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A NEW METHOD OF TREATMENT FOR SHEEP INFESTED WITH THE LARVAE OF THE SHEEP NASAL-FLY, OESTRUS OVIS. L. IN THE UNION OF SOUTH AFRICA.

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The occurrence of the larvae of the sheep nasal-fly *Oestrus ovis* L. in the head sinuses and nasal passages of sheep has attracted attention in practically every country in the world since earliest times. A very extensive literature on the subject exists scattered throughout the scientific publications of many countries. From the views expressed it is apparent that there is great diversity of opinon regarding the significance which may be attached to the infection in sheep. Generally speaking the parasite is regarded as benign and responsible for comparatively little ill-effects. On the other hand many observers hold that the constant irritation produced by the cuticular spines and oral hooks of the larvae together with certain toxic substances excreted by them profoundly affect the well-being of infected animals and that the infection should be regarded in a serious light.

The fact remains that by virtue of its rather peculiar life history, characteristic of the family *Oestridae* in general in which all feeding is accomplished in the larval stage only, the sheep nasal-fly enjoys a very considerable degree of immunity against all attempts to control it. The result is that there appears to have been a gradual but sustained increase in its incidence in many sheep raising countries as can be deduced from the more recent references to it in the scientific literature.

Fallis (1940) reported an incidence of 50 per cent infection in sheep with an infection rate of over 96 per cent in lambs between August and May in Western Canada. Roberts (1940) reports widespread infection of sheep in Queensland, Australia. Cobbett and Mitchell (1941) found 96 per cent of sheep in New Mexico, U.S.A., infected, whereas Brodskii (1941), Sapogov (1947) and Bashakov (1947) make mention of widespread and severe infection in Uzbekistan, U.S.S.R.

An analysis of reports from field veterinarians and enquiries from farmers received at Onderstepoort between 1940 and 1952 has revealed the infection to be widespread throughout the Union of South Africa. Not only do these reports and enquiries point to an extension of those areas known to harbour the infection but they seem to indicate an increase in its severity. This appears obvious from the more serious view taken of nasal worm infection, as it is known locally, in recent years, an attitude not wholly attributable to the higher economic value placed upon sheep as a result of the increase in wool prices. The more recent reports indicate larger numbers of larvae encountered in the heads of individual sheep than was previously the case and greater severity in the symptoms shown.

The accompanying map (Fig. 1) has been compiled from the above-mentioned reports and enquiries received between 1940 and 1952 and indicates the distribution of *Oestrus ovis* infection in South Africa. It will be noted that the condition tends to be more prevalent in the Transvaal, particularly towards the east, the northern Orange Free State and northern Transvaal. In the Karoo portions of the Cape

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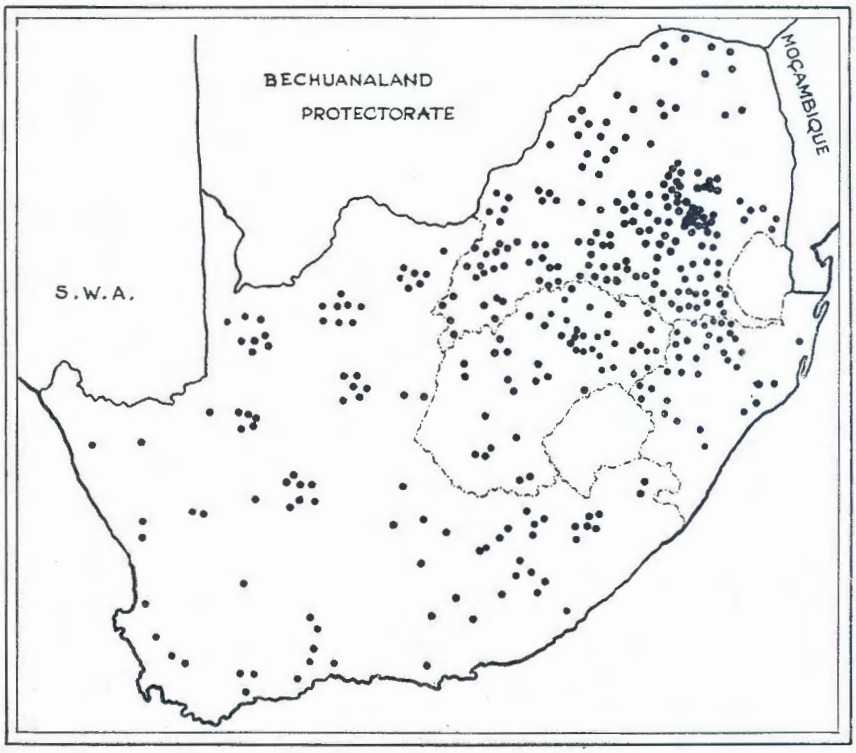
Province, which carry the greatest concentration of sheep, the incidence of infection is comparatively low. Increasing interest in the problem of recent years in the Karoo, however, is interpreted as indicating that the infection appears to be spreading into these areas as well.

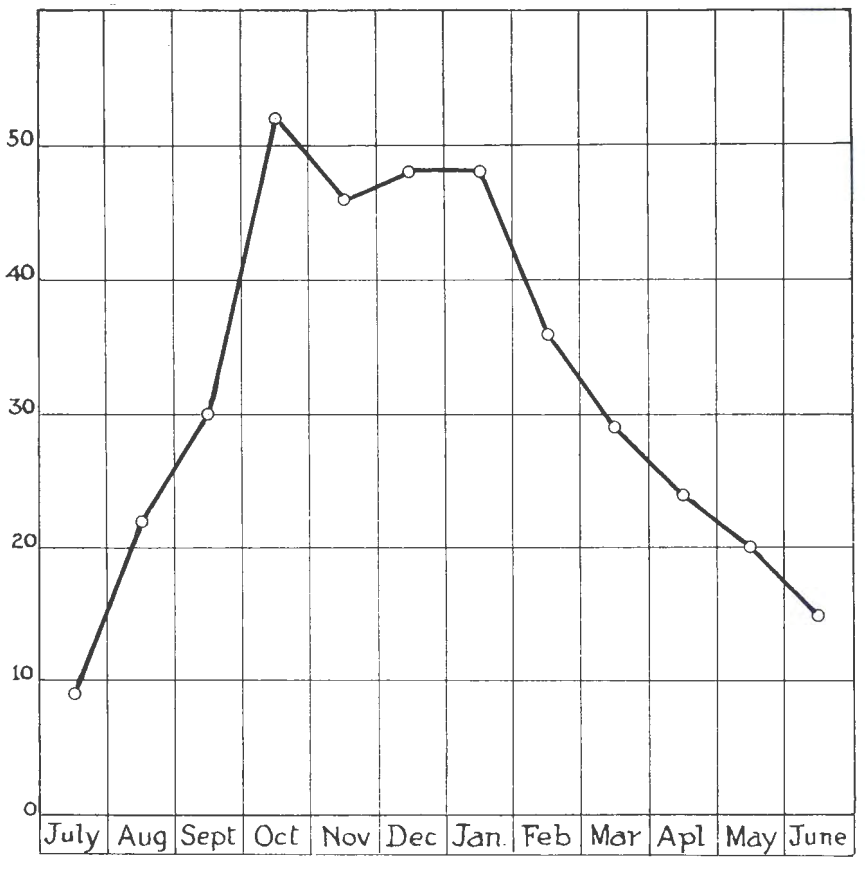
Fig. 1.



In Fig. 2 an attempt has been made to represent graphically the seasonal incidence of infection in sheep. The data are based upon the enquiries and reports referred to previously over a period of twelve years in terms of the average numbers received monthly throughout the year. Whereas the winter months of June and July represent a period of comparative freedom from infection, the requests for assistance in combating the parasite in sheep mount rapidly to reach a peak in October. This peak is maintained at a high level until January when the infection subsides rapidly to the low level prevailing in the cooler portions of the year.

Cobbett and Mitchell (1941), from their observations on the biology of *Oestrus ovis* in New Mexico and Texas, have demonstrated a considerable degree of variation in the rate of development of the larvae in the heads of sheep. This phenomenon has been noted by other workers as well although no satisfactory explanation to account for this variable developmental rate has been forthcoming. Climatic conditions appear to play no role as variable development of larvae occurs at any particular time of the year although there is a general tendency for the rate of growth to slow down during the winter months. This observation is also borne out in South Africa where larval development appears to follow very

Fig. 2.



closely the pattern observed in America. Mature larvae have been obtained from lambs at Onderstepoort no more than a month old. This would appear to indicate that infection had occurred shortly after birth and that larval development could be completed in as short a period as 30 days.

Control Measures.

The fact that the adult fly does not feed and that its sole function appears to be the propagation of the species over a comparatively short period of not more than a few weeks at most makes the application of measures to control this stage extremely difficult. Little success has attended efforts made at protecting sheep against attacks of the adult flies by the use of repellents smeared on to the nostrils of sheep directly, or indirectly by their application to narrow troughs, etc., so designed that sheep automatically rub their noses against the treated surfaces when attempting to reach salt or bone meal contained in them.

The extruded larvae and pupae resulting from them appear to be equally invulnerable as these occur over wide areas in pasture or other situations where their occurrence in the soil makes them inaccessible.

The immature larval stages occurring on the mucous membrane of the nasal cavity and over the turbinate bones together with the more advanced and mature larvae found mainly in the frontal sinuses appear to represent the most vulnerable stage and offer the greatest chance of success in combating the infection. Cobbett (1940) claims a considerable degree of control amounting to a 90 to 98 per cent reduction of larvae in the heads of sheep by the intra-nasal injection of a 3 per cent saponified cresol emulsion at a pressure of 35 to 45 lb. per square inch. On the other hand Schwardt (1950) states that " no effective measures against the bot-fly are known ".

Du Toit and Clark (1935) advocate the use of a small guarded trocar and canula by which medicaments (carbon bisulphide or tetrachlorethylene) can be injected directly into the frontal sinuses where they are effective in destroying the larvae in these situations. It must be mentioned that some skill is required in driving in the instrument correctly and coupled with the fact that the remedies advocated exert a stupefying effect upon sheep which, though of short duration, may appear rather alarming, the farming community in general do not favour the method.

Brodskii (1941), Sapagov (1947) and Bashakov (1947) recommend the capture and destruction of the adult flies in spring. They report the finding of large numbers of adults resting on buildings and other objects in the early mornings and late afternoons. Such spring collections of adults, they claim, bring about a marked reduction in the incidence of the condition in autumn. It must be mentioned that in South Africa it is a comparatively rare occurrence to encounter the adult flies, at any rate in any numbers, resting on objects as reported by these observers and the method would appear to have little application in this country.

Rossiter (1953) records a marked improvement in the condition of sheep and a pronounced lowering of the incidence of *Oestrus ovis* infection as judged by the cessation of nasal discharges in sheep following upon treatment for intestinal worm parasites by means of tetrachlorethylene. This would appear to suggest, perhaps, a correlation between worm infestation with consequent lowered general condition and *Oestrus ovis* infection.

Experimental.

It is obvious that with the present state of our knowledge attempts at controlling nasal worm infection should be directed at the more vulnerable immature stages occurring in the nasal passages and sinuses of sheep. With this object in mind the present investigation was directed at determining the effect of certain of the new chlorinated hydrocarbon insecticides upon the larvae in their natural environment in the heads of sheep. At the same time the extent to which various solvents capable of carrying effective concentrations of the insecticides could be tolerated by the sheep had to be ascertained. Finally, the form in which the insecticide should be introduced in order to ensure maximum penetration into the rather inaccessible situations in which the larvae occur had to be determined.

It appears more logical to correlate the larvae of *Oestrus ovis* with those of blow-flies in so far as their susceptibility to insecticides is concerned than to compare them with the intestinal worms upon which the use of a substance such as tetrachlorethylene, much used in South Africa, has been based.

It has been demonstrated by Du Toit and Fiedler (1952) that the third instar larvae of the sheep blow-fly *Lucilia cuprina* Wied, showed a high degree of susceptibility to the gamma isomer of B.H.C. which, with the exception of Parathion,

had proved to be the most effective of the insecticides investigated. Parathion was regarded as too toxic to the sheep itself to be included in the present investigation and attention was confined to Lindane, the pure gamma isomer of benzene hexachloride.

As previously mentioned the introduction of any larvicide directly into the sinuses of sheep by means of a trephining method such as the guarded trocar and canula suggested by Du Toit and Clark (1935) appears to find little favour amongst the farming community.

A method of introducing tetrachlorethylene in emulsion form into the nostrils of sheep has been used in the Union of South Africa for a considerable time. This consisted of placing the sheep upon its back, as illustrated, in Fig. 3, and injecting the drug slowly into each nostril with the head held at an angle of 45 degrees with the ground.

Fig. 3.

Results have been fairly good but the sheep reacted violently to the drug frequently rearing over backwards when released and showing signs of intoxication which were of temporary duration only. Frequent failures to destroy the larvae in the sinuses were encountered, however, and this was presumed to be due to insufficient penetration owing to the copious mucoid secretion clogging the openings to the sinuses and preventing the drug from gravitating into them.

Whereas many solvents such as benzol, acetone, alcohol, pine tar derivatives etc., have been found to be irritating *per se* when introduced into the nasal cavity and often produced swelling of the nasal mucosa with persistent secretions, they

were found to be better tolerated when introduced in emulsion form. Such emulsions had little penetrating power, however, and failed to enter the sinuses in the presence of large amounts of nasal secretion so commonly encountered in sheep heavily infested with *Oestrus* larvae.

The idea was conceived of introducing the insecticide in a fairly concentrated form in a base capable of emulsification in the serous discharges covering the mucous membrane. In other words, the base or emulsifiable concentrate should possess the property of lowering surface tension and, during the process of emulsification in the serous exudate covering the mucous membrane lining the upper respiratory passages, "creeping" into the sinuses in spite of the presence of a large amount of heavy mucoid secretion.

With this object in mind a considerable amount of empirical experimentation was undertaken to find a miscible or emulsifiable base capable of holding in solution a concentration of at least 4 per cent Lindane and at the same time being non-irritating, and measuring up to the standard required.

The formula ultimately decided upon consisted of a mixture of solvents and emulsifiers held in a perfectly clear homogeneous state by the addition of an accessory solvent, in this case oleic acid. If a drop of this emulsifiable base is dropped on to the surface of water in a petri dish it instantly spreads over the entire surface.

The formula adopted consists of the following:—

Solvents—		
Benzol	12·5	parts by volume.
Acetone	12·5	parts by volume.
Paraffin (Kerosene)	10·0	parts by volume.
Emulsificants—		
Sulphonated castor oil (technical)	57·0	parts by volume.
Triton × 100	2·0	parts by volume.
Accessory solvent—		
Oleic acid (technical)	6·0	parts by volume.
	100·0	
Insecticide—		
Lindane	4	gms. per 100 c.c.

Four cubic centimetres of the above mixture is injected into each nostril of a sheep in the prone position as illustrated in Fig. 3 and the animal is held in this position for an additional ten seconds after injection so as to allow the gravitational effect to assist the remedy in penetrating the sinuses.

The remedy is extremely well tolerated and although an occasional sheep may sneeze when allowed to rise most animals show no effects at all.

Determination of Results Following Treatment.

No satisfactory method appears to exist of establishing the actual death of larvae in the head sinuses after treatment. Clinical observation of the nasal secretions and the general well-being of treated sheep appear to provide the only reliable index of the effects of treatment upon infected sheep.

With the object of endeavouring to assess the effects of treatment upon sheep treated under field conditions test quantities of the above-mentioned remedy were sent to veterinarians stationed in different parts of the Union. In all, 2,865 sheep judged to be severely affected on clinical grounds were reported upon. In practically all cases the reports received were similar, namely, that mucoid secretions ceased in the vast majority of cases in from 9 to 14 days; the animals commenced feeding normally again and a marked improvement in condition resulted. In some cases it was reported that from 3 per cent to 6 per cent of sheep treated failed to respond and these required a second treatment 14 days to 3 weeks after the original treatment. Of the sheep treated a second time only in one case was it necessary to apply a third treatment in the case of a few sheep where nasal discharges persisted.

From Natal it was reported that ten weeks after the original treatment a number, not specified, of the sheep commenced showing signs of reinfection.

In one case in the Rustenburg district a number of ewes with suckling lambs were treated together with their lambs. The dosage given to the lambs was similar to that given to the adult sheep, namely, in this case 4 c.c. of a mixture containing 6 per cent Lindane. The dose for the lambs was apparently excessive and three succumbed with muscular tremors typical of B.H.C. poisoning. The greater percentage of the remaining lambs showed some swelling of the nasal mucosa and their sense of smell appeared to be affected together with that of the ewes. The result was that great difficulty was experienced in getting the ewes to accept the lambs or the lambs to find their mothers after treatment.

To test the toxicity of the remedy administered by the intranasal route in the case of young lambs an experiment was conducted at Onderstepoort the results of which are tabulated in Table No. 1.

TABLE 1.

Intranasal Injection of 2 *c.c.* Oestrus ovis *Remedy Containing* 6 *Per Cent Lindane in each Nostril of Lambs Held in the Prone Position. Date:* 20*th January,* 1953.

Sheep No.	Age.	Weight.	Symptoms.	Onset Time After Treatment.	Result.
No number	1 day.	8·5 lb.	Muscular tremors	25 minutes	Died.
86545	3 days	9·5 lb.	Muscular tremors	20 minutes	Recovered.
86544	7 days	9·0 lb.	Muscular tremors	20 minutes	Died.
86543	7 days	13·0 lb.	Muscular tremors	30 minutes	Died.
86542	7 days	14·5 lb.	None	—	—
86536	22 days	12·0 lb.	None	—	—
86485	4 months	33·5 lb.	None	—	—
86483	4 months	25·0 lb.	None	—	—
86354	5 months	25·0 lb.	None	—	—
86353	5 months	23·5 lb.	None	—	—
85483	6 months	22·0 lb.	None	—	—
85451	7 months	19·0 lb.	Muscular tremors	2 hours	Recovered.

It will be noted from the above table that the lambs which succumbed as a result of absorption of Lindane through the nasal mucosa received doses varying from 40 mg. per kg. to 60 mg. per kg. whereas lamb No. 85451 weighing 19 lb. showed distinct symptoms of Lindane poisoning with a dose equivalent to 28 mg. per kg. In the case of adult sheep the dose of Lindane averages approximately 8 mg. per kg. body weight.

DISCUSSION.

In view of the fact that a dosage in excess of say 20 mg. per kg. body weight appears to possess distinct toxic hazards it would appear advisable not to treat lambs under 20 lb. body weight. Furthermore, the effect which the remedy may have in interfering with the sense of smell of both ewes and lambs even though of a temporary nature only, suggests that it is inadvisable to treat either ewes or lambs before the latter have been weaned due to the danger of the ewes not accepting the lambs after treatment.

The treatment of sheep infested with the larvae of *Oestrus ovis* by the method described appears to be very successful in clearing up the infection in the majority of cases with a single treatment. A small percentage of sheep, however, fail to respond and a second and even a third treatment may be advisable spaced at approximately three-weekly intervals. At the same time a large number of pupae present in the ground will hatch during a period which normally averages about one month during summer. A distinct danger exists, therefore, that sheep already cleared of the infection by treatment will become reinfected. With these considerations in mind it would appear advisable to apply a minimum of three treatments to an entire infected flock spacing the treatments at intervals of three weeks or preferably one month. The object is to allow all pupae present in the ground to hatch and to destroy the larvae originating from them in the sheep. As the adult fly has a life span of comparatively short duration which rarely exceeds two weeks, the period covered by the treatments applied at monthly intervals should not be shorter than about two months. During this period pupae present in the ground will have given rise to adults and these in turn will have completed their life span while the resultant progeny in the sheep will have been dealt with.

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