Bulletin of the World Health Organization, 56 (3): 433-443 (1978)

The Styx Field Trial

Effect of treatment of the definitive host for tapeworms on larval forms in the intermediate host

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*A 13-year assessment has been made of the effectiveness of a monthly drug treatment programme for the control of tapeworms in dogs in order to prevent hydatidosis (*Echinococcus granulosus*) and cysticercosis (*Taenia hydatigena *and* T. ovis*) in sheep. The age-specific prevalence of* T. hydatigena *in lambs was used as the principal indicator. The trial was carried out in the Styx Valley of the Maniototo Plain in the South Island of New Zealand.*

Over an 8-year period dogs were treated monthly with bunamidine hydrochloride at about 25 mg/kg with little effect on the prevalence of T. hydatigena *in lambs. The addition of niclosamide at 50 mg/kg for 1 year also had little effect. Eggs appeared to survive from one season to the next. Those shed prior to the lamb-rearing season gave rise to endemic-type patterns; whereas patent infections occurring during this period rapidly gave rise to an epidemic-type pattern or a "cysticercosis storm". In this 9-year period there were 16 "cysticercosis storms" and all susceptible lambs were infected. These storms did not necessarily give rise to a similar prevalence on neighbouring farms, but may have contributed to the overall infective pattern. A similar situation occurred in the first year that nitroscanate at 100 mg/kg was introduced. During this 10-year period, arecoline surveillance of the dog population was undertaken in the remainder of the county and many dogs were found to harbour tapeworms. Both resident and introduced dogs may have contributed to the infective patterns in the Styx Valley.*

Treatment with nitroscanate was continued monthly in the Styx Valley and niclosamide was used in the remainder of the County for a further 3 years. There was a marked reduction in the age-specific prevalence and lambs on many farms were free from T. hydatigena *at slaughter. However, one "breakdown" occurred and this was almost certainly autochthonous.*

Comparisons with an earlier period when arecoline surveillance was used in the Styx Valley, indicate that the present evidence favours a drug-orientated treatment programme of the definitive host for the control of cysticercosis. However, "breakdowns" caused by either autochthonous or itinerant sources have profound effects, since they involve all susceptible age-cohorts including those that have never been infected and those that have lost the immunity induced by an earlier infection.

The Styx Field Trial for the control of tapeworms in dogs was initiated in 1943 in a relatively isolated valley of the Maniototo County on the South Island of New Zealand in order to prevent hydatidosis (*Echinococcus granulosus*) and cysticercosis (*Taenia hydatigena* and *T. ovis*) in sheep. During the first 9 years, dogs were treated every 3 months with arecoline hydrobromide. During a further 6 years the drug was administered to their dogs by the owners. Subsequently, for 7 years, arecoline hydrobromide was used 3-monthly for surveillance of tapeworms in dogs in conjunction with an educational approach to dog-control and feeding. The age-specific prevalence data for *T. hydatigena* in lambs and prevalence data for *T. hydatigena* and *E.*

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granulosus in aged sheep were used as indicators. Both laboratory and field diagnostic methods were evaluated. The results obtained during the first 21 years have been described (*2*). An assessment of the trial indicated that these methods, particularly the educational component of arecoline surveillance reduced the prevalence of hydatidosis in the aged sheep. Cysticercosis caused by *T. hydatigena* was not effectively modified, and that caused by *T. ovis* actually increased.

This paper extends the previous 21-year study, and describes the results obtained over 13 years by treating dogs each month with bunamidine hydrochloride (8 years), bunamidine hydrochloride and niclosamide (1 year), and nitroscanate (4 years). The value and limitations of an educational approach using arecoline surveillance and drug-oriented programmes are compared and contrasted using the prevalence of *T. hydatigena* in lambs and aged sheep as the principal indicator.

MATERIALS AND METHODS

The topography, flora, fauna, and the farming practices and statistics of the Styx Valley have previously been described (*2*). No significant changes in these factors occurred between the first 21 years (1943–63 inclusive) and the 13-year period described in this paper (1965–77 inclusive). Arecoline surveillance was continued in 1964 and 0, 3, and 7 dogs were detected with *E. granulosus*, *T. hydatigena*, and *T. ovis*, respectively. Larval *T. hydatigena* was found in 8% of the 8129 lambs and 45% of the 594 old ewes examined.

Table 1. The efficiency of bunamidine hydrochloride against *Taenia hydatigena* infections in dogs

	Dose rate (mg/kg) [a]					
	0	25 (1)	25 (2)	25 (3)	50 (1)	100 (1)
No. of dogs infected/no. examined	10/10	4/10	1/10	0/10	0/10	0/10
No. of worms remaining	4, 4, 4, 4, 4, 3, 3, 2, 2, 2	2, 2, 1, 1	3	—	—	—

[a] Explanation of figures in parentheses in column headings: (1) = single treatment; (2) = two treatments with a 2-day interval; (3) = three treatments with 2-day intervals.

Table 2. Number of dogs detected with *Echinococcus granulosus, Taenia hydatigena* and *T. ovis*, using arecoline surveillance, in the region surrounding the Styx Field Trial (1965-77)

Year	No. samples tested	*E. granulosus*	*T. hydatigena*	*T. ovis* [a]	Unidentified [a]
1965	4259	82	269	na	na
1966	5242	65	371	na	na
1967	3261	29	161	153	na
1968	3568	62	320	263	na
1969	4045	53	182	241	46
1970	3430	27	119	194	61
1971	2007	6	66	82	36
1972	4717	32	164	241	71
1973	3095	8	65	86	35
1974	3220	10	52	57	19
1975 [b]	1297	1	0	3	1
1976 [b]	1158	1	0	2	3
1977 [b]	1349	1	3	8	4

[a] na = not available.
[b] 6-weekly niclosamide treatments.

An evaluation of the effectiveness of bunamidine hydrochloride against *E. granulosus* was recorded by Gemmell & Shearer (*13*). Effectiveness for *T. hydatigena* is summarized in Table 1. Similar evaluations for nitroscanate and niclosamide against both species have been reported (*12, 15*). Niclosamide has no lethal effect against *E. granulosus*.

Control programme within the Styx Valley

During the period under review bunamidine hydrochloride [a] was used at a dose rate of about 25 mg/kg (1965–72). During 1973, niclosamide [b] at 50 mg/kg was given together with bunamidine hydrochloride. From 1974, nitroscanate [c] only was administered at 100 mg/kg. These drugs were given monthly to all dogs resident in the Styx Valley, a total of 60–80. A further 60–80 dogs bordering the trial area and known to visit the Styx Valley were also regarded as resident and were treated each month.

[a] Burroughs Wellcome.
[b] Bayer.
[c] Ciba-Geigy.

Table 3. The effect of monthly dog treatments with specific drugs on the age-specific prevalence of *Taenia hydatigena* in lambs in the Styx Field Trial (all observations)

Drug treatment	Number of lambs by age group																	
	4 months			5 months			6 months			7 months			8 months			All age groups		
	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%
bunamidine (1956–72)	18 703	1 352	7.2	31 811	2 328	7.3	15 227	1 155	7.6	13 267	2 186	16.5	8 259	1 559	18.9	87 267	8 580	9.8
bunamidine and niclosamide (1973)	5 154	286	5.6	9 153	336	3.7	455	129	28.4	1 695	41	2.4	433	73	16.9	16 890	865	5.1
nitroscanate (1974)	4 720	187	4.0	6 477	439	6.8	800	58	7.3	934	21	2.3	715	53	7.4	13 646	758	5.6
nitroscanate [a] (1975–77)	8 637	83	1.1	16 030	313	1.9	9 888	415	4.2	7 435	340	4.6	1 326	111	8.4	43 316	1 272	2.9

[a] Dogs in adjacent region previously on arecoline surveillance treated with niclosamide.

Table 4. Epidemic-type patterns for *Taenia hydatigena* in lambs in the Styx Field Trial when dogs were treated monthly with bunamidine hydrochloride (1965–73) (observations from at least 3 age groups on the same farm in the same year)

Number of episodes	Number of lambs by age group																	
	4 months			5 months			6 months			7 months			8 months			Total		
	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%	Examined	Infected	%
1 [a]	816	408	50.0	434	173	39.9										1250	581	46.5
1	460	18	3.9	360	112	31.1	510	175	34.3							1330	305	22.9
4	2148	94	4.4	1794	129	7.2	707	373	52.8	505	139	27.5	871	224	25.7	6025	959	15.9
5	1751	221	12.1	2413	133	5.5	1769	131	7.4	2027	771	38.0	498	212	42.6	8458	1458	17.2
5	155	15	9.7	4296	169	3.9	1330	97	7.3	331	32	9.7	1026	311	30.3	7138	624	8.7

[a] Observations from 2 age groups only.

Control programme in the area surrounding the Styx Valley

As part of the National Hydatid Control Programme, arecoline surveillance was used on the dogs in the remainder of the Maniototo County at various intervals between 1965 and 1977. From 1975, the dogs were also treated every 6 weeks with niclosamide at 50 mg/kg. The numbers of dogs found to be infected each year are recorded in Table 2. Owing to the limitations of arecoline hydrobromide in removing tapeworms, these data represent only a proportion of the total population of infected dogs each year (*3*).

Indicators

Data on the age-specific prevalence of *T. hydatigena* and prevalence of *E. granulosus* were obtained during routine killing of stock submitted to abattoirs. The methods have been described previously (*2*). Observations were also made on *T. ovis*, particularly in the heart, but these data were not regarded as representative of the frequency (*4*). A small group of aged ewes was examined in detail at autopsy for evidence of infection with more than one species.

RESULTS

The age-specific prevalence of *T. hydatigena* in lambs from all observations for each drug treatment are summarized in Table 3.

Where observations were made on *T. hydatigena* from at least 3 different age groups of lambs from a farm in the same year, 3 epidemiological patterns could be distinguished. In the epidemic-type pattern the prevalence of *T. hydatigena* exceeded 30% in at least one age group. The increase in prevalence occurred rapidly and was observed in 16 out of 47 episodes during the period of the bunamidine treatments (Table 4). The locations of these epidemic-type outbreaks are recorded in Table 5.

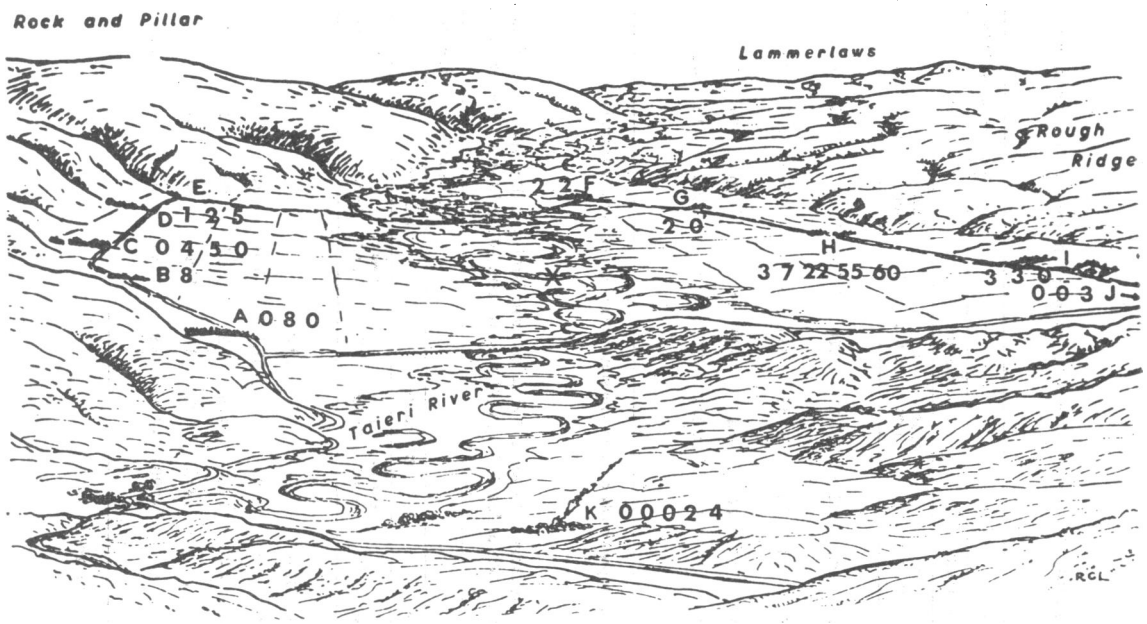

Fig. 1. The Styx Valley, showing the prevalence of *Taenia hydatigena* in lambs in 1977 when the dogs in the Valley were treated with nitroscanate at 100 mg/kg every month and those in the surrounding area were treated with niclosamide at 50 mg/kg every 6 weeks.

The letters A to E refer to farms lying below the Rock and Pillar Range, the letters F to K to farms below the Rough Ridge Range. These two ranges of hills are contiguous with the Lammerlaw Range and thus there is a barrier to stock movement at the head of the valley. The entrance to the Styx Valley is between farms A and K. The numbers 0 to 60 refer to the prevalence of *T. hydatigena* in lambs at the time they were drafted from each farm. The distance between the homesteads of farms H to B and C is approximately 10 km. The boundary is the Taieri River. X is the point where 150 sheep were drowned in the river before the lambing season commenced.

Table 5. Distribution of epidemic- and endemic-type patterns of *Taenia hydatigena* in lambs during a 13-year treatment of dogs every month in the Styx Field Trial (observations based on at least 3 age groups of lambs on the same farm in the same year)

Farm	bunamidine hydrochloride									nitroscanate [b]			
	1965	1966	1967	1968	1969	1970	1971	1972	1973 [a]	1974	1975	1976	1977
A	W	—	S	S	S	S [c]	—	L	L	L	*	L**	L**
B	—	—	L	—	—	W	—	S	W	—	—	—	—
C	W	W	W	L	W	—	W*	S	W*	L**	*	L	L**
D	W	W	—	—	—	—	L*	—	—	—	*	—	L
E	—	W	W	—	—	—	S	—	—	—	—	—	—
F	—	—	L	*	W	*	L*	—	*	*	—	L	—
G	—	—	—			—	—	W	—	W [c]	L*	L*	*
H	—	—	—	—	—	—	—	—	—	—	—	**	W
I	S	W	—	W	L	—	W	W*	—	—	—	L*	L*
J	S	—	—	W	—	W	S	S	S	—	—	L*	L***
K	S	—	S	S	—	—	S	W	L	W [c]	*	L	L***

[a] Niclosamide given in addition to bunamidine hydrochloride.
[b] From 1975 all dogs in surrounding country changed from arecoline surveillance to 6-weekly niclosamide treatments.
[c] Two observations only.
S = epidemic-type pattern " cysticercosis storm " probably from eggs deposited in same summer.
W = endemic-type pattern with increasing prevalence probably from eggs deposited in previous winter.
L = endemic-type pattern with low prevalence from eggs of unknown origin.
* = Individual draft with no infection.
— = Insufficient observations.

Table 6. Endemic-type patterns for *Taenia hydatigena* in lambs in the Styx Field Trial when dogs were treated monthly with specified drugs (1965–77) (each episode based on observations from at least 3 age groups on the same farm in the same year)

Drug treatment		Age of lambs (months)					Total
		4	5	6	7	8	
bunamidine (22/47) [a] (1965–73)	No. lambs examined	4411	11 514	6878	4384	3368	30 555
	No. infected	214	720	336	544	546	2 360
	%	4.9	6.3	4.9	12.5	16.2	7.7
bunamidine (9/47) [a] (1965–73)	No. lambs examined	4126	5 896	1617	1692	370	13 674
	No. infected	191	205	50	77	13	536
	%	4.6	3.5	3.1	4.6	3.5	3.9
nitroscanate (16/17) [a] (1974–77)	No. lambs examined	8345	9 791	5252	3714	1118	27 102
	No. infected	145	191	218	57	27	638
	%	1.7	2.0	4.2	1.5	2.4	2.4

[a] Proportion of total episodes.

Table 7. Prevalence of *Taenia hydatigena* in aged sheep in the Styx Field Trial (1965–77) (all observations)

Control activity when sheep born	Year examined at autopsy	No. examined	No. infected	%
3-monthly arecoline surveillance of dogs	1965–72	5536	2231	40.3
4-weekly bunamidine treatment of dogs	1973–77	3644	1504	41.3

Table 8. Number of larval tapeworms in twenty 7-year old sheep born in the Styx Valley during the monthly bunamidine treatment programme [a]

Sheep No.	*T. hydatigena*		*T. ovis*		*E. granulosus*	
	Liver	Abdominal cavity	Heart/ diaphragm/ tongue	Carcase	Liver	Lungs
1	22	1 v	0	0	0	0
2	17	0	0	0	0	0
3	14	0	0	0	0	0
4	13	0	0	0	0	0
5	12	0	0	0	0	0
6	10	0	0	0	0	0
7	9	0	0	1	0	0
8	9	0	0	1	0	0
9	8	0	0	1	0	1 v
10	7	1 v	0	1	0	0
11	2	1 v	0	0	0	0
12	2	0	0	1 v	0	0
13	2	0	0	0	0	0
14	1	1 v	0	0	0	0
15	1	1 v	0	0	0	0
16	0	0	0	9	0	0
17	0	0	0	3 (1v)	0	0
18	0	0	0	1	0	0
19	0	0	0	1	0	0
20	0	0	0	1	0	0
Total	129	5	0	20	0	1
Percentage of animals infected	75.0	25.0	0.0	50.0	0.0	5.0

[a] v = number viable.

Two endemic-type patterns were observed (Tables 5 and 6). With the first, there was a trend for an increase from about 2% up to 20% in the prevalence in pooled samples as the age of the lambs increased. This pattern (22/47 episodes) occurred mainly during the period when bunamidine was used. With the second endemic-type pattern there was virtually no increase during the period and the prevalence did not exceed 5%. This pattern was observed on 9 occasions during the period when bunamidine was used (Tables 5 and 6), and was the predominant pattern (16/17 episodes) after nitroscanate was introduced. This indicates that the risk of infection had been reduced. Also, in this latter period many batches of 100 or more lambs were free from *T. hydatigena* (Table 5). These was, however, one " breakdown " on farm H during 1977 (Table 5, Fig. 1).

No differences were observed in the prevalence of *T. hydatigena* in the aged sheep, irrespective of whether they were born before or after bunamidine was introduced (Table 7).

T. ovis was frequently observed in the heart and occasionally on the surface of the carcase, but the prevalence was not estimated. *E. granulosus* was rarely identified in the lungs or liver of the aged sheep. However in 1976, 19 out of 91 merino sheep were found with hydatid cysts. These sheep had been introduced into the Styx Valley more than 10 years previously and were approximately 13 years old at the time of slaughter. Aged ewes were examined in detail for interrelationship between the species and the data are recorded in Table 8. Occasionally all three species were found in the same animal.

DISCUSSION

Epidemiological studies have been reported on the infection pressure and clustering effects of tapeworm eggs and their influence on the infective pattern of larval cestodes (*10*). Within 10 days of the introduction of a dog infected with *T. hydatigena* to a fixed kennel-site, the eggs spread in clusters up to 80 m (*9*). The eggs spread radially and gradually dispersed from their clusters within about 5 weeks. Embryos may remain invasive for about 1 year, but most will not complete reorganization and survive as cysts (*8*). When infected dogs were present, about 60% of the lambs within the zone of egg dispersion, ingested eggs every day. This rate was reduced to 6.5% and 3.5% from 3 and 6 months, respectively, after the removal of the dogs (*11*). From birth to 5 weeks, lambs ingested only a few eggs and gradually acquired resistance. However, older lambs introduced into the contaminated zone for the first time, ingested many eggs within the 14 days required to acquire immunity (*6*). This gives rise to an epidemic-type infective pattern or " cysticercosis storm " (*7*). High infection rates reflect both temporal and spatial proximity of grazing to the original site of egg-deposition (*14*). In the Styx Field Trial, the movements of infected dogs and their defaecation habits determine the number of egg-contaminated zones. Movements of the sheep population should influence the frequency of contact with these zones. Thus, not all lambs on the same farm have the same opportunity to ingest eggs. Furthermore, they will vary in their susceptibility to infection.

In the year before the start of the 4-weekly treatment programme with bunamidine, 3 and 7 dogs were detected with *T. hydatigena* and *T. ovis*, respectively. This indicates that despite previous educational control measures, some dogs were still gaining access to infective material. Also, during the 10-year period (1965–74 inclusive) until niclosamide was used, many dogs in the surrounding area were detected with *T. hydatigena* and *T. ovis* (Table 2). If these dogs entered the Valley, they could have provided a source of infection.

During the period 1965–72 inclusive, evidence is provided that the dose rate of 25 mg/kg of bunamidine hydrochloride was not always effective against *T. hydatigena* (Table 1). This dose rate was chosen because lethal effects in dogs had been attributed to higher dose rates. In 1973, mansonil at 50 mg/kg was superimposed to overcome this problem. During the 8-year period (1965–73), 16 " cysticercosis storms " were observed (Tables 4 and 5). The infections may have been derived from autochthonous or itinerant dogs introduced for short intervals (perhaps only 2 or 3 days) between dosing periods. Very little evidence could be found for a correlation between a " storm " on one farm and a similar prevalence of cysticercosis on a neighbouring farm in the same year. For example, on farm E in 1971 there was a " storm " but a low prevalence was recorded on farm D (Table 5). In addition, although " cysticercosis storms " were observed in consecutive years on some farms there is little evidence that they were associated with the same infection in the same dog. The possibility, however, that infection gave rise to an endemic-type pattern on the same or a neighbouring farm in the following year, cannot be ruled out from the data presented (Table 5).

Two endemic-type patterns were evident during

the period of bunamidine treatment. One demonstrated a gradually increasing prevalence associated with age, and the other showed no obvious increase between 4 and 8 months of age. The former pattern predominated during this period (Tables 5 and 6). Infected dogs could possibly be introduced in the interval between the slaughter of one lamb crop and the birth of the next. In addition, autochthonous infections would have occurred and some infections would have been unsuccessfully treated during this period. Either could have given rise to the endemic-type pattern because some of the eggs would have survived until lambs were capable of ingesting them.

Nitroscanate at a dose rate of 100 mg/kg should have been adequate to eliminate *T. hydatigena* within the prepatent period. From 1974 to 1977 inclusive, in the Styx Valley, there was either no infection or a low prevalence that did not increase with age (Tables 5 and 6). Only two possible increases in prevalence (2 observations only) were detected during 1974. In this year, arecoline surveillance was still used in the remainder of the region and 52 dogs were detected with *T. hydatigena*. From 1975, niclosamide was also used there every 6 weeks and only 4 itinerant dogs were detected with *T. hydatigena*. Thus, from 1974 there should have been no autochthonous cases and from 1975 few introductions. The pattern of infection was complicated by the introduction of nitroscanate and niclosamide into the Styx Valley and surrounding area, respectively. Thus, it cannot be determined from the data presented whether autochthonous or itinerant dogs were responsible for the egg deposition before the lambing season that led to the continuous low prevalence of *T. hydatigena* on some farms. A breakdown, described below, occurred in 1977 (Fig. 1).

Although the events of one era may greatly influence those of a succeeding period, it is possible to compare the results obtained by arecoline surveillance with those obtained by the monthly drug-treatment programmes. The prevalence of *E. granulosus* was reduced by the arecoline surveillance programme. This parasite was infrequently observed in older sheep after the drug-treatment regime was introduced. Although no conclusions can be made on the effect of drug-orientated programmes against this species, analogies may be drawn from the results obtained for *T. hydatigena*.

The prevalence of *T. hydatigena* in the lambs in each period is illustrated in Fig. 2. Between 1943 and 1951 when arecoline hydrobromide was used for the treatment of dogs every 3 months, there was a predominance of epidemic-type patterns and almost all susceptible lambs were infected by 4 months of age. When arecoline was used for surveillance over 7 years, the upper asymptote was reduced but both epidemic-type and endemic-type patterns were evident. This was similar during the 8-year period when the dogs were treated with bunamidine hydrochloride every month (1965–72). Indeed, the prevalence rates of *T. hydatigena* in the aged sheep that had been born in the respective periods were similar (Table 7). The arecoline surveillance and monthly bunamidine treatment programme were both inadequate to eliminate " cysticercosis storms " and the endemic-type pattern of increasing prevalence in lambs as their age increased. The continuing " storms " may have been partly accounted for by using too low a dose rate of bunamidine hydrochloride.

In 1973, the addition of niclosamide to the bunamidine treatment reduced but did not eliminate high infection rates on farms in the Styx Valley. This was probably also the case when nitroscanate was first introduced in 1974 when the remainder of the region was still undergoing arecoline surveillance. This may not necessarily have been due to faults in the dosing procedure or the dose rate of the drug used, but more likely to egg-contamination by itinerant dogs.

From 1975, when niclosamide was used throughout the region and nitroscanate was used in the Styx Valley, the prevalence of *T. hydatigena* remained low. On many farms, the parasite was not detected in lambs (Table 5). This suggests that the effective treatment of all dogs outside and within the control zone was necessary to reduce the prevalence of larval tapeworms such as *T. hydatigena* and *T. ovis*. While the evidence favours a drug-orientated programme, it is unclear from the data presented whether an effective monthly treatment programme involving dogs from outside and inside the control zone would be sufficient to prevent high infection rates of cysticercosis when the educational component is absent and dogs have unrestricted access to raw offal.

An explanation is required for the " breakdown " observed on farm H during 1977 when many groups of lambs from other farms were virtually free from *T. hydatigena*. This " breakdown " was characteristic of the deposition of eggs before the lambing season. During the winter about 150 ewes were drowned on this farm while attempting to cross the ice on the Taieri River. Those that were found were used for dog meat. The availability for several weeks of infective material to dogs cannot be excluded. One dog known to vomit deliberately after dosing

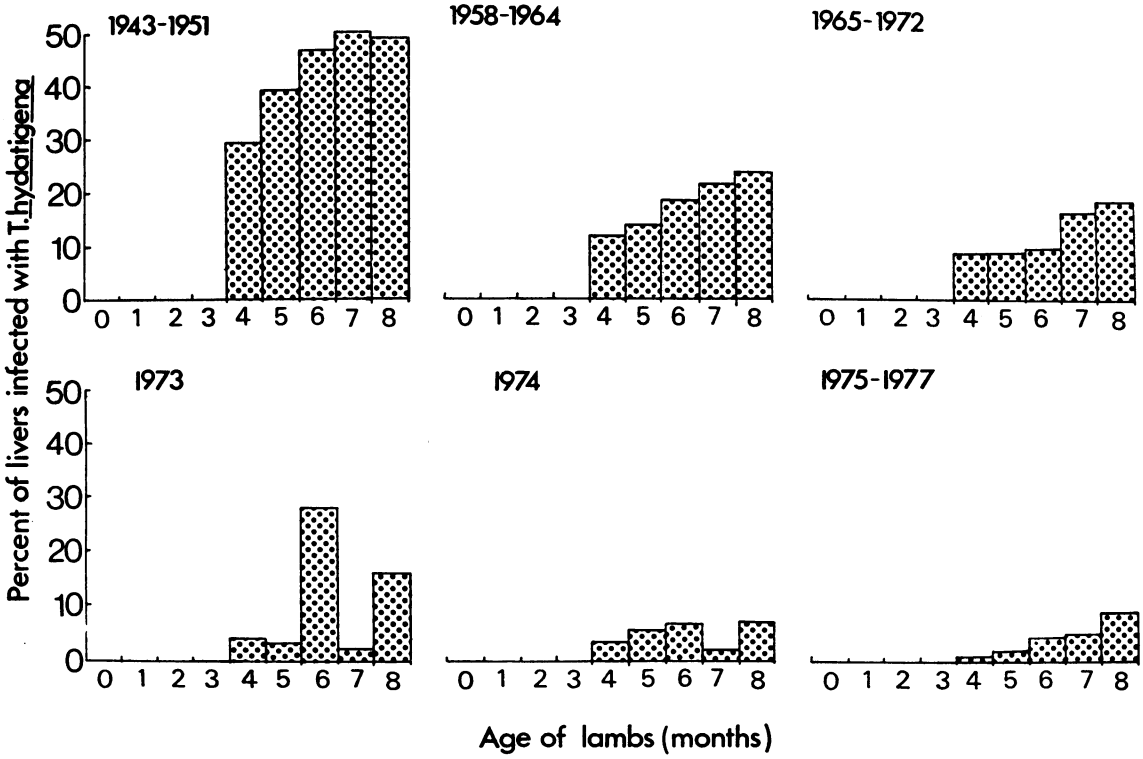

Fig. 2. Age-specific prevalence of *Taenia hydatigena* in lambs in the Styx Field Trial, 1943 to 1977.
1943–51, 3-monthly arecoline hydrobromide treatment; 1958–64, 3-monthly arecoline surveillance; 1965–72, monthly bunamidine hydrochloride treatment; 1973, monthly bunamidine and niclosamide treatment; 1974, monthly nitroscanate treatment; 1975–77, monthly nitroscanate treatment. Prior to 1975, dogs in the surrounding area (Maniototo County) were on periodic arecoline surveillance and from 1975 were on 6-weekly niclosamide treatment.

with nitroscanate could have harboured a worm long enough to reach patency. An explanation is also required for the very low prevalence observed in a few groups of lambs on other farms in the same year. This male dog was rarely tied up and when wandering in search of bitches could have deposited a few eggs on other farms (Fig. 1). While the evidence is circumstantial, this event illustrates the difficulties of controlling accidental breakdowns with drugs.

The introduction of an infected dog may have a devastating effect on all susceptible sheep once a strong drug-treatment programme has been successfully established for several years. Evidence was found that sheep that had been infected with *T. ovis* during the period of bunamidine treatment in the Styx Valley were no longer resistant to infection with this parasite during the period of nitroscanate treatment when challenged artificially with eggs even though they still harboured cysticerci from an earlier period. In addition, the colostrum from these parasitized sheep did not confer immunity against *T. ovis* to their offspring (Sutton, R. J. personal communication).

In a Memorandum (*1*) on research needs in cysticercosis caused by *T. saginata* and *T. solium* it was reported that " there is a lack of systematic epidemiological investigations of the transmission of these infections under different environmental, social, and husbandry conditions ". The present model using *T. hydatigena* as the indicator may assist in planning control trials against these cestode zoonoses. Very little is known of the time required before a monthly treatment schedule can be modified or stopped altogether. This, together with the impact of " breakdowns " in control on the infective pattern are under investigation.

ACKNOWLEDGEMENTS

I wish to record that J. N. Aitken of Glenayr, Paerau, treated the dogs in the Styx Valley in an honorary capacity during the whole period under review. The writer also wishes to record thanks to Senior Meat Inspectors of the Ministry of Agriculture and Fisheries for supplying data on prevalence of larval tapeworms in sheep from the Styx Valley.

Professeur R. G. Lister of the Department of Geography, University of Otago, made the original line-drawing of the Styx Valley used in Fig. 1.

RÉSUMÉ

L'ESSAI DE LA VALLÉE DU STYX:
EFFET DU TRAITEMENT DE L'HÔTE DÉFINITIF DES TÉNIAS SUR LES FORMES LARVAIRES CHEZ L'HÔTE INTERMÉDIAIRE

Il s'agissait d'évaluer l'efficacité d'un programme de traitement chimiothérapique mensuel contre les ténias chez les chiens pour prévenir l'hydatidose (*Echinococcus granulosus*) et la cysticercose (*Taenia hydatigena* et *T. ovis*) chez les ovins. Pour cette évaluation, qui s'est étendue sur treize années et avait pour cadre la vallée du Styx (plaine de Maniototo, île du Sud de la Nouvelle-Zélande), on a utilisé comme principal indicateur la prévalence spécifique par âge de *T. hydatigena* chez les agneaux.

Les chiens ont été traités mensuellement pendant huit ans par la bunamidine à raison de 25 mg/kg sans grand effet sur la prévalence de *T. hydatigena* chez les agneaux. L'adjonction de niclosamide à raison de 50 mg/kg pendant un an n'a pas eu non plus beaucoup d'effet. Les œufs semblaient survivre d'une saison à l'autre. Ceux qui étaient expulsés avant l'époque d'agnelage provoquaient des manifestations endémiques, alors que les infestations patentes au cours de la saison d'agnelage engendraient des poussées de cysticercose d'allure épidémique. Seize de ces poussées sont survenues au cours de cette période de neuf ans et tous les agneaux sensibles ont été infectés. Bien que les poussées n'aient pas toujours entraîné une prévalence du même ordre dans les fermes avoisinantes, il se peut qu'elles aient joué un rôle dans le tableau général de l'infection. La même situation s'est prolongée pendant la première année d'utilisation de nitroscanate à 100 mg/kg. Pendant toute la période de dix ans, la surveillance des chiens au moyen d'arécoline a été assurée dans l'ensemble du Comté de Maniototo et beaucoup d'entre eux se sont révélés porteurs de ténias. Le tableau de l'infection dans la vallée du Styx peut avoir été influencé par les chiens locaux aussi bien que par ceux amenés dans la région.

Pendant les trois années suivantes, le traitement mensuel par le nitroscanate a été poursuivi dans la vallée du Styx et le niclosamide a été employé dans le reste du Comté. On a constaté une réduction très sensible de la prévalence spécifique par âge et, dans de nombreuses fermes, les agneaux abattus étaient exempts de *T. hydatigena*. Il y a eu cependant une « rechute » dont l'origine autochtone n'était pas douteuse.

Au vu des comparaisons avec la période antérieure au cours de laquelle on avait eu recours dans la vallée du Styx à la surveillance par l'arécoline, la situation actuelle semble en faveur d'un programme de traitement à base chimiothérapique administré à l'hôte définitif pour lutter contre la cysticercose. Les « rechutes » — qu'elles soient dues à des sources locales ou itinérantes — ont toutefois des effets étendus étant donné qu'elles affectent tous les groupes d'âge sensibles, englobant ceux qui n'avaient pas encore été infectés aussi bien que ceux qui ont perdu l'immunité que leur avait conférée une infection antérieure.

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