OPHTHALMOMYIASIS IN MAN, WITH SPECIAL REFERENCE TO THE SITUATION IN SOUTHERN AFRICA*

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The term 'ophthalmomyiasis' implies the presence of fly larvae in the orbit and the accessory organs of the eye (ophthalmomyiasis externa) or in the eyeball itself (ophthalmomyiasis interna). The resulting pathological effects may be slight or moderate, with a benign outcome, or they may be severe and malign.

Such eye infections are quite common in many parts of the world, and sometimes pose a serious medical problem, especially in countries of the Mediterranean and in Asiatic parts of the USSR. The larvae responsible belong to species which are (1) *obligatory parasites*, i.e. they are able to develop only in or on living tissue; or (2) *facultative parasites*, which are normally free-living, and as a rule feed on decomposing organic matter, and only occasionally and under certain circumstances adopt a parasitic mode of life.

OBLIGATORY PARASITES

The group of obligatory parasites will be discussed first. It is composed of two subgroups, namely those fly larvae which are unable to complete their development in the human host, and those which could if not prevented from doing so by adequate medical treatment.

Sheep Nasal Bot Fly

The most commonly found causal agent of human ophthalmomyiasis is the first larval stage of the sheep nasal bot fly *(Oestrus ovis L.)*. Sergent[1] wrote a comprehensive paper on the medical importance and distribution of this fly, and Krümmel and Brauns[2] made some additional notes.

The usual hosts of *Oestrus ovis* are sheep and goats. While hovering in front of the host's head, the mother fly deposits a number of freshly-hatched larvae into the nostrils or the orbits. The larvae, which are about 1 mm. long (Fig. 1), invade the nasal cavities, where after some

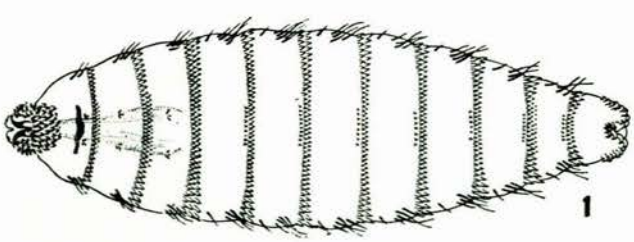

Fig. 1. Oestrus ovis Linnaeus. First instar larva in ventral view (after Grunin).

time they reach the second stage and then migrate further up, mainly to the frontal sinuses, where they reach maturity, and are eventually discharged again, *via* the nostrils, to the ground for pupating. The length of the larval period varies considerably; it may last less than 25 days, or it may possibly be extended for up to nearly a year — the conditions causing this long larval period are still unknown. The dropping of the young larvae into the nostrils or orbits of the normal hosts and the consequent migration through the nasal passages or the naso-lachrymal duct causes some unrest among the animals and perhaps a slight irritation, but no serious pathological effects, and the eyeball, especially, is not harmed. Only the growing larvae cause more or less severe clinical symptoms, depending on the number of maggots present in the head cavities, and the resistance of the sheep race concerned.

Man is affected mainly in those areas where the density of sheep or goats is relatively low compared with that of human beings. The explanation for this curious fact is that the highly pregnant flies do not find their suitable hosts quickly enough, and attack humans 'in desperation', especially when the humans have handled sheep or goats and are contaminated with their odour or, as has been claimed in parts of Northern Africa, when they have eaten goat cheese. But these conditions need not necessarily exist, and quite often people who have had nothing at all to do with animals are attacked.

In humans the flies usually drop their larvae into the orbit, rarely into the mouth or the outer ear. In typical cases, the patient reports being struck in the eye by an insect or a small foreign object. A few hours later a more or less painful inflammation develops, and the syndrome is usually diagnosed as an acute catarrhal conjunctivitis. The young larvae cannot develop further and the trouble usually lasts only a few days. Sometimes the larvae reach the nasal cavities, where they cause swelling and pain as well as frontal headache. In the throat they may cause an inflammation and make swallowing difficult, but these symptoms also gradually disappear and rarely last longer than up to 10 days. Man is an unsuitable host for *Oestrus ovis*, and these misguided larvae have not been found to develop beyond the first stage.

Only one human case has so far been reported from Southern Africa, by Du Toit and Meyer.[3] It will be quoted to illustrate all the features of the numerous cases in the literature, especially those described by French authors:

'On 16 October 1959 one of the members of the staff of the Veterinary Research Institute at Onderstepoort, while walking within the grounds of the Institute at about 11 a.m., experienced sudden intense irritation in the right eye and complained of feeling a moving object under the upper lid. Upon examination a small white maggot-like larva was clearly discernible moving fairly rapidly over the sclera. Attempts at irrigating the sclera with normal saline with the object of washing out the larva failed to remove it and it was finally extracted by means of a pair of fine-pointed forceps. The irritation, however, persisted and the patient stated that he was aware of further movement over the sclera, especially at the medial canthus. As superficial examination failed to reveal any further larvae present, and by this time a fairly severe conjunctivitis had set in, he was advised to consult an ophthalmologist. Upon the patient's arrival at the consulting room the affected eye was subjected to close scrutiny.

'With the naked eye nothing could be detected. On $\times 16$

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magnification with the corneal microscope and slit lamp the larvae could be seen clearly in the upper and lower fornix, hiding in the conjunctival folds. As soon as they were exposed by manual eversion of the conjunctival folds they moved away from the light at a speed of 1 cm. in two or three seconds to disappear in another fold of the fornix . . .

'After a local anaesthetic was instilled into the eye, irrigation was attempted with a plastic bottle. A strong stream of water was squirted into the fornix several times, but with no success. Removal was then accomplished with the aid of the slit lamp and ×16 magnification. Small non-tooth forceps were used to catch each larva as it passed the eye field. Eight larvae were removed.'

The larva of *Oestrus ovis* causes a benign ophthalmomyiasis in Man, and the same is apparently true for *Rhinoestrus purpureus* (Brauer), which has a similar mode of life and develops in horses and donkeys. This fly is rare and only locally distributed in Southern Africa, where it is not yet of medical importance. In the USSR, however, many cases of ophthalmomyiasis externa have come to our knowledge, and also some cases of ophthalmomyiasis interna with destruction of the eyeball. These malign cases need confirmation, and may not have been caused by *Rhinoestrus purpureus*, but by *Hypoderma* larvae (see below). The first instar larvae of *R. purpureus* are clearly

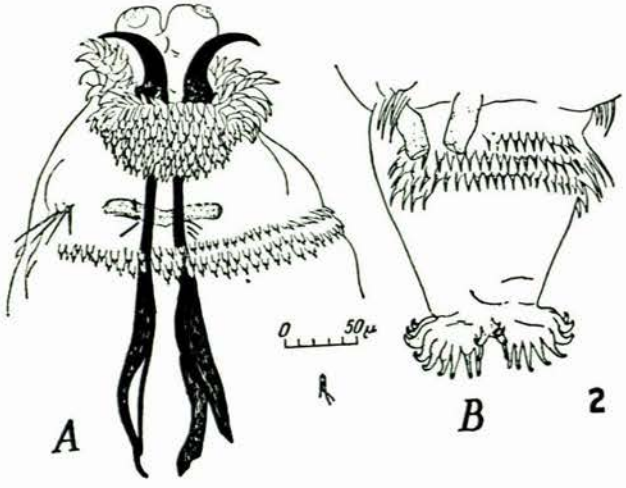

Fig. 2. Oestrus ovis Linnaeus. Anterior part (A) and posterior part (B) of the first instar larva (after Galliard).

separable from those of *O. ovis* and of *Hypoderma* (Figs. 2, 3 and 5).

Gedoelstia

Another fly genus closely related to *Oestrus* and *Rhinoestrus* is *Gedoelstia*, which comprises two species and occurs only in Africa south of the Sahara. The normal hosts are antelopes of the Alcelaphini *(Connochaetes, Alcelaphus, Damaliscus)*, in which the first larval stages, as in *O. ovis* in sheep and goats, apparently do not cause noteworthy pathological effects. In several domestic animals, however, especially in certain breeds of sheep, they cause a disease with a high mortality, the so-called oculovascular myiasis ('uitpeuloog'), the aetiology of which was only recently cleared up by Basson.[4] In these cases, too, the larvae do not develop beyond the first stage. They

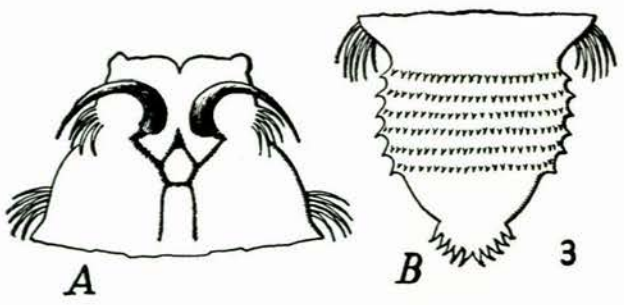

Fig. 3. Rhinoestrus purpureus (Brauer). Anterior part (A) and posterior part (B) of the first instar larva (after James).

do not affect only the eye, but also the central nervous system.

Basson said that farmers in South West Africa insist 'that cases have occurred in dogs and Man'. Du Toit and Meyer[3] recorded a case from the Kuruman district, where a specimen of *Gedoelstia cristata* Rodh. & Bequ. was captured after it had deposited large numbers of larvae in the external ear of a man, and I have received a first instar larva of *Gedoelstia hässleri* Ged., which was extracted from the eye of an African who acquired the infection in September 1960 near Nairobi in Kenya (Fig. 4). The course of the illness was benign, but with regard

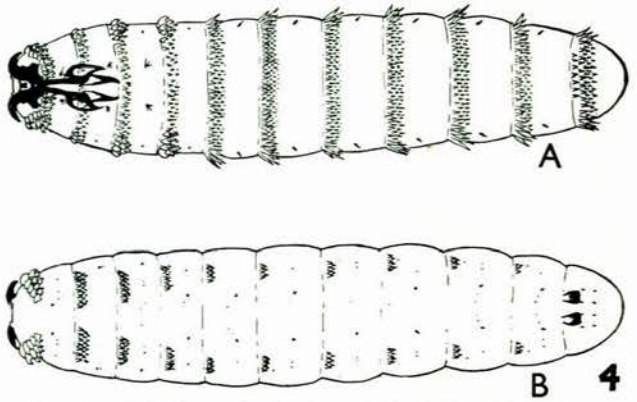

Fig. 4. Gedoelstia hässleri Gedoelst. Ventral (A) and dorsal (B) views of the first instar larva (after Basson).

to the severe symptoms caused by the larvae in certain domestic animals, it is quite probable that a malign syndrome may also develop in humans. The ophthalmologist should therefore be aware of this possibility in areas where 'uitpeuloog' or 'bulging-eye disease' occurs in sheep, goats, cattle and horses.

Warble Flies

A malign ophthalmomyiasis interna is caused by the first instar larvae of warble flies (*Hypoderma*), mainly by *H. lineatum* (Villiers), which has as normal hosts cattle and the North American bison (Fig. 5). Another species in cattle is *H. bovis* (L.). The first larval stages of these two species are very similar to one another, and it is therefore understandable that they have often been confused by various authors. Nowadays it is believed that most records of *H. bovis* in connection with human ophthalmomyiasis actually refer to *H. lineatum*.

The life-history of the *Hypoderma* species is quite different from that of *Oestrus* and related genera. The larvae do not

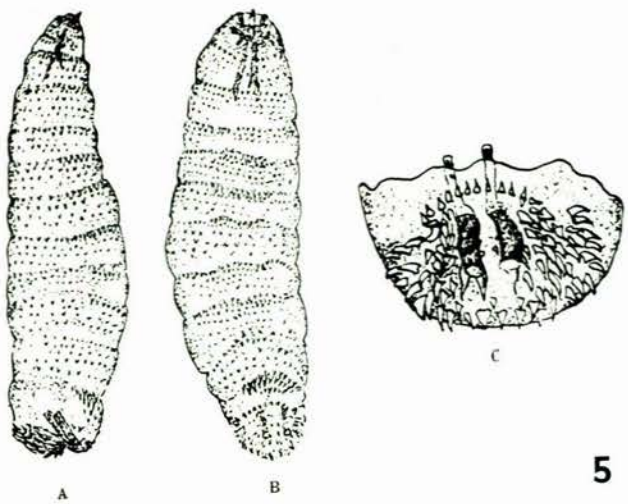

Fig. 5. Hypoderma bovis (Linnaeus). First larval stage in lateral (A), ventral (B) and posterior and enlarged (C) views (after Carpenter, Hewitt and Laake).

develop in the head cavities, but are subcutaneous parasites, which in the second and third stages form the so-called 'warbles'. After having reached maturity, the larvae drop from these boils through a perforation and pupate on the ground. The flies, furthermore, are not larviparous, but deposit eggs which are attached to the body-hairs, and the hatching larvae, which are about 1 mm. long, immediately burrow into the skin at the base of the hair and migrate by a more or less circuitous route through the intermuscular connective tissues, finally lodging in the back of the animal.

In Man, occasional subcutaneous infections are known, but the larvae do not reach maturity. The infection of the eye, which always takes a serious course, is actually the fortuitous striking of a very vulnerable organ during normal migration in an unsuitable host. There has been some discussion in the literature of how the *Hypoderma* larva reaches the orbit. One opportunity arises when people handling cattle contaminate their hands with freshly-hatched larvae and then rub their eyes. The light-shunning maggot will invade the conjunctival sac and somewhere penetrate the eyeball, just as it normally invades the skin of cattle. Or possibly the fly may deposit eggs on hairs, mainly those of the eyebrows or eyelids, and the hatched larva then may reach the eye on a short migration route.

For the first instar larvae of *Oestrus, Rhinoestrus* and *Gedoelstia,* the orbit is one of the normal invading places. They are adapted to this route of migration and avoid the eyeball, which would only be a trap for them. In the case of *Hypoderma,* however, the eyeball is just another tissue into which to penetrate; this penetration has very severe pathological effects. A more recent summary of this syndrome was given by Krümmel and Brauns.[2]

Hypoderma species do not occur in Southern Africa, in spite of the fact that infested cattle have been imported often enough in the past. Fortunately the flies have never settled here; however, this does not mean that it may not happen sometime in the future, and great care should be taken with regard to these dangerous and economically important parasites.

All fly species mentioned so far belong to the family Oestridae, which is characterized in the adult stage by rudimentary, non-functional mouthparts. The flies are therefore very short-lived and rarely seen in the field.

Calliphoridae

A number of other flies which have been found to cause ophthalmomyiasis in humans belong to the family Calliphoridae, which includes the well-known blowflies. Among the species recorded are three which, in the larval stages, are obligatory parasites like the Oestridae. These are *Callitroga americana* (Cush. & Patt.) in the New World, and *Chrysomya bezziana* Vill. and *Wohlfahrtia magnifica* (Schin.) in the Old World.

Callitroga americana is a most serious myiasis-producing fly, which attacks only fresh, clean wounds in Man and animals. These wounds may be very small; even a scratch or a stubbed toenail may become infested. The fly is oviparous and attaches the eggs to dry skin nearby. The hatched larvae then penetrate the wound and feed on the healthy tissue, producing characteristic pocket-like injuries. They grow rapidly and reach maturity within 4 - 8 days, after which time they drop to the ground to pupate. Larvae have also been shown to be capable of entering the unbroken soft skin of guinea-pigs and rabbits, and the same may occur in humans. Infections of the orbit in humans are often recorded as well as of the nose, mouth and ear. If untreated, they may easily result in death. Man, like many animals, is a suitable host for *Callitroga americana,* and the maggots undergo an unretarded development in the wounds they create.

The two Old World species have a similar mode of life. *W. magnifica* occurs in the warmer parts of Europe and in the USSR; *C. bezziana* in Africa south of the Sahara, and in many parts of the Orient. The orbit is only one part of the human body which may become infested, but it is a very vulnerable one, and the fast-growing, tissue-feeding larvae may destroy the eye within a very short time, before any medical help is available.

In contrast to the Orient, records of human cases of myiasis due to *Chrysomya bezziana* are rare in Africa, and no cases of ophthalmomyiasis are known. They may be expected, however.

FACULTATIVE PARASITES

In the literature on human ophthalmomyiasis, there are also some fly species mentioned which belong to the Calliphoridae and Muscidae, and which normally breed in carcasses and other decomposing organic matter. These flies are known to act occasionally as facultative parasites and to cause a traumatic myiasis. The flies are attracted by bacterially infected, foul-smelling and putrefying wounds; the dead tissue plays the role of 'a piece of carcass' in the living body. James[5] briefly mentioned *Lucilia sericata* (Meig.), the common green bottle fly, in this connection; and Krümmel and Brauns[2] quoted the following from the literature: *Sarcophaga* species, *Calliphora vomitoria* (L.), *Lucilia caesar* (L.) and *Stomoxys calcitrans* (L.). But they themselves doubted the reliability of these records.

A typical example of how carelessly records are sometimes brought to publication is the paper by Eickemeyer, quoted by Krümmel and Brauns. At a meeting of the German Ophthalmological Association in Munich in 1950, Eickemeyer reported a case of ophthalmomyiasis interna posterior. He had made cross-sections and identified from them the causative larva as *Lucilia caesar,* or *Sarcophaga*

carnaria, or *Stomoxys calcitrans.* It is hardly possible even for an experienced dipterologist to identify the first larval stage of these fly species from tissue sections. Moreover, the case history he gave makes it quite clear that most probably a *Hypoderma* larva was concerned. Krümmel and Brauns[2] also mentioned two cases from the Argentine and from North Africa, where larvae of *Calliphora* and *Sarcophaga* had been found to persist for several months in the lachrymal sac of humans. They did not give the references for these cases, but they are simply unbelievable.

Another 'unbelievable' case is reported by Wardill (1947), who found larvae of the African tumbu fly, *Cordylobia anthropophaga* (Blanch.), involved in an ophthalmomyiasis of a negro in Trinidad. This fly does not occur there, and moreover it does not attack the eye, as the numerous cases which come to the knowledge of practitioners in Africa every year show. The larvae of *C. anthropophaga* are subcutaneous parasites which develop in skin boils and are well adapted to humans, dogs, rats and other animals. Another erroneous quotation by Krümmel and Brauns[2] is the listing of the neotropical bot fly, *Dermatobia hominis* (L.), as a producer of ophthalmomyiasis. The larvae of this fly are subcutaneous parasites like those of the African tumbu fly, and they cause a similar syndrome, but they attack neither the orbit nor the eye. Most probably these authors confused it with *Callitroga americana,* which is not mentioned in their list.

A myiasis of the orbit caused by *Lucilia sericata* and other carcass-breeders can and does occur, but only when pre-existing, putrefying wounds in or near the orbit are attacked by the flies. The wound may then enlarge and even infect the eyeball, but we are then actually dealing with a typical wound myiasis as it may occur in other parts of the body as well, the original cause being the traumatic injury with a subsequent bacterial infection, and not the fly larva.

Such cases are, however, very rare, and I do not know of any from Southern Africa.

SUMMARY

The most common cause of ophthalmomyiasis in man is the sheep nasal bot fly *(Oestrus ovis).* The illness is short and takes a benign course. The larva of the horse nasal bot fly *(Rhinoestrus purpureus)* probably also causes only a benign eye infection, and cases recorded with destruction of the eyeball may refer to warble flies of the genus *Hypoderma.* The larvae of this genus cause an ophthalmomyiasis which is always severe. It was recently discovered that the first instar larvae of *Gedoelstia hässleri* and *G. cristata* cause a malign oculovascular myiasis in certain domestic animals in Southern Africa, and one human case from Kenya has been reported which, however, took a benign course. All these fly species belong to the family Oestridae and are obligatory parasites, but Man is an unsuitable host.

Other fly species involved in a severe ophthalmomyiasis are *Callitroga americana* in the New World, and *Chrysomya bezziana* and *Wohlfahrtia magnifica* in the Old World. They belong to the family Calliphoridae and are also obligatory parasites of humans and various animals. The myiasis they cause is not restricted to the orbit, but may affect any part of the body, and Man is a very suitable host.

Several other species of the Calliphoridae and Muscidae recorded in connection with human ophthalmomyiasis are normally carcass-breeders, and the larvae act only occasionally as facultative wound parasites. A pre-existing bacterially infected wound is necessary for attracting the mother flies, and the resulting myiasis should be grouped under wound myiasis.

From Southern Africa only one case of ophthalmomyiasis caused by *Oestrus ovis* has so far been reported, but cases of so-called 'acute catarrhal conjunctivitis' may have been wrongly diagnosed in the past. Ophthalmomyiasis caused by *Gedoelstia* larvae is said to occur in humans in certain areas of South West Africa. A severe ophthalmomyiasis caused by *Chrysomya bezziana* is to be expected in Southern Africa, but no cases have yet been reported; neither are cases of wound myiasis affecting the orbit known.

REFERENCES

1. Sergent, E. (1952): Arch. Inst. Pasteur Algér., **30,** 319.
2. Krümmel, H. and Brauns, A. (1956): Z. angew. Zool., **43,** 129.
3. Du Toit, R. and Meyer, H. (1960): S.Afr. Med. J., **34,** 581.
4. Basson, P. A. (1962): Onderstepoort J. Vet. Res., **29,** 81.
5. James, M. T. (1947): U.S. Dept. Agric., Misc. Publ. no. 631.