteers from different areas and of different races the probability cannot be completely excluded, and man cannot be definitely listed as an unsuitable host for *C. anthropophaga*.

ACQUIRED IMMUNITY IN MAN AND ANIMALS

As the above-quoted experiments have shown, many of the larvae of *C. anthropophaga* do not continue their development in the human skin beyond the 2nd day. This phenomenon can be explained on the basis either of a natural resistance or of an acquired immunity resulting from a previous infection.

Blacklock and Thompson, to some extent, dealt with this problem, too, and recorded the case of an adult European in Sierra Leone who had suffered from a natural infection in which 9 larvae developed in the skin, reaching a length of 6–8 mm. when they were removed. Thereafter he proved resistant to experimental infection at several attempts 4–7 months afterwards, the larvae dying on each occasion.

Similar results have been obtained with dogs, monkeys and guinea-pigs which had previously been infected with positive results. This acquired immunity, however, does not seem to last very long. A European who had contracted an infection in the Congo went back to Europe. Just over a year later he returned to the Congo and promptly became infected a second time. Exactly the same thing happened to his dog.

Blacklock and Thompson have also obtained some paradoxical results. A Coloured youth had received an infection of 4 larvae on 7 March 1923, which developed to papules only; on 8 April he contracted another infection by a single larva, which developed to the 3rd stage. A similar result was obtained with a small dog.

Unfortunately, Blacklock and Thompson did not undertake immunity experiments with rats, the main hosts of *Cordylobia anthropophaga* in nature. In the field, adult rats are often found infected with a great number of larvae, which may cause the death of the host. It may be that those rats did not have a previous infection, or that the immunity broke down later owing to some unknown cause. These are the conclusions drawn by Blacklock and Thompson. It may also be possible that the rats are not able to build up an immunity at all.

TREATMENT

The larvae may be expressed by digital pressure. It is advisable to cover the lesion with petroleum jelly some time before. The larva, which is now excluded from air, will make strenuous efforts towards the aperture, thus facilitating extraction. After extraction, the wound heals easily, but a mark remains for a long time.

The larvae of the 2nd and 3rd stages are not able to invade the skin again, so that they are quite harmless after extraction. They should be preserved in 70% spirit (under no circumstances in formalin) and sent to the Institute with a full case history, so as to add to our knowledge of this parasite and its medical significance. We are also very interested in seeing patients with advanced and heavy infections in order to get some new photographs.

I wish to thank all the doctors who have provided us with material and case histories of *Cordylobia* infections. Furthermore, I am indebted to Mr. D. H. S. Davis, Head of the Medical Ecology Centre, for the map prepared in his department.

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