HELMINTHIASIS IN GOATS AND SHEEP OF PESHAWAR WITH SPECIAL REFERENCE TO THEIR "TAXONOMY, INCIDENCE WORM BURDEN AND SEASONAL VARIATION"

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M. Sc.

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بسم الله الرحمن الرحيم

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF DEGREE OF DOCTOR OF PHILOSOPHY IN ZOOLOGY, UNIVERSITY OF PESHAWAR, 1990.

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BY

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A thesis submitted in partial fulfillment of

Degree of

Doctor of Philosophy in Zoology, University of Peshawar.

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THIS THESIS IS AFFECTIONATELY DEDICATED TO MY DEAR PARENTS WHOSE PRAYER ARE AND WILL REMAIN WITH ME.

ABSTRACT:

A detailed study of Helminths of sheep and goats was undertaken with emphasis on taxonomy, incidence, seasonal variation, and worm burden. This work was carried out for two years i.e. from December 1978 to November, 1980. Gastro-intestinal tracts of 203 sheep and 202 goats were examined during 24 months. Extra lungs and liver of 208 sheep and 190 goats were also examined.

This study showed that helminthiasis is quite common in N.W.F.P. 94.08% of sheep and 91.58% of goats carried one or more helminthic infection. In case of extra lungs and liver examined helminthic infection was 80.28% in sheep and 79.47% in goats.

Species of nematodes recorded from sheep in two years alongwith their percentage infection were Haemoncus contortus (74.38%), Dictyocaulus filaria (13.79%), Pneumocaulus kadenazii (6.90%), Trichuris parvispiculum (66.01%), T. globulosa (38.42%), T. lani (28.08), Oesophagostomum asperum (4.43%), O. columbianum (44.83%), O. venulosum (8.37%), Chabertia ovina (3.94%) & Bunostomum trigonocephalum (2.46%). Cestodes from sheep were represented by Echinococcus granulosus (Hydatid cyst) 3.45%), Cysticercus tenuicollis (larval form) (16.75%), Moniezia (B) benedeni (6.90%), M. expansa (4.43%), Avitellina centripunctata (6.89%), Stilesia vittata (11.82%).

Five species of trematodes were found in sheep Fasciola hepatica (30.54%), Dicrocoelium lanceolatum (1.97%), Cotylophoron ovatum (3.45%), Paramphistomum (E) explanatum (2.96%) & Gastrothylax crumenifer (6.40%).

Helminth parasites recorded from extra lungs and liver of sheep were Dictyocaulus filaria (23.92%), and Pneumocaulus kadenazii (5.75%) from lungs, Echinococcus granulosus (Hydatid cyst)(10.53%) and Cysticercus tenuicollis (2.88%) were recovered from lungs as well as from the

liver. Dicrocoelium lanceolatum (0.96%) Fasciola hepatica (70.19%) and Cotylophoron ovatum (0.47%) were also found in the extra liver of sheep.

Species of Nematodes recorded from goats along with their percentage of infection were : Haemoncus contortus (63.36%) Dictyocaulus filaria (8.91%), Pneumocaulus kadenazii (2.48%), Skrjabinema ovis (2.90%), Oesophagostomum asperum (1.90%), O. columbianum (43.56%), O. brevicaudum (0.50%), O. venulosum (10.89%), Chabertia ovina (3.96%), Trichuris indica (0.49%), T. globulosa (41.09), T. lani (28.71%) and T. parvispiculum (64.36%).

Cestodes recorded from goats were: Moniezia (B) benedeni (6.93%), M. expansa (4.45%), Echinococcus granulosus (Hydatid cycst, 4.90%), Cysticercus tenuicollis (17.33%), Avitellina centripunctata (7.43%) and Stilesia vittata (10.89%).

Trematodes in goats were represented by Fasciola hepatica(26.74%), Dicrocoelium lanceolatum (1.4%), Paramphistomum (E) explanatum (2.48%), Gastrothylax crumenifer (6.93%), Cotylophoron ovatum (5.45%), Watsonius capri sp nov. (0.50%).

Extra lungs and liver examined from goats carried Fasciola hepatica (70.00%), Dicrocoelium lanceolatum (0.53%), Echinococcus granulosus (Hydatid cyst, 14.21%), Cysticercus tenuicollis (2.11%), Dictyocaulus filaria (21.58%) and Pneumocaulus kadenazii (4.27%).

The present survey also established some new host records Pneumocaulus kadenazii, T. lani and Watsonius capri sp.nov., have been reported for the first time from sheep and goats.

Beside new host record many new locality records have been established.

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Beside new host record many new locality records have been established.

The total worm burden of individual host is also of significance as a few helminths do not cause much damage, so total worm load of individual parasite per host have been recorded.

Analysis of data on seasonal variation showed that definite patterns of seasonal variation are not found, however certain trends were noted.

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Claim of Originality and Contribution to Knowledge

The present study constitutes the first comprehensive survey of helminth parasites of sheep and goats of N.W.F.P.

Full gastro-intestinal tract alongwith liver and lungs have been examined for two years on weekly basis.

Incidence, worm burden and seasonal variation has been observed. Total worm burden has been recorded instead of using sampling technique.

A new species of genus Watsonius, W. capri from goat has been described and many new host and locality records have been established.

This survey will hopefully lay down the basis for future studies leading to control measures.

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INTRODUCTION

Sheep and goats are a rich source of animal protein, and provide Skins and Wool. For many people in N.W.F.P. and Baluchistan the main source of living is sheep and goat raising. N.W.F.P. has a sizeable population of these animals and hence play an important role in the national live stock industry. According to a Census of 1988 there are 2.226 million sheep and 4.190 million goats in N.W.F.P.

Herlic (1978) as quoted by Speacht (1982) estimated that loss due to helminthic parasites throughout the world is almost 30 million sheep and goats. Losses caused by parasites are immense, low quality of meat, decreased milk production and low fertility may be the result of parasitism. Helminthic infections are associated with enteritis, anemia, diarrhoes, malabsorption, retardation of growth and even death, (Lapage,1956; Georgi,1961; Soulsby,1968).

Fascioliasis alone is the major factor limiting livestock development in Pakistan (Kendall, 1954).

In the Indian Punjab Chabra, et al, (1978) Observed 35.95% mortality rate in goats and 53.5% in sheep due to amphistomiasis alone. In Rajistan and Andra Pardesh (India) heavy mortality in sheep was recorded due to helminthiasis. In England sheep industry suffers due to Parasitic worm more than any other cause (U.K. Ministry of Agriculture and Fishries, 1949).

A review of literature showed that no comprehensive knowledge exists about the helminth parasites of sheep and goat from any part of N.W.F.P. Unless correct taxonomic diagnosis are made of the helminth parasites, any control measures will be rather ineffective.

Alongwith correct taxonomic identification, worm burden and seasonal variation are the very basic factors for control measures.

Delimitations of the Problem:

1. This study is restricted to sheep and goats slaughtered in the abbotoirs of Peshawar.
2. The work is restricted to two years i.e December, 1978 to November 1980.
3. Gastro-intestinal tract alongwith liver and lungs of the same individulas were examined. In addition 208 lungs and liver from sheep and 198 from other goats were also examined per week for two years.
4. Two sheep and two goats were examined per week for two years.
5. The screening of the full gastro-intestinal tract was done, instead of employing representative sampling techniques and record of total worm burden was maintained.

The present survey of helminth parasites of sheep and goats of N.W.F.P. was conducted to study the taxonomy, seasonal veriation and worms burden. Gastro-intestinal tracts of sheeps and goats for examination of helminthic infection were obtained from local slaughter houses which are brought from various parts of N.W.F.P. These include Swat, Chitral, Dir, Dera Ismail Khan, Mardan, Malakand Agency, Hazara and villages of Peshawar Division.

REVIEW OF LITERATURE

Helminthiasis is responsible for great economical lossess in domesticated animals all over the world.

Pakistan is mainly an agricultural country and major part of its populations is dependant economically on agriculture and livestock. Sheep and goats occupy a significantly important position in the livestock population. One of the most important problem affecting sheep and goat population in Pakistan is helminthic infections. Before taking steps for the control, it is necessary to study their taxonomy, incidence, intensity of infection, epidemiology and seasonal variation.

Srivastava (1939) examined material of goat suffering from pulmonary strongyliasis from N.W.F.P. in Mukteswar Veterinary Institute (India), he recovered Fasciola gigantica from the lungs of the goat, this was the first record of the occurrence of liverflukes in atypical foci in goats in India.

Bawa (1939) investigated an outbreak of amphistomiasis in sheep in Sind area, which was associated with immature form of amphistomiasis, he also found that the disease occurs after rain and floods, pathological conditions were also noted by him, and control measures were taken which gave good results.

Kendall (1954) conducted a study of helminthological diseases of livestock under a technical assistance to the Government of Pakistan from F.A.O. He toured two wings of Pakistan and published his report only on Fascioliasis in Pakistan (Loc. cit). According to his observations Fasciola hepatica and F. gigantica are found in different parts of Pakistan. In N.W.F.P. he considered that F. gigantica is the common

liver fluke, while in highland areas of Dir, Swat and Chitral Fasciola gigantica is replaced by F. hepatica and mixed infection of F. hepatica and F. gigantica may be found on the boundries of the highland areas. Thus according to him the predominant species in plain area is F. gigantica to be replaced in highland by F. hepatica. The clear demarcation in the distribution of the two species is due to specific snail vectors. F. hepatica employs Lymnea truncatula and F. gigantica employs L. auricularia rufescens as vector. L. truncatula was never found by him below 4000 ft, while L. auricularia rufescens is found in highland areas.

He further mentioned that in Sind Province 40% of 3.5 million animals contract fascioliasis. Acute disease in the Province may cause a mortality of more than 50% of the sheep population.

Wahid (1954) in an article on control of liver fluke disease in N.W.F.P. described the situation regarding the status of liver fluke disease in Pakistan and particularly in N.W.F.P. According to him disease is worst killer than Rinderpest. The outbreaks of Rinderpest have been sporadic in N.W.F.P., while liverfluke disease was thought to be present throughout the year and several hundred outbreaks have been recorded in the last 15 years. The disease was confined to areas, which are situated on the banks of river, canals or streamlets or in such localities as are waterlogged or are subject to periodic flood. In some localities he observed that losses due to liver fluke disease were so heavy that it was practically impossible for the farmers to keep the livestock alive for more than 2-3 years.

Sarwar (1955) found Oesophagostomum asperum and O. venulosum from sheep and goats from Murree, Mirpur and Kaghan valley(N.W.F.P.).

Sarwar (1955) recorded a new lungworm Pneumostrongylus ovis from bronchiols of the lungs of Ovis aries and Capra hircus from Murree (Pakistan).

Sarwar (1956) conducted a comprehensive study on some trichostrongylids of ruminants from the Indo-Pakistan Sub-continent. He dealt with two genera, Ostertagia and Trichostrongylus and provided a new scheme of classification of the two genera. The relevant information for the present review is briefly summarised. He reported Ostertagia mossi from Kaghan Valley(N.W.F.P.). Stadelmannia circumcincta (Ostertagia circumcincta) from Peshawar from sheep, S. turkestanica from goat from Murree (Punjab) S. trifurcata and S. pinnata from sheep and goat from Murree and Kaghan, Sjobergia nemorhoedi from sheep and goat from Murree. Grosspiculagia trifida from sheep from Kaghan Valley. In summary he presented his finding that S. circumcincta S. trifurcata, S. pinnata and S. marshalli is found in Peshawar, while in Kaghan Valley S. circumcincta, Grosspiculagia occidentalis, Marshallagia marshalli, S. trifurcata and S. pinnata were found. Both these areas are characterised by having winter rainfall.

According to him Trichostrongylus shows restricted distribution in Peshawar and Mardan area and is represented by T. vitrinus and T. longispicularis. A good winter rainfall seems to favour the trichostrongyliasis.

The most comprehensive report of helminth parasites and parasitic diseases of animals of West Pakistan (which now constitutes Pakistan) is that of Sarwar (1962). As no formal information is given on the methodology of collection of data,one can only infer from the details that some information had been obtained by actual examination of hosts for parasitic infections and rest of it seems to be from

secondary sources (either already published work or veterinary records).

He made an attempt to correlate the distribution of the helminth parasites with climatological region of Pakistan. He divided the whole region into a number of zones (a) extreme northern tracts: Peshawar district (b) higher level Himalayan tracts: Murree (c) lower level mountainous tract Sub-Himalayan zone and salt range (d) Sub-montane (e) South Eastern alluvial plains and (f) palaerctic region of Kalat.

The account mostly deals with nematodes though trematode distribution also has been dealt with in the end of the narrative. The more relevant portion from the point of view of this study is the first region i.e. extreme northern tract. The helminth fauna of this region has been reported only from goats and sheep of Peshawar District. Physically, he characterised this region as a vast plateau and a huge basin into which flows the waters from surrounding hills. The temperature in winter sometimes falls below 30°F and the nights are intensely cold. The temperature during the hottest part of the year rises to 110° - 120°F. Average rainfall is 15.2 inches and the greater part of the fall is during winter.

The studies of the heliminth fauna of this region is based on sheep and goats brought to Lahore for slaughtering during winter. The species found have been mentioned in the Table-I.

Table I: Distribution of the helminth of sheep and goats in different tract of West Pakistan (modified after Sarwar, 1962).

Name of tract.	Climatological characteristics.	Parasites found	Remarks.
(a): Extreme northern tract (Peshawar District)	Vast plateau temperature 30°-120°F	Ostertagia circumcincta	Trichostongylosis of considerable significance.
		O. trifurcata	
		O. pinnata	
		Marshallagia marshalli	
		Trichostrongylus axei	
		T. vitrinus	First report from Indo-Pakistan Sub-continent.
		T. colubriformis	
		T. probolurus	
		Oesophagostomum venulosum	
		Namatodirus spathiger...	First report from Indo-Pakistan Sub-continent.
		Protostrongylus kochi	
		Dictyocaulus filaria	
		Trichuris globulosa	
		T. skrjabini	
		Haemonchus contortus....	Minor epidemiological significance.
(b): Higher altitude Himalayan tract (Murree, Abbottabad and Kaghan)	400-6500 ft high average rain fall 50"-100"	Ostertagia muraschkinzevi	
		O. nemorhoedi	
		O. trifurcata	
		O. pinnata	
		O. circumcincta	
		O. trifida	Kaghan only
		Trichostrongylus axei	-do-
		T. colubriformis	
		T. longispicularis	
		Bunostomum trigonocephalum ..	Significant infection are Trichostongylosis Ostertigiasis and Bunostmaisis
		Oesophagostomum asperum	
		Chabertia ovina	
		Trichuris (sp.inq)	
		Varestrongylus pneumonicus	
		Bicaulus schulzi	
		Pneumostrongylus ovis	

			Echinococcus cyst	
			Strongyloides Papillosus	
			Haemoncus contortus	Little epidemiological significance.
(c):	Lower altitude Mountainous tracts. Sub-Himalayan zone and Salt	Hot valleys and cool regions 2000-5000ft. Average rainfall 25'-50"	Haemoncus contortus	
			Camelostrongylus mentulata	
			Oestertagia ostertagi	
			O. lyrata	
			Trichostrongylus axei	
			T. colubriformis	
			T. probolurus	
			T. longispicularis	
			Marshallagia marshalli	arid parts
			Squamanema skrjabini...	Salt range
			O. columblnum	in valleys
			Trichuris globulosa	
			T. skrjabini	
			Protostrongylus kochi	
			Dictyocaulus filaria	
			Skrjabinema ovis	
			Avitellina spp.	
(d):	Submontane (Sialkot and Rawalpindi Districts)	Average Rainfall 30-50"	Haemoncus contortus	Haemonchiasis and Oesophagostomiasis seems to be of epidemiological significance.
			Trichostrongylus colubriformis	
			T. probolurus	
			Bunostomum trigonocephalum	
			Oesophagostomum columbianum	
			Trichuris globulosa	
			T. skrjabini	
			Dictyocaulus filaria	
			Strongyloides papillosus	
			Avitellina spp.	

			Moniezia expansa	
(e):	Alluvial plains	Region of extensive irrigation extends south east of extreme climate.	Oesophagostomum columbinum	Serious epidemiological nature in wheat Growing area.
			Heamoncus contortus	
			Avitellina spp.	Lyallpur(Faisalabad) serious outbreak.
			Thysaniezia giardi	Thal -along Indus river.
			Trichostrongylus colubriformis	Haemoncus and Oesophagostomum outbreaks occur twice in April and October cause 50% mortality in flocks of sheep.
			Squamanema skrjabini	
				Haemoncus alone occur in mild summer hill valleys whereever moisture is sufficiently high.
(f):	Palaearctic region of Kalat.	Arid with low relative humidity variable temperature and Rainfall	Marshallagia marshalli	
			Skrjabinema sp.	
			Camelostrongylus mentulata	
			Avitellina spp.	
			Bunostomum trigonocephalum	
			Trichuris skrjabini	No Trichostrongylus species throughout Khuzdar. Kharan, Mustung.
			Haemoncus contortus	
			Skrjabenema ovis	
			Protostrongylus sp.	

He also formulated a theory of seasonal incidence. He suggested that the pattern of seasonal incidence is not necessarily one which can be attributed to seasonal changes of climate, but is a consequence of the life history pattern of individual species and is directly connected with the rate of egg production and the time required for the development of each generation.

Chaudhary and Durrani (1964) carried out a systematic survey of 240 ruminants in Lyallpure district (Faisalabad) for Paramphistome infection. They found three species of family Paramphistomidae from sheep and goats, five species from cattle and one species from wild boar. They also studied the life cycle of Cotylophoron cotylophorum and found that Indoplanorbis exustus acts as an intermediate host in this area.

Hayat and Durrani (1965) studied the lungworms of sheep with special emphasis on the bionomics of the larvae of Dictyocaulus filaria and Protostrongylus rufescens. Examination of 683 faecal sample and 336 lungs revealed that 21.4% lungs were infected with D. filaria, 3.6% with P. rufescens and 0.6% Muellerius capillaris. The examination of faecal sample showed that 1.2% were infected with D. filaria and 5.1% with Protostrongylus sp.

Durrani et al. (1965) studied gastro-intestinal parasites of sheep of Lyallpur District by examining 154 guts over a period of 12 months. Overall infection was 72.07%. The species encountered were identified as Haemoncus contortus, Oesophagostomum columbianum, O. venulosum, Trichuris ovis, Moniezia expansa, M. benedeni, Avitellina spp. Stilesia spp. Thysaniezia spp. Paramphistomum cervi, P. explanatum and Cotylophoron sp.

Chaudhry and Durrani (1966) conducted a survey of various species of genus Moniezia occurring in sheep and goats in Lyallpur (Faisalabad) District by examining 32,845 guts over a period of three years, 64.0% of the total guts examined were found infected with one or more species of genus Moniezia. They found M. expansa, M. benedeni and described a new species M. lyllpuriensis. The results were not published and the incidence rather seems to be very high.

Hussain and Durrani (1966) studied the relationship of nutrition to the development of Heemonchosis in lambs and found that ration containing 9.9% crude protein had an optimum level of nutrition and exerted a profound influence on the degree of parasitism.

Hashmi and Mohiuddin (1967) studied helminth parasites of ovine of Hyderabad Division for various species encountered and seasonal variation from 1964-65. Helminth species encountered were: Cotylophoron cotylophorum, Gastrothylax crumenifer, Fasciola gigantica, Moniezia expansa, M. benedeni, Thysaniezia giardi, Avitellina centripunctata, Stilesia globipunctata, S. vittata, Trichuris globulosa, Oesophagostomum columbianum, Haemoncus contortus, and Gaigeria pachyscelis.

Rizvi and Barya (1967) found the survival of infective larvae of Haemoncus contortus on Lyallpur (Faisalabad) pasture. The temperature for development of egg and larvae was found to be 27°c. Summer season was less favourable than spring and autmn. The optimum humidity for the development of the larvae was 75%.

The migration of the infective larvae of Haemoncus contortus on different type of vegetation and soil was favoured by moisture, darkness and temperature. Rotational grazing of pasture reduced the danger of infection.

A study was under taken by Majid and Barya (1968) and Yousuf and Barya (1968) on the species of genus Stilesia and Avitellina in sheep and goats. Out of 1786 guts and 896 livers examined 48.8% were infected with Stilesia. The species involved were not mentioned, however it was observed that the incidence was higher in July-September period. Four species of Avitellina recovered were A. centripunctata, A. lahorea, A. sudanea, and A. woodlandi. The over all incidence was 43%.

One of the survey in recent past and in a systematic way was carried out in the Province of Sind by Mohiuddin (1976-77). The various parasites, inhabiting the gastro-intestinal tract of sheep and goats have been recorded by examining representative samples. Thirteen species of helminth Parasites namely: Cotylophoron cotylophorum, Gastrothylax crumenifer, Moniezia expansa, M. benedeni, Avitellina centripunctata, Stilesia globipunctata, Haemoncus contortus, Trichuris globulosa, Oesophagostomum columbianum, Gaigeria Pachycelis, Thysaniezia giardi, Strongylus papillosus and Skrjabinema ovis were reported from different parts of Sind. Their survey also showed that sheep are more prone to infection than goats in Sind area. This was attributed to grazing habits. They also provided essential data on the incidence of Parasites involved and the general pattern of their seasonal variation.

Munir and Anwar (1980) studied the incidence of hydatidosis in ruminants at Faisalabad abattoir. In sheep and goats they found that out of 5000 sheep and goats incidence of hydatid cyst was 1.2% in sheep and 0.2% in goats. No cysts were found in lambs and kids. Percentage of fertile cyst in sheep was 24.13% while the cysts in the goats were all sterile. In general more cysts were found in lungs than in liver.

Majid and Hussain (1980) carried out a survey of trematodes of sheep in Lahore (Punjab). Three hundred and twenty sheep were examined, over all incidence of trematodes was found to be 59.37% Five species of trematodes Paramphistomum cervi, Cotylophoron cotylophorum, Fasciola hepatica, F. gigantica, Dicroceolium dendriticum were found. The most common trematode parasites was Paramphistomum cervi (33.25%) while Fasciola hepatica and F. gigantica was rather rare and found only in 3.125% hosts.

Siddiqi and Ashraf (1980) examined full gastrointestinal tracts of 19 goats from slaughter house of Peshawar city and found Dicrocoelium dendriticum, Fasciola hepatica, Paramphistomum (E) explanatum, Cotylophoron ovatum, Watsonius sp. Moniezia expansa, M. benedeni, Avitellina centripunctata, Stilesia vittata, Trichuris discolor, T. globulosa, T. indica, T. infundibulum, T. lani, T. ovina, T. paryispiculum, T. vondwei, Pneumocaulus kadenazii, Haemoncus contortus, Dictyocaulus filaria, Oesophagostomum columbianum, O. venulosum, Chabertia ovina, Bunostomum trigonocephalum, Globocephalus urosubulatus, Skrjabinema ovis, Acanthoxynema lucknowense. A number of new host records were established and this survey though limited in number of hosts examined, was the first survey of goats in Peshawar area.

Shah et al. (1980) examined 500 guts of sheep from different parts of Pakistan including Peshawar and found Haemoncus contortus (36.8%), Oesophagostomum venulosum,(27.6%), O. columbianum (21.2%), Ostertagia circumcincta (14.6%) Bunostomum trigonocephalum, (10.2%) Trichostrongylus axei (0.2%), T. vitrinus (0.4%) and Chabertia ovina (0.2%).

The highest incidence in their survey was during the wet season. They did not specifically mentioned which parasites out of those reported were found in Peshawar. However, they have quoted

Sarwar (1962) that trichostrongyliasis is of considerable significance in Peshawar, Murree, Abbottabad and Kaghan valley.

Khan (1981) presented a review of the work on animal parasitic nematodes in Pakistan. The relevant part of his report mentioned the occurrence of the following parasites from Pakistan: Trichuris globulosa in Ovis aries, Ostertagia ostertagi from Capra hircus, O. murasehkinzevi, O. mossi from sheep O. occidentalis from Ovis aries, O. pinnata O. nemorheadi from Ovis aries & Capra hircus, O. circumcincts from Ovis aries, O. turkestanica from Capra hircus, Grosspiculagia trifida, Cooperia pectinalia, Trichostrongylus axei, Camelostrongylus mentulata, Marshallagia marshalli (also in Capra hircus), Trichostrongylus longispicularis, T. retortaeformis in sheep and goat, T. colubriformis and Pneumiostrongylus ovis from Ovis aries.

Durrani, et al. (1981) carried out a parasite survey in Azad Kashmir. Faecal samples of one thousand ovine and Caprine hosts were studied randomly, 19 species of helminth parasite were recorded namely: Ascaris vitulorum, Bunostomum trigonocephalum, Dictyocaulus filaria, Haemoncus contortus, Nematodirus spp. Ostertagia ostertagi, Oesophagostomum columbianum, Strongyloids papillosus, Tricostrongylus axei, T. colubriformis, Dicrocoelium dendriticum, Fasciola hepatica, F. gigantica, Cotylophoron cotylophorum, Schistosoma indicum, Avitellina centripunctata, Moniezia expansa and M. benedeni, The highest incidence of infection among them were of Fasciola gigantica, Ostertagia ostertagi, Haemoncus contortus, and Oesophagostomum columbianum. Helminthic infection was 100% and each animal was parasitized by more than one species of helminth parasites.

Chaudhry and Niaz (1984) examined 22,773 faecal sample of ruminants in Divisional Diagnostic Laboratory, Bahawalpur, and the

total number of sample positive for various parasitic infection was 17,483, out of which 1749 were positive for fascioliasis. and outbreak of facioliasis was also reported.

Ansari et al. (1985) reported an analysis of data collected for 60 years (1923-83) and showed that Parasitic gastritis in goats of Sind was caused by Haemoncus, Mecistocirrus, Trichostrongylus and Paramphistomum. Araian et al. (1985) compiled the data for facioliasis in goats of Sind for sixty years (1923-83) and came to the conclusion that average death toll was 193.23 goats per annum. The details of this study were not available regarding methodology and how they came to this conclusion.

Hayat, et al. (1986) examined two hundred sheep from Faisalabad abattoir. The overall incidence of Hydatidosis was recorded to be 24%, 12% in lungs, 8% in liver, and 4% animals had hyatid cysts in both of these organs. Gross observation showed enlargement, congestion and inflammatory reaction.

Hayat et al.(1986) collected 1008 lungs of sheep from Faisalabad abattoir to observe the seasonal prevalence of Facioliasis and lung worm disease. An overall incidence of fascioiasis and lung worm disease was recorded as 17.58% and 30.66% respectively. Two species of flukes i,e. Fasciola hepatica, F. gigantica and three species of lungs worm i.e. Dictyocaulus filaria. Protostrongylus rufescens and Muellerius capillaris were recorded. The highest incidence (30%) of fascioliasis was found in the month of November, and lowest (4%) in June. The prevalence of lung-worm disease was highest in October and November (50%) and lowest(3.57%)in June. Muellerius capillaris was recorded only in the month of February and March.

Iqbal et al.(1986) examined four hundred liver and equal number of lungs for the presence of helminth infection at Faisalabad. The result showed that overall incidence of parasitic infection in liver was 34% in sheep and 11% in goats. In lungs, the parasitic infection recorded was 21% in sheep and 8% in goats. The helminths recovered from liver of sheep and goats were: Fasciola hepatica, F. gigantica, Hydatid cysts and Toxocara canis (larvae). Dictyocaulus filaria and Protostrongylus rufescens were recorded from lungs.

In another study Iqbal et al. (1986) examined 1,000 teddy goats slaughtered at Faisalabad abattoir for the presence of hydatid cysts. The overall rate of infection recorded was 8%. Sexwise incidence was 5.48% in males and 14.5% in females. The cysts were only observed in lungs.

Considerable work on helminth parasite of sheep and goats and other animals have been done in India in the form of systematic survey, incidence of infection, intensity, epidemiology, and control measures. Many workers have also studied helminthiasis caused by one or more highly pathogenic species and investigated their control measures.

One of the earlier account of helminth Parasites of domesticated animals including sheep and goats in India is that of Gaiger (1910). He provided a check list of the Parasites of domesticated animals of India. An analysis of the list showed that 21 species of helminths were recorded up to his time from sheep and goats. They were: Echinococcus polymorphis, Schistosomum indicum, Strongylus filaria, S. rufuescens, S. filaria, Spiroptera acutata, Teania expansa, T. globipunctata, T. centripunctata, Oesophagostomum columbianum, Strongylus contortus, S. colubriformis, Trichocephalus affinis, Stilesia

globipunctata, S. colubriformis, Trichocephalus affinis, Amphistomum epiditum, Echinococcus polymorphis, Distomum hepaticum, Cysticercus tenuicollis, Coenurus serialis. Out of these parasites 19 species of helminth parasites were present in case of sheep and the number of species recorded in goats were less than sheep.

Southwell (1930) recorded Moniezia benedeni, M. expansa, Stilesia globipunctata, S. vitta, Avitellina goughi, A. lahorea, Cysticercus tenuicollis, Coenurus gaigeri, Coenurus cerebralis, Echinococcus (larva) from sheep and goats of India, Ceylon and Burma.

Bhalerao (1932) collected seven species of nematode parasites from three kinds of sheep and goats, Tibetan goats (Capra sibirca myer), Hill sheep (Ovis naburo gray) and Tibetan sheep (Ovis hodgsoni Blyth) from Muktesar, India. He found Oesophagostomum venulosum, Ostertagia occidentalis, O. circumcincta, Haemoncus contortus and three new species namely Varestrongylus pneumonicus, Dictyocaulus unequalis and Ostertagia orientalis.

A large number of stomachs of the "Desi" variety of sheep and goats from Allabad (India) was examined for two years by Harshey(1934). Amphistomate parasites of the genera Gastrothylax and Cotylophoron were reported namely: G. elongatus G. crumenifer and 3 new species of Cotylophoron C. ovatum, C. orientalis and C. elongatum. The incidence of amphistome ranged from 60-100%.

Bayyis (1936) mentioned Ascaris lumbricoides, Oesophagostomum venulosum, O. columbianum, Bunostomum trigonocephalum, Chabertia ovina, Gaigeria pachyscelis, Trichostrongylus colubriformis, T. probolurus, Haemoncus contortus, Nematodirus filicollis, Dictyocaulus filaria, Protostrongylus rufescens, Gongylonema pulchrum, G. verruc-

osum, Trichuris ovis as nematode parasites from sheep and goats, from India, Ceylon and Burma.

Sarwar (1944) described two new species of lungs worm: Verestrongylus capricola and Protostrongylus indicus from the bronchi of Hill goat Cara sibirica from Muktesar (India).

Sarwar (1945) studied the incidence of Trichuris and trichostrongylids in the ruminants of Punjab and United Provinces and found Trichostrongylus probolurus, Camelostrongylus mentulatus, Ostertagia ostertagi, O. cercumcincta, Cooperia punctata and Trichuris globulosa from sheep and goats.

Moghe (1945) in a survey on the nature and incidence of helminth infection in cattle, goats and sheep in the Central Provinces and Berar and Central India found 42 species of helminth parasites out of which 36 were found in sheep and goats namely: Cotylophoron cotylophorum, C. ovatum, Gastrothylax crumenifer, Paramphistomum cervi, Fasciola gigantica, F. hepatica, Schistosoma spindalis, S. indicum, S. bovis, S. haematobium, Cysticercus ovis, Stilesia vittata, S. globipunctata, S. hepatica, Avitellina lahorea, A. centripunctata, A. woodlandi, A. sudanea, A. goughi, Moniezia expansa, M. benedeni, Echinococcus granulosus, Cysticercus bovis, C. tenuicollis, Trichuris ovis, Haemoncus contortus, Bunostomum trigonocephalum, Oesophagostomum columbianum, O. radiatum, O. venulosum, Gaigeria pachycelis, Gongylonema pulchrum, G. verrucosum, Strongyloides papillosus, Ostertagia circumcincta, Trichostrongylus colubriformin, among them the common species were Schistoma sp., Stilesia sp., Avitellina, sp., Haemoncus contortus, Bunostomum trigonocephalum, and Gaigeria pachyscelis, while Fasciola hepatica was only common in sheep not in goats.

Thapar (1956) surveyed domesticated animal, including sheep, goats, buffaloes, and cattle of India, for the study of helminth parasites. In sheep and goats helminth parasite found were: Fasciola gigantica, Fischoederius cobboldi, F. elongatus, Cotylophoron cotylophorum, Gastrothylax crumenifer, Paramphistomum cervi, P. explanatum, P. orthoceolium, Schistosoma indicum, Ascaris vitulorum, Haemoncus contortus, Oesophagostomum columbianum, O. vitulorum, O. venulosum, O. asperum, Nematodrius filicollis, Strongyloides papillosus, Trichostrongylus colubriformis, Trichuris ovis, Avitellina centripunctata, A. lahorea, A. tatia, A. woodlandi, A. sudanea, Cysticercus tenuicollis, Echinococcus granulosus (hydatid) Moniezia benedeni, M. expansa, Stilesia globipunctata, Dicrocoelium sp. Eurytrema pancreaticum, Homologaster paloniae, Ostertagia cricumcincta, Verastrongylus pneumonicus, Coenurus cerebralis, Taenia gaigeri (Larval form). Among these parasites paramphistomes were found in abundance. He also noted that the highest degree of infection was during rainy season. F. hepatica was found in rare cases, the most commonly found species in India was F. gigantica but in case of sheep and goats, it was not so common. It was common only in buffaloes and cattle, Moniezia expansa, Trichuris ovis, Bunostomum, Haemoncus contortus were very common in sheep and goats.

Mukherjee and Deorani (1962) examined a large number of sheep, goats and buffaloes at Brially (India) for amphistome infection and found five species of Paramphistomes: Gastrothylax crumenifer, Ceylonocotyle scoliocoelium, Olveria indica, O. bovis and Calcophoron sp., among these Gastrothylax crumenifer and Ceylonocotyle scoliocoelium were found with very heavy worm load. They also noted histopathological changes in the infected rumen.

Observations were made by Katiyar and Varshney (1963) for a period of 6 years from 1953-59 on several outbreaks of amphistomiasis in sheep and goats in Uttar Predesh (India) with a view to evolve control measures. Species involved in this outbreak according to their frequency order were: Gastrothylax crumenifer, Cotylophoron cotylophorum, Paramphistomum cervi, Fischoederius elongatus, and Paramphistomum explanatum.

Jain and Kamalpur (1971) reported Trichuris globulosa from sheep and goats in Madhya Pradesh (India) for the first time, the incidence was 10% in sheep and 6% in goats.

Kaushik, and Kalra (1971) studied parasitic pneumonia in sheep and goats by two species of lungs worms (Dictyoculus filaria and Protostrongylus rufescens) in Punjab and Haryana (India).

Dhar et al. (1972) reported 29.5% infection of Varestrongylus sp, and 21.3% infection of Dictyocaulus filaria in sheep in Kashmir. They also found that Dictyocaulus filaria was most common during summer months.

Rajaseharaiah and Venkatarathnam (1973) established cutaneous infection in sheep by Bunostomum trigonocephalum in Andra Pardesh (India). They studied the course of disease and blood picture in experimental infection.

Sinha and Sahai (1973) reported 16 species of helminth parasite from goat in Bihar (India): Fasciola gigantica, Cotylophoron cotylophorum, Carmyerius spatiosus, Gastrothylax crumenifer, Ceylonocotyle sp., Moniezia expansa, Stilesia globipunctata, Echinococcus granulosus (Hydatid cyst), Cysticercus tenuicillis, Oesophagostomum columbianum, Trichuris ovis, Haemoncus bispinosus and H. contortus.

Chabra and Gill (1975) investigated helminth infections by faecal examination of the goats and also studied control measures for the infection of Amphistomiasis and Fascioliasis in Punjab (India). Faecal examination revealed that animals were infected with amphistomes like Cotylophoron, Gastrothylax, Paramphistomum and Gigantocotyle, Strongyles like Haemoncus, Bunostomum, Trichostrongylus, Oesophagostomum, and Strongylides. The incidence ranged from 17.4 to 38.7% in the two villages surveyed. Seasonal variation particularly that of amphistomes was evident, it was highest in July and Progressively decreased in December. The incidence of strongyles was higher in July and it declined in September and again rose in the following March and reached its peak in June.

Chabra et al. (1978) studied Paramphistomiasis with reference to pathogenesis and symptoms of diseases alongwith their life cycles in sheep and goats. Out of 2344 affected sheep 39.75% died due to immature pharamphistomiasis. Among 430 goats the mortality was 53.5%. The animals grazed poorly, showed intermandibular oedema and acute diarrhoea which resulted in death in a week. The carcasses were emaciated and viscera was pale. Mucosa of the entire duodenum was highly inflammed and densely studded with numerous immature flukes. In acute cases 5000-8000 immature flukes were recovered from the duodenum. Immature paramphistomiasis has seasonal incidence from November to March. The parasite involved in this outbreak was identified as Paramphistomum cervi.

Bali and Singh (1979) found Haemoncus contortus, in 80% sheep and 63.5% goats in Hissar (India). They also studied atmospheric influence on Haemoncus contortus. Incidence of H. contortus was highest (100%) in the months of July-November and lowest (15%) in the month of February and March. The infection percentage was maximum

in autumn followed by summer and winter and lowest in spring.

Sadano at al. (1980) detected Protostrongylus Spp. and Dictyocaulus filaria in lungs of 5.7% of sheep and goats, slaughtered in Haryana (India) between September 1975 and August 1979. The incidence of Pneumonia was 6% in goats and 4.3% in sheep.

Survey of helminth parasites of sheep and goats have been also conducted in other part of the world. One of earlier survey was carried out by Boulenger (1914) in England and he found 11 species of nematode parasites from sheep namely, Bunostomum trigonocephalum, Chabertia ovina, Oesophagostomum venulosum trigonocephalum, Chabertia ovina, Oesophagostomum venulosum, Haemoncus contortus, Ostertagia circumcinta, O. trifurcata, Cooperia oncophora, Nematodirus filicollis, Trichostrongylus instabilis T. vitrinus and T. extenuatus.

Skrjabin (1916) as quoted by Satubaldin (1958) found 17 species of helminths from goats of Kazakhistan namely: Fasciola hepatica, Dicrocoelium lanceatum, Moniezia expansa, Thysanosoma ovilla, Taenia echinococcus, T. marginata, (Cysticercus tenuicollis), Oesophagostomum venulosum, Chabertia ovina, Bunostomum trigonocephalum, Haemoncus contortus, Trichostrongylus retortaeformis, Nematodirus filicollis, Dictyocaulus filaria, Synthetocaulus rufescens, S. capillaris, Gongylonema scutata, and Trichuris ovis. Later on one more species was added namely Parabronema skrjabini by Vershchagin (1926). Boev and Murzina (1948) and Boev (1952) studied pulmonary helminths in sheep and goats and found five species of Protostrongylus, P. hobmaieri, P. raillieti, P. skrjabini, P. davtiani, and P. kochi. Beside this genus other five species of lungworms were Spiculocaulus orloffi, S. cuestriacus, Cystocaulus nigrescens, Neostrongylus zvetkovi, and Bicaulus schulzi.

Goodey (1924) found 3 species of Oesophagostomum, O. columbianum, O. asperum, and O. venulosum from sheep and goats of Malaya, China and also from Scottish sheep.

Daubney (1933) from Kenya found following species of Trichostrongylid nematode from sheep: Trichostrongylus colubriformis, T. probolurus, T. axei, T. vitrinus, T. hamatus, Cooperia curtcei C. oncophora, C. pectinata, C. serrata, Ostertagia circumcincta, O. pinnata, and Impalaia nudicollis. Out of these new Genus Cooperiodes was also established by him for a new species of C. kenensis.

During a survey on whipworm incidence in South African ruminants Ortlepp (1937) found Trichuris globulosa and T. parvispiculum in sheep and goats.

Swales (1940) studied helminthiasis in sheep in Canada and effect of winter upon free living stage of nematodes parasites. He found that the eggs of Haemoncus and Oesophagostomum did not survive in the freezing temperature of pasture during winter months and continuity of life cycle depends on the worms which remain immature at the end of summer season.

Gerichter (1950) studied the lung nematodes of sheep and goats in the Levant and found the following species of lung worms: Dictyocaulus filaria, Cystocaulus ocreatus and Muellerius capillaris.

Crofton (1953) observed the commercial flock of sheep in South West England. For their nematode population he studied the frequency of occurrence per host and seasonal variation. He found that when the mean number of parasite per host was low, the incidence was also low, with the increase in number of worms per host incidence also increased. He also formulated a theory of seasonal incidence. He suggested that

the pattern of seasonal incidence is not necessarily one which can be attributed to seasonal changes of climate, but is a consequence of the life history, pattern of individual species and is directly connected with the rate of egg production and the time required for the development of each generation.

Skolova (1955) as quoted by Satubaldin (1958) reported Avitellina Sp., Moniezia benedeni, Cysticercus tenuicollis, Nematodirus spathiger, N. oiratianus and Marshallagia marshalli from Kazakhstan's wild ruminants. Under this background information Satubaldin (1958) started his investigation and enhanced our knowledge of helminth fauna of sheep and goats in Kazakhstan region of U.S.S.R. He found 46 species in sheep and 39 in goats. Listing of the species found will be a mere repetition. However, some of their conclusions regarding ecological aspects of helminthiasis is worth quoting, "Ecologically close animal hosts have under identical existence condition the most similar endoparasitic fauna, independently of their phylogenetic affinity". He came to this conclusion after finding that the wild goat and domesticated goat have different helminth fauna, while domestic sheep and goat shared similar helminth fauna.

In U.S.A Turk (1956) studied helminth infection and found that Haemoncus contortus was a common parasite of sheep and goat. The parasites were more abundant after the rain following a dry season.

In Western Australia Parnell (1963) studied helminthiasis in sheep for their seasonal incidence and immature stages which persist in the wall of the digestive tract. He found Haemoncus contortus, Ostertagia sp. Trichostrongylus axei, T. sp. Nematodirus sp. and Chabertia ovina.

Horak (1966) experimentally studied paramphistomiasis for pathogenesis and symptoms of diseases, alongwith their life cycles. Experimental infection with 20,000 paramphistoms show little clinical symptoms but infection with 40,000 lead invariably to death.

Mc Culloch and Kasimbala (1968) reported seven species of gastro-intestinal nematodes from Tanzania. A high incidence of Trichostrongylus colubriformis and a lower incidence of Haemoncus contortus was recorded. Climatological factors exerted influence on the distribtion of the worm burdens in Tanzania. Desophagostomum columbianum was widely distributed, incidence of Haemoncus contortus was high in the wet season, and low in dry season.

Waller and Thomas (1975) studied inhibition of Haemoncus contortus in sheep in North East England and found that neither autumn climate effect nor host immunity was responsible for inhibition in the strain of Haemoncus contortus used by him.

Eslami and Faizy (1975) reported 29 species of Helminth parasite from goats: Haemoncus contortus, Marshallagia marshalli, Parabronema skrjabini, Camelostrongylus mentulatus, Ostertagia circumcincta, O. occidentalis, O. trifurcata, O. ostertagi, Trichostrongylus capricola, T. probulurus, T. vitrinus, T. colubriformis, Bunostomum trigonocephalum, Chabertia ovina, Oesophagostomum venulosum, Skrjabinema ovis, T. skrjabani, T. discolor, T. barbertonensis, Paramphistomum cervi, and Moniezia expansa.

El-Moukdad (1977) studied endoparasite of sheep in Austria and he found the following species of helminths: Trichuris ovis, Nematodirus filicollis, Ostertagia trifurcata, Trichostrongylus vitrinus, Trichostrongylus sp., Chabertia ovina, Capillaria bovis, Strongyloides papillosus, and Haemoncus contortus.

A study of the helminth fauna of lamb in Syria was made by El-Moukdad (1977). He collected following species of helminth from the gastro-intestinal tract: Marshallagia marshalli, Ostertagia circumcincta, O. trifurcata, Haemoncus contortus, Trichostrongylus vitrinus, T. colubriformis, T. capricola, Nematodirus filicollis, N. spathigar, N. oiratianus, Moniezia expansa, M. benedeni, Avitellina centripunctata, Thysaniezia giardi, Trichuris ovis, T. globulosa, T. skrjabini and T. gazellae. Dictyocaulus filaria, Protostrongylus rufescens, Cystocaulus ocreatus, Muellerius capillaris, Neostrongylus linearis were collected from lungs.

LLoyd and Soulsby (1978) studied the prevalence and intensity of Parasitic infection in goats in Southeastern Pennsylvania and Northern Maryland. Examination of faecal samples of 336 goats showed: Strongyles, Strongyloides papillosus, Moniezia, Trichuris, Nematodirus Muellerius capillaris, Skrjabinema caprea eggs.

Schillhorn et al. (1980) in a survey of helminth parasites of ruminants of Northern Nigeria from 1973-75 found that out of 1748 goats 17.6% carried Fasciola gigantica and 5.2% Dicrocoelium hospes. Out of 550 sheep examined F. gigantica was found in 40.4% and Dicrocoelium hospes in 13.1% hosts. Amer, et al.(1980) studied Dicrocoëlium dendriticum and Fasciola hepatica infection in 97 sheep and 42 cattle of local and imported origin in Tripoli region of Libya. Locally bred sheep were infected with F. hepatica and D. dendriticum to the extent of 17% and 4% respectively, while the imported sheep showed infection upto 70% and 18% respectively.

Cabert, at el. (1980) during a study in Morocco on first stage larvae of Protostrongylid of sheep found that high prevalence among them were Muellerius and Neostrongylus and less common were Cystocaulus and Protostrongylus.

Van Veen (1980) observed an out break of fascioloisis on the Ahmadu Bello University farm in dry season. Larval Fasciola infection in the snail were most common during the begining of the dry season. Stopping grazing around the lake, especially during the wet season evidently prevented the occurrence of fascioliasis.

Eysber (1980) observed high Mortality in lambs and ewes from acute haemonchosis and trichostrongylosis in Northern Nigeria.

Ashraf (1982) studied seasonal variation and prevalence of lungworms, gastro-intestinal nematodes and Coccidia of Maryland dairy goats in U.S.A. 60% does and 33% kids were infected with strongyle parasites, 64% adult goats were infected with lungworms and 64% goats were infected with tapeworms. Ninety percent were infected with Trichuris spp. The study was based on examination of faecal sample and culturing of eggs upto larval stage for diagnostic features of nematode species. By culturing methods he could identify Haemoncus contortus, Trichostrongylus axei, Dictyocaulus filaria, Muellerius capillaris. Specific diagnosis of Trichuris spp. and that of cestodes were not made. All parasite infection rates increased in summer and fall to low peak during November-December.

Elzbieta (1982) studied lung nematodes (Protostrongylidae and Dictyocaulidae) in sheep of Pod hale region Tetra Highland, Poland. A total of 13,414 sample of sheep faeces and 276 lungs were examined. The most frequently occuring nematodes were Muellerius capillaris (42%) Protostrongylus rufescens (32.3%) Neostrongylus linearis (7%) Cystocaulus ocreatus (5.8%) and Dictyocaulus filaria (25.6%).

Beveridge and Ford (1983) examined 376 sheep from different agricultural region of South Australia for trichostrongyloid infection.

Teladorsagia circumcincta, T. furcata, T. davtiani, Camelostrongylus mentulatus, Haemoncus contortus and Trichostrongylus axei were found in abomasum. Trichostrongylus axei, T. vitrinus, T. culbriformis, T. probalurus, Nematodiries filicollis, N. spathiger, and N. abnormalis were found in small intestine.

Biggs and Anthanissen (1983) studied in Namaba (West Africa) seasonal incidence of gastro-intestinal helminths by slaughtering lambs (Karakul sheep) each exposed for thirty three days on pasture. Haemoncus contortus was present from March to July with generally increasing percentage of 4th stage larvae in each successive month. Spring rise in the egg count was seen in flock sheep in October. Oesophagostomum was seen in flock sheep in October. Moniezia Spp. were present from November to July.

Opasina and Dipeolu (1983) recovered five hundred specimens of Mammomonogamus nasicola from larynx, trachea, and bronchial tree of a Nigerian dead sheep. It is believed that it might have caused the death of the sheep by obstructing the air passages.

Denev and Kostov (1983) studied survival of free living stages of Ostertagia, Haemoncus and Oesophagostomum for three years in Bulgaria and found that helminthasis was likely to be severe when heavy summer precipitation was accompanied by high temperature.

Darmono (1984) studied occurrence of Haemoncus contortus among sheep slaughtered at Bogor (Indonesia). He found H. contortus infection in about 85% sheep out of 142 sheep examined.

Hunter and Heath (1984) during examination of faecal samples of ewes and Lambs in Yemen found Haemoncus, Trichostrongylus and Fasciola infection.

Hussein et al.(1985) collected Haemoncus longistipes from experimentally infected Suddanese goats and camels for morphological studies. Goats and camels from the same area in the Sudan were found to be naturally infected with Haemoncus longistipes but sheep were not and were resistant to experimental infection.

Vercruyssee and Schandeyl (1985) found two different species: Schistomsoma bovis and S. haematobium after examining 3,032 sheep in Senegal. They also observed pathological changes such as lesions due to presence of eggs in the liver and distal part of the intestinal tract, and acute cellular infiltration was also observed in infected area.

This comprehensive review of literature led us to make the following conclusions:

1. Most of the studies made on helminth parasites of sheep and goat are regional studies based on restricted areas. Thus a complete study on one well defined region is not available.

2. Most of the studies are based on isolated post mortem examinations.

3. Faecal samples or "representative samples" from a few hosts have been examined.

4. In most of the cases the conclusions on incidence, worm burden & seasonal variation have been drawn from a very restricted data.

5. Comprehensive lists of helminths found in literature are from secondary sources.

Therefore there is a need for study to examine comparatively large number of hosts from a well defined region over a longer period of time to evolve a complete picture of helminthiasis and draw conclusions on species involved, their incidence, worm burden and seasonal variation.

MATERIALS AND METHODS

Gastro-intestinal tracts of sheep and goats were collected from the slaughter houses of Peshawar city where sheep and goats are brought from various parts of the North West Frontier Province.

Guts, lungs, liver, spleens, hearts and trachea of 203 sheep and 202 goats were examined during two years of survey work which commenced in December, 1978 and ended in November, 1980. Besides these organs, additional lungs and livers of 208 sheep and 190 goats were also examined. Sheep and goats examined ranged in age from 6 months to two years. Normally, two sheep and two goats were examined per week, beside this extra lungs and liver of two sheep and two goats were also examined.

Such surveys have been previously conducted by examining faecal samples. However, we felt that in the absence of any previous information on helminthic infection in this region, the specific diagnosis may not be valid in all the cases. Secondly, light infection or presence of immature stages may not be reflected in faeces. Therefore, we made the decision to examine complete digestive tract so that light infection or even immature stages may also be recorded. Some workers have also adopted the method of examining the representative sample from gastrointestinal tract as examining the whole gastro-intestinal tract is very time-consuming and cumbersome. In the present survey we examined the entire gastro-intestinal tracts for the same reason as mentioned above so that even lightest infection may also be recorded.

Gastro-intestinal tracts, lungs, liver, spleen, heart and trachea were brought to the laboratory early in the morning and were dissected out to search for the helminths. Mesentery and connective tissue were separated carefully from the alimentary canal and cysticercus or any other parasite were removed, if present. Pathological condition of mesentery and of connective tissue around the cysticercus was noted. The gastrointestinal tracts was divided in to convenient parts and placed in separate dishes.

Gross pathological lesions if present were recorded. Bile ducts and biliary passages were cut open and deep parenchmatous tissue of the liver was exposed. Gall bladder was cut open and the content were examined carefully under a low power binocular microscope. Trachea and lungs were cut open and were traced up to the pulmonary tissue, Hydatid cysts when found were separated and put in physiological saline.

Heart and spleen tissues were thoroughly searched for parasites particularly for hydatids.

Contents of the parts of the alimentary canal were examined for parasistes, either by sieving or sedimentation method. Inner lining of the organ was thoroughly observed for attached parasites. Small intestine was opened by a careful longitudinal slit and was placed in a separate dish. After cleaning its mucous cestodes were detached carefully. Gross pathology at the sites of attachment was noted, caecum and large intestine were opened in the similar fashion and the parasites were recovered.

All parasites were washed in physiological saline and placed in separate dishes. Parasites were relaxed and killed in 70% hot alcohol. Nematodes were kept in a mixture of half glycerine and

half 70% alcohol in open vials for a week, after which they were preserved in pure glycerine. Cestodes and trematode were stained with aceto-alum-carmine, dehydrated and mounted in Canada Balsam.

Diagram of the parasites were made with the help of camera lucida and drawing apparatus. Measurements were taken on a calibrated microscope and micro-photographs were taken with a camera attached to a microscope. Enface view of nematodes were made with the help of a cut made by a sharp razor blade. In a drop of glycerine they were mounted and studied under binocular microscope.

RESULTS

CHAPTER I

SYSTEMATIC ACCOUNT.

The following species of helminth parasites were found from sheep and goat:

Trematoda:

Family : Fasciolidae Railliet, 1895

Fasciola hepatica Linnaeus, 1758.

Family : Dicrocoelidae Odhner, 1911

Dicrocoelium lanceatum stiles et Hassal, 1898

Family : Paramphistomidae, Fischoeder, 1901

Sub family : Paramphistominae, Fischoeder, 1901

Cotylophoron ovatum Harshey, 1934

Paramphistomum (E) explanatum (Crepl,1847)

Sub family : Gastrothylacinae Stiles Goldberger, 1910

Gastrothylax crumenifer(Crepl.,1847), Otto, 1896.

Sub family : Pseudodiscinae Nasmark, 1939

Watsonius capri sp.nov.

Cestoda:

Family : Anoplocephalidae Choladkovsky, 1902

Sub family : Anoplocephalinae Blanchard, 1891

Moniezia expansa (Rud., 1805)

M. benedeni (Meniez, 1879)

Sub family : Thysanosomatinae Skrjabin, 1933

Avitellina centripunctata (Rivolta,1874)

Stilesia vittata Railliet, 1896.

Family : Taeniidae Ludwig, 1886

Taenia hydatigena Pallas, 1766

Cysticercus tenuicollis (larval form)

Echinococcus granulosus (Batsch, 1786)

Hydatid cyst (larval form)

Nematoda:

Family : Trichuridae Railliet, 1915

Sub family : Trichurinae Ransom,1911

Trichuris globulosa (Linet., 1901)

Trichuris parvispiculum Ortlepp, 1937)

Trichuris indica Sarwar, 1946

Trichuris lani (Artiukh, 1948)

Family : Cyathostomidae Yamaguti, 1961.

Sub family : Oesophagostominae Railliet, 1916

Oesophagostomum asperum Railliet et Henry, 1913.

O. brevicaudum Schwarts et Alicata,1930

O. columbianumCurtice, 1890

O. venulosum (Rud., 1809)

Chabertia ovina (Fabricius, 1794)

Family : Ancylostomatidae Nicoll, 1927

Sub family : Bunostominae Looss, 1911

Bunostomum trigonocephalum* (Rud., 1808)

Family : Trichostrongylidae Leiper 1912

Sub family : Haemoncinae Yamaguti, 1961

(Haemenchinae Skrjabin et Schulz, 1952)

Haemoncus contortus (Rud., 1803)

Family : Protostrongylidae Leiper, 1926

Sub family : Protostrongylinae Kamensky, 1905 Partim.

Pneumocaulus Kademazil Schulz-et-Andreeva, 1948.

* not found in goat.

Sub family : Dictyocaulinae Skrjabin, 1933

Dictyocaulus filaria (Rud., 1809)

Family : Oxyuridae Cobbold, 1864.

Sub family : Syphaciinae Railliet, 1916

Skrjabinema ovis* (Skrjabin, 1915) Wereschitchagin, 1926.

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* Not found in sheep.

Trematoda:

Family : Fasciolidae Railliet, 1895

Syn. Fasciolopsidae Odhner, 1926

Brachycladiidae Faust, 1929

Sub family : Fasciolinae Stiles et Hassal, 1898

Genus : Fasciola Linnaeus, 1758

Syn : Cladocoelium Duj., 1845

Fasciola hepatica Linnaeus, 1758

(Fig. I)

Host : Sheep and goats

Location : Gall bladder and billary Passages

Locality : Peshawar

Description : Worm greyish brown, cuticle spiny, body large and broad, flat and leaf like, with characteristic cephalic cone, bearing mouth at its tip, anterior end more rounded than posterior end.

Body length measuring 23-35 mm (average 29.2 mm) and width being 7-12 mm (average 8.8 mm). Cephalic cone measuring 2.23-2.86 mm (average 2.49 mm). Oral sucker smaller than ventral sucker, measuring 0.599 - 0.828 x 0.685-0.885 (average 0.73 x 0.83 mm) in diameter; ventral sucker rounded in its diameter being 0.54 - 1.37 x 0.71-1.43 mm (average 1.03 x 1.18 mm).

Pharynx well developed, measuring 0.60-0.91 mm (average 0.75) in length and diameter being 0.43-0.66 mm (average 0.52 mm). Oesophagus short, measuring 0.09-0.14 mm (average 0.10 mm) in length, intestinal ceca long, reaching posterior end, profusely branched. Excretory bladder long, slender, with lateral branches.

Ovary branched, pretesticular and situated right of middle uterus having ascending limb which form rosette-like cluster of folds between

testes and ventral sucker, vitellaria well developed in lateral field and extend from base of cephalic cone to extreme posterior end of body: transverse vitelline ducts open in median reservior which lie just behind ootype. Egg yellowish brown, measuring 0.15-0.37 x 0.08-0.77 mm (average 0.27 x 0.26 mm).

Testes profusely branched, tandem, occupying greater part of post-ovarian intervitellarian field, duct originates from each testis, open into genital pore by a common duct; cirrus well developed, measuring 1.00 - 1.43 x 0.74 - 1.77 mm in size.

REMARKS:

According to Faust et al. (1970) Fasciola hepatica Linnaeus, 1758 was the first trematode described by Jean de Brie (1379). He recognised the disease in sheep in fourteenth century, and according to Soulsby (1965) interest was also shown, in the common liver fluke by early biologists such as Redi, van Leeuwenhoek and Linnaeus, who in 1758 in his systema naturae, gave it the name of F. hepatica.

This fluke has a cosmopolitan distribution. According to Yamaguti (1958) five other species of genus Fasciola have been reported from various mammalian hosts from different countries of the world: F. californica Sinitzin (1934) F. gigantica Cobbold, 1955, F. halli Sinitzin (1934), F. indica Varma, 1953, and F. jacksoni (Cobbold, 1869).

Fasciola hepatica, F. gigantica and F. indica have been reported from domestic mammals in Indo-Pakistan Sub-continent. According to Thapar and Tandon (1952) F. gigantica is very common parasite of the cattle buffaloes, sheep and goats in India and is responsible for heavy mortality in domestic animals. F. hepatica and F. gigantica can be separated from each other on the basis of relative size and presence of broad

Table II : Measurements of Fasciola hepatica Linnaeus, 1758 found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length of Worm	23	35	35	29	24	29.2
Width of worm	8	12	7	9	8	8.8
Diameter of oral sucker	0.799 x 0.885	0.628 x 0.685	0.799 x 0.857	0.599 x 0.885	0.828 x 0.857	0.73 x 0.83
Diameter of ventral sucker.	1.26 x 1.40	0.71 x 0.71	1.37 x 1.43	0.54 x 0.91	1.26 x 1.43	1.03 x 1.18
Length of cephalic cone.	2.23	2.86	2.57	2.57	2.23	2.49
Length of pharynx	0.91	0.86	0.60	0.60	0.77	0.75
Width of pharynx	0.43	0.43	0.57	0.49	0.66	0.52
Length of Oesophagus	0.09	0.09	0.09	0.14	0.09	0.10
Size of cirrus	1.43 x 1.14	1.00 x 0.74	1.00 x 0.74	1.00 x 1.77	1.14 x 1.03	1.11 x 1.08
Size of egg	0.37 x 0.17	0.34 x 0.23	0.31 x 0.77	0.16 x 0.08	0.15 x 0.08	0.27 x 0.26

shoulders in F. hepatica. The anterior cone is smaller in F. gigantica than in F. hepatica, the body is more transparent and testes are smaller in F. gigantica than in F. hepatica.

According to Soulsby (1965) F. indica Varma 1953, is intermediate between F. hepatica and F. gigantica but in many respects it resembles F. gigantica. Points of differentiation are the strongly marked cuticular scales and lateral intestinal branches, which are intermediate between the right angle arrangement in F. hepatica and the backward direction of F. gigantica, but these differences were not marked by Sarwar (1957). Kendall (1960), as quoted by Soulsby (1965) considered F. indica as synonym of F. hepatica. According to him F. gigantica and F. hepatica may form the two end of the series between which a variety of forms may occur. Soulsby (loc. cit) also quoted , other species i.e F. halli and F. californica which were considered synonym of the North American flukes of rumen F. gigantica and F. halli, in a review by Price (1953).

Watanabe (1965) after observing the ecological and morphological features of the species of liver fluke found in Japan, discussed that the liver fluke recovered in Japan could be identified as Fasciola hepatica Linnaeus, 1758 but they have larger bodies and eggs than F. hepatica. Watanabe (loc cit) also mentioned the sub-species or intermediate type of F. hepatica. According to him Railliet (1895) first found an elongated and slender form of F. hepatica from cattle, buffaloes and sheep from Cairo and he described this as F. hepatica var., aegyptica, Watanabe (loc cit) also quoted the indian species as Fasciola indica.

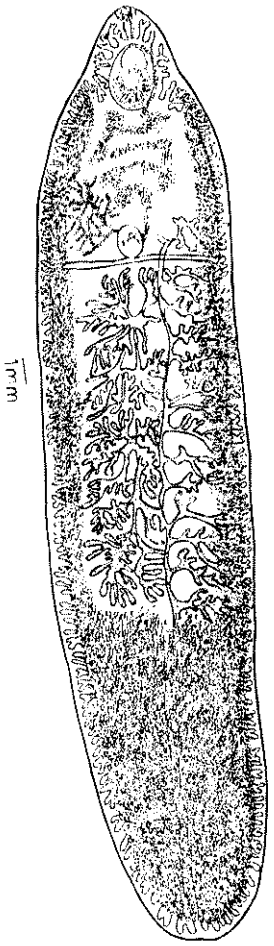


Fig. 1. Fasciola hepatica

Family : Dicrocoelidae Odhner, 1911

Sub family : Dicrocoeliinae Looss, 1899

Tribe : Dicrocoeliini Yamaguti, 1958

Genus : Dicrocoelium Duj., 1845

Dicrocoelium lanceatum Stiles et Hassall, 1898.

Syn : D. dendriticum (Rud., 1819)

D. macaci Kobayashi, 1915.

(Fig. 2)

Host : Sheep and goats

Location : Liver, Bile duct and gall bladder

Locality : Peshawar

Description : Worm translucent and delicate in appearance. Cuticle smooth. Body elongated, oral sucker smaller than ventral sucker, and measuring 0.170-0.284 x 0.193-0.249 mm (average 0.206 x 0.216 mm) in diameter.

Oesophagus short, measuring 0.142-0.571 mm (average 0.302 mm). Intestinal ceca unbranched, measuring 3.81 mm in length. Excretory bladder tubular with oblique arms.

Testes slightly lobed and almost tandem, anterior slightly smaller and being 0.314-0.428 x 0.285-0.485 (average 0.348 x 0.370 mm) and posterior testes measuring 0.285 - 0.542 x 0.228-0.485 mm (average 0.405 x 0.388 mm). Cirrus pouch preacetabular, containing winding seminal vesicle, par prostatica and ductus ejaculatorius. Genital pore near intestinal bifurcation.

Ovary closely behind posterior testes, diameter being 0.142 -0.314x 0.171-0.228 mm (average 0.193 x 0.199 mm). Uterus runs towards genital pore, passing some what in between testes; uterus filled with brown eggs operculated and measuring 0.018-0.034 x 0.021-0.032 (average 0.030 x 0.026 mm). Vitelline glands occupy middle third of lateral field, small

Table III: Measurements of Dicrocoelium lanceatum Stiles et Hassall, 1898 found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length of worm	6.0	5.0	5.5	5.0	6.0	5.5
Width of worm	1.192	1.136	1.397	1.510	1.192	1.280
Diameter of oral sucker.	0.170 x 0.222	0.284 x 0.249	0.193 x 0.227	0.193 x 0.193	0.193 x 0.193	0.206 x 0.216
Diameter of ventral sucker	0.285 x 0.342	0.285 x 0.342	0.342 x 0.342	0.371 x 0.371	0.685 x 0.371	0.393 x 0.353
Length of oesophagus	0.142	0.199	0.571	0.228	0.371	0.302
Diameter of anterior testis.	0.314 x 0.371	0.342 x 0.285	0.314 x 0.314	0.342 x 0.399	0.428 x 0.485	0.348 x 0.370
Diameter of Posterior testis.	0.485 x 0.457	0.285 x 0.228	0.371 x 0.342	0.542 x 0.485	0.342 x 0.428	0.405 x 0.388
Diameter of ovary	0.142 x 0.171	0.142 x 0.171	0.314 x 0.199	0.199 x 0.228	0.171 x 0.228	0.193 x 0.199
Diameter of egg	0.018 x 0.021	0.032 x 0.024	0.034 x 0.029	0.034 x 0.024	0.034 x 0.032	0.030 x 0.026
Length of cirrus pouch	0.457	0.457	0.457	0.514	0.399	0.456

rounded mehlis' gland lies just behind ovary.

REMARKS:

According to Yamaguti, (1958) seven species of Dicrocoelium have been reported from various mammalian hosts from different parts of the world. D. lanceatum Stiles and Hassal 1898 D. colobusicola Sandground, 1929, D. hopes Looss, 1907, D. lasiuri McIntoch 1933, D. rileyi Macy, 1931, D. moschiferi Oschmarin, 1952, D. orientale Sudarikov et Ryjikov, 1951 and D. soricis (Dies, 1858).

Dicrocoelium lanceatum commonly known as lancet fluke occurs in bile ducts of a wide variety of animals including sheep, goats, cattle, pig, dog, horse, bear, Nemorhaedus goral, Cercocebus, Cercopithecus, Semnopithecus and occassionally in man all over the world (Yamaguti, 1958).This worm was first discovered in United States in cow from upper New York State in 1941 (Chandler and Read, 1961). The life cycle was first worked out by Krull and Mapes (1952). In series of careful studies they demonstrated that an ant Formica fusca, is required as a second intermediate host for the development of metacarcarial cyst in U.S.A. and that infection of mamalian host results from ingesting of infected ants. According to Krull and Mapes (Loc cit) adult flukes which are 5-15 mm long and 1.5-2.5 mm broad, live in bile duct, which reach directly from intestine. Krull and Mapes found up to 50,000 flukes in the liver of older sheep. Vogal and Falcao (1954) confirmed this study for Germany (Chandler and Read, 1961). Srivastva (1944) also studied life history of this parasite in India and mentioned a water snail as the intermediate host. (Loc cit).

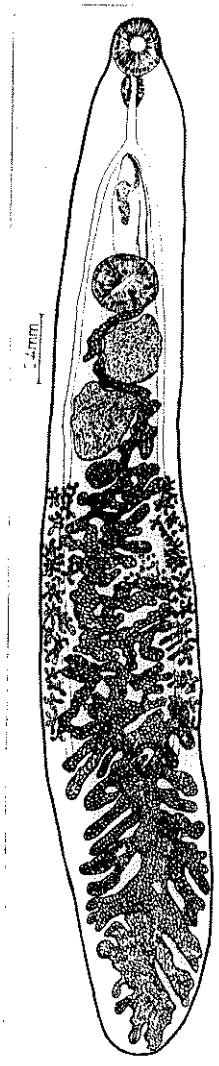


Fig. 2. Dicrocoelium lanceatum

Family : Paramphistomidae Fischoeder, 1901

Sub family : Paramphistominae Fischoeder, 1901

Genus : Cotylophoron Stiles et Goldberger, 1901

Cotylophoron ovatum Harshey, 1934

(Fig. 3)

Host : Sheep and goats

Location : Rumen and liver.

Locality : Peshawar

Description : Body oval in shape, measuring 6.5-7.5 mm (average 7 mm) in length and maximum width being 2.5-3.5 mm (average 3 mm). Oral sucker subterminal measuring 0.485-0.657 x 0.628-0.714 mm (average 0.616 x 0.696 mm). Acetabulum large, ventroterminal, having an index 1:2.15, measuring 1.428-1.771 x 1.457-1.714 mm (average 1.611 x 1.594 mm). Occasionally projection on body wall present. Oesophagus not bulbous, having thick muscular wall, measuring 0.285 - 0.514 mm (average 0.473mm) Intestinal ceca long coiled having zig-zag course and extending up to anterior margin of acetabulum.

Reproductive organs situated in posterior two thirds of body. Testes lie close behind each other, equal in size and rounded, lobulated in appearence, anterior testis measuring in diameter 0.428-1.371 x 0.428 -1.142 mm (average 0.845 x 0.839 mm) and posterior testis measuring 0.571-0.857 x 0.685 - 1.571 mm (average 0.708 x 1.233 mm).

Vasa efferentia arise from about middle anterior margin of testes and unite a little anterior to anterior testis in median line to form vas deferens which enters into transversely coiled thin-walled vesicula seminalis, which enters in turn into highly muscular and transversely coiled pars musculosa. Genital sucker well developed and post bifurcal, lying close to right ceca at a distance 0.257-0.799 mm (average 0.588mm)

Table IV : Measurements of Cotylophoron ovatum Harshey, 1934 found in sheep and goats from Peshawar (in mm).

Length of worm	7.0	7.5	7.0	7.0	6.5	7.0
Width of worm	2.5	3.0	3.5	3.0	3.0	3.0
Diameter of oral sucker	0.657 x 0.714	0.657 x 0.714	0.628 x 0.714	0.657 x 0.714	0.485 x 0.628	0.616 x 0.696
Diameter of ventral sucker	1.571 x 1.571	1.571 x 1.571	1.771 x 1.714	1.714 x 1.657	1.428 x 1.457	1.611 x 1.594
Length of oesophagus	0.571	0.571	0.285	0.514	0.428	0.473
Width of oesophagus	0.199	0.228	0.314	0.257	0.257	0.251
Distance of genital sucker from intestinal bifurcation.	0.571	0.571	0.742	0.799	0.257	0.588
Diameter of anterior testis.	0.428 x 0.428	1.371 x 0.857	0.571 x 0.771	1.028 x 1.142	0.828 x 0.999	0.845 x 0.839
Diameter of posterior testis.	0.571 x 0.685	0.771 x 1.714	0.628 x 0.771	0.714 x 1.571	0.857 x 1.428	0.708 x 1.233
Diameter of genital sucker.	0.0284 x 0.340	0.295 x 0.340	0.284 x 0.340	0.329 x 0.318	0.340 x 0.340	0.306 x 0.335
Diameter of ovary	0.285 x 0.542	0.571 x 0.571	0.542 x 0.628	0.571 x 0.628	0.571 x 0.472	0.508 x 0.568
Size of egg	0.113 x 0.056	0.124 x 0.056	0.136 x 0.249	0.136 x 0.079	0.136 x 0.090	0.129 x 0.100

from intestinal bifurcation, genital sucker measuring 0.284-0.340 x 0.318 - 0.340 mm (average 0.306 x 0.335 mm). Ovary situated at anterior margin of acetabulum and near right ceca, being 0.285-0.571 x 0.542 - 0.628 mm (average 0.508 x 0.568 mm). Uterus convoluted and open into genital sucker; vitellaria dispersed in lateral field extending from oral sucker to acetabulum.

REMARKS:

This parasite has been found attached to the rumen and bile ducts in sheep and goats. It was described by Harshey (1934) from sheep and goats from Allahabad (India). Nine other species belonging to the genus Cotylophoron have been reported from India, Africa and U.S.A (Yamaguti, 1958).

Harshey (1934) found 100% of sheep and goats infected with the parasite in Allahabad (India). This was recorded for the first time from goats from Pakistan (Peshawar) in 1980 by Siddiqi and Ashraf from 19 goats examined in Peshawar.

Specimens in our collection are similar in all essential characters such as body length, width, acetubular index, shape of intestinal ceca, position of testes and ovary, genital sucker and other essential characters with the description given by Harshey (1934). Moghe (1945) in a survey of helminths of goats and sheep and cattle found C. ovatum beside C. cotylophorum in the Central Provinces of Berar and Central India. Except this reference we were unable to trace the finding of C. ovatum in any survey conducted after its first discovery by Harshey (1934).

Horak (1971) in a comprehensive review of paramphistomiasis of domestic ruminants did not mention Cotylophoron ovatum as causative agent of paramphistomiasis from any where including India. Though, he

reviewed the work of Pande (1935), De Souza (1948), Ramakrishnan (1950) for cattle and those of Baldray (1906), Walker (1906), Haji (1935), Bawa (1939) Mudaliar (1945), Katiyar and Varshney (1963), Katiyar and Garg (1965), Sharma Deorani and Katiyar (1967) for goat and sheep in India, he did not quote the work of Harshey (1934). It is just possible that he was not aware of Harshey's work. This is borne out by the fact that if he did not consider C. ovatum or others as new species described by Harshey (Loc cit.) he would have atleast mentioned those species which have been already reported from sheep and goats and which were mentioned by Harshey. Yamguti (1958) considers C. ovatum as a valid species. Those working with paramphistomes have always recognised and appreciated the difficulty of separating species of Paramphistomes.

It is likely that either Cotylophoron ovatum has a restricted distribution in some parts of India and Pakistan or in surveys where the diagnosis is simply based on examination of faecal material it is difficult to distinguish between the eggs of C. cotylophorum and C. ovatum. The actual examination of adult flukes is essential for correct diagnosis. After identification of our specimens as Cotylophoron ovatum we have re-examined our specimens more critically and a comparative table of diagnostic feature and morphometric studies is presented in Table V. From this we have concluded that the species in our collection conforms to C. ovatum Harshey, 1934.

Seven specimen of Cotylophoron ovatum were found from sheep (host n. 104) from bile duct in the month of December, 1979. This is the first report of finding of Cotylophoron ovatum from bile duct. This is apparentlly an unusual site for the adult of C. ovatum.

The life history of Cotylophoron cotylophorum has been described by Srivastave (1944b) Sinha (1950) and Varma (1961). It has been shown that there is an intestinal phase in the definitive host before the para-

sites finally settle in the rumen. According to Horak (1971) Sharma Deorani and Jain (1969) have put forward an interesting theory for intestinal phase in the life cycle of C. cotylophorum. They Suggested that the young flukes after excystment are unable to withstand the effects of the acid abomasal PH and consequantly can not migrate directly to the rumen. The worms are thus forced to remain in small intestine for a certain amount of development before migration can commence. Some of the parasites may bore through intestinal wall and may enter the hepatic tissue. Horak, (1971) has mentioned of finding some paramphistomes attached to the wall of gall bladder. In such situation the bile is frequently thick and viscous and superficial necrosis of the gall bladder epithelium is noticeable.

Life history of C. ovatum has not been worked out. It is just possible that C. ovatum faces the same problem of unhospitable enviroment as does C. cotylophorum as postulated by Sharma Deorani and Jain (1969) and may have intestinal phase before settling in the rumen. It may be postulated that some worms from the intestinal phase may follow the route to hepatic region and may settle in the bile duct and finding environment conducive reach sexual maturity. The specimens from the bile duct were critically evaluated, their measurements and other diagnostic features were thoroughly examined. They conform to C. ovatum.

This is an interesting finding that beside rumen it is also found in bile duct. Paramphistomum cervi has also been found in bile duct as reported frequently in literature.

Table V : A comparison of diagnostic features of Cotylophcron ovatum (Harshey, 1934) with in the present collection.

	(Present observation) Host: sheep and goats.	(Harshey's observation) Host: sheep and goats.
1.	Body oval, elongated, length 6.5-7 mm, Width: 2.5-3.5mm.	Body oval, length: 4.32-6.63mm, maximum width: 2.20-2.30 mm.
2.	Oral sucker: 0.485-0.657 x 0.628 - 0.714 mm in diameter.	Oral sucker: 0.38-0.61x0.326-0.442 mm in diameter.
3.	Ventral sucker: 1.428-1.771x 1.457-1.714 mm in diameter	Ventral sucker: 0.526-0.90 mm in diameter.
4.	Acetabular index: 1: 2.15	Not given.
5.	Limbs of intestinal fork at at right angles to oesophagus	Intestinal fork at right angle to oesophagus.
6.	Ceca long having Zigzag course	Ceca extending up to acetabulum and having zigzag course.
7.	Reproductive organs in posterior two third of body.	Reproductive organs in posterior two third of body.
8.	Genital sucker well developed and post bifurcal, diameter: 0.284-0.329 x 0.318-0.340 mm.	Genital sucker well developed and postbifurcal, diameter: 0.24 - 0.32 mm.
9.	Eggs diameter: 0.124-0.136 x 0.056-0.249 mm.	Eggs diameter : 0.13 - 0.132 x 0.069 mm.

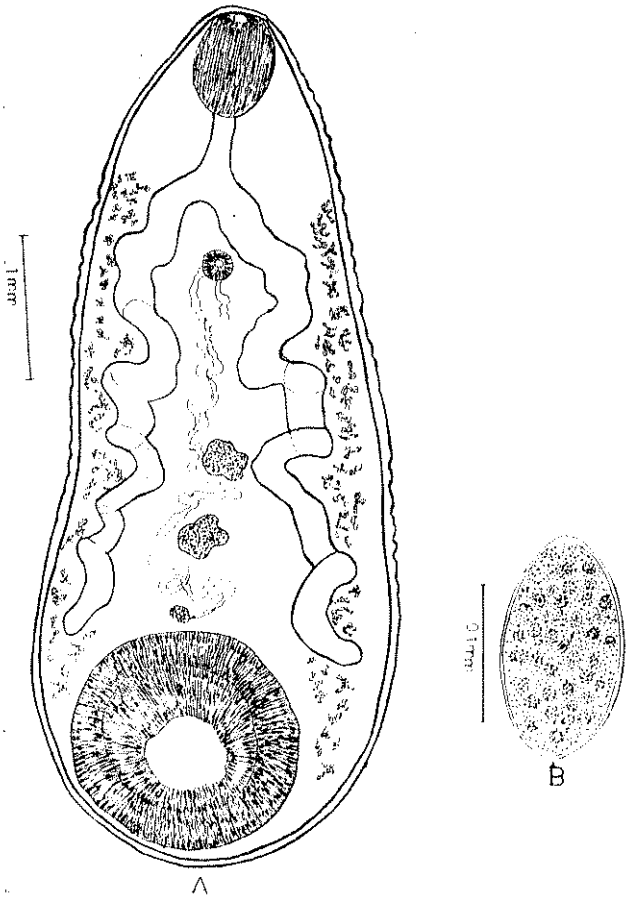


Fig. 3. Cotylophoron ovatum

A - entire

B - egg

D.IV - 1070 c.v

Genus : Paramphistomum Fischoeder, 1901

Syn : Gigantocotyle Nasmark, 1937

Paramphistomum (E) explanatum (Crepl, 1847)

(Fig. 4)

Host : Sheep and goats

Location : Rumen

Locality : Peshawar

Description : Body conical in shape, measuring 5-7 mm (average 6 mm) in length and width being 2.5-3 mm (average 2.7 mm). Oral sucker subterminal, diameter being 0.628-0.999 x 0.514-1.428. Acetabulum large, and measuring 2.142-5.571 x 2.142-3.771 mm (average 3.108 x 2.139 mm). Acetabular index being 1: 4.18, occasionally projections on body wall present.

Oesophagus not bulbous, short, measuring 0.285-0.428 mm (average 0.319 mm). Intestinal ceca long, sinous, reaching to acetabular zone, measuring 2.428 - 5.856 mm (average 3.872 mm) and width being 0.342 - 0.599 mm (average 0.586 mm).

Testes tandem, oval and non-lobate; posterior testis slightly large, measuring 0.485-0.99 x 0.99-2.285 (average 0.896 x 1.507mm) and anterior testis measuring 0.571-1.142 x 1.285-1.999 mm (average 0.936 x 1.290 mm) in diameter. Vasa efferentia arises from lateral margin of testis; sperm duct much convoluted and open into genital pore; genital pore prebifurcal. Ovary postesticular, measuring 0.142-0.284 x 0.227 - 0.428 mm (average 0.214 x 0.332 mm); oviduct arises from posterior margin and runs to acetabulum; uterus slightly convoluted; vitellaria restricted in lateral field between two suckers, and not very profuse. Egg measuring 0.113 - 0.124 x 0.056 - 0.079 mm (average 0.121 x 0.074 mm) in diameter.

Table VI : Measurements of Paramphistomum (E) explanatum (Crepl, 1874) found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length worm	7.0	7.0	5.0	6.0	5.0	6.0
Width of worm	3.0	2.5	3.0	2.5	2.5	2.7
Diameter of oral Sucker.	0.714 x 0.714	0.714 x 0.657	0.628 x 0.514	0.657 x 0.599	0.999 x 1.428	0.742 x 0.782
Diameter of ventral sucker	2.857 x 2.714	2.828 x 2.285	2.142 x 2.142	2.142 x 2.657	5.571 x 3.771	3.108 x 2.319
Length of oesophagus.	0.257	0.285	0.342	0.285	0.428	0.319
Length of intestinal ceca	3.428	3.371	2.428	4.285	5.586	3.872
Diameter of intestinal ceca.	0.342	0.514	0.399	0.599	1.080	0.586
Diameter of anterior testis.	1.057 x 1.285	1.142 x 1.285	0.571 x 1.199	1.057 x 1.485	0.857 x 1.999	0.936 x 1.290
Diameter of posterior testis.	0.999 x 1.428	0.999 x 1.342	0.485 x 0.999	0.857 x 1.485	1.142 x 2.285	0.896 x 1.507
Size of genital sucker	0.124 x 0.068	0.147 x 0.170	0.113 x 0.113	0.090 x 0.079	0.170 x 0.170	0.644 x 0.600
Diameter of ovary.	0.142 x 0.428	0.284 x 0.227	0.171 x 0.428	0.227 x 0.284	0.249 x 0.295	0.214 x 0.332
Size of egg.	0.124 x 0.079	0.124 x 0.079	0.124 x 0.079	0.124 x 0.079	0.113 x 0.056	0.121 x 0.074

REMARKS:

Paramphistomum (E) explanatum (Crepl, 1847) is the type of sub genus Explanatum and has been found attached to the rumen of sheep and goats. In other countries of the world it has been found in Bos taurus, B. indicus and Bubalis bulbalis.

The various genera of the family Paramphistomatidae are difficult to identify from the systematic point of view. Nasmark (1937) has overcome this difficulty by histological examination of the median sagittal section in which particular attention is directed to the acetabulum, pharynx and genital atrium. Nasmark (1937) differentiated Gigantocotyle explanatum from Gigantocotyle bathycotyle (Fischoeder 1901) on the relative position of the testes.

Kulasiri and Seneviratne (1956) found Gigantocotyle explanatum Creplin, of which G. bathycotyle and Explanatum are considered synonyms in the liver of the buffalo in Ceylon. This parasite was collected from different sites of the host, liver substance, portal vein and the bile duct.

Patnaik (1964) identified P. (E) explanatum (Crepl, 1847) after the system devised by Nasmark based on the characteristics of the acetabulum, genital atrium, and pharynx as seen in the sagittal section. He described this species from the buffalo and calves as the elongated and conical fluke had a well developed oral sucker and a large acetabulum with posteroventral position. Specimens measured 8 mm in length and 3.8 mm in maximum width, oral sucker was 0.55 mm in diameter, the acetabulum index was 1: 6.5 and ratio with body length was 1: 2.3 and it was highly muscular with an oval to round opening. An oesophageal bulb was absent and intestinal ceca extended up to the acetabulum.

Yamaguti (1958) mentioned that it is found in Bos taurus, Bos indicus and Bubalis bulbalis. It means that upto his time it was not reported either from sheep or goat.

On the basis of acetabulum index our specimen agree with the subgenus explanatum. The species under disscussion has been identified as P. (E) explanatum as ratio of the acetabulum, length of body, length of intestinal ceca and other characters are essentially similar. However, the testis in all specimen were observed to be tandem rather than diagnol. This may be affected by the size of the ventral sucker.

Yamaguti (1958) has divided family Paramphistomatidae into two tribes paramphistomini and Ceylonocotylini. The valid genera of Paramphistomini considered by him are:Ugandocotyle, Calicophoron, Cotylophoron and Paramphistomum. In the present study, two genera of Paramphistomini have been found namely Cotylophoron and Paramphistomum. Cotylophoron has been discussed in the preceeding account. Paramphistomum on the basis of acetabular index has been divided into two subgenera, namely Explanatum and Paramphistomum. Sub genus Paramphistomum having an acetabular index of 1: 1.5-2.6 is mainly a parasite of cattle and buffalo, except P. (P.) microbothroides which has been reported from sheep from U.S.A. While subgenus Explanatum with a larger acetabular index 1: 3.6-7.6 has been found mainly from cattle and buffaloes. Upto Yamaguti's publication (Yamaguti, 1958) P. (E.) birmense, P. explanatum was only reported from India. The most recent review after Yamaguti's monographic compilation we came across is that of Horak (1971). He quoted Dawes (1946,56,68) as saying that majority of species of Paramphistomum are synonyms of either P. cervi or P. explanatum. Boray (1969) has reported an outbreak of disease caused by P. inchikawai in sheep from Australia. This species was placed in subgenus Paramphistomum by Yamaguti, (1958) and was originally described from Bos taurus by Fukui (1922). Roach and Lopes (1966)

reported an outbreak of disease in sheep caused by P. microbothrium and P. daubnevi. Deiiana, et al. (1962) as quoted by Horak (1971) has reported an outbreak by P. cervi in goats in Sardinia, while Cretkovic (1968) identified P. microbothrium in outbreak in flocks of sheep in Yugoslavia. On the basis of acetabular index and other characteristics mentioned by Yamaguti (1958) we have taken the position that the specimens in our collection from sheep and goat conform to P. (E) explanatum.

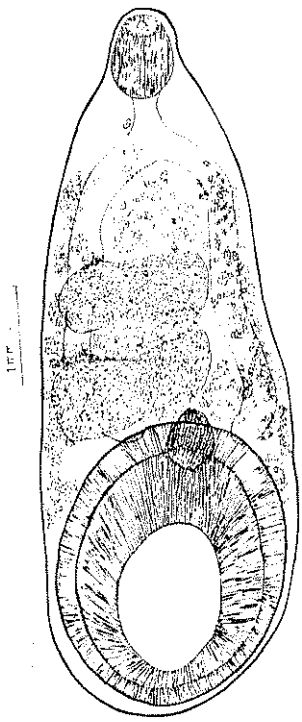


Fig. 4. Paramphistomum (E) explanatum

A - entire

B - egg

Sub family : Gastrothylacinae Stiles et Goldberger, 1910

Genus: Gastrothylax Poirier, 1883

Gastrothylax crumenifer (Crepl.,1847)Otto,1896.

(Fig. 5)

Host : Sheep and goats

Location : Rumen

Locality : Peshawar

Description : Body elongated, Cylindrical, measuring 5.318-9.2mm (average 7.264 mm) in length and width of body measuring at maximum 2.924 - 4.467 (average 3.945 mm).

Body wall smooth, oral sucker much smaller than ventral sucker and measuring 0.478 - 0.584 x 0.425 - 0.531 mm (average 0.584 x 0.531 mm), ventral sucker having a diameter of 0.797-1.276 x 1.329 - 2.393 mm (average 1.180 x 1.914 mm), ventral pouch reach to near acetabulum, traingular in cross section.

Oesophagus without bulb, having a length 0.319-0.797 mm (average 0.51 mm) and width being 0.159 - 0.212 mm (average 0.201 mm). Intestinal ceca long somewhat wavy, terminating at front of testes, and measuring 3.988 - 4.786 mm (average 4.259 mm).

Testes two, side by side, lobed, testis on left side being 1.116 - 1.648 x 1.116-1.914 (average 1.509 x 1.669 mm) in diameter and testis on right side measuring 1.116 - 2.127 x 0.850-1.595 mm (average 1.595 x 1.297 mm) in diameter, ovary intertesticular, measuring 0.265-1.010 x 0.265 -1.116 mm (average 0.701 x 0.797 mm) in diameter, vitellaria extending from intestinal bifurcation to acetabulum. Cephalic half of uterus and vas defrens on opposite sides. Eggs measuring 0.107 - 0.174 x 0.053 - 0.067 mm (average 0.123 x 0.016 mm) in diameter.

Table VII : Measurement of Gastrothylax crumenifer (Crepl.,1847) Otto, 1896 found in sheep and goats from Peshawar (in mm).

Length of worm	8.615	9.200	7.019	5.318	6.158	7.264
Width of worm	3.775	3.988	4.467	4.573	2.924	3.945
Diameter of oral sucker	0.584 x 0.531	0.584 x 0.584	0.531 x 0.531	0.744 x 0.584	0.478 x 0.425	0.584 x 0.531
Diameter of ventral sucker	0.797 x 1.329	1.276 x 2.393	1.276 x 2.127	1.276 x 2.127	1.276 x 1.595	1.180 x 1.914
Length of oesophagus	0.319	0.531	0.797	0.425	0.478	0.510
Diameter of oesophagus	0.212	0.212	0.212	0.159	0.212	0.201
Length of intestinal ceca.	4.786	3.988	3.988	-	-	4.254
Diameter of left anterior testis	1.116 x 1.116	1.648 x 2.020	1.801 x 1.914	1.329 x 1.754	1.595 x 1.542	1.509 x 1.669
Diameter of right posterior testis	1.116 x 0.850	2.127 x 1.595	1.861 x 1.489	1.542 x 1.223	1.329 x 1.329	1.595 x 1.297
Diameter of ovary	0.265 x 0.265	0.957 x 1.116	0.744 x 1.063	0.531 x 0.904	1.010 x 0.638	0.701 x 0.797
Size of egg	0.107 x 0.053	0.107 x 0.067	0.107 x 0.067	0.120 x 0.053	0.174 x 0.067	0.123 x 0.016

REMARKS:

Genus Gastrothylax Poirier, 1883 differ from all other Digenea in having an enormous ventral pouch, probably a very large genital atrium, which occupies most ventral region of the body and part of the lateral region, and into which the genital pore opens (Dawes, 1956). Gastrothylax crumenifer is the type species of the genus Gastrothylax. It occurs in the rumen of buffalo, cattle, sheep and goats. Dawes (1936) identified this species from 18 specimen collected from the rumen of buffalo. The specimen were 7-8 mm in length, the posterior sucker 1.8 mm in diameter, the ceca fairly straight and egg diameter being 0.116 x 0.060 mm. These general characters are very similar to the specimens found in our collection.

According to Harshey (1934) the specimens recovered from goat agreed with G. crumenifer, while those from sheep with G. elongatus. In the present survey material from sheep and goats was essentially similar and conformed to G. crumenifer. It seems that species elongatus has not been accepted as valid as it has been mentioned by Yamaguti (1958). Beside G. crumenifer, other two valid species are G. compressus Brandes, 1898 in Bos indicus and G. glandiformis Yamaguti, 1939 in rumen of Bubalus bulbalis, Dawes (1936) in a study of paramphistomidae recognised eight species of Gastrothylax namely G. exoporus, G. wenyoni, G. crumenifer, G. elogatus, G. cobbolodii, G. gregarius, G. spatiosus and G. synethes. Apparently this scheme has not been accepted by later workers.

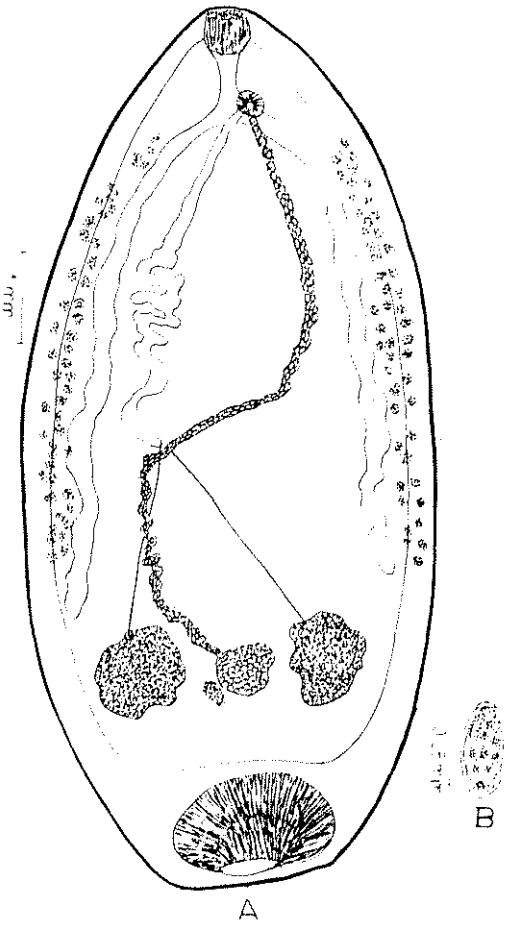


Fig. 5. Gestrothylax crumenifer

A - entire

B - egg

Sub family : Pseudodiscinae Nasmark, 1937

Genus : Watsonius Stiles et Goldberger, 1910

Watsonius capri sp.nov.

(Fig. 6)

Host : Goats

Location : Rumen

Locality : Peshawar

Description : Worm elongated and oval, measuring 3-5.5 mm (average 5 mm) in length and width being 1.5-2.5 mm (average 1.9 mm). Oral sucker subterminal, measuring 0.428-0.742 x 0.485-0.742 mm (average 0.588 x 0.616 mm) in diameter, ventral sucker comparatively large, measuring 0.885 -1.285 x 0.942-1.285 mm (average 1.10 x 1.142 mm) in diameter, actetabular index 1: 1.86.

Oral diverticula double. Oesophagus with thick muscular wall 0.257 -0.514 mm (average 0.399 mm) in length. Intestinal ceca long, straight and sinous reaching up to middle of acetabulum. measuring 1.714-2.857 mm (average 2.371 mm) in length and width being 0.199-0.285 (average 0.267mm)

Testes two large, tandem,oval in shape, anterior testis measuring 0.342-0.799 x 0.399-1.142 mm(average 0.559x0.765 mm) in diameter and posterior testis measuring 0.314 - 0.571 x 0.371 - 1.228 mm (average 0.468 x 0.771 mm) in diameter. Vasa effrentia arises from anterior margin of left side of testis and open into genital sucker. Genital sucker prebifurcal and situated in region of oesophagus, just above intestinal bifurcation, genital sucker well developed and measuring 0.147-0.250 x 0.170-0.284 mm (average 0.210 x 0.218 mm). Ovary rounded median in position and situated at anterior margin of acetabulum, ovary measuring 0.113-0.428 x 0.090-0.485 mm(average 0.262 - 0.331 mm).

Table VIII : Measurement of Watsonius capri sp. nov. found in goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length of worm	5.5	4.5	3.0	4.5	3.5	5.0
Width of worm	2.5	2.0	1.5	2.0	1.5	1.9
Diameter of oral sucker	0.742 x 0.742	0.742 x 0.771	0.428 x 0.485	0.457 x 0.514	0.571 x 0.571	0.588 x 0.616
Diameter of ventral sucker.	1.257 x 1.285	1.285 x 1.285	0.885 x 0.942	1.142 x 1.228	0.942 x 0.971	1.100 x 1.142
Length of oesophagus	0.342	0.257	0.628	0.514	0.257	0.399
Length of intestinal ceca	2.857	2.571	1.714	2.571	2.142	2.371
Diameter of anterior testis	0.799 x 1.142	0.628 x 0.999	0.342 x 0.514	0.571 x 0.771	0.457 x 0.399	0.559 x 0.765
Diameter of posterior testis	0.571 x 1.228	0.485 x 0.914	0.314 x 0.485	0.571 x 0.857	0.399 x 0.371	0.468 x 0.771
Diameter of genital sucker	0.228 x 0.228	0.227 x 0.284	0.147 x 0.170	0.199 x 0.171	0.250 x 0.238	0.210 x 0.218
Diameter of ovary	0.428 x 0.485	0.428 x 0.228	0.113 x 0.284	0.228 x 0.571	0.113 x 0.090	0.262 x 0.331
Size of egg	0.125 x 0.079	0.136 x 0.079	-	0.125 x 0.068	-	0.128 x 0.075

REMARKS:

Due to double oral diverticula and absence of appendage associated with acetabulum the present form falls in sub family Pseudodiscinae of family Paramphistomidae. Pseudodiscinae contain only three genera,namely Pseudodiscus. Hawkesius and Watsonius. The present form agree with Watsonius in having shorter ceca with genital pore prebifurcal, with testes tandem and Oesophagus with muscular thickening. However, presently, we have described it as new species after review of literature.

Watsonius capri was found in the stomach region of a goat. Species of genus Watsonius stiles and Goldberger, 1910 have been reported from monkey and man from Africa. So it is important from zoonotic point of view as the first case was reported from negro as Amphistoma watsoni by Conyngham (1904). Large number of trematodes were recovered from the person who died of starvation and diarrhoea.

In the present study only one goat, was infected with this parasite out of 202 goats examined. It was found in rumen, incidence of infection was 0.99 and worm load was six. Siddiqi and Ashraf (1980) tentatively indentified it as Watsonius sp. The same host in their study harboured Cotylophoron ovatum and an unidentified species of Cotylophoron with a single testis which they considered probably was an immature form of C. ovatum.

The present collection and the specimen from Previous collection of Siddiqi and Ashraf (1980) showed presence of genital sucker and oral diverticula.

According to Yamaguti (1958) family Paramphistomatidae is divided into 11 sub families, namely Gastrodiscinae, Gastrothylacianae, Johnsonitrematinae, Sclenorchiinae, Brumptiinae, Stephanopharyngiae and

Paramphistominae. The specimens in the present collection resemble closely with Sub family Pseudodiscinae, except for the presence of genital sucker which is mentioned to be absent in the sub-family diagnosis as given by Yamaguti (1958).

In sub-family Paramphistominae genital atrium is said to be some times very large, muscular, may or may not be forming a genital sucker, but there is no oral diverticula in Paramphistomatinae.

Amongst Paramphistominae Yamaguti (1958) recognised two new tribes, namely Paramphistomini and Ceylonocotylini. In Ceylonocotylini the acetabulum is huge structure as compared with the oral sucker.

The acetabular index of eight genera included in Ceylonocotylinae ranges from 1: 1.6 in Paramphistomoides to 1: 9.67 in Macropharynx.

Ceylonocolyte is reported from bovine host, Bruifrons, Gigantatrium, Glytamphistoma, Macropharynx, Nilocotyle and Platyamphistoma from Hippopotamus, Pseudoparamphistoma cuonum has been reported from stomach and intestine of wild dog from India. The acetabular index of Paramphistomoides which is a genus erected by Yamaguti (1958) to accomodate P. maplestonei (Bhalerao, 1937) n.com. comes closer to the flukes in our collection. It was originally recovered from Hyelapus porcinus. In this genus there is no oral diverticula nor genital sucker and it is found in ungulates.

Tribe paramphistomini includes genera Ugandocolyte, Celicophoron, Cotylophoron and Paramphistomum. Ugandocotyle has been reported from Hippopotamus with an acetabular index 1: 3.8 and is without genital sucker and oral diverticula.

Calicophoron also has rather larger acetabular index 1: 3.0-3.4 and genital papilla is surrounded by discoid muscular calyx.

All the species of this genus have been reported from bovine hosts. Cotylophoron has an acetabular index of 1: 2.7-4.9. We have specimen Cotylophoron ovatum collected from ovine and caprine host, but also differ in the absence of oral diverticula, though the genital sucker is present.

In Paramphistomum two sub-genera have been recognised Paramphistomum with an acetabular index of 1: 1.5-2.6 and Explanatum with acetabular index of 1: 3.6-7.6. If acetabular index is taken as a sole criterion our specimen resembles sub-genus Paramphistomum. But genus Paramphistomum lacks a true genital sucker and oral diverticula. In two surveys (Present survey and Marwat's survey) we have found P. E.explantum from sheep and goat which conforms to the description as given in literature.

Summing up the review we may draw some conculusions. Amongst the subfamilies of Paramphistomitidae beside Pseudodiscinae, Brumptiniae has oral diverticula as well as genital sucker in Chiostichorchis, Stichorchis and Cladorchis, Stichorchis has a cirrus pouch and genital sucker bifurcal, both condition lacking in our specimen. Stichorchis also has a cirrus pouch. Cladorchis has been reported from Tapir from Brazil. In the second tribe of Cladorchiinae the oesophagus is divided into anterior muscular and posterior glandular portion. In Gastrodiscinae the body is divided into two portions, though it also posses oral diverticula, but genital pore is also without genital sucker.

Gastrothylacinae is with ventral pouch. We have found Gastrothylax crumenifer from caprine and ovine host and the specimens under discussion are different considerably from them.

In Solenorchinae the body is more or less fusiform with lip-like terminal lobe, the presence of oral diverticula is doubtful, it is not mentioned in type genus (Yamaguti, 1958). There is no mention of genital

sucker, while cirrus pouch may be present or absent. Moreover, they are parasites of marine mammals.

In Slephanopharynginae the oral diverticula is unpaired. Genital atrium may be muscular, but no proper genital sucker is mentioned in the diagnosis of sub family.

Lastly, Zygocotylinae (Zygocotyle lunata) has been found from sheep This subfamily has representative in birds and has been seldom reported from mammals. Acetabulum has caudal overhanging. Oral sucker with small posterior diverticula, but there is no genital sucker.

In acetabular index the present material comes closer to Cotylophoron ovatum. However, it differ from the later in average body size, oral sucker being subterminal, limbs of intestinal fork are right to the oesophagus. The ceca are long, zigzag in appearance and does not extend into the acetabulum as in the case of present material. The genital sucker is post-bifurcal, while in the present material it is prebifurcal.

The present material resemble with genus Watsonius except the presence of genital sucker and the difference of host. Three species of the genus reported from Yamaguti are W. watsoni in jejunum and doudenum of man and monkey, W. deschiensi from Papio Sphnix and W. macaci in Caecum of Macacus cynomolgus in Japan.

The present specimenshave been recovered from the rumen of goat in the present survey as well as previously by Siddiqi and Ashraf (1980). This means that the species of Watsonius described are not restricted to one organ.

It also shows resemblance to the subgenus Explanatum of genus Paramphistomum in acetabular index, but in genus Paramphistomum the genital pore is bifurcal or near it and lacks a well developed genital

sucker and oral diverticula.

If we can incorporate the presence of genital sucker in the diagnosis of genus Watsonius then the problem will be solved by describing the material in the present collection as a new species from a Caprine host. On the basis of new host record the species is named after the type host. As other species of Watsonius have been described from man, there is a possibility of finding this species from man as well, thus emphasising its zoonotic importance.

In a recent paper Sey (1984) has described a new species of Watsonius, W. papillatus based on material which was described as Amphistoma papillatus by Nasmark (1937). Neither host nor locality was given, but it was suggested that the material was collected by Odhener during Swedish-Sudan expedition of 1900-1901.

Sey (loc cit.) considered that subfamily Watsoniinae should include four genera, namely Watsonius, Homalogaster, Gastrodiacoides and Skrjabinocladorchis. The last three genera are monotypic comprising of H. paloniae G. homonis and S. judilaricim. According to the arrangement given by Yamaguti (1958) Homologaster and Gastrodiscoides was included in sub family Gastrodiscinae and Skrjabino cladorchis seem to be a new nomeclature for Cladorchis which was included in Cladorchiinae.

Genus Watsonius according to Sey's account contain five species Watsonius watsoni, W. noci N. Comb. (Chiochis noci,), W. macaci, W. deschiense and W. papillatus.

We did not have access to the full paper till the writing of this account, still, we consider our observation as valid regarding the new species, however its placement into subfamily may rest with the availability of full account of Sey's paper (Loc cit).

In previous account by Yamaguti (1958) three species mentioned in genus are Watsonius watsoni (Conyngham, 1904) stiles et Goldberger, 1910 W. deschiensi Pick, 1951 and W. macaci all these are from primate. The fourth species is W. noci Barios, 1908 which is also from a primate host. The host and locality of W. papillatus, which has been described as new species is not known to us. As it seems that the description is based on Odhener's material for which host and locality is not known. Therefore one may conclude that the description of our material as a new species is valid.

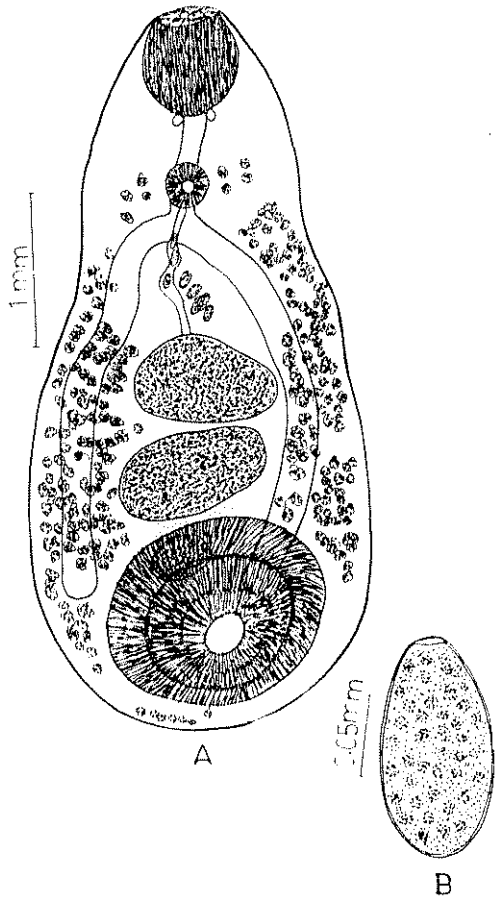


Fig. 6. Watsonius capri sp. nov.

A - entire

B - egg.

Cestoda:

Family : Anoplocephalidae Cholodkovsky, 1902

Sub family : Anoplocephalinae Blanchard, 1891

Genus : Moniezia Blanchard, 1891

Sub genus : Blanchariezia Skrjabin and Schulz(1937)

Moniezia (B) benedeni Moniez (1979)

Syn : M. conjugens Sauter, 1917;

M. crassicollis Sauter, 1917;

M. latiforns Sauter, 1917

M. neumanni Moniez, 1891;

M. Parva Sauter, 1917

M. pelluicida Blei 1922;

M. planissima stiles et Hassal 1893;

M. P. Var lobata Sauter 1917;

M. translucida jankins, 1923;

M. triagularis Morotal, 1912.

(Fig. 7)

Host : Sheep and goats

Location : Small intestine

Locality : Peshawar.

Description : Worm measuring 50-411 cm (average 168.60 cm) in length, strobila consists of very large number of segments, posterior ones being fleshy and having thickness of about 2mm, genital pore situated in anterior quarter of segment. Scolex large and compact, diameter being 0.43-0.86 x 0.63-1.71 mm (average 0.61 x 1.03 mm). Suckers fairly large having diameter 0.26-0.40 x 0.26-0.34 mm (average 0.33 x 0.31 mm). Segments crespedote,mature segments measuring 0.29-0.77 mm (average 0.45 mm) in length and width being 1.77-3.89 mm (average 2.54 mm), gravid segment measuring 0.34-1.43 mm (average 0.384 mm) in length and width

Table IX : Measurements of Moniezia (B) benedeni (Moniez, 1879) found in sheep and goats from Peshawar (in mm).

Length of worm	105	411	207	70	50	168.60
Diameter of scolex	0.66 x 1.71	0.51 x 0.86	0.86 x 1.00	0.57 x 0.94	0.43 x 0.63	0.61 x 1.03
Diameter of suckers.	0.34 x 0.34	0.34 x 0.34	0.40 x 0.29	0.29 x 0.34	0.26 x 0.26	0.33 x 0.31
Length and width of mature segments	L.0.77 W.1.77	L.0.46 W.2.17	L.0.29 W.3.86	L.0.31 W.3.49	L.0.43 W.1.43	L.0.45 W.2.54
Length and width of gravid segments.	L.1.00 W.3.00	L.1.06 W.3.86	L.0.34 W.7.14	L.1.43 W.4.71	L.0.34 W.2.86	L.0.834 W.4.31
Diameter of internal excretory canal.	0.11	0.11	0.05	0.09	0.05	0.41
Diameter of external excretory canal.	0.06	0.09	0.05	0.06	0.05	0.06
Diameter of testes	0.06 x 0.06	0.05 x 0.05	0.05 x 0.05	0.07 x 0.07	0.03 x 0.03	0.05 x 0.05
Length of cirrus	0.17	0.17	0.17	-	-	0.17
Length of cirrus pouch	0.28	0.18	0.18	0.18	0.14	0.19
Diameter of ovary	0.11 x 0.17	0.18 x 0.26	0.18 x 0.11	0.18 x 0.34	0.14 x 0.34	0.13 x 0.24
Size of vitelline gland.	0.06 x 0.06	0.08 x 0.06	0.06 x 0.06	0.06 x 0.06	0.09 x 0.09	0.07 x 0.07

being 2.86-7.14 mm (average 4.31 mm). Interproglottid glands linear in shape, varying in size and lying close to the posterior margin of segments.

Excretory system consists of two longitudinal vessels, internal excretory vessel measuring 0.05-0.11 mm and external excretory vessel being 0.05-0.09 mm.

Double set of gentalia per segment. Testes numerous in number lying in central field, but in young segments in form of two triangles, testis having a diameter of 0.03-0.07 x 0.03-0.07 mm (average 0.05 x 0.05 mm). Cirrus pouch measuring 0.14-0.28 mm (average 0.19 mm) in length, average length of cirrus 0.17 mm. Sperm duct convoluted. Ovary rosette-shaped measuring 0.11-0.18 x 0.11-0.34 mm (average 0.13 x 0.24 mm). Vitelline glands measuring 0.06-0.09 x 0.06-0.09 mm (average 0.07 x 0.07 mm) in diameter.

Moniezia expansa (Rud., 1805)

Syn: M. oblangicens stiles et Hassal, 1893

M. minima Marotel, 1912;

M. nullicollis Moniez, 1891

(Fig. 8)

Host : Sheep and goats

Location : Small intestine

Locality : Peshawar

Description : Worm measuring 80-410 cm (average 159.80 cm) in length. Scolex ball-shaped and measuring 0.25-0.57 x 0.40 - 0.71 mm (average 0.39 x 0.48 mm.) Sucker, having an average diameter of 0.20 x 0.19 mm. Segments crespedote, mature segment measuring 0.28-1.71 mm (average 0.80 mm) in length and width being 4.00 - 6.34 mm (average 5.24 mm), segments always broader than long, interproglottid glands present at

Table X : Measurements of Moniezia expansa (Rud., 1805), found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length of worm*	410	159	230	100	80	159.80
Diameter of scolex	0.43 x 0.71	0.25 x 0.45	0.28 x 0.40	0.43 x 0.43	0.57 x 0.40	0.39 x 0.48
Diameter of sucker	0.20 x 0.28	0.18 x 0.17	0.18 x 0.15	0.23 x 0.14	0.23 x 0.23	0.20 x 0.19
Length and width of mature segments	L.0.28 W.5.29	L.0.54 W.4.00	L.0.71 W.5.29	L.0.77 W.5.29	L.1.71 W.6.34	L.0.80 W.5.24
Length and width of gravid segments.	L.1.43 W.7.14	L.1.17 W.8.14	L.1.43 W.6.86	L.1.63 W.4.94	L.1.57 W.9.43	L.1.45 W.7.30
Diameter of ventral excretory canal	0.05	0.09	0.05	0.02	0.14	0.07
Diameter of testes	0.09 x 0.09	0.11 x 0.11	0.11 x 0.11	0.11 x 0.11	0.11 x 0.11	0.11 x 0.11
Size of cirrus pouch	0.14 x 0.29	0.29 x 0.23	0.29 x 0.20	0.63 x 0.49	0.29 x 0.74	0.33 x 0.39
Diameter of ovary	0.07 x 0.09	0.20 x 0.11	0.20 x 0.34	0.26 x 0.49	0.57 x 0.74	0.26 x 0.35
Size of Vitalline gland	0.06 x 0.05	0.11 x 0.11	0.71 x 0.14	0.14 x 0.17	0.23 x 0.14	0.25 x 0.12

* in Cm

the posterior margin of segment, number in each segments varies from 7-20, and occasionally segments may be found without interproglottid glands.

Excretory system consists of two pairs of longitudinal vessels, dorsal excretory vessel having an average diameter of 0.05 mm.

Genital pore double in each segments and situated slightly anterior to middle of lateral margin of segment. Cirrus pouch fusiform in length and diameter being 0.20-0.74 mm (average 0.39 mm).

Testes numerous, occupying about posterior two third of each segment between excretory vessels, extending in front to the level of anterior margin of ovary, each testis measuring 0.09-0.11 x 0.09 - 0.11 mm (average 0.11 x 0.11 mm). Ovary bilobed, situated anterior to middle of segment close to excretory vessel. Each lobe prominent and Fan-shaped, diameter of ovary 0.07-0.57 x 0.09-0.74 mm (average 0.26 x 0.35 mm). Vitalline gland immediately behind ovary diameter being 0.06-0.71 x 0.05-0.17 mm (average 0.25 x 0.12 mm).

REMARKS:

We owe to Spasskii (1951) for the revision of genus Moniezia. Though, since this publication few more papers have appeared on the subject, but still we consider this classical work to be valid upto date. According to him genus Moniezia was established by Blanchard (1891) in which he included all cestodes from herbivors with a double genital apparatus. Twelve species were reported from ruminants namely: Moniezia expansa (Rudolphi 1810) M. alba (Perroncito, 1878) M. benedeni (Moniez 1879) M. neumenni (Moniez, 1891) M. denticulata (Rudolphi, 1810) and M. ovilla (Rivolta, 1878). After a thorough review of literature he came to the conclusion that M. expansa and M. benedeni are the only valid species

within genus Moniezia.

Yamaguti (1959) recognised three subgenera: Moniezia, Blanchariezia and Baeriezia following Skrjabin and Schulz (1937) and six species namely M. expansa, M. benedeni, M. denticulata, M. pallida, M. rugosa and M. trigonophora. He also mentioned a number of uncertain species. The species which are considered valid namely M. expansa and M. benedeni have been considered universal parasites of sheep and goats. M. denticulata has been reported from sheep only. Saxena and Deo (1964) have provided detailed description of M. denticulata and reaffirmed that M. denticulata is a valid species found in sheep of India.

Southwell (1930) recognised only two species in genus Moniezia: M. expansa and M. benedeni. The former was reported from sheep and goats of India and the later was reported from sheep from Lahore.

On the basis of presence or absence of interproglottid glands and their structure, species of genus Moniezia found in our collection from sheep and goats are Moniezia expansa and M. benedeni. In M. expansa the interproglottid glands are saccular and rounded. The number in each segment varies from 12 to 28 and occasionally segments may be present in which they are entirely absent. Southwell (1930), Bhalerao (1935) described the number of interproglottid glands in the range of 12-30. The second species recovered from small intestine of sheep and goats is Moniezia benedeni, in which the interproglattid gland is a narrow linear structure of varying size lying close to the posterior margin of the segments. The interproglottid glands do not extend upto the lateral margin of the proglottids and are present in a row along the interproglottidal region. It is difficult to determine their exact location. However, they seem to be present on the posterior margin of each proglottid. In

case of Moniezia expansa these are grouped in rosettes around a blind sac.

Singh and Singh (1958) studied the morphology and histochemistry of interporglottidal glands in M. expansa and their description of morphological structure and location of these interproglottid glands is similar to the specimen identified in our collection.

According to Saxena and Deo (1964) Yamaguti (1942) while describing the morphology of M. expansa stated that interproglottidal band of gland cells is confined to the median field, except in posterior proglottids it reaches the field of shell gland tending to be interrupted laterally. It consists of dense mass of large rounded vesicular cells with likewise vesicular nuclei, 4-5 microns in diameter, Varma (1956) mentioned the arrangement of interproglottid glands in the median field of the mature segments of M. expansa.

However, Saxena and Deo (1964) found that interproglottid glands in the species are always present in the immature, mature and gravid segments. In all segments they are saccular, about 12-30 in number, consisting of dense-mass of large rounded vesicular cells, with vesicular nuclei, 4-5 microns in diameter and are arranged in a line along the posterior border of the proglottids.

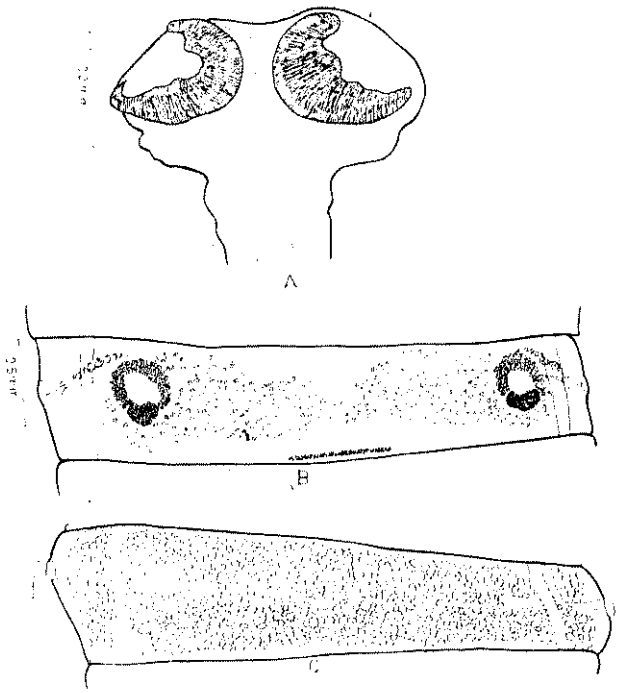


Fig. 7. Moniezia (B) benedeni

A - Scolex

B - Mature proglottid

C - Gravid proglottid.

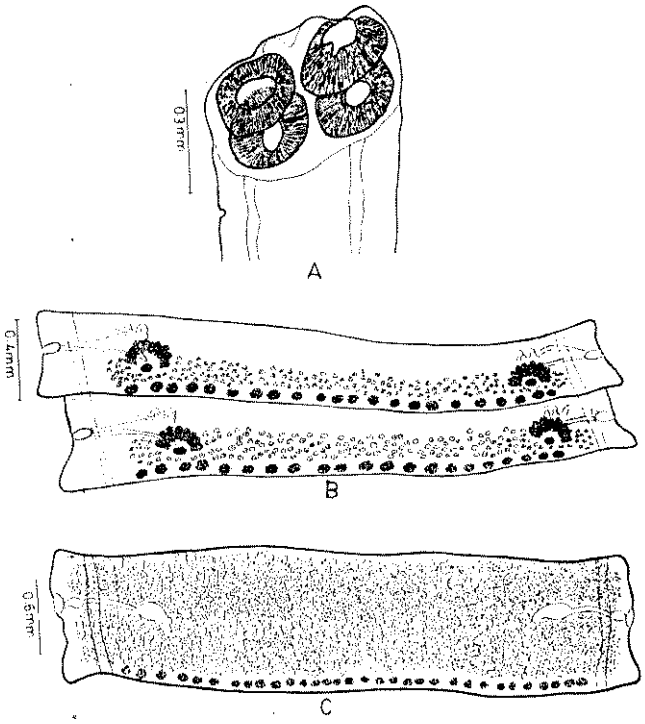


Fig. 8. Moniezia expansa

A - Scolex

B - Muture proglottid

C - Gravid proglottid.

Sub family : Thysanosomatinae Skrjabin, 1933, for

Syn. Thysanosominae Fuhrm., 1907

Genus: Avitellina Gough, 1911

Syn. Hexastichorchis Blei, 1922

Avitellina centripunctata (Rivolata, 1874)

Syn. A. laciniosa Blei; Haxastichorchis pintnari Blei, 1922

(Fig. 9)

Host : Sheep and goats

Location : Small intestine

Locality : Peshawar

Description : Worm large, narrow and long, strobila measuring 49-123 cm (average 78.6 cm) in length, Scolex rounded, diameter being 0.57-1.20 x 1.03-1.46 mm (average 0.99 x 1.29 mm), carrying four powerful suckers, 0.66-0.91 x 0.51-0.71 mm (average 0.73 x 0.64 mm) in diameter. Neck long,followed by young segment being 0.06-0.11 mm in length (average 0.09 mm) and 0.91-2.18 mm (average 1.47mm) in width. Gravid segments measuring 0.14-0.31 (average 0.26 mm) and 0.40-0.93 mm (average 0.73 mm) in length.

Body covered with thin cuticle. Segmentation indistinct anteriorly, external segmentation absent in first proglottids of strobila, internal segmentation not clearly marked in region with developed genital glands, number of segments may be determined from number of cirrus pouches and/ or uteri.

Excretory system consists of two pairs of longitudinal vessels, well developed throughout the strobila, ventral having average diameter of 0.06 mm (0.03-0.09 mm), dorsal vessel extend internally to the ventral ones and measuring 0.02-0.07 mm (0.04 mm average) in

diameter. Lateral longitudinal nerve passes between the margin of strobila and ventral excretory canals.

Genital apertures alternate irregularly, genital ducts extend dorsally to excretory vessels and nerve. Male genitalia consist of four longitudinal columns of testes arranged one on each side of excretory canals. Testes spherical, fully mature testes measuring 0.05-0.06 x 0.05-0.06 mm (average 0.06 x 0.06 mm), testes not extending laterally beyond nerve. Internal column of testes two to four, testes deep and extends from internal wall of excretory canal to region of ovary. Testes of external row almost always lie in a single column. Vasa afferentia arise from aporal group of testes joining poral group of testes and form sperm ducts. After crossing ventral vessels sperm duct form convolutions and transform into a long narrow cirrus canal. Cirrus pouch a thin-walled elongated sac of a cylindrical shape and having a length of 0.11-0.17 mm (average 0.14 mm) and never extend till ventral to excretory canal.

Female genitalia consist of ovaries, ovary single in each segment and situated internally to both excretory vessels on poral side not far from middle of segment; ovary measuring 0.02-0.05 mm (average 0.03 x 0.03 mm),in diameter an oviduct emerges out from ovary which bifurcates into two ducts, internal being uterus and external one enlarging into an oval sac-receptaculum seminis; vagina thin walled; situated posteriorly to cirrus sac; uterus single in each segment and arises in mid longitudinal line and quickly replaced by paruterine organ, a fibrous lining lies closely against anterior surface of paruterine organ in form of a round half cap. Mature paruterine organ consists of an ovate pear-shaped body composed of fibrous tissue which contain eggs capsule.

Table XI : Measurements of Avitellina centripunctata (Rivolta, 1874) found in sheep and goats from Peshawar (in mm).

Length of worm	123 cm	90 cm	78 cm	49 cm	49 cm	78.6 cm
Diameter of scolex.	0.86 x 1.09	0.57 x 1.43	0.94 x 1.46	1.37 x 1.43	1.20 x 1.03	0.99 x 1.29
Diameter of sucker.	0.66 x 0.51	0.66 x 0.71	0.91 x 0.71	0.69 x 0.69	0.71 x 0.57	0.73 x 0.64
Length and width of mature segment	L.0.06 W.0.091	L.0.07 W.1.36	L.0.11 W.2.18	L.0.11 W.1.93	L.0.08 W.0.97	L.0.09 W.1.47
Length and width of gravid segment	L.0.26 W.0.91	L.0.31 W.0.40	L.0.28 W.0.51	L.0.31 W.0.91	L.0.14 W.0.93	L.0.26 W.0.73
Diameter of dorsal excretory canal.	0.02	0.02	0.02	0.07	0.06	0.04
Diameter of ventral excretory canal.	0.05	0.05	0.09	0.03	0.06	0.06
Diameter of testes.	0.06 x 0.06	0.05 x 0.06	0.06 x 0.06	0.06 x 0.06	0.05 x 0.05	0.06 x 0.06
Length of cirrus pouch	0.11	0.17	0.17	0.15	0.11	0.14
Diameter of ovary	0.02 x 0.02	0.02 x 0.02	0.03 x 0.03	0.02 x 0.02	0.05 x 0.05	0.03 x 0.03

REMARKS:

Spassakii (1952) in a treatise on anoplocephalate tapeworms of domestic and wild animals critically evaluated the information available on genus Avitellina. The details of his discussion are left out for the sake of brevity, however salient features relevant to our work are being summarised:

After reconstitution of the genus Avitellina in the light of his studies and those of other workers he recognised the following species to be valid: A. recardi, A. monardi, A. pygargi, A. chalmersi, A. edifrontaineus, A. sandgroundi, A. aegyptica, A. goughi, A. tatia, A. arctica, A. centripunctata. Out of these A. centripunctata, A. chalmersi, A. goughi, A. tatia are found in sheep and goat and have been reported from India.

Yamaguti (1959) considered the following species to be valid: A. centripunctata, A. aegyptica, A. arctica, A. bigemina A. bulbalinae, A. chalmersi, A. goughi, A. lahorea, A. nagatyi, A. sandgroundi, A. southwelli, A. spirillometra, A. sudanea, var. punjabensis, A. tatia and A. woodlandi. He considered A. goughi, A. lahorea, A. sandgroundi, A. southwelli, A. sudanea as synonym of A. woodlandi and in this way only seven valid species are left, out of which A. bigemina, A. chalmersi, A. centripunctata, A. spirillometra, A tatia, and A. woodlandi, have been found in sheep and goat in India.

Yamaguti (loc cit.) mentioned A. bigemina Amin, 1939 A. spirillometra Amin, 1939, A. sudanea Amin var. punjabensis from ovine of Punjab. However, workers like Spassakii (1951) did not even refer to these species. Whether Spassakii did not consider it worthy of repporting or was not aware of publication could not be ascertained.

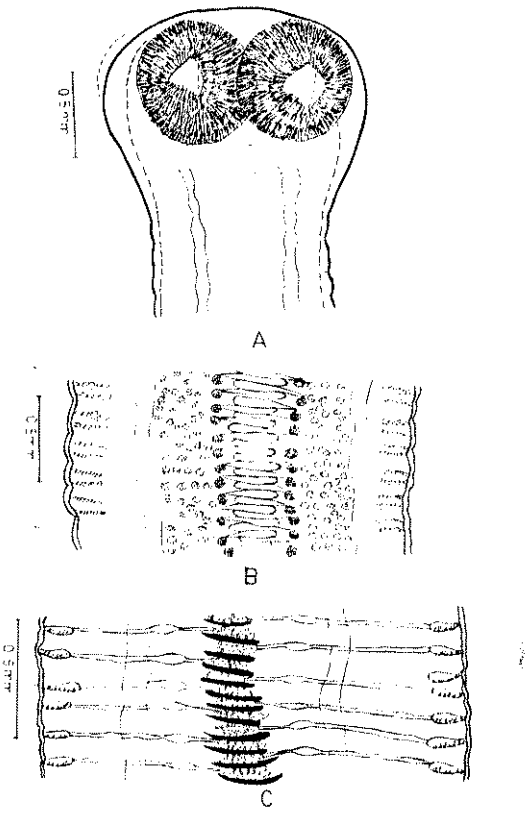


Fig. 9. Avitellina centripunctata

A - Scolex

B - Mature proglottid

C - Gravid proglottid.

Genus : Stilesia Railliet, 1893

Stilesia vittata Railliet, 1896

(Fig. 10)

Host : Sheep and goats

Location : Small intestine

Locality : Peshawar

Description: Worm white in appearence, small in size, narrow and very much coiled in counter clockwise direction. Body covered with very thin cuticle. Strobila measuring from 45 mm - 90 mm (average 56.5 mm) and of uneven thickness, thin and elongated along central lines. Scolex, rounded and measuring 0.34-0.57 mm x 0.41-0.68 mm in diameter (Average 0.43 x 0.50 mm). Neck measuring 0.08-0.17 mm in length (average 0.11 mm), mature proglottids measuring 0.06-0.15 mm in length and 0.42-0.62 mm in width.

Excretory system consists of two pairs of longitudinal trunks, dorsal excretory canal having diameter of 0.01 mm and ventral excretory canal having a diameter of 0.02-0.03 mm.

Genital apparatus single in each segment. Genital aperature alternate irregularly lying in anterior half of lateral margin of proglottids. Ovaries two in number in each mature proglottid. Ovary small rounded and each ovary situated in between two excretory vessels lateral to each segments, diameter of ovary being 0.02-0.05 x 0.02-0.05 mm (average 0.03 x 0.03 mm); vagina fusiform; uterus at first long transverse dumbbell-shaped tube and posteriorly replaced by two paruterine organ, its medial end more often bent anteriorly and covered by fibrous cap; paruterine organ thickwalled paruterine organs become rounded in gravid proglotid. Each paruterine organ containing about 10 eggs; eggs oval with two sharp conical append-

ages on poles which turn into filament.

Testes rounded and oval in shape situated in lateral field, external to ventral excretory vessel. Testes arranged in two rows, about seven testes in each row, diameter of each testis being 0.01-0.03 x 0.01-0.05 mm (average 0.02 x 0.03 mm), sperm duct convoluted and lies between excretory vessel. Cirrus pouch thin-walled, oval in shape and measuring 0.08-0.10 (average 0.09 mm) in length; cirrus armed and having an average length of 0.08 mm.

REMARKS:

Spasskii (1951) considered Stilesia as genus of Avitellininae on the basis of number of Paruterine organ, there is only one paruterine organ in genus Avitellina, while in genus Stilesia parutarine organs are two.

According to Spasskii (loc cit.) genus Stilesia was established by Railliet (1893) with type species Taenia globipunctata Rivolta, 1874 (Synonym T. ovipunctata, Rivolta 1874). Another species was then included in this genus Taenia centripunctata Rivolta 1874. In 1896 Rivolta included another new species in the genus, Stilesia vittata, Railliet 1896 from the intestine of a camel. In 1903 Wollfhuegel and in 1909 Fuhramann added Stilesia hepatica, Wollfhuegel 1903, S. sjostedti, Fuhrmann 1909 to the list. Later Gough (1911) transferred Taenia centripunctata to the genus Avitellina, amended the generic diagnosis of Stilesia and recognized S. sjostedti, Fuhrmann 1909 as a synonym of S. hepatica, Wollfhuegel 1903. He also provided detailed description of the remaining three species of Stilesia recognised as valid uptil today. However, the species distinctiveness of S. vittata Railliet 1896 raises doubts as the author of the species himself suspect that S. vittata may be only a veriety of S. globipunctata,

Table XII : Measurements of Stilesia vittata Railliet, 1896 found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average:
Length of worm	53	45	80	60	90	56.5
Diameter of scolex	0.36 x 0.42	0.34 x 0.52	0.40 x 0.41	0.57 x 0.68	0.49 x 0.45	0.43 x 0.50
Diameter of suckers	0.17 x 0.17	0.17 x 0.17	0.18 x 0.17	0.35 x 0.28	0.34 x 0.23	0.24 x 0.20
Length of neck	0.09	0.11	0.17	0.08	0.11	0.10
Length and width of mature proglottids.	L.0.06 W.0.53	0.07 0.48	0.09 0.49	0.15 0.42	0.11 0.62	0.10 0.51
Diameter of ventral excretory canal.	0.02	0.02	0.02	0.02	0.03	0.02
Diameter of dorsal excretory canal.	0.01	0.01	0.01	0.01	0.01	0.01
Length of cirrus pouch	0.08	0.10	0.08	0.09	0.09	0.09
Length of cirrus	0.08	0.08	0.08	0.09	0.08	0.08
Diameter of testes	0.01 x 0.01	0.02 x 0.02	0.01 x 0.03	0.02 x 0.02	0.03 x 0.05	0.02 x 0.03
Diameter of ovary	0.02 x 0.02	0.02 x 0.02	0.03 x 0.03	0.02 x 0.02	0.05 x 0.05	0.03 x 0.03

Rivolta 1874. The only distinguishing feature of S. vittata according to Gough (1911) is the lesser number of convolutions of sperm ducts which wind loosely, where as in S. globipunctata they form a dense loop. A comparision of natural material has shown that in S. globipunctata the duct does in fact form a dense bundle of convolutions where as in the majority of segments of S. vittata the convolutions of sperm ducts are less numerour and extend loosely. However, in many segments of S. globipunctata from camel the same type of bundle was observed. Spasskii (loc cit.) further mentioned that in anoplocephalids and avitellinids this feature may vary in accordance with the degree of maturity of the proglottids and the condition of the strobilar musculature. It is possible that the camel is a facultative host of S. globipunctata, in organs of which the genital organs of this parasite are unable to attain normal development and that S. vittata is identical with S. globipunctata. Indian scientists like Pande (1942) and Mudalier (1942-1943) noted that S. vittata occurred in sheep and goats.

Leiper (1935) described a new species Stilesia okapi from the Okapi (family Giraffidae). Thus genus Stilesia today contains four species of which one S. vittata is considered by some authors doubtful; Stilesia globipunctata (Rivolta 1874) Railliet 1893. Stilesia okapi Leiper 1935, Stilesia hepatica, Wöllfhuegel, 1903 and Stilesia vittata Railliet 1896.

If one considers the convolutions of the sperm duct of the two closely related species that is S. vittata and S. globipunctata our material is S. vittata as the specimens have been thoroughly examined from a number of hosts. The convolutions were always loose and not compact as in S. globipunctata as observed by Spasskii (loc cit.) as shown in table XIV.

We have tabulated diagnostic and other characters for S. vittata from our material and S. vittata from sheep, goat, cattle and antelope by different authors (Table XIII). At a glance one can find that it is not very helpful in either separating S. globipunctata from S. vittata or establishing the validity of S. vittata due to uniformity of observation by various authors.

Summing up we have taken the position that the material under study from the present collection is S. vittata due to its previous report from the subcontinent in sheep and goat and due to loose convolution of sperm duct.

According to Yamaguti (1959) there are three species in the genus Stilesia, S. hepatica Wollfhuegel 1903, S. okapi Leiper, 1936 and S. vitatta Railliet 1896, in Camelus dromedarius, C. bactrianus; from Africa and also in cattle sheep and goat of India.

Table XIII: A comparison of diagnostic features of Stilesia vittata Railliet 1896 by different authors.

S.No:	Subject	Observations South well (1930)	Observations Bhalerao (1935)	Observations Gough(1911)	Observations Gupta and Singla (1972)	Observations Siddiqi and Ashraf(1981)	Our observations (1989)
	HOST:	SHEEP	CAMEL,SHEEP, GOAT.	DROMEDARY	GOATS.	GOATS	SHEEP, GOATS
1.	Length of worm	230 mm	180-280 mm	18-23 cm	100-250 mm	83-150 mm	45-90 mm
2.	Diameter of scolex	Not given	0.54-0.60 mm	0.5-0.8 mm	0.7-0.9 x 1-1.2 mm	0.50-0.86	0.43 x 0.50mm
3.	Size of neck	Not given	Not given	2.0 mm	2.00 x0.49mm	Not given	0.08-0.17 mm
4.	Number of testes	7 on each side	5 - 7	5-9 testes	5-7 testes	4 testes in each row	4-7 testes in each row.
5.	Size of testes	Not given	Not given	0.46-0.066 mm	0.043x0.043-0.045x0.046	0.043x0.70	0.02x0.03 mm
6.	Diameter of ovary	Not given	Not given	Not given	Not given	Not given	0.02-0.05 x 0.02-0.05 mm
7.	Genital pore alternate irregularly.	Same	Same	Same	Same	Same	Same
8.	Sperm duct convolution.	Close Convolution	Close convolution	Convolution not close up to 10.	Convolution not close	No mention about convolution coils.	Convolution not very close up-to 4-5 convolution.
9.	Size of cirrus pouch.	Not given	Length 0.075	0.06-0.08mm	0.089-0.095 x 0.05 mm	0.06x0.043 mm	0.08-0.09 mm.

Table XIV: Variation in general characters between Stilesia vittata and S. globipunctata.

S.No.		S. vittata In our collection (1987)	S. globipunctata According to Spasskii (1951)
	Host:	Sheep, Goats.	Sheep, Goats, Cattle, antelopes.
1.	Length of the worm	45-90 mm	600 mm
2.	Diameter of scolex	0.45 x 0.50 mm	0.5 - 0.8 mm
3.	Size of testes	0.02 x 0.03 mm	0.05 mm
4.	No. of testes	4-7 in each side	4-7 testes in each side.
5.	Length of cirrus pouch.	0.08-0.09 mm	0.06 - 0.08 mm
6.	Sperm duct convolution.	Sperm duct have less convolutions up to 4-5 convolution.	Sperm duct having more convolutions than in S. vittata.

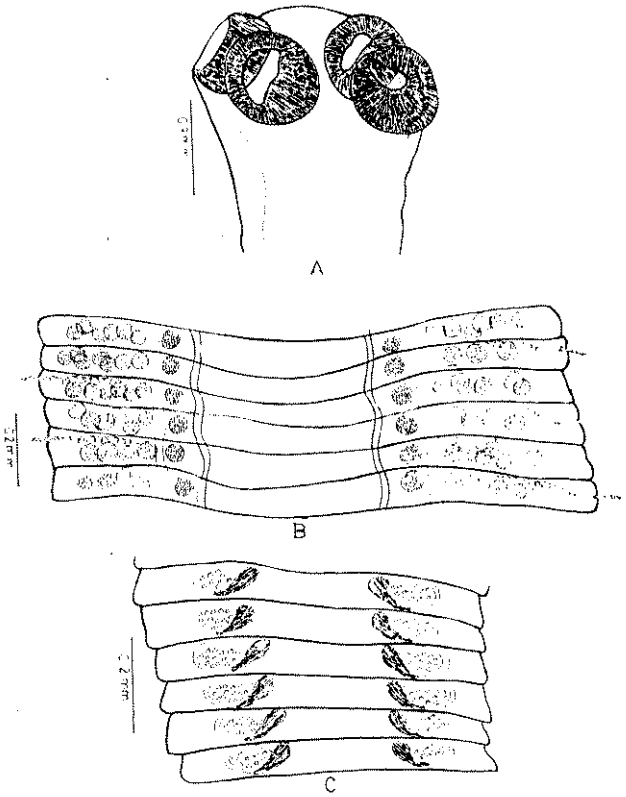


Fig. 10. Stilesia vittata

A - Scolex

B - Mature proglottid

C - Gravid proglottid

Family : Taeniidae Ludwig, 1886

Genus : Taenia Linnaeus, 1758

Syn : Acanthortrias Weinland, 1858

Alyselminthus Zeder, 1800

Cystotaenia Leuckart, 1863

Cysticercus Zeder, 1800

Finna Brera, 1809

Fishiosoma Brera, 1809

Geoziane Rud., 1810

Halysis Zeder, 1803

Hydatigena Geoze, 1782

Hydatis Maratti, 1776

Hygroma Schrank, 1803

Hydatula Abildgaard, 1790

Megocephalos Gooze, 1782

Neotenia Sodero, 1886

Physchiosoma Brera, 1809

Taeniola Pallas, 1760

Trachelocampylus Fredault, 1847

Cysticercus of Taenia Hydatigena Pallas 1766

(Fig. 11, 12)

Host : Sheep and goat

Location : Liver and abdominal cavity

Locality : Peshawar

Description of Mature bladder worm found in liver (Liver Pleura) and abdominal cavity, bladder worm half filled with a fluid and lying in a delicate cyst called external membrane formed by host tissue, size of bladder worm measuring 20-130 mm in length and 20-50 mm in diameter.

Table XV: Measurements of Cysticercus tenuicollis (bladder worm) found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average
Length of bladder worm.	130	70	20	45	110	75
Diameter of bladder worm.	40	20	15	35	50	32
Diameter of sucker	0.277 x 0.284	0.341 x 0.227	0.352 x 0.227	0.341 x 0.341	0.341 x 0.341	0.320 x 0.276
No. of hooks.	30	32	34	26	32	30.80
Length of large hooks.	0.204	0.163	0.160	0.190	0.190	0.180
Length of small hooks.	0.109	0.122	0.10	0.12	0.12	0.11

Scolex invaginated and having four suckers, armed with a double row of hooks varying from 26-32 in number. First row of hooks (large) measuring 0.160-0.204 mm (average 0.180 mm) and 2nd row of hooks (small) length varies from 0.10 mm to 0.122 mm (0.11 mm). Sucker measuring 0.277-0.352 x 0.227 - 0.341 mm (0.11 mm) in diameter.

REMARKS:

The intermediate stage of Taenia hydatigena Pallas, 1766 (Syn. T marginata) occurs normally in the peritoneal cavity of sheep, goat, cattle, pig, squirrel, hamster, dog, cat, rodents and man. The mature bladder worm may be found any where in the abdominal cavity, lying in a delicate cyst formed by the peritoneum. The vesicle contains a watery fluid and scolex invaginated in to a long neck (Soulsby, 1968).

The final hosts such as dogs, jackals and other related carnivora become infected by ingesting the cysticercus (larval stage of Taenia hydatigena Pallas, 1766).

According to Abuladze (1964) T. hydatigena was first described by Tyson (1691) from the larval stage, which he called Lumbricus hydropicus. In 1810, Rudolphi changed this designation into Cyticercus tenuicollis, which was firmly associated with larvocyst of Taenia hydatigena. In 1854 Seibold established that when Cysticercus tenuicollis is fed to dog T. hydatigena developed in its intestine. Leuckart (1855) completed the description of the life cycle of the cestode, by demonstrating that various herbivores are the intermediate stage.

Soviet researchers Efimov (1941), Seliverstov (1950) Anishchenko (1954) and Shepelov (1958) have made interesting studies on Taenia hydatigena.

As this seems to be the first report of finding C.tenucollis in

Pakistan, it is worthwhile to compare some morpho-taxonomic feature with studies elsewhere. The description of cystic stage is favourably comparable which is given by Shepelov (1958) as quoted by Abuladze (1970). The number of hooks varies from 28-40 according to Shepelov (loc cit.), while in the present study 26-34 were found. The size of hooks in the first row in the present survey were within the range as reported by Shepelov, while in the second row are slightly smaller.

The distribution of the cysticerci in various organs as observed is given in Table XVI. It can be observed that the cycts seem to have predilection for mesentry in the region of gastro-intestinal tract as compared to liver. The cysts which were found were in the liver pleura. Shepelev (1958) observed some cysts subjected to caseous suppurative degeneration and putrifaction. Such cysts, inspite of careful examination were not found.

The larval teaniod cestodes found in sheep and goat are Cysticercus ovis, C. tenuicollis, Coenurus cerebralis and hydatid cyst. In the present survey C. tenuicollis and hydatid cyst have been found. Coenurus cerebralis is found in the brain or spinal cord of sheep and goats. The brain or spinal cord was not examined in the present survey, therefore, nothing can be said about its presence in N.W.F.P. Bhalerao (1935) has mentioned the presence of Coenurus of Multiceps spp. in many domesticated animals in India.

Cysticercus ovis, though a common larval cyst of sheep and goats has not been reported from Pakistan. Bhalerao (1935) indicated that though it was not reported from India, but the presence of adult Tacnia ovis in dogs is indicative of the fact that it should be found in the larval stage in herbivore like sheep and/or goat. Cysticercus ovis has a predilection for muscles, but some may be found on wall of stomach (Bhalerao, 1935). We never found it in our survey on any mesentry. However, as examination

of muscles was beyond the scope of this survey we might have missed the opportunity of its finding. Though heart muscles and lungs liver were examined but no C. ovis were found.

Table XVI: Distribution of Cysticercus tenuicollis (larval stage of Taenia hydatigena) in various organs from 411 sheeps and *392 goats examined from N.W.F.P.*

S.No.	Organ:	SHEEP: Total Host infected	SHEEP: % infected	GOATS: Total Host infected	GOATS: % infected.
1.	Stomach	18	4.37	22	5.58
2.	Small intestinal	6	1.46	3	0.76
3.	Caecum	4	0.97	3	0.76
4.	Liver	5	1.21	9	2.28

*Liver associated with 203 sheep and 202 goats were examined. In addition extra 208 and 190 lungs and liver respectively of sheep and goat were also examined.

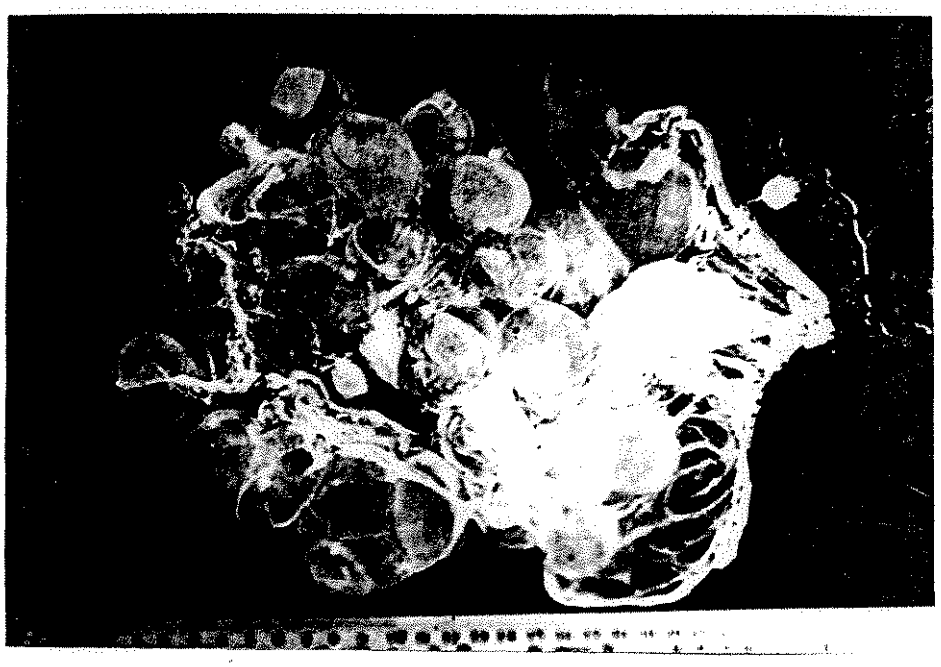


Fig. 11. Cysticercus tenuicollis

(Cysticerci in Mesentery)

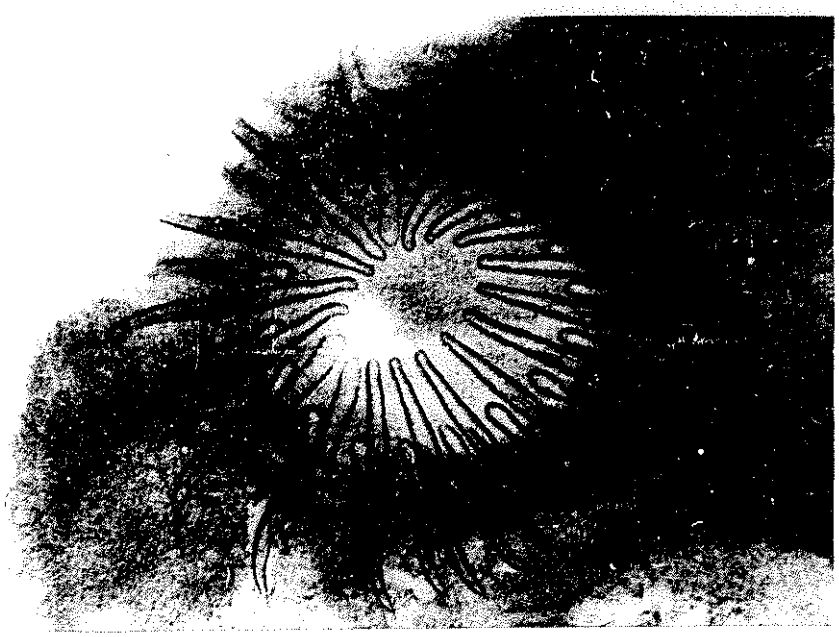


Fig. 12. Cysticercus tenuicollis

(Corona of hooks x 1000)

Genus : Echinococcus Rud., 1801

Syn : Echinococcifer Weinland, 1858

Echinococcus granulosus (Batsch, 1786)

Hydatigena granulosus Batsch, 1876

Echinococcifer echinococcus Zeder, 1803

Hydatid of Echinococcus granulosus (Batsch, 1786)

(Fig. 13, 14, 15, 16, 17 & 18)

Host : Sheep and goat

Organ: Liver, lung and spleen.

Locality : Peshawar.

Description of larval stage: Monolocular echinococcus with fluid-filled cyst, size varies from 40-100 x 30-57 mm, cyst wall consists of two layers or membranes, an external cuticular membrane and internal germinative membrane, cuticular membrane white or slightly yellowish in colour and becomes darker in older cysts.

Germinative or generative membrane lining interior of cyst cavity thin and delicate, germinative membrane produces proliferating capsules, scoleces and secondary cysts as an outgrowths; number of proliferating capsules in one cyst varies from nearly hundreds to thousands. Size of proliferating capsule varies from 0.62-1.144 x 0.45-0.74 mm, each proliferating capsule containing 9-27 embryonic scoleces or protoscoleces.

Embryonic scolex oval in shape and measuring 0.15-0.19 x 0.12 - 0.20 mm (average 0.17 x 0.15 mm) in diameter, scolex invaginated having four suckers and armed with double row of 28-35 hooks. First row of hooks large, 0.022-0.25 mm long and those of 2nd row small, 0.019-0.022 mm long, their shape not constant, shaft short and blade usually longer than shaft, embryonic scolex filled with numerous transparent formations of various shapes and size.

Table XVII: Measurement of Hydatid cyst of Echinococcus granulosus (Batsch, 1976) found in sheep and goats from Peshawar (in mm).

Size of hydatid cysts.	L. 100 x W. 70	L. 40 x W. 30	L. 90 x W. 57	L. 50 x W. 25	L. 40 x W. 35	L. 64.00 x W. 43.40
Size of Proliferating capsule.	L.0.80 x W.0.57	L.0.62 x W.0.62	L.1.144 x W.0.74	L.0.85 x W.0.45	L.0.68 x W.0.45	L.0.82 x W.0.57
Diameter of protoscolex or Embryonic scolex	L.0.15 x W.0.12	L.0.19 x W.0.20	L.0.17 x W.0.12	L.0.17 x W.0.15	L.0.15 x W.0.14	L.0.17 x W.0.15
No. of Embryonic scoleces in proliferating capsule.	18	14	9	27	22	18
No. of hooks in first row.	33	33	30	28	35	31.80
No. of hooks in 2nd row.	33	33	30	28	35	31.80
Length of large hooks.	0.023	0.024	0.023	0.025	0.022	0.23
Length of small hooks.	0.019	0.020	0.022	0.020	0.020	0.020

REMARKS:

Hydatid infection is one of those few helminthic diseases, which were known even to earlier greeks. Faust et al (1970) have provided the early history of hydatid which is reproduced below: Hippocrates, Aretaeus and Galen were clinically familiar with hydatid cysts. Hartman(1685) and Tyson (1766) were first to show similarity of hydatid in man and other mammals, Hartman (1695) and later Rudolphi (1808) first studied the adult worms in dog intestine. Von Siebold (1853) followed by a number of workers fed Scoleces of cysts from domestic animals to dogs and developed the adult worms in the intestine of dog. A number of workers in the later part of 19th century bred adult worms in dogs from scoleces of human origin.

Hydatid infection owes its importance due to its occurrence in humans as a disease of definite etiology. Considerable work has been done on human infection and many surveys have been done on dogs for adult parasites and herbivorous mammals for hydatid cyst.

According to Faust et al. (1970) the adult worms are found in dogs (optimal definitive host). There is however an impressive list of herbivorous and other mammals, which harbour the hydatid cyst. This includes sheep, cattle, pigs (considered common reservoir host by Faust et al. 1970). Naturally infected mammals include horses, camel, goats, monkeys, baboon, lemur, African elephant, orgali, antelope, moose, reindeer, caribou, elk, coast deer, white-tailed deer, bison, giraffe, cat, wild cats, panther, jaguar, leopard, squirrel, mouse, guinea pig, rabbit, arctic bear, wolf, dingo and dog.

The natural cycle may differ from one place to another, for example in northwest Canada the natural cycle involves the wolf and moose. Pack dog consume the infected viscera of moose and the dogs excreta provides

the source for human exposure (Miller, 1953 as quoted by Faust et al. 1970). In sylvatic cycle in Australia the larval host is usually the wallaby, to a lesser extent the Kangroo and rabbit, with the dingo as the definitive host.

How many valid species of Echinococcus granulosus exist have been a question debated for a very long time by many workers? Symth (1964) has presented the historical review on speciation. According to him the general conclusion was that there were two species of Echinococcus responsible for Hydatid disease: E. granulosus which matured in dogs and closely allied species, but not in foxes and utilized mainly ungulates for intermediate host and E. multilocularis which matured additionally in foxes and cats and utilised mainly microtine rodents as intermediate hosts. Symth concluded from an exhaustive survey of literature on Echinococcus that "speciation in Echinococcus is a complex matter involving perhaps at each end of a hypothetical scale well defined species with morphological, physiological and immunological characteristics clearly recognizeble as belonging to E. granulosus and E. multilocularis, between these two points are a variety of "races" "strains" or sub species" incorporating characteristics belonging to both species.

Symth (1964) has further mentioned that beside E. granulosus and E. multilocularis, ten other species of the genus have been reported in literature. These are E. oligarthrus, E. cruzi, E. felidis, E. lycaontis E. longimanubrius, E. minimus E. intermedius, E. cameroni, E. ortleppi and E. patagonicus. However, many of these species have been either not validated or may be co-specific with E. granulosus or E. multilocularis. Yamaguti (1959) has mentioned all these species except E. cruzi and E. felides, E. cruzi has been synonymised with E. oligarthrus.

Rausch and Nelson (1967) has reviewed genus Echinococcus and has

considered infra-specific catagories in the genus Echinococcus. The subject has not been cleared any further more than what Symth (1964) has concluded in his review.

Table XVIII: Distribution of Hydatid cysts of Echinococcus granulosus on various organs from 411* sheep and 392* goats examined from Peshawar*.

	(SHEEPS)			(GOATS)	
S.No	Organ:	Total Host infected.	% infected	Total Host infected.	% infected.
1.	Lungs	22	5.33	13	3.29
2.	Liver	16	3.88	27	6.85
3.	Spleen	2	0.48	1	0.25
4.	Heart	-	----	1	0.25

*Lungs, livers, spleens and heart associated with 203 sheep and 202 goats were examined. 208 and 190 extra lungs and liver of sheep and goats respectively were also examined.

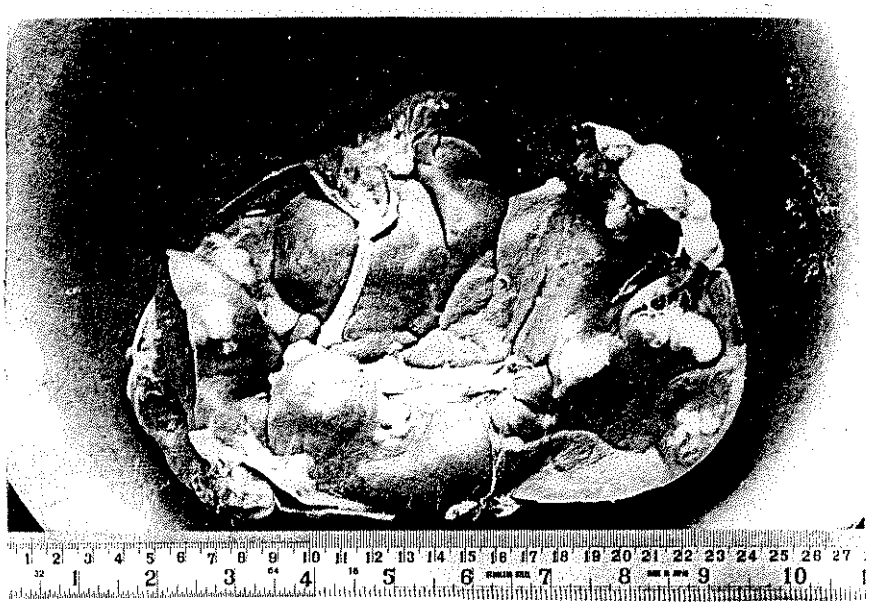


Fig. 13. Liver showing hydatid cysts of Echinococcus granulosus.



Fig. 14. Lungs showing hydatid cysts of Echinococcus granulosus.

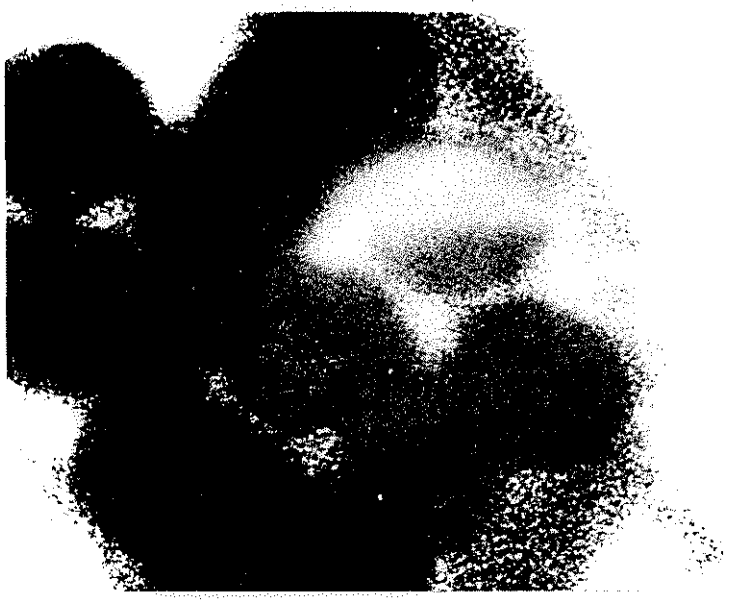


Fig. 15. Hydatid cysts of Echinococcus granulosus
(Brood capsules containing Scoleces x 400)



Fig. 16. Hydatid cysts of Echinococcus granulosus
(Scolex from brood capsule with Corona of hooksx400)



Fig. 17. Hydatid cysts of Echinococcus granulosus (Scolex with corona of hooks and suckers x 400).

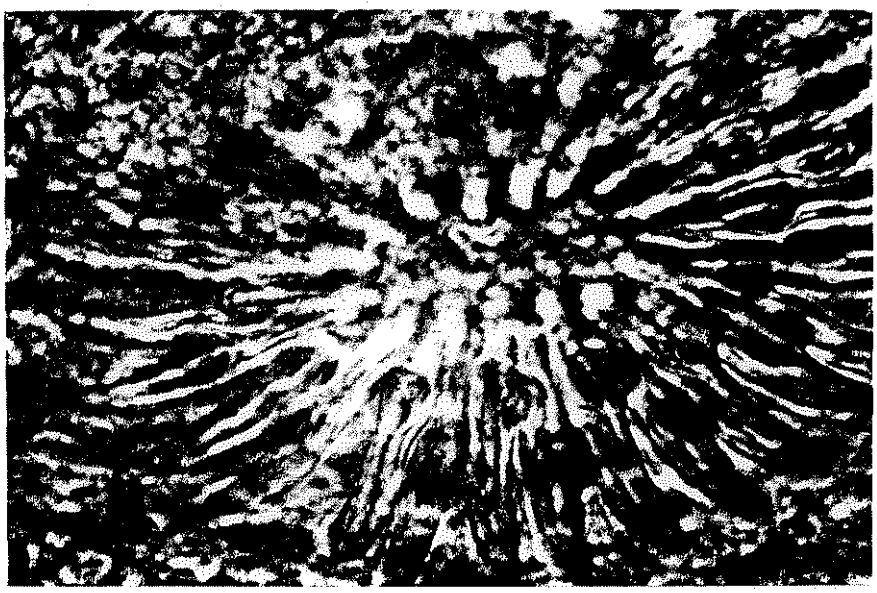


Fig. 18. Hydatid cysts of Echinococcus granulosus (Scolex with corona of hooks: a x 400, b x 1000).

Nematoda:

Family : Trichuridae Railliet, 1915

Syn : Trichocephalidae Baird, 1853

Trichosomidae Leiper, 1912

Sub family : Trichurinae Ransom, 1911

Genus : Trichuris Roederar, 1761

Syn : Trichoecephalus Schrank, 1788

Mastigodes Zeder, 1800

Trichuris globolusa (Linst, 1901)

Syn: T. echinocephalus Nitzsch, 1849

Sprehn, (1927).

(Fig. 19)

Host : Sheep and goats

Locality : Peshawar

Location : Large intestine

Description : Mouth rounded, Oesophagus runs up to thick portion, anterior part of body with lateral swellings.

Male: Anterior part of body measuring 26-40 mm in length (average 33.20 mm), posterior part of body measuring 12-16 mm in length (average 13.40 mm), width of anterior part of body 0-13-0.17 mm (average 0.14 mm) and posterior part measuring 0.47-0.96 mm (average 0.71 mm) in width. Spicule elongated, cylindrical, distal end pointed, proximal end with large swelling or expanded portion, everted portion of spicule covered with hyaline cuticle, spicule measuring 3.46-5.11 mm (average 4.59 mm) and diameter being 0.04-0.05 mm, spicular sheath large bearing large bulb near distal portion, while at distal end, this globular portion becomes narrow again, spicular sheath at tip with circular opening, globular portion, hyaline in appearence, spicular sheath measuring 0.85-1.07 mm in

Table XIX: Measurement of Trichuris globulosa (Linst, 1901) found in Sheep and goats from Peshawar (in mm).

Male:		1	2	3	4	5	Average:
Length of body	Ant.	40	35	26	35	30	33.20
Width of body	Ant.	0.15	0.17	0.13	0.14	0.13	0.14
	Post.	0.47	0.56	0.90	0.96	0.68	0.71
Length of spicule		3.46	4.77	4.65	4.99	5.11	4.59
Width of spicule		0.04	0.05	0.05	0.05	0.05	0.04
Length of cloaca		1.70	1.14	1.14	1.36	1.11	1.29
Length of spicular sheath		0.79	0.85	0.90	1.07	0.09	0.90
Width of spicular sheath	*Exp.	0.20	0.25	1.07	0.27	0.27	0.53
	Not Exp.	0.11	0.10	0.10	0.11	0.11	0.10
Length of Ejaculatory duct.		5.68	6.70	6.02	6.93	5.68	6.20
Length of vas deferens		3.98	3.86	3.86	3.95	3.90	3.92
Distance of testes from posterior end.		2.27	1.14	1.14	1.14	1.19	1.38
Female:							
Length of body	Ant.	30	30	35	50	40	37
	Post.	9	10	15	12	15	12.20
Width of body	Ant.	0.15	0.14	0.13	0.17	0.20	0.15
	Post.	0.43	0.59	0.62	0.73	0.73	0.52
Length of vulvar flap		0.05	0.05	0.06	0.06	0.05	0.05
Length of vagina		0.68	0.62	0.68	0.80	0.68	0.69
Diameter of vagina at distal end.		0.07	0.07	0.06	0.08	0.08	0.07
Size of egg.		0.06 x 0.03	0.06 x 0.03	0.06 x 0.03	0.06 x 0.03	0.07 x 0.03	0.06 x 0.03

* Exp: expanded

length, expanded portion measuring 0.20-1.7 mm (average 0.53 mm) in diameter. Cloaca large, 1.14-1.70 mm in length. Ejaculatory duct measuring 5.68-6.93 mm and Vas deferens measuring 3.86-3.98 mm. Testis begins at a distance 1.14-2.27 mm from posterior end.

Female: Anterior thin part of worm 30-50 mm (average 37 mm) in length and posterior thick part measuring 9-15 mm (average 12.20 mm), width of anterior thin portion measuring 0.13-0.20 mm (average 0.15 mm). Vulvar flap small, 0.05-0.06 mm (average 0.05 mm) in length, beset with small spines, vagina short, muscular thick and 0.62-0.80 mm in length and diameter being at distal end from 0.07-0.08 mm (average 0.07 mm), lumen and distal part of vagina lined with spine vagina having 3 or 4 arches before entering uterus, first portion of uterus thinwalled, this portion enters into next wider portion by a short muscular constriction measuring 0.57 x 0.17 mm in diameter. Uterus full of eggs, size of eggs 0.06-0.07 x 0.03 mm (average 0.06 x 0.03 mm) in diameter.

Trichuris indica Sarwar, 1946

(Fig. 20)

Host : Goat

Location : Large intestine

Locality : Peshawar

Description: Only two male specimen have been found. One specimen was damaged.

Male : Length of anterior thin portion 25 mm and thick posterior portion measuring 14 mm. Anterior thin portion measuring 0.14 mm in width and thick posterior portion 0.60 mm in width. Spicule large with an anterior expansion, tapers gradually towards posterior end terminating in a fairly sharp tip, spicule 4.54-4.65 mm in length and 0.04-0.05 mm in diameter; spicular sheath tubular in shape in both specimen examined,

Table XX: Measurements of Trichuris indica Sarwar, 1946 found in goats from Peshawar (in mm).

	1	2	Average:
Male:			
Length of body	Ant. 25 Post. 14	--- ---	Ant. 25 Post. 14
Width of body	Ant.0.14 Post.0.60	--- ---	Ant.0.14 Post.0.60
Length of cloaca	1.14	1.70	1.42
Length of ejaculatory duct.	5.68	---	5.68
Length of vas deferens	3.41	---	3.41
Length of spicule	4.54	4.65	4.60
Diameter of spicule	0.05	0.04	0.05
Length of spicular sheath.	0.20	0.57	0.39
Diameter of spicular sheath	0.09	0.14	0.12
Distance of testis from posterior end.	3.07	---	3.07
Length of spine on spicular sheath.	0.01	0.01	0.01

measuring 0.20-0.57 mm in length and 0.09-0.14 mm in width, spine on sheath uniform in size and measuring 0.01 mm in length. Cloaca comparatively long and measuring 1.14-1.70 mm. Testis begin behind begining of cloaca at a distance 3.07 mm from posterior end. Testis straight in area of ejaculatory duct, but twisted in region of vas deferens, length of ejaculatory duct 5.68 mm and vas deferens measuring 3.41 mm.

Trichuris lani (Artiukh, 1948)

(Fig. 21)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar.

Description: Male: Anterior thin part of body 20-32 mm (average 24.40 mm) in length, width of anterior thin part 0.09-0.18 mm and posterior thick part 0.17-0.85 mm . Tail spirally bent. Spicular sheath tubular in shape covered with small spines, and protrudes from the cloaca for a fairly large distance, and measuring 0.62-0.90 mm in diameter, testis begin at proximal part of cloaca at a distance 1.70-3.24 mm (average 2.44 mm) from posterior end, testis convoluted in vas deferens regions and tightly coiled as it proceeds towards anterior end of body, vas deferens 3.41-5.68 mm (average 4.32 mm) in length and ejaculatory duct measuring 8.29-9.09 mm (average 8.84 mm).

Female : Anterior thin part of body 35-65 mm (average 50 mm) in length and posterior thick portion measuring 12-15 mm (average 12.20 mm), width of anterior thin portion 0.13-0.19 mm (average 0.17 mm), and thick posterior portion measuring 0.98-1.02 mm (average 0.95 mm). Ovary much convoluted and begin at a distance of 0.40 mm from posterior end, vulvar flap absent. Vagina long with thick muscular wall, opens to exterior through a small opening lined with spines, its length measuring 3.41-3.64 mm

Table XXI: Measurements of Trichuris lani (Artiukh, 1948) found in sheep and goats from Peshawar (in mm).

Male:		1	2	3	4	5	Average:
Length of body	Ant.	20	20	30	20	32	24.40
	Post.	8	9	14	20	15	13.20
Width of body	Ant.	0.13	0.14	0.12	0.09	0.18	0.14
	Post.	0.48	0.85	0.71	0.17	0.57	0.54
Length of spicule.		3.89	4.48	3.57	3.74	3.18	3.77
Diameter of spicule.		0.02	0.02	0.02	0.01	0.02	0.01
Length of spicular sheath		0.62	0.68	0.79	0.39	0.90	0.67
Diameter of spicular sheath.		0.04	0.05	0.05	0.04	0.04	0.04
Length of cloaca.		3.24	3.64	1.48	1.82	1.48	2.33
Length of ejaculatory duct.		9.09	8.29	9.09	9.09	8.68	8.84
Length of vas-deferens.		3.41	4.54	5.68	3.41	4.54	4.32
Distance of testis from posterior end.		3.24	1.70	2.61	2.39	2.27	2.44
Female:							
Length of body		65.00	35.00	60.00	40.00	50.00	50.00
Width of body	Ant.	0.19	0.19	0.17	0.17	0.13	0.17
	Post.	0.98	0.81	1.02	1.05	0.93	0.95
Length of vagina		3.41	3.41	3.64	3.41	3.41	3.46
Diameter of vagina at distal end	Dist.	0.09	0.14	0.08	0.09	0.09	0.01
proximal end.	Prox.	0.66	0.23	0.68	0.51	0.37	0.49
Size of eggs.		0.05 x 0.03	0.10 x 0.04	0.06 x 0.03	0.05 x 0.03	0.08 x 0.04	0.06 x 0.03

(average 3.46 mm). Diameter of vagina at promimal end being 0.09-0.14 mm and its distal end measuring 0.23-0.66 mm. Tail bluntly rounded terminally. Eggs measuring 0.05-0.10 x 0.03 - 0.04 mm (average 0.06 x 0.03 mm) in diameter.

Trichuris parvispiculum Ortlepp, 1937

Syn : T. discolor (Linst.) Bear, (1950)

(Fig. 22)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar.

Male : Anterior thin portion of worm 21-30 mm (average 27.20 mm) in length and width being 0.15-0.20 mm (average 0.16 mm), length of posterior thick portion measuring 10-15 mm (average 13.20 mm) and width being 0.51-0.59 mm (average 0.53 mm). Spicule short, having bluntly rounded tip and measuring 0.90-1.02 mm (average 0.98 mm) in length and width being 0.01-0.02 mm (average 0.01 mm). Spicular sheath varies in shape and size, when completely everted its distal end saccularly expanded; its length being 0.03-0.68 mm (average 0.31 mm), entire sheath, except neck covered by small spines measuring 0.01 mm. A conical papilla present on both side of cloaca, Cloaca short and measuring 0.42-0.57 mm (average 0.46 mm). Ejaculatory duct very long measuring 8.75-9.45 mm (average 8.93 mm), vas deferens measuring 3.64-4.66 mm (average 4.28 mm), ejaculatory duct and vas deferens join by a narrow constriction 0.15-0.34 mm (average 0.25mm) in length. Testis begins at a distance 1.70-3.41 mm (average 2.47) from posterior end. It forms small convolutions in region of ejaculatory, duct, convolution being tighter near vas deferens.

Female: Anterior thin portion of body measuring 20-34 mm (average 29.60 mm) and width measuring 0.17-0.19 mm (average 0.18 mm), posterior

Table XXII: Measurements Trichuris parvispiculum Ortlepp, 1937 found in sheep and goats from Peshawar (in mm).

Male:		1	2	3	4	5	Average:
Length of body.	Ant.	25	21	30	30	30	27.20
	Post.	12	10	15	15	14	13.20
Width of body	Ant.	0.15	0.15	0.20	0.17	0.17	0.16
Length of spicule		1.02	1.02	1.02	0.90	0.96	0.98
Diameter of spicule		0.01	0.01	0.02	0.02	0.01	0.01
Length of spicular sheath.		0.03	0.06	0.26	0.56	0.68	0.31
Width of spicular sheath at expanded portion.		0.03	0.03	0.06	0.11	0.12	0.07
Length of cloaca		0.45	0.45	0.42	0.42	0.57	0.46
Length of ejaculatory duct.		9.45	8.85	9.66	8.75	7.95	8.93
Length of vas deferens.		4.54	4.66	4.32	3.64	4.26	4.28
Distance of testis from posterior end.		2.27	2.92	3.41	2.04	1.70	2.47
Female:							
Length of body.	Ant.	20.00	30.00	30.00	34.00	29.60	29.60
	Post.	12.00	12.00	13.00	11.00	14.00	12.40
Width of body.	Ant.	0.19	0.20	0.17	0.19	0.17	0.18
	Post.	0.77	0.73	0.77	0.74	0.74	0.75
Length of vulvar flap.		0.09	0.11	0.10	0.09	0.09	0.09
Length of vagina		2.04	2.16	1.59	1.36	2.50	1.93
Diameter of vagina at proximal and distal end.	Prox.	0.30	0.34	0.40	0.30	0.27	0.32
	dist.	0.11	0.10	0.10	0.10	0.06	0.09
Length of ovary from posterior end.		0.44	0.23	0.23	0.28	0.40	0.32
Size of egg		0.06 x 0.04	0.06 x 0.04	0.06 x 0.03	0.06 x 0.03	0.06 x 0.03	0.06 x 0.03

thick portion of body measuring 12-14 mm (average 12.40 mm) in length and width being 0.73-0.77 mm (average 0.75 mm). Vulvar flap directed downwards and measuring 0.09-0.011 mm in length beset with small spines, vagina convoluted and measuring 1.36-2.16 mm (average 1.93 mm) in length, diameter at proximal end being 0.30-0.40 mm and of distal end being 0.06-0.11 mm (average 0.09 mm), after 5-7 convolution vagina becomes sinous and opens into uterus, uterus straight and full of eggs, egg measuring 0.06 x 0.03 mm on average diameter.

REMARKS:

We owe to Skrjabin et al.(1957) for the early history of the genus. Trichuris Syn. Trichocephalus Schrank 1788 or whipworm was first time discovered in 1739 by Morgagni. In 1760-61 whipworm were second time discovered by a student during dissection of a dead body. Roeders in 1761 described these worms and called them "Whipworms" using the name"Trichuris" as a specific rather than a generic name. In 1771 Linnaeus named the whipworm Ascaris trichuris following the principles of binomial nomenclature and included it into the list of parasitic worms in his systema Naturea. In 1782 Goez created an independent genus Trichocephalus and gave the human whipworm the specific name Trichocephalus hominis. Rudolphi in 1802 described the parasite under the specific name Trichocephalus dispar Rudolphi, 1802. At the same time Zeder transfered species T. hominis into genus Mastigodes. Stiles (1901), while studying the history of the species, reintroduced the generic name provided by Linnaeus and described the whipworm as Trichuris trichura. The parasite was known under this specific name for a long time, in 1926 Leiper studied in detail the confused nomenclature of human whipworm and reestablished the generic name, which was first time proposed by Goez (1782) and introduced by Schrank (1771). Thus the type species of genus Trichocephalus was named T. trichura (Linn. 1771) Schrank, 1778.

According to Skrjabin et al.(1957). This name does not completely corresoond to the rule of the International Commission on zoological nomenclature, so he retained the name Trichocephalus for the genus.

Trichuris is a large genus and 71 species are mentioned by Yamaguti (1961) from different hosts from various parts of the world.

The species which have been reported from sheep and goats are T. globulosa, T. ovina, T. ovis and T. parvispiculum from Indo-Pakistan Subcontinent. Beside, these T. parvispiculum from goat from Africa, T. longispicula from sheep from U.S.S.R. and T. skrjabini from sheep and goats from U.S.S.R. have been reported.

Thus, six species of Trichuris have been reported to best of our knowledge from sheep and goats from different parts of the world. Similarly seven species of Trichuris have their distribution in Indo-Pakistan Sub-continent namely: T. alcocki, T. discolar, T. globulosa, T. indica, T. ovina, T. muris and T. ovis. Siddiqi and Ashraf (1980) has reported T. discolor from goat of Peshawar, N.W.F.P. (Pakistan).

Sarwar (1945 a, b, c and 1959) in a series of papers has reported a number of species of Trichuris from cattle, buffaloes, sheep and goats of India and Pakistan. He also reconstructed genus Trichuris into four genera, namely Trichuris, Rudolphi, Buckleyuris and Salamia. However it has not met general acceptance amongst the students of trichurids.

He reported T. globulosa from sheep and goats of Lahore, Multan, Sialkot, Trichuris indica, in Sheikhopura and he also described a species of Trichuris namely T. ovina from sheep and goat from Punjab. This species is closely related to T. parvispiculum.

In a recent survey of helminth parasites of goats, Siddiqi and Ashraf (1980) reported eight species of Trichuris, namely T. infundibulum

T. vondwei, T. parvispiculum, T. discolor, T. indica, T. ovina, T. lani and T. globulosa. This seems to be the maximum number of species to be described from a single host (goat) from any where in the world.

The four species found in the present survey are T. globulosa T. parvispiculum, T. indica, T. lani out of these T. globulosa is very common in sheep and goats as reported from Pakistan from Sialkot, Multan and Lahore (Sarwar 1945).

Mohiuddin (1976-77) have found T. globulosa as a common parasite of caecum of sheep and goat in Sind Area. Durrani et al. (1981) did not find any species of genus Trichuris from sheep and goat in faecal sample examined from Azad Kashmir.

The Morphological study of individual species of genus Trichuris is often difficult. So different workers have used different criteria for species differentiation: Schwartz (1926) and Baylis (1932) use length of spicules, shape of spicular sheath, and the size of the eggs, for diagnosis of various species of Trichuris. The validity of already described species and particularly the taxonomic criteria used for distinguishing various species of Trichuris has also been questioned by Chandler (1930b). According to him the spicular sheath, a character used for specific diagnosis is liable to considerable individual variation. He emphasised the length of spicule, cloaca, length and shape of ejaculatory duct, the structure of testes and vas deferens, length of oesophagus as of more significance in the specific diagnosis. Bhalerao (1935) emphasized the significance of anterior and posterior body length, structure of spicule and its sheath and the size of eggs for specific diagnosis. According to Skrjabin et al. (1957) Artiukh (1948) considered that spicular sheath changes with the physiological conditions of the male and thus can not be used as a diagnostic feature.

Clapham (1945) supported the opinion of Chandler (1930) to use diagnostic feature like length of cloacal tube, length and shape of ejaculatory duct and the nature and folding of the testes and vas deferens. According to him female is less characteristic than male, but when female alone are present the structure of vulva may be useful in the diagnosis of species, he also included lateral wings or cuticular expansions near the head, the number, size and shape of the cuticular plaques in the anterior oesophageal region, common to both sexes. All the species examined show a pair of glandular cells connected with the intestine and lying anterior to it along side the oesophagus, while according to Skrjabin et al.(1957) Tiner (1950) used length of oesophagus, intestine, ejaculatory duct, vas deferens and shape of vagina and size of eggs. Thaper and Singh (1954) considered the relative length of intestine, oesophagus, length of spicule and structure of spicular sheath, ejaculatory duct, vas deferens and shape of vagina and size of eggs. Sarwar (1945 a, 1945c, 1959), stressed the unsatisfactory state of the taxonomy of genus Trichuris. The taxonomic characters used by him for identification of the species of Trichuris, relate largely to the internal and external genitalia and the ratio of anterior to posterior portion of the body. The reliability of external genitalia is often held in doubt, on account of the presence of variations in the external genital organs in the species, but this variability has never been reported to occur, to any appreciable extent in the species other than T. trichura. However, according to him the variability in the external genitalia is confined to the genus Trichuris. He also mentioned that characters of internal genitalia and the ratio of anterior to posterior portion of the body, are reliable characters for generic differentiation and not for the differentiation of the species as originally proposed. The size of the internal genitalia depends on the posterior portion of the body and which however, shows a good deal of variation in material from different sources in species, such as

T. ovis and T. globulosa.

Skrjabin et al. (1957) added that while differentiating species of genus Trichuris beside, anatomical, and morphological criteria, ecological criteria should also be taken into account.

In the present investigation of species of genus Trichuris we have emphasized largely on the character used by Chandler (1930b). The characters used for identification of species are the ratio of anterior to posterior part of the body, size and shape of spicule, size shape and length of spicular sheath, spine length and arrangement on spicular sheath, papillae on posterior end of body, while in case of female, length and width of vagina and the shape of vagina, size of egg and vulvar flap, spine length on the vulvar flap are taken into consideration. In our opinion the most constant and reliable characters for diagnosing the species of Trichuris are spicule length and width, tip of spicule and proximal end of spicule, and other morphological feature added to spicule. Size and shape of spicular sheath and their distribution in different region may be considered reliable. But this does not mean that we totally ignore spicullar sheath as diagnostic feature because we have noticed during examining hundred of male specimens of individual species, spicular sheath is found in different two or four morphologic forms, for example T. parvispiculum nearly half of the male specimens examined having spicular sheath in retracted position. In 5% specimens it was found slightly protruded from the body while in 30% individuals it was found in the form of funnel shaped and in 15% was found completely everted, its distal end is saccularly expanded and the entire sheath except neck is ccvered by extremely small spines like the specimen of T. parvispiculum examined by Ortlepp, (1937).

In case of female, shape of vagina is more characteristic than other feature like ratio of anterior to posterior end of the body and length and width of intestine. A comparative chart of the diagnostic characters are given in Table XXIII.

Table XXIII: A comparison of various diagnostic characters of four species of genus Trichuris found in sheep and goats in Peshawar.

	T. globulosa (Linst, 1901)	T. indica (Sarwar, 1946)	T. lani (Artiukh, 1948	T. parvespiculum (Ortlepp, 1937)
1.	Male length * Ant.26-40 *Post.12-16	Length .25 mm 14 mm	Male length 20-32 8-15	Male length 21-30 mm 10-15 mm
2.	Female length. Ant.30-40 Post. 9-15	Female not found	Female length 35-65 12-15	Female length. 20-34 mm 12-14 mm
3.	Spicule elongated cylindrical, distal end pointed proximal end with large swelling or expanded portion, everted portion covered with hyaline cuticle spicule length 3.46-5.11 mm.	Spicule large an anterior expansion tapers gradually towards posterior end terminating in a fairly sharp tip. Spicule length 4.54 - 4.65 mm.	Spicule elongated and narrow, distal end bluntly rounded, and measuring 3.18-3.89 mm in length.	Spicule short, having bluntly rounded tip, length being 0.90-1.02 mm
4.	Spicule sheath has spherical expansion distally, Spine at distal end markedly longer than in other area.	Spicular sheath tublar in shape, spine on sheath uniform in size.	Spicular sheath tubular in shape, covered with small spine, and protrudes from cloaca for a fairly large distance.	Spicular sheath varies in shape and size when completely everted its distal end saccularly expanded.
5.	Vagina in female short, length 0.62-0.80 mm having 3 or 4 arches before entering uterus.	No female	Vagina long, with thick muscular wall, without vulvar flap, length of vagina 3.41-3.64 mm.	Vagina convoluted, and measuring 1.36-2.16 mm.
6.	Egg diameter 0.06-0.07 x 0.03 mm.	No female	Egg diameter 0.05-0.10 x 0.03-0.04 mm.	Egg measuring 0.60 x 0.03 mm in diameter.

*Ant. : Anterior
*Post.: Posterior.

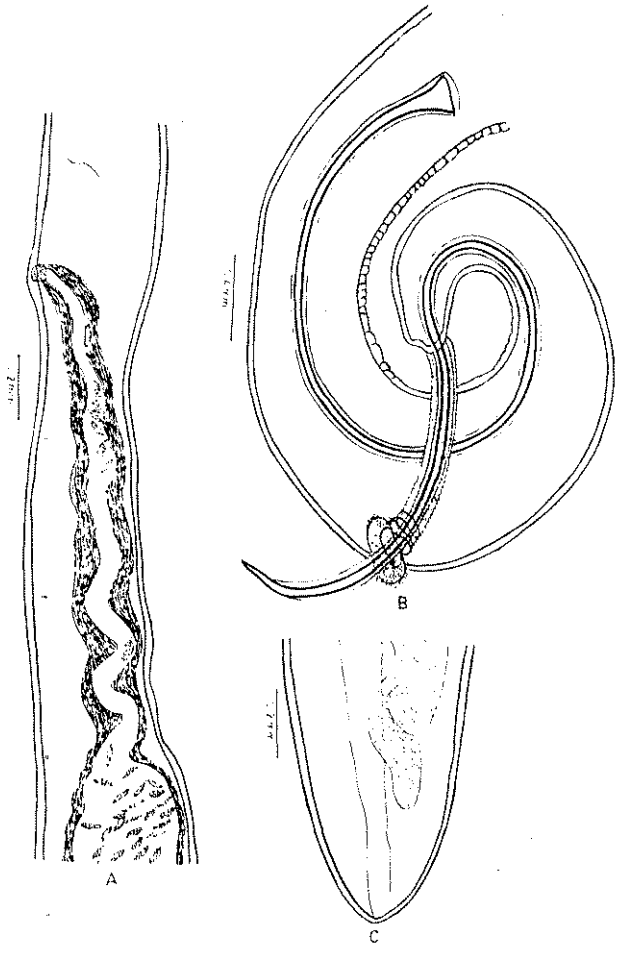


Fig. 19. Trichuris globulosa

A - Part of female showing vulva and vagina

B - Posterior part of male

C - Posterior part of female.

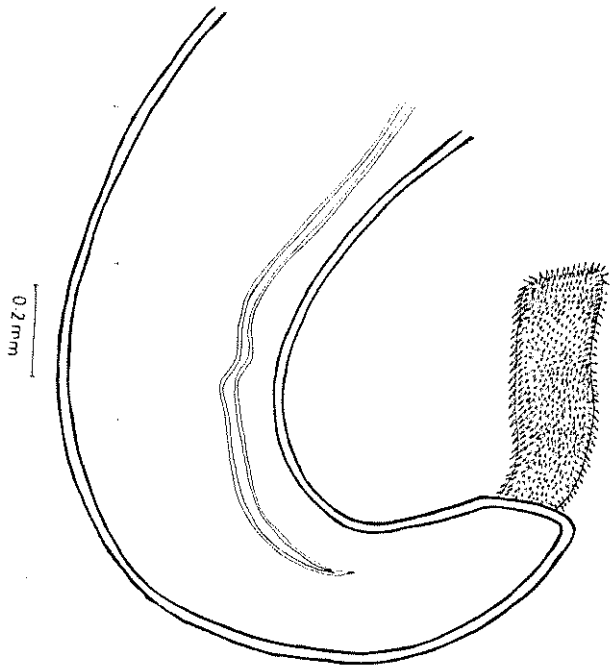


Fig. 20. Trichuris indica

Posterior part of male showing

Spicule and spicular sheath.

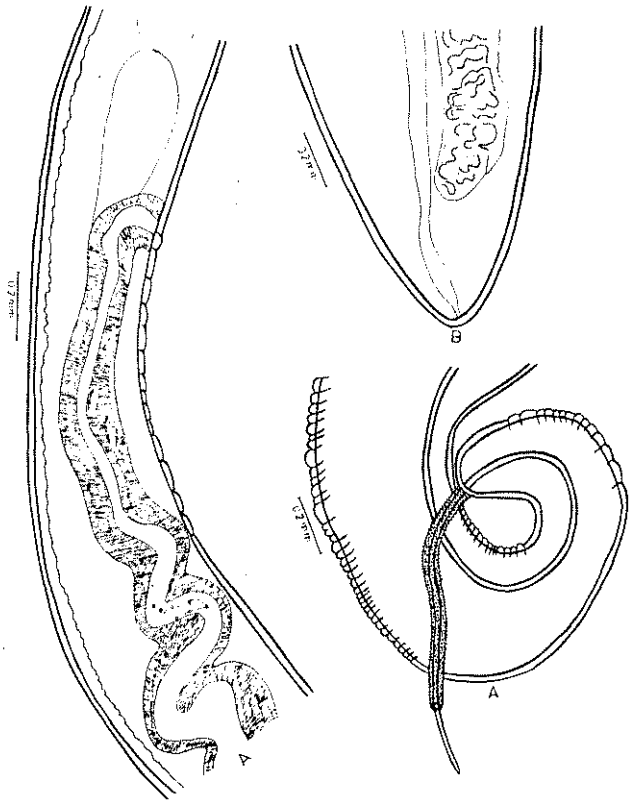


Fig. 21. Trichuris lani

A - Part of female showing vulva and vagina.

B - Posterior part of female.

C - Posterior part of male.

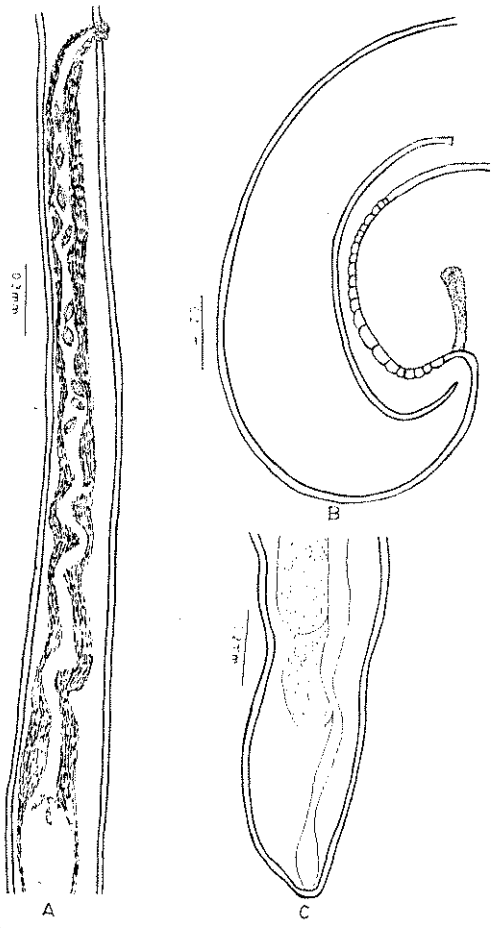


Fig. 22. Trichuris parvispiculum

A - Part of female showing vulva and vagina.

B - Posterior part of male.

C - Posterior part of female.

Family : Ancylostomatidae Nicoll, 1927

Sub family : Bunostominae Loose, 1911

Syn. Necatorinae Lane, 1917

Genus: Bunostomum Railliet, 1902

Syn. Monodontus Molin, 1861, Partim

Bustomum Lane, 1917

Bunostomum trigonocephalum (Rud., 1808)

Syn. Sclerostoma hypostomum (Rud., 1819)

Monodontus Wedlii Molin, 1861

Dochmius cernuus (Crepl., 1829) Partim;

Bunostomum Rashinathi Lane, 1917

(Fig. 23)

Host : Sheep

Location : Large intestine

Locality : Peshawar

Description: Anterior end bent in a dorsal direction, so that buccal capsule opens antero-dorsally, buccal capsule relatively large, and having a diameter 0.187-0.201 x 0.134-0.214 mm (average 0.190 x 187 mm). A pair of ventral cutting, chitinous, plates present at margin of buccal capsule, near its base a pair of small subventral lancet present, dorsal gutter carrying duct of dorsal oesophageal gland end in a large dorsal cone, with tooth projecting into buccal capsule, dorsal tooth relatively long, and its dorsal border longer than distance from its tip to mouth opening. Length of oesophagus 1.139-1.676 mm (average 1.246) and width being 0.134-0.160 mm (average 0.168 mm).

Male : Body length 15-16 mm (average 15.4 mm), and width being 0.388-0.415 mm (average 0.420 mm). Bursa well developed, dorsal lobe asymmetrical: right externo-dorsal ray arising higher up on dorsal stem,

and longer than left, left externo-dorsal arising near the bifurcation of dorsal ray, dorsal ray divides into two tridigitate branches, ventral and lateral rays arising from a large common trunk, ventral cleft, medio-lateral and postero-lateral fused proximally but separated distally;, spicule equal, short, slightly twisted and measuring 0.576-0.657 mm (average 0.611 mm); gubernaculum absent.

Female: Lenth of female measuring 13-18 mm (average 16 mm) and 0.335-0.496 mm (average 0.41 mm) in width. Vulva in front of middle of body, uteri opposed, vagina short. Eggs measuring 0.039-0.069 x 0.09 - 0.39 mm (average 0.056 x 0.031 mm).

REMARKS:

According to Skrjabin et al.(1952) sub family Bunostominae Looss, 1911 was originally established by Looss in 1911 with the type genus Bunostomum Railliet, 1902. In 1917 Lane proposed a new name for the sub family Necatorinae, which was accepted by the majority of authors like York and Maplestone (1926), Sprehn (1932), Baylis (1936), Neveu-Lemarie (1936) and others. Skrjabin and Schulz (1937) on the basis of the rule of Zoological Nomenclature, reestablished sub family Bunostomatinae Looss, 1911. Ten species are included in the genus Bunostomum, out of which according to Yamaguti (1961) four species are reported from various parts of the world from sheep and goats. B. trigonocephalum Rud; (1808) in sheep, goats and ox is cosmopolitan in distribution, B. bovis Maplestone 1931, B. cobi Maplestone, 1931 from Antelope, sheep from India and North Rhodesia and B. phelobotmum (Railliet in Rizzo 1900) in cattle and sheep is cosmopolitan in distribution.

Bunostomum trigonocephalum (Rud., 1808) Railliet, 1902 was recorded by Lane (1917) from sheep in Darjeeling district of Bengal. At the same time he recorded, under the name of B. kashinathi from the goats in

Table XXIV: Measurements of Bunostomum trigonocephalum (Rud., 1808) found in sheep from Peshawar (in mm).

Female:	1	2	3	4	5	Average:
Length of body.	18.00	16.00	17.00	16.00	13.00	16.00
Width of body.	0.335	0.455	0.362	0.496	0.402	0.41
Diameter of buccal capsule.	L.0.201 x W.0.201	0.187 x 0.201	0.174 x 0.214	0.201 x 0.187	0.188 x 0.134	0.190 x 0.187
Length of oesophagus.	1.206	1.676	1.139	1.139	1.072	1.246
Width of oesophagus.	0.147	0.160	0.160	0.241	0.134	0.168
Length of tail	0.295	0.295	0.281	0.254	0.282	0.281
Size of egg	0.053 x 0.033	0.039 x 0.029	0.049 x 0.023	0.073 x 0.039	0.069 x 0.033	0.056 x 0.031
Male:						
Length of body	15.00	16.00	15.00	16.00	15.00	15.400
Width of body	0.415	0.388	0.442	0.429	0.429	0.420
Length of spicule	0.630	0.590	0.576	0.657	0.604	0.611

the same locality. Later York and Maplestone (1926) have placed B. kashinathi in the synonmy of B. trigonocephalum. Beside B. trigonocephalum, B. bovis, B. cobi and B. phelobotmum have been reported from sheep. A comparison of B. trigonocephalum with other species found in Indo-Pakistan is given in Table XXV.

Siddiqi and Ashraf (1980) reported B. trigonocephalum for the first time from goats from Peshawar.

Table XXV: A comparison of various characters of Bunostomum spp. from sheep from Pakistan (Peshawar) and India.

Bunostomum trigonocephalum Rud. (1808) (our observation)	B. cobi Maplestone, 1931. (observation according to Baylis 1936)	B. bovis Maplestone, 1931. (observation according to Baylis 1936)	B. phelobotum (Railliet in Rizzo,1900). (Observation according to Baylis 1936).
1. Length of male 15-16 mm	Length of male 9.8-11 mm	Length of male 15-16mm	Length of male 10-12 mm
2. Length of female 13-18	Length of female 15-16	Length of female 15-16	Length of female 16-19
3. Buccal capsule diameter being 0.187-0.201 x 0.134-0.21 mm.	buccal capsule length 0.164-0.176 mm.	buccal capsule rather elongate, measurement not given,	Not described.
4. Dorsal tooth relatively long and its dorsal border longer than distance from its tip to mouth opening.	dorsal tooth truncated at tip, its dorsal border about half as long as distance from its tip to mouth opening.	Dorsal border of dorsal tooth shorter than distance from its tip.	Dorsal tooth relatively short, and its dorsal border shorter than distance from its tip to mouth opening.
5. One pair of small subventral lancets present.	A single pair of broad rounded subventral lancet present.	A single pair of long, pointed subventral, lancets present.	Two pair subventral lancets present.
6. Oesophagus length 1.139-1.67 mm	Oesophagus length 0.18-0.2 mm	Not described.	Oesophagus length 1.25-1.5 mm.
7. Spicule length 0.576-0.657 mm, slightly twisted filiform.	Spicule length 0.55-0.66 mm slightly twisted filiform.	Spicule length 4.5 mm slender, tapering with fine straight points which fused and surrounded by membranous sheath.	Spicule length 3.5-4 mm alae present.
8. Diameter of egg 0.039-0.069 x 0.023-0.39 mm.	Diameter of egg 0.058-0.06 x 0.036 mm.	Diameter of egg 0.072-0.076 x 0.044-0.046 mm	Diameter of egg 0.075-0.098 x 0.04-0.05 mm.

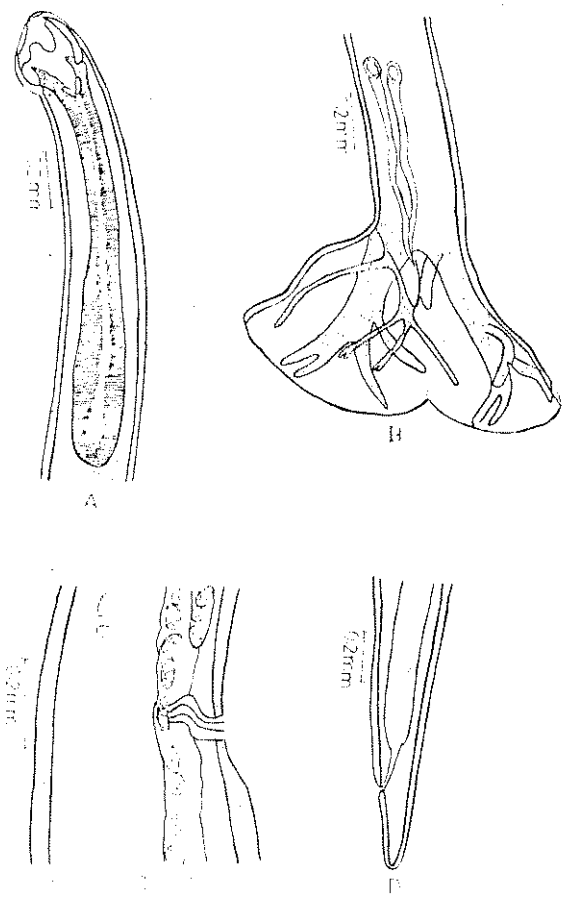


Fig. 23. Bunostomum trigonocephalum

A - Anterior end

B- Posterior end

C - Part of female showing vagina and eggs.

D - Posterior end of female.

Family : Cyathostomidae Yamaguti, 1961

Syn. Trichonematidae Witenberg, 1925

Sub family : Oesophagostominae Railliet, 1916

Genus : Oesophagostomum Molin, 1861

Syn : Hypostomum Stewart, 1898

Bourgelatioides Chandler, 1931

Paraoesophagostomum Scheidegger et Kreis, 1934.

Daubneyia Leroux, 1940

Oesophagostomum asperum Railliet and Henry, 1913.

(Fig. 24)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar

Description : Body yellowish white, cuticle transversly striated, buccal collar rounded and measuring 0.05-0.06 x 0.17-0.18 mm (average 0.05 x 0.17 mm) in diameter, cephalic swelling of cuticle well developed. Oesophagus club-shaped and measuring 0.85-1.02 mm (average 0.95 mm) in length; cervical groove well marked ventrally and extends on to lateral surface as for as lateral line. Mouth surrounded by a double set of leaf crown, consist of 24 small elements. Six cephalic papillae present on buccal collar, two lateral and four sublateral. Cervical papillae delicate in appearance and situated at a distance 1.13-1.30 mm from anterior end. Nerve ring present in middle of oesophagus.

Male : Body measuring 12-14 mm (average 13.00 mm) in length and width being 0.47-0.63 mm (average 0.51 mm). Male bursa not voluminous; both ventral rays thin and long, separated from one another by a narrow slit, lateral rays arise from common stem; medio-and postero-lateral rays adjoining, extend to bursal margin; dorsal rays bifurcate soon behind

Table XXVI: Measurements of Oesophagostomum asperum Railliet et Henry, 1913 found in sheep and goats from Peshawar (in mm).

	1	2	3	4	5	Average
Female:						
Length of body.	17.00	17.00	18.00	17.00	17.00	17.20
Width of body	0.68	0.68	0.75	0.68	0.71	0.69
Diameter of buccal collar	L.0.05 x W.0.18	0.06 x 0.17	0.05 x 0.18	0.06 x 0.17	0.06 x 0.17	0.05 x 0.17
Length of oesophagus	0.85	0.96	1.02	0.99	0.94	0.95
Distance of cervical papillae from head	1.27	1.15	1.30	1.24	1.13	1.21
Size of egg	0.09 x 0.05	0.09 x 0.05	0.08 x 0.06	0.09 x 0.06	0.08 x 0.05	0.08 x 0.05
Length of vagina	0.79	1.13	1.02	0.84	1.13	0.98
Male:						
Length of body	L.14.00	12.00	14.00	12.00	13.00	13.00
Width of body	0.53	0.63	0.47	0.47	0.47	0.51
Length of spicule	1.93	1.70	1.93	1.47	1.61	1.72

site of separation from externo-dorsal rays. Genital cone situated centrally at bottom of bursa. Spicule consist of a tubular core and layer surround this core, near end of spicule another similar layer present; spicule measuring 1.47-1.93 mm (average 1.72 mm) in length; gubernaculum horseshoe-shaped, 0.12 mm long.

Female: Body length 17-18 mm (average 17.20 mm) and width measuring 0.68-0.75 mm (average 0.69 mm). Anus and vulva rather prominent; vagina long and lined with cuticle and measuring 0.79-1.13 mm (average 0.98 mm) in length. Tail tapers sharply posterior to anus. Egg oval with thin shell measuring 0.08-0.09 x 0.05-0.06 mm, average being 0.08x0.05mm.

Oesophagostomum brevicaudum Schwartz and Alicata, 1930

Syn. O. suis Maplestone, 1930-Trav, and Vogels. (1932).

(Fig. 25)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar

Description : Body yellowish in colour, cuticle transversly striated, Buccal collar measuring 0.05 x 0.09 mm in diameter and surrounded by a double set of leaf crown, external leaf crown consists of 14-16 elements, internal leaf crown consisting of 28-32 elements, external leaf crown projects slightly from mouth opening. Buccal capsule small 0.02 x 0.04mm in diameter. Cephalic swelling well developed. Two lateral and four sub-lateral cephalic papillae present in head region. Cervical papillae lying behind middle of oesophagus at a distance of 0.76-0.94 mm (average 0.81 mm) from anterior end. Nerve ring situated at about level of cervical groove. Oesophagus flask-shaped, a slight swelling present anteriorly, and measuring 0.89-1.12 mm (average 0.99 mm) in length.

Table XXVII: Measurements of Oesophagostomum brevicaudum Schwartz and Alicata, 1930 found in goats from Peshawar (in mm).

	1	2	3	4	5	Average
Length of male body	12.00	10.00	13.00	14.00	13.00	12.40
Width of male body	0.42	0.45	0.43	0.54	0.72	0.51
Diameter of head	L.0.09	-	-	-	-	-
	W.0.05	-	-	-	-	-
Length of oesophagus	L.0.94	0.89	1.12	1.02	1.02	0.99
Diameter of buccal capsule	L.0.02 x W.0.04	-	-	-	-	-
Distance of cervical Papillae from head.	0.77	0.79	0.80	0.76	0.94	0.81
Length of spicule	1.53	1.51	0.80	0.76	1.57	1.23
Length of Gubernaculum	0.08	-	-	-	-	-
Length of female	12.00	-	-	-	-	-

Male : Body measuring 10-14 mm (average 12.40 mm) and width being 0.43-0.72 mm (average 0.51 mm). Male bursa well developed; dorsal ray of bursa with powerful stem, giving off externo-dorsal ray subsequently bifurcating distally, two ventral rays parallel and adjoining lateral comprise three diverging rays. Spicule length measuring 0.76-1.57 mm; gubernaculum horse-shoe shaped and measuring 0.08 mm in length.

Female : Body measuring 12 mm and width being 0.53 mm. Tail of female short and bend dorsally.

Oesophagostomum columbianum Curtice, 1890

Syn. O. venulosum Gedeolst, 1916 Travassos and Vogelsang (1932)

(Fig. 26)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar

Description : Body yellowish in colour, anterior end bend into hook. Buccal collar measuring 0.03-0.06 x 0.10-0.12 mm (average 0.05 x 0.11 mm) in diameter, buccal collar with two lateral and four sublateral head papillae. Cephalic vesicle not inflated cervical groove, extends only as far as lateral lines. Lateral alae present extending from cervical groove almost entire length of worm. Cervical papillae well developed, project through lateral alae just behind cervical groove at a distance of 0.28 - 0.43 mm (average 0.35 mm) from anterior end. Mouth surrounded by a double set of leaf crown, external leaf crown composed of 20.24 element and internal leaf crown composed of 40-48 element, anterior end of each element rounded and with pointed process directed inwards; internal leaf crown consists of rather long narrow elements. Oesophagus club-shaped, measuring 0.92-1.00 mm (average 0.97 mm) in length, nerve ring just behind cervical groove.

Table XXVIII: Measurements of Oesophagostomum columbianum Curtice, 1890 found in sheep and goats from Peshawar (in mm)

		1	2	3	4	5	Average
Female:							
Length of body		27.00	25.00	25.00	26.00	23.00	25.00
Width of body		0.49	0.45	0.45	0.45	0.41	0.45
Diameter of head	*L.	0.03	0.03	0.05	0.06	0.06	0.05
	x		x	x	x	x	x
	*W.	0.10	0.10	0.12	0.12	0.12	0.11
Length of oesophagus		1.00	1.00	0.99	0.92	0.92	0.97
Distance of cervical papillae from head.		0.43	0.40	0.34	0.30	0.28	0.35
Size of egg		0.08	0.09	0.07	0.06	0.09	0.08
	x		x	x	x	x	x
		0.05	0.05	0.05	0.05	0.05	0.05
Length of tail		0.43	0.43	0.37	0.40	0.40	0.41
Male:							
Length of body		19.00	17.00	18.00	17.00	17.00	18.00
Width of body		0.42	0.42	0.43	0.36	0.35	0.40
Length of spicule		1.08	0.91	0.94	0.91	0.97	0.96
Diameter of spicule		0.02	0.02	0.02	0.02	0.02	0.02

* L : Length

* W : Width

Male : Body length measuring 17-19 mm (average 18 mm) and width measuring 0.35-0.43 mm (average 0.40 mm). Bursa large, dorsal lobe not clearly separated from lateral lobes, merges with it and separated from it by deep longitudinal slit, ventral ray cleft medio-lateral and postero lateral fused proximally, antero-lateral separated, externo-dorsal arises from a common trunk, dorsal ray divided into two short lateral branches, externo-dorsal unbranched. Spicule equal, alate, measuring 0.91 - 1.08 mm (average 0.96 mm) in length and diameter being 0.02 mm; gubernaculum 0.12 mm long and horse-shoe shaped.

Female : Body measuring 23-27 mm (average 25 mm) in length and width being 0.41-0.49 mm (average 0.45 mm). Vulva lies on apex of bluntly conical projection with thick muscular wall at a distance.1.20 mm from posterior end. Vagina very short, leading into kidney-shaped pars ejectrix. Eggs thin-shelled, and measuring 0.08 x 0.05 mm in average diameter. Tail long, gradually tapering, immediatly bent ventrally, before vulva.

Oesophagostomum venulosum (Rud., 1809)

Syn. O. inflatum ovis Carita, 1887 Railliet (1893)
O. acutum Molin, 1861 Skrj. et al. (1952)
Strongylus follicularis Ostertag in Olt, 1898 Sprehn(1932).

(Fig. 27).

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar.

Description : Buccal collar like an extended cone, separated from cephalic vesicle by a well marked groove, and measuring 0.42 x 0.179 mm in average diameter, cephalic inflation well marked, diminishing in width before cervical groove, cervical groove may extends only as far as lateral line. A narrow lateral alae extends nearly whole length of body.

Cervical papillae lies behind oesophagus at a distance 1.23-1.27 mm from anterior end. Mouth opening surrounded by a double set of leaf crown; external leaf crown consist of 18 elements, anterior end of which obtusely rounded; internal leaf crown consists of 36 element, situated in pairs at base of each element of external crown. Buccal capsule wider than long. Oesophagus club-shaped and measuring 0.965-1.045 mm in length. Nerve ring lies at level of cervical groove.

Male : Length of male body measuring 14-16 mm (average 15.00 mm) and width being 0.454 - 613 mm (average 0.524 mm). Bursa well developed, rays of caudal bursa extend almost to bursal margins, both ventral rays thin and long, separated from one another by a narrow slit, three lateral rays arise from common trunk; medio-and postero-lateral rays adjoining, diverge distally, antero-lateral ray separated from medio-lateral; externo-dorsal ray commences with dorsal ray, does not extend to bursal margin and slightly bent in its median, third dorsal ray bifurcates soon behind site of separation from externo-dorsal ray, both branches of dorsal ray give off two small branches of different thickness. Spicule long, measuring 1.442-1.590 mm (average 1.514 mm) in length, spicule consists of a tublar core and a sheath coiled around core, near end of spicule a layer coils around tip, looks like a swelling, but not extend to tip of spicule. Gubernaculum horse-shoe shaped, 0.10 mm long.

Female : Body length 19-22 mm (average 20.2 mm) and width being 0.52-0.64 mm (average 0.569 mm). Tail tapers gradually from anus to tip, and measuring 0.17-0.19 mm. Vulva rather prominent and situated at a distance of 0.454-0.556 mm from tail end. Vagina runs forward in body. Egg measures 0.68-0.090 mm x 0.034 - 0.045mm (average 0.085 x 0.040 mm) in diameter.

Table XXIX: Measurements of Oesophagostomum venulosum (Rud., 1809) found in sheep and goats from Peshawar (in mm).

Female:		1	2	3	4	5	Average
Length of body		20.00	22.00	21.00	19.00	19.00	20.20
Width of body		0.535	0.522	0.647	0.579	0.568	0.569
Diameter of head	L.	0.034	0.045	0.034	0.056	0.045	0.042
		x	x	x	x	x	x
	W.	0.170	0.181	0.193	0.170	0.181	0.179
Distance of Papillae from anterior end.		1.23	1.27	-	-	-	1.25
Length of Oesophagus		1.022	0.965	1.011	1.045	0.999	1.008
Length of tail		0.170	0.170	0.193	0.193	0.193	0.183
Size of egg		0.090	0.090	0.090	0.090	0.068	0.085
		x	x	x	x	x	x
		0.034	0.045	0.034	0.045	0.045	0.040
Distance of vulva from tail	L.	0.511	0.522	0.454	0.556	0.533	0.515
Male:							
Length of body		15.00	16.00	14.00	15.00	15.00	15.00
Width of body		0.511	0.454	0.465	0.579	0.613	0.524
Length of spicule		1.476	1.442	1.590	1.533	1.533	1.514

REMARKS:

According to Popova (1958) the genus Oesophagostomum was established by Molin in 1861. It was divided by Railliet and Henry (1913) and Ihle (1922) into four subgenera:

Hysteracrum Railliet and Henry, 1913;
Proteracrum Railliet and Henry, 1913;
Oesophagostomum (Molin, 1861) Railliet and Henry, 1913;
Conoweberia Ihle, 1922.

Travassos and Vogelsang (1932) established two additional subgenera, Ihleia Travassos and Vogelsang, 1932 and Bosicola (Sandground, 1929) Travassos and Vogelsang, 1932. In 1940 Le Roux introduced two additional subgenera; Hudosonia Le Roux, 1940 and Pucuia Le Roux 1940. Popova in 1958 described key to the species of Oesophagostomum.

Goodey (1924) Thornton (1924), Baylis and Doubney (1926) and Yamaguti (1961) do not agree with division of the genus into four subgenera Oesophagostomum, Proteracrum, and Hysteracrum of Railliet and Henry, 1913 and Conoweberia of Ihle, (1922) as it is unnecessary, and so are the additional subgenera Hudsonia Le Roux 1940, and Pucuia Leroux, 1940.

According to Yamaguti (1961) genus Oesophagostomum have 50 species from various mammalian hosts from various countries, out of which four species has been reported from sheep and goats namely O. asperum Curtice, 1890, O. indicum Maplestone 1931 and O. venulosum (Rud., 1809) Baylis, 1936.

Four species has been found in our collection from sheep and goats, O. asperum Railliet et Henry, 1913, O. brevicaudum, Schwartz and Alicata 1930, O. columbianum Curtice, 1890 and O. venulusum (Rud., 1809) Baylis, 1936.

Oesophagostomum asperum Railliet and Henry, (1913), was originally described from goat from Panama Canal zone, Goodey (1924) redescribed it in greater detail from material collected from China and Federated Malaya State. Sarwar (1955) collected the species from goat from Murree(Pakistan). Thapar (1956) also collected this species from goat from India. Bhalerao (1935) has recorded it from the Himalayan ibex (Capra sibrica) from United Provinces (India). A comparison of description of this species with previous workers is given in Table No. XXX.

This species very closely resembles O. venulosum which is also represented in our collection and is cosmopolitan in distribution in sheep and goats. Main differences from O. venulosum is the number and shape of leaf crown surrounding the mouth. External leaf crown in this species consist of 12 elements, the edges of which are bluntly rounded, while in O. venulosum external leaf crown consists of 18 elements and cervical papillae lies at a distance of 1.23-1.27 mm from anterior end as opposed to O. asperum where it is situated at a distance of 1.13-1.30 mm from anterior end. In female the vulva and anus stand out rather prominently than in O. venulosum.

Another species of the genus which Maplestone (1931) differentiated from O. asperum is O. indicum reported from spotted deer, and red deer from Zoological Garden, Calcutta. According to him the differences between the two species seem to lie in the number of leaf crown, he mentioned 10 elements in the external leaf crown of O. indicum, while 12-14 element in the external leaf crown of O. asperum. The cervical papillae were described by Maplestone (1931) as located opposite the junction of oesophagus and intestine, while in O. asperum, they are located at variable distance behind the oesophagus since the shape of the cephalic extremity which has a very important bearing on differentiation of the species of the group, are alike in both O. asperum and O. indicum, and

Table XXX: A comparison of diagnostic features of Oesophagostomum asperum Railliet et Henry, 1913.

	Characters Host:	Railliet et Henry, 1913 Goats:	Goodey (1924) Goats:	Sarwar (1955) Goats:	In the present study sheep and goats:
1.	Length of male	11.5-13.0 mm	12-13 mm	14-15 mm	12-14 mm
2.	Length of female	14.0-17.5 mm	15-17.5 mm	17-20 mm	17-18 mm
3.	No. of leaf crown	External 12, Internal 24	External 12, Internal 24	Ext. 12-14	External 12, Internal 24
4.	Diameter of buccal collar and buccal capsule size.	0.060-0.062 length, buccal capsule a little broader than its depth.	Not given, size about twice as broad as deep.	Mouth collar and capsule 0.175x0.08 mm	Mouth collar 0.05x0.17 mm buccal capsule about twice as broad as deep.
5.	Cephalic swelling	Well developed uniformly distended.	Well inflated and cervical groove well developed on ventral side.	Not given	Well developed cervical groove, well developed on ventral side.
6.	Distance of cervical papillae from head and thickness.	Very thin, lying 0.32 - 0.36 from anterior end.	delicate in appearance 1.5 mm from anterior end.	1.11-1.35 mm from anterior end.	Delicate in appearance 1.13-1.30 mm from anterior end.
7.	Bursa shape.	Not given	Not voluminous	Not given	Not voluminous
8.	Spicule length	1.35-1.62 mm	1.5-1.7 mm		1.47-1.93 mm
9.	Gubernaculum shape and length.	Not given	0.1 mm shovel-shaped.	Not given	Shovel-shaped 0.12 mm.
10.	Vulva shape	Not given	Vulva stand out rather prominent.	Not given	Vulva stand out rather prominent.
11.	Size of egg	0.083-0.085x0.055-0.60 mm	Not given	Not given	0.08-0.09x0.05 - 0.06 mm
12.	Vagina length.	0.65 - 0.70 mm	0.67 mm	0.18 mm	0.79-1.13 mm
13.	Tail	Immediately behind anus, tail tapers abruptly terminated in a pointed conoid process.	Tail tapers sharply posterior to the anus.	Not given	Tail tapers sharply posterior to the anus.

since the number of elements in the leaf crown has been found to vary in species of this group, O. indicum is treated by Sarwar (1955) as a Synonym of O. asperum.

According to Yamaguti (1961) Oesophagostomum brevicaudum Schwartz and Alicata, 1930 was first described from domestic Swine (Sus scrofa)from U.S.A. After Schwartz and Alicata (1930) Maplestone (1931) and Baylis(1936) redescribed this species from India from domestic Pig and Trav. and Vogels (1932) from domestic pig from U.S.A. The description of Schwartz and Alicata, (1930) and Baylis (1936) is simillar in all essential characters with the specimens collected in our survey. A detail comparison of their work is given in Table No. XXXI. As the table shows there is no difference, except some variation in measurements of various parts of the body. This may be perhaps due to different environment or different host.

This is the new host records as this parasite was only found in goat in our survey. Mohiuddin (1976-77) Shah et al. (1980) Durrani et al. (1981), Siddiqi and Ashraf (1980) did not mention any incidence of this parasite from sheep and goat from various parts of Pakistan and thus it also constitutes a new locality record for Pakistan.

Oesophagostomum columbianum Curtice, 1890 is a widely distributed species which occurs in the large intestine of sheep, goats and occasionally been recorded from cattle (Baylis, 1936). In India, it was first reported by Gaiger (1910) from sheep and goats. Other Indian workers who found this in sheep and goats are Moghe (1945) Thapar (1956). Le-jambre (1976) found this parasite in sheep and goat of New South Wales. From Tanzania it was reported by McCulloch and Kasimbala (1968).

Goodey (1924) redescribed it in greater detail from material collected from China and Fedrated Malaya State. Baylis (1936) also redescribed this species found in sheep and goat of India. A comparison of their desc-

Table XXXI: Comparison of diagnostic features of Oesophagostomum brevicaudum Schwartz and Alicata, 1930.

Author Host:	Schwartz and Alicata (1930) domestic Swine (Sus scrofa)	Baylis (1936) domestic pig	In the present study sheep and goats:
Characters			
1. Length of male body	6.2-6.8 mm	6.20 mm 8.75 mm	10-14 mm
2. Length of female body	6.4-8.5 mm	Not given	12 mm
3. Diameter of buccal collar and buccal capsule	Not given	Diameter of buccal collar not given buccal capsule 0.016x0.040 mm	Buccal collar 0.09 x 0.05 mm buccal capsul 0.02 x 0.04 mm
4. No. of leaf crown and shape	External 14-16 Internal 28-32 triangular.	External 14-16, Internal 28-32.	External 14-16, Internal 28-32.
5. Cephalic swelling and cervical grooves.	Both well developed	Cephalic swelling clearely pronounced, cervical groove extend laterally.	Cephalic swelling and cervical groove well developed.
6. Oesophagus shape and length.	Flask shaped.	0.36-0.45 mm long.	Flask shaped, length 0.89-1.12 mm.
7. Distance of cervical papillae from anterior end.	Some what before posterior third of oesophagus.	Behind middle of oesophagus at a distance 0.33-0.38 mm from cephalic end.	Behind middle of oesophagus at a distance 0.76-0.94 mm.
8. Length of spicule	Filiform, 1.05-1.23 mm.	1.0-1.3 mm long	0.76-1.57 mm.
9. Female tail	Directed dorsally (short) 0.081-0.120 mm.	directed dorsally 0.18-0.120 mm long	directed dorsally (short)
10. Gubernaculum length.	Not given	0.098-0.120 mm	0.08 mm.

Table XXXII: A comparison of diagnostic features Oesophagostomum columbianum Curtice, 1890.

Author / Host	Goodey (1924) sheep and goats	Baylis, (1936) sheep, goat, cattle	Our observation (1987) sheep and goats
Character			
1. Anterior end	Hook-shaped	Hook-shaped	Hook-shaped
2. Length of male worm	12.0-14.0 mm	12-16 mm	17-19 mm
3. Length of female worm.	15.0-18.0 mm	14-18 mm	23-26 mm
4. Lateral alae	Lateral alae extend from groove throughout length of body.	Lateral alae extend from groove through-out length of body.	Lateral alae extend from groove through-out length of body.
5. No of leaf crown	External 20-24, Internal 40-48.	External 20-24, Internal 40-48.	External 20-24, Internal 40-48.
6. Diameter of buccal collars.	Not given	Not given	0.03-0.06x0.10-0.12
7. Cepalic swelling and cephalic groove	Cephalic vesicle not distended.	No cephalic inflation present	Cephalic vesicle not distended.
8. Bursa	Large	Large	Large
9. Distance of cervical papillae from anterior end.	Well developed cervical papillae situated just posterior to groove.	Cervical papillae project through lateral alae just behind cervical groove.	Cervical papillae project through lateral alae at distance 0.28 - 0.43 mm from anterior end.
10. Oesophagus shape and length.	Oesophagus club-shaped.	Oesophagus length 1 mm long.	Club-shaped, length 0.92-1.00 mm.
11. Length of spicule	Spicule short, 0.75 - 0.85 mm.	Spicule length 0.75 - 0.85 mm.	Spicule short, length 0.91-1.08 mm.
12. Gubernaculum	Shovel-shaped, 0.1 mm long.	0.1 mm	shoval-shaped, length 0.12 mm
13. Vulva shape	Vulva on apex of bluntly conical projection with thick muscular wall.	Vulva slightly prominent.	Vulva on apex of a projection.
14. Vagina length	Vagina short, less than 0.1 mm.	Vagina less than 0.1 mm	-----
15. Size of egg	Not given	0.065-0.075x0.04-0.05mm.	0.06-0.09x0.05
16. Tail shape	Tail long, gradually tapering	Female tail tapering	Tail long gradually tapering

-ription with species found in our collection is given in table No.XXXII.

Oesophagostomum venulosum (Rud., 1809) is commonly found in sheep and goat of India, Pakistan and other countries of the world. Bhalerao (1935) Moghe (1945) Thapar (1956) Bhatia and Pande (1961) reported this parasite from sheep and goat from different parts of India. Boulenger (1914), Crofton (1953) and Le Rich et al.(1973) reported this parasite from sheep and goat from England, South West England and Cyprus respectively.

In Pakistan, it was first reported by Sarwar (1955) from sheep from Peshawar and Sialkot. Later on Mohiuddin et al. (1984) reported it from Sind. Durrani et al. (1981) did not find this parasite in Azad Kashmir. Siddiqi and Ashraf (1980) recovered this parasite from goats from Peshawar.

Goodey (1924) redescribed this species in greater detail from Scottish deer, and according to Skrjabin et al. (1952) Rukhlyadev (1948) described O. venulosum from roe deer, Red deer and mouflon. Baylis (1936) described this from sheep and goat of India. A comparison of their description is given in table No. XXXIII with the specimen recovered in our collection from sheep and goat.

Though O. venulosum and O. columbianum occur in the same site and have similar life cycle, yet pathological condition produced by them are quite different. In case of O. columbianum nodules were found on the bowl wall, on the other hand with O. venulosum even though if a large number of worms were found, few or no lesions were observed during examining the viscra. The nodule formation can interfere with the health of animal as observed by Goldberg (1952).

The effect of O. venulosum infection of sheep and goats were studied by Goldberg (1952). After an experimental work he concluded that O. venulosum is not so pathogenic as O. columbianum. In case of O. venulosum

Table XXXIII: A comparison of diagnostic characters of Oesophagostomum venulosum (Rud., 1809).

	Authof Host:	Goodey (1924) Sheep, goat:	Baylis (1936) Sheep, goats, deer Camel.	In the present study sheep, goats:
Character				
1.	Length of Male body	12.0-14.0 mm	11-16 mm	14-15 mm
2.	Length of female body	16.0-20.0 mm	13-24 mm	19-22 mm
3.	Diameter of buccal collar.	Not given	Not given	0.034-0.056x0.170-0.193.
4.	No. of leaf crown and shape.	External 18, Internal 36 anterior margin obtusely rounded.	External 18, Internal 36.	External 18, Internal 36.
5.	Cepalic swelling and cervical grooves.	Well defined, slightly narrowing at cervical groove which terminate in lateral line.	Well developed, diminishes in width before cervical groove which extend only as for as lateral line.	Well marked, diminishing in width immediately before cervical groove, which extend as for as lateral line.
6.	Oesophagus shape and length.	Club-shaped, length not given.	Length 0.8 mm	Club-shaped, 0.96-1.00 mm.
7.	Distance of cervical papillae from anterior end.	Behind oesophagus at distance 1.26	Behind posterior end of oesophagus at about 1.25 mm distance.	Behind oesophagus at a distance 1.23-1.27 mm from anterior end.
8.	Length of spicule	1.1-1.2 mm long	1.1-1.5 mm long	1.442-1.590 mm
9.	Guberaculum	Gubernaculum 0.12	0.09 mm	0.10 mm
10.	Female tail	Gradually tapering	Straight and sharply point. Gradually tapering.	
11.	Vulva distance from posterior end.	Not given	Situated at 0.375-0.5 mm from posterior end.	Situated at a distance 0.45-0.55 from posterior end.
12.	Diameter of egg.	Not given	0.085-0.1 x 0.045-0.055 mm.	0.068-0.090 x 0.034 - 0.45 mm.

nodule formation is rare by feeding 180.000 larvae to a sheep, while in case of O. columbianum several thousands nodules have been produced by the same number of larvae fed to a sheep. Goldberg (loc cit.) also found that older animals were more resistant to infection.

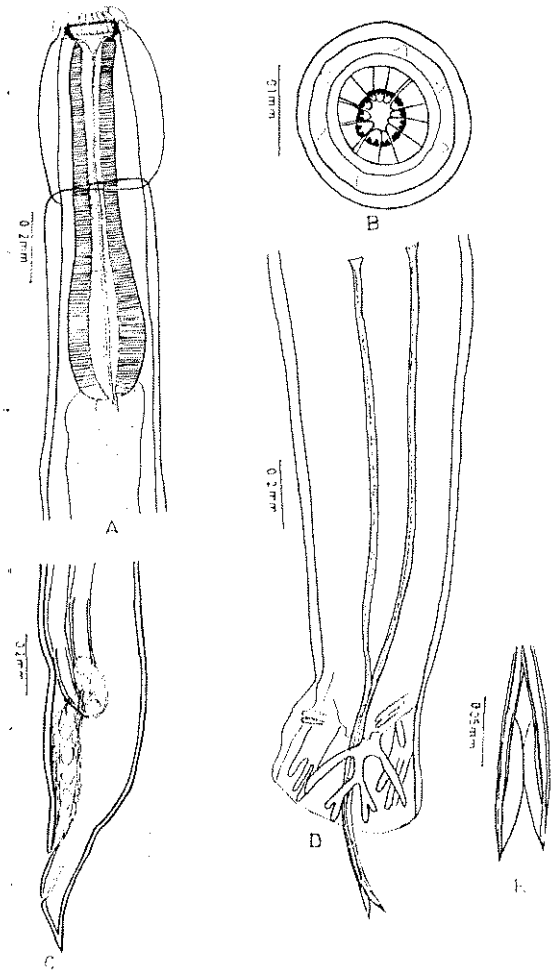


Fig. 24. Oesophagostomum asperum

A - Anterior end

B - Enface view

C - Posterior end of female

D - Posterior end of male

E - Terminal part of spicules.

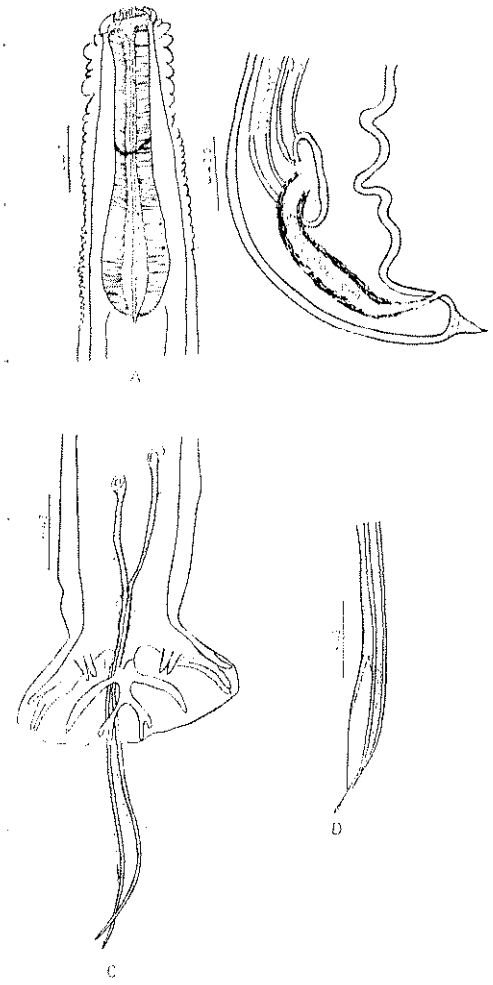


Fig. 25. Oesophagostomum brevicaudum

A - Anterior end

B - Posterior end of female

C - Posterior end of male

D - Terminal part of spicules.

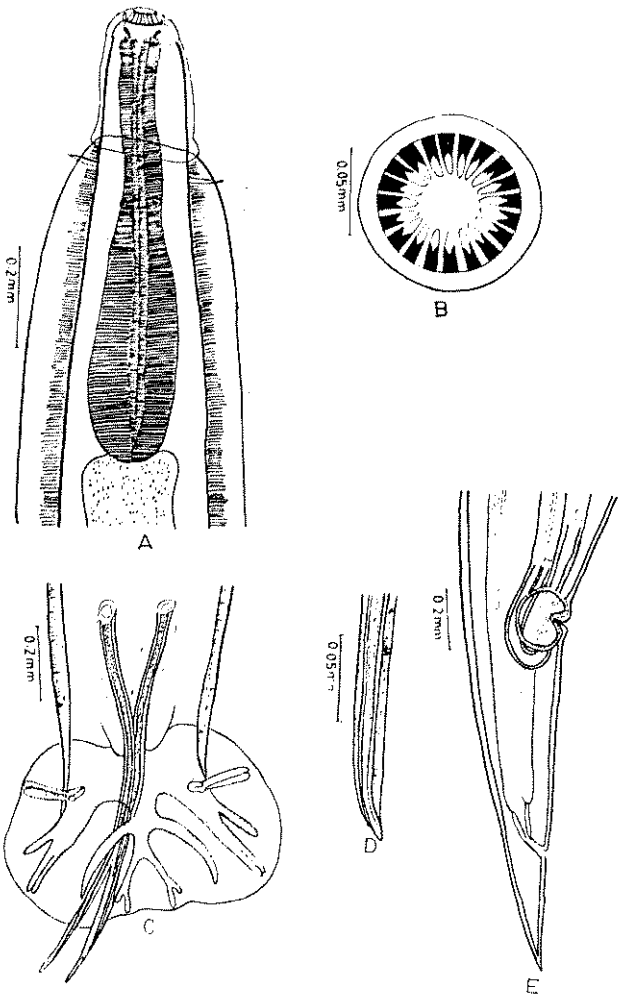


Fig. 26. Oesophagostomum columbianum

A - Anterior end

B - Enface view

C - Posterior end of male

D - Posterior end of female

E - Terminal part of spicule

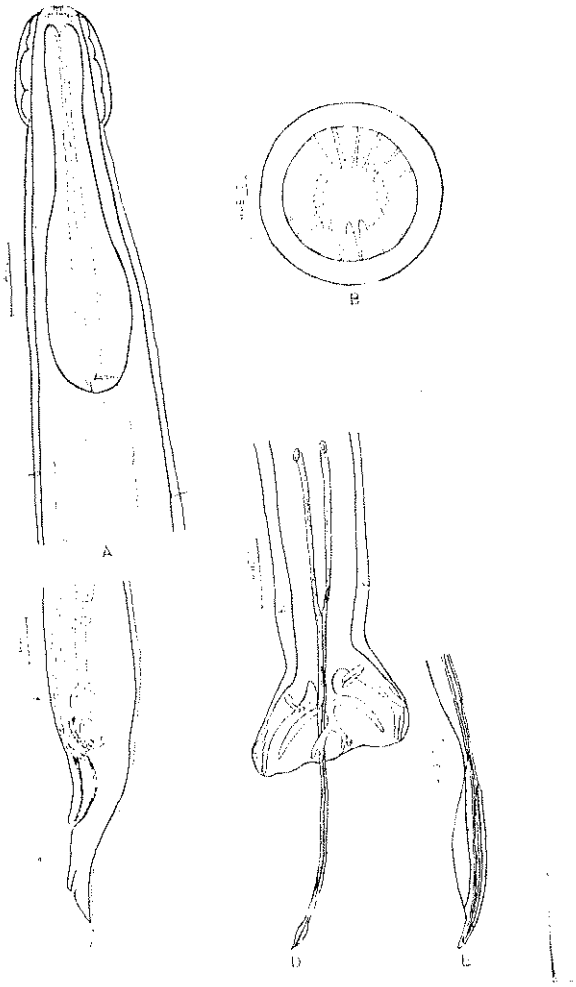


Fig. 27. Oesophagostomum venulosum

A - Anterior end

B - Enface view

C - Posterior end of female

D - Posterior end of male

E - Terminal end of spicule

Genus : Chabertia Railliet et Henry, 1909

Chabertia ovina (Febricius, 1794)

Syn : Strongylus hypostomus Rud., 1819

S. cernuus Crepl., C.P.Sprehn, 1932,

(Fig. 28)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar.

Description : Mouth directed anterio-ventrally, Buccal capsule large, subglobular anteriorly and some what narrowed posteriorly, having a diameter 0.397-0.420 x 0.397-0.420 mm (average 0.408 x 0.412 mm). Double set of leaf crown present, consist of numerous small pointed elements. Ventral cervical groove faint, a trace only cephalic vesicle present ventrally. Buccal capsule without teeth. Oesophagus club-shaped and measuring 1.363-1.476 mm (average 1.430 mm) in length. Nerve ring situated at about anterior third of oesophagus, cervical papillae present and lies at a distance 0.988 mm from anterior end.

Male : Body length measuring 12-19 mm (average 15.4 mm) and width being 0.363-0.477 mm (average 0.425 mm). Bursa short, dorsal lobe slightly larger than lateral lobes, tips of antero-lateral and externo-dorsal rays some what at a distance from edge of bursa, other rays reaching edge, ventral rays close together, medio-lateral stouter than other rays branches of dorsal ray bidigitate, inner termination only reaching edge of bursa, large pre-bursal papillae present. Spicules equal, slender provided with alae, proximal end blunt and distally pointed and measuring 1.510-1.817 mm (average 1.683 mm) in length, accessory place present having a length 0.113 mm.

Female : Body length measuring 20-24 mm (average 21.4 mm) and width being 0.545-0.636 mm (average 0.601 mm). Tail of female measuring 0.227-0.238 mm (average 0.229 mm) in length, tail diminishing rapidly in thickness from anus to a short point, pointed end curved dorsally. Vulva near anus. Eggs measuring 0.068-0.090 x 0.037 - 0.056 mm (average 0.076x 0.045 mm).

REMARKS:

Cythostomatidae was established as family by Yamaguti (1961) synonymising it with family Trichonematidae Witenberg, 1925. It includes three sub-families namely Oesophagostominae, Sauricolinae and Cyathostominae. The russian authors (Skrjabin et al. 1952) include Chabertia ovina in sub-family Chaberttiinae Popova, 1952 of family Strongilidae.

Two representative of sub-family Oesophagostominae were found in the present survey, namely Oesophagostomum and Chabertia. Oesophagostomum has been discussed in previous pages. Chabertia includes two species, namely C. ovina and C. rishati. The former is the type species and has been reported from a wide veriety of hosts including sheep and goat and is cosmipolitan in distribution. Previously it has been reported from goats in Peshawar (Siddiqi and Ashraf, 1980). C. rishati was described from camel from India by Akhtar (1937). Chabertia ovina has also been reported from young cattle in Peshawar (Shah 1985, unpublished data). Bhalerao (1935) as quoted by Baylis (1936) collected this species from cattle and sheep from Mukhtesar, United Province and Punjab.

So far we could ascertain we did not find any reference of finding Chabertia ovina from Pakistan in sheep and goat or cattle, except from Peshawar, therefore, it seems to be a new locality record for Pakistan.

Table XXXIV: Measurements of Chabertia ovina Fabricius, 1794 found in sheep and goat from Peshawar (in mm).

		1	2	3	4	5	Average
Length of male body.	L.	12.00	15.00	19.00	15.00	16.00	15.4
Width of male body	W.	0.454	0.477	0.408	0.363	0.420	0.425
Length of Oesophagus	L.	1.442	1.42	1.47	1.397	1.476	1.441
Length of spicule	L.	1.647	1.738	1.510	1.704	1.817	1.683
Length of female body.	L.	20mm	24 mm	23 mm	19 mm	21 mm	21.4
Width of female body	W.	0.636	0.613	0.613	0.602	0.545	0.601
Length of Oesophagus	L.	1.363	1.476	1.431	1.408	1.476	1.430
Length of tail	L.	0.238	0.227	0.227	0.227	0.227	0.229
Size of egg	L.	0.090	0.079	0.068	0.079	0.068	0.076
		x	x	x	x	x	x
	W.	0.045	0.037	0.045	0.056	0.045	0.045
Distance of papillae from head.		—	0.988	—	—	—	—
Diameter of buccal capsule.	L.	0.397	0.397	0.420	0.408	0.420	0.408
		x	x	x	x	x	x
	W.	0.408	0.420	0.431	0.391	0.408	0.412

Table XXXV: A comparison of diagnostic features of Chabertia ovina (Fabricius, 1794)

Author Host:	Ransom, (1911) Cattle, sheep, goats, Gazella, Goral.	Baylis, (1936) Ox, sheep, goat.	In the present study sheep and goats.
Characters			
1. Length of male	13.0-18.0 mm	13-16 mm	12-19 mm
2. Length of female	14.0-26.0 mm	12-25 mm	20-24 mm
3. Diameter of buccal capsule.	0.345-0.450 x 0.421 - 0.606 mm	Length of buccal Capsule 0.54 mm	0.397-0.420 x 0.397 - 0.420 mm
4. Oesophagus shape, length.	Clavate, length 1.39 - 1.65 mm	Club-shaped 1.2 - 1.4 mm	Club-shaped, 1.363 - 1.47 mm
5. Distance of cervical papillae from anterior end.	Not found	Not given	0.988 mm
6. Spicule length and shape.	1.3-1.8 mm, provided with thin membrane decreasing in thickness distally and curving at tip.	1.3-1.7 mm, provided with alae.	1.510-1.817 mm, provided with alae, proximal end blunt and distally pointed.
7. Gubernaculum length.	0.080 - 0.180 mm	0.08 - 0.1 mm	0.113 mm
8. Female tail length and shape.	Body of female behind vulva bends some what ventrally and behind anus dorsally.	0.2 - 0.23 mm, in length diminish rapidly in thickness from anus to about its middle and then tapers more gradually to a sharp point.	0.227 - 0.238 mm in length diminishing rapidly from anus to its middle and then gradually tapers to short point.
9. Pre-bursal papillae	Large	Large	Large
10. Diameter of egg.	0.09-0.11 x 0.05 mm	0.09-0.01 x 0.05 mm	0.068-0.090 x 0.037-0.056 mm.

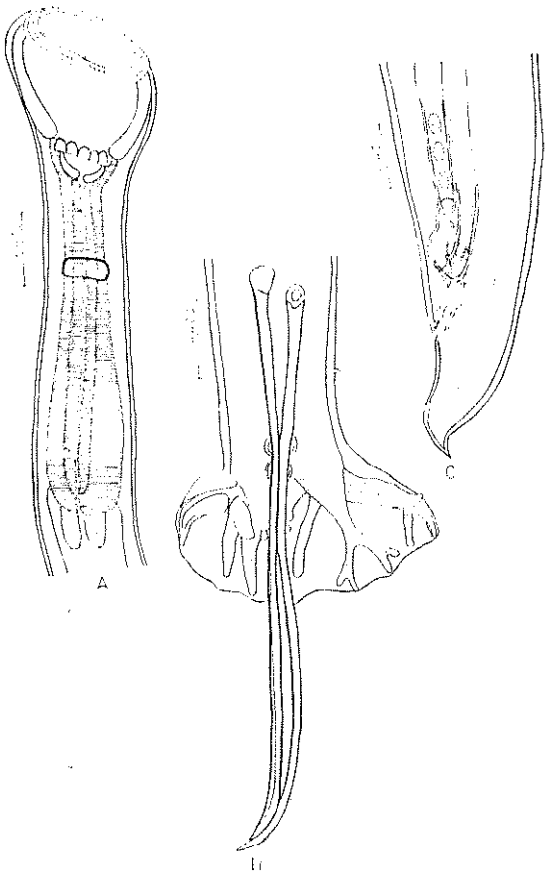


Fig. 28. Chabertia ovina

A - Anterior end

B - Posterior end of male

C - Posterior end of female

Family : Trichostrongylidae Leiper, 1912

Sub family : Haemoncinae Yamaguti, 1961

(Haemonchinae Skrjabin et Schulz, 1952)

Heamoncus (Cobbold, 1898)

Heamoncus contortus (Rud., 1803)

(Fig. 29)

Host : Sheep and goats

Location : Abomasum

Locality : Peshawar.

Description : Head without cuticular dilatation. Head papillae inconspicous. Cervical papillae prominent. Buccal cavity small with a slender tooth originating from dorsal side of its base. Head measuring 0.01 - 0.02 x 0.010 - 0.011 mm (average 0.02 x 0.10 mm) in length.

Male : Worm measuring 12-16 mm (average 13.60 mm) and width being 0.23-0.27 mm (average 0.25 mm). Bursa well developed, lateral lobes large and symmetrical, dorsal lobe asymmetrical, small placed usually on left side of median line; ventro-ventral and latero-ventral rays fused proximally and separated distally; antero-lateral separate from other laterals; externo-dorsal arising separately from dorsal, long, slender; dorsal bifurcate, each limb usually bidigitate. Spicules relatively short, dark-brown measuring 0.45-0.48 mm (average 0.46 mm) in length and width being 0.02-0.03 mm (average 0.03 mm) in diameter, each spicule has a small barb on its tip outer surface, accessory piece fusiform, with thickened edges, and 0.21-0.25 mm (average 0.23 mm).

Female : Body measuring 17-23 mm (average 20.40 mm) in length and width being 0.28-0.51 mm (average 0.34 mm). Vulva covered by a backwardly directed, tongue-shaped flap measuring 1.08-1.19 mm (average 1.146 mm) in length or covered by knob-shaped flap measuring 0.17-0.19 mm(average 0.18 mm) in length.

Table XXXVI: Measurements of Haemoncus contortus (Rud., 1803) found in sheep and goats from Peshawar (in mm).

		1	2	3	4	5	Average
Diameter of head	L.	0.02 x	0.02 x	0.01 x	0.02 x	0.02 x	0.02 x
	W.	0.10	0.11	0.10	0.10	0.10	0.10
Male:							
Length of body		12.00	14.00	11.00	15.00	16.00	13.60
Width of body		0.27	0.27	0.23	0.25	0.23	0.25
Length of Oesophagus		1.48	1.50	1.18	1.22	1.25	1.33
Distance of cervical papillae from anterior end.		0.431	0.397	0.420	0.454	0.432	0.426
Length of spicule		0.47	0.45	0.45	0.48	0.47	0.46
Diameter of spicule.		0.03	0.03	0.03	0.03	0.02	0.03
Barb distance from tip of right spicule.		0.03	0.03	0.03	0.04	0.04	0.04
Barb distance from tip of left spicule.		0.02	0.02	0.02	0.02	0.02	0.02
Length of Gubernaculu.		0.22	0.22	0.25	0.23	0.21	0.23
Female:							
Length of body		20.00	19.00	23.00	17.00	23.00	24.40
Width of body.		0.28	0.28	0.33	0.30	0.51	0.34
Length of vulvar flap (knob form)		0.17	0.19	--	--	--	0.18
Length of vulvar flap (tongue shaped)		--	--	1.19	1.17	1.08	1.146
Size of egg		0.03 x 0.02	0.04 x 0.04	0.04 x 0.02	0.05 x 0.03	0.06 x 0.04	0.04 x 0.03
Length of tail		0.57	0.57	0.33	0.51	0.61	0.51

REMARKS:

Genus Haemoncus Cobbold, 1898 was placed in family Trichostrongylidae and sub-family Haemoncinae (Haemonchinae nom. Haemonchinae Skrjabin et Schulz, 1952) by Yamaguti (1961). H. contortus is the type species while other species recognised by Yamaguti (loc cit.) are H. bedfordi, H. bispinosus, H. lawrencei, H. longistipes, H. lunatus, H. mitchelli, H. okapiae, H. santomei, H. similis, H. tataricus, and H. vegliai. Skrjabin et al. (1952) also mentioned the same species except that apparantly they also consider H. cervinus as valid species.

Out of these species H. contortus has been reported from a wide range of mammalian host and is distributed throughout world. H. bedfordi Le Roux, 1929 and H. similis Travassos, 1914 has been reported from sheep (Ovis aries)the later one from India as well.

Though there are many species synonymised with H. contortus but there is no apparent controversy regarding the constitution of the genus. However, intraspecific variation within the species H. contortus have been subject of interest amongst many workers. Kamensky and Lebedev(1929) as quoted by Skrjabin et al.(1952) noticed great variation in the vulvar region of the females of H. contortus. Based on this observation they created four species of the genus;H. fuhrmanni, H. atectus, H. pseudocontortus and H. contortus. Almeida (1935) while critically evaluating the material realised the significance of the variation merely as intraspecific and concluded that the elevation of such intraspecific variations to the status of distinct species is unwarranted. He further emphasised the role of males in the specific determination particularly the length of the spicules and situation of hooks at various levels. The genital cone, gubernaculum, dorsal ray may also be useful characters in taxonomic discrimination.

Das and Whitlock (1960) as quoted by Soulsby (1965) have studied the comparative morphology of Haemoncus spp. from various geographical regions. According to them consistent morphological differences were found and they considered that substantial evidence was available for sub speciation. Studies of vulvar flap led these authors to believe it as an evolving character in Haemoncus and they proposed two new sub - species and a variety as follows. H. C. contortus in which the vulvar flap is linguiform in over 80% females, knobed in under 10% and smooth in under 10%, H. contortus cayugensis in which over 60% of the female have smooth vulvar flap, over 30% have linguiform and under 15% have knobed flap and H. contortus var. utkalensis 20-25% of the vulvar flap linguiform 40-60% are knobed and under 20% are smooth. The type location of these two species and variety are respectively Queensland (Australia), Newyork state (U.S.A.) and Orissa (India). According to Das and Whitlock (loc cit.) the evolution of the H. contortus is reflection of adaptation of the parasite to a host microclimate interaction.

The only work which has been done to determine biological differences between the various morphological types of females of H. contortus is that of Daskalov (1972). In their previous work (Daskalov, 1963) has already established that the number of knobbed form of subsepecies H. contortus cayugensis is greater in goats than in sheep. Daskalov (1972) experimentally studied that question whether any differences in longevity and intensity of egg production in the different morphologic types of female H. contortus or whether in lamb and kid infections of both hosts offer equally favourable condition for development and survival of larvae and lastly, if there were any differences in the survival of the larvae of all three types of female when stored in water. From these experiments he concluded that environmental conditions or host do not apparently exert any influence on the existance of morpho-types or place any

preferential survival value. He further concluded that these morphological characters are not ordinary modification but have a firmly fixed heritable basis.

According to Soulsby (1968) it was customary to refer to the Haemoncus species of cattle as H. contortus, but studies in Australia by Roberts et al. (1954) led them to conculude that the cattle and sheep forms were distinct and represented two species, H. contortus in sheep and H. placei in cattle. Studies by Bremner (1955) on the chromosomes indicated differences in x chromosomes in two species. The major differences are based on mean spicule length, the distance between the barbs and the tip of the spicule and difference in size and activity of infective larvae.

Sahai and Deo (1964) studied material from sheep and goat from Bareilly (India) which was identified as Haemoncus contortus and H. bispinosus. They considered that H. placei may be synonymised with H. bisp inosus and the later may be considered as valid species.

Bhalerao (1932) in a study of nematode parasites of goats and sheep at Muktesar (India) found great variation in Haemoncus contortus recovered during their study. They listed seven type of variation in the presence or absence of vulvular flap and the variation it undergoes when it is present. These were:

a. No vulvar flap.

b. A small protuberance over-hanging the vulva.

c. Well developed linguiform flap.

d. Bilobed flap resembling bird's head.

e. Well developed linguiform flap with cuticular Swelling or boss.

f. Vulvar flap absent, instead a cuticular boss is developed anterior to vulva and

g. a boss may be present laterally on each side of vulva.

Bhalerao (loc cit.) considered that all these structures help in the process of copulation. Bhalerao, though described maximum variation but did not specify which were more common or characteristic of cattle or goats or were distributed at random in both hosts.

Concluding from the foregoing account one may consider that intra-specific variation mainly related to vulvar flap in female has been a universal observation.

In the present study we also gave considerable time to the problem of intra-specific variation within H. contortus. Our material presented the situation that vulva with flap and knobed were equally distributed and smooth type is not found. The study in young cattle from Peshawar also showed the presence of H. contortus and the situation regarding the distribution of females with vulvar flap and knobed form was almost with equal distribution. In cattle, in female H. contortus with smooth vulva were conspicous due to their absence (Shah, 1985).

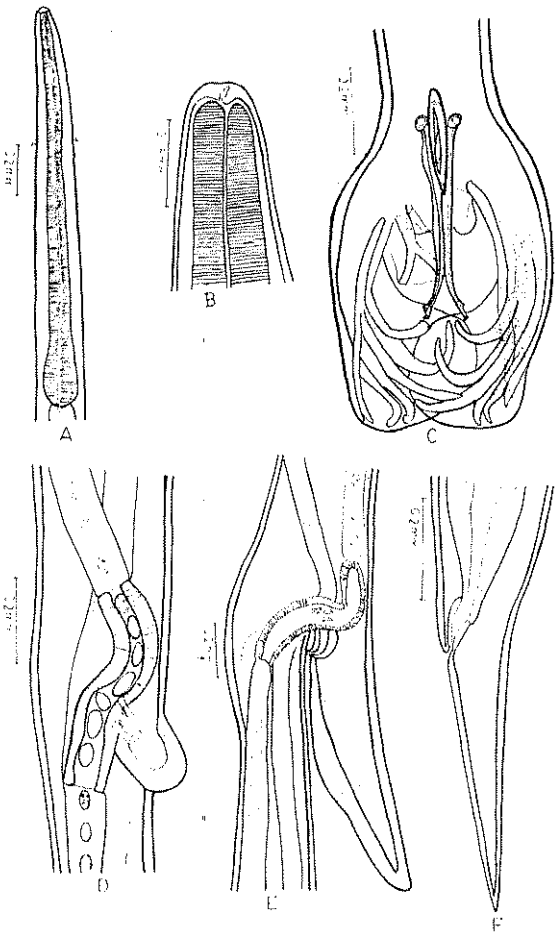


Fig. 29. Haemoncus contortus

A - Anterior end

B - Anterior end (enlarged)

C - Posterior end of male

D - Posterior end of female.

E - Part of female showing knob-like vulva.

F - Part of female showing linguiform vulva.

Family : Protostrongylidae Leiper 1926

Sub family : Dictyocaulinae Skrjabin, 1933

Genus : Dictyocaulus Railliet et-Henry, 1907

Dictyocaulus filaria (Rud., 1809)

Syn : D. sibiricus Orlov in Skrj. and Schulz, 1934

(Fig. 30)

Host : Sheep and goats

Location : Lungs

Locality : Peshawar.

Description : Body filiform mouth surrounded by four lip-like structures, two larger lateral and two other dorsal and ventral. Head bluntly rounded, measuring 0.008-0.013 x 0.094-0.121 mm (average 0.09 x 0.139 mm) in diameter. Buccal capsule distinct but small. Oesophagus club-shaped, measuring 0.363-0.403 mm (average 0.387 mm) in length.

Male : Measuring 55-83 in length (average 68.8 mm). Bursa of male very short, antero-lateral ray originate separately from dorsal rays, medio-lateral and postero-lateral ray fused at least for greater part of their length; externo-dorsal rays originate separatly from dorsal rays, which consist of two separate portions with bidigitate or tridigitate termination. Spicules short, stout, boot-shaped, dark brown having reticulated surface, simple and measuring 0.511-0.647 mm (average 0.583 mm), an accessory piece present.

Female : Measuring 94-108 mm (average 98 mm) in length width being 0.340-0.465 mm (average 0.415 mm). Tail pointed, measuring 0.624-0.727 mm (average 0.688 mm). Vulva near middle of body and rather prominent. Uterine branches opposed. Egg without chitinoid shell, and when laid contain embryo, and having a diameter 0.102-0.136 x 0.056-0.090 mm (average 0.117 x 0.069 mm).

Table XXXVII: Measurements of Dicyocaulus filaria (Rud., 1809) found in sheep and goats from Peshawar (in mm).

		1	2	3	4	5	Average
Length of female worm		94.00	96.00	108.00	97.00	95.00	98.00
Width of female worm		0.420	0.454	0.465	0.397	0.340	0.415
Diameter of head	L.	0.013 x	0.010 x	0.008 x	0.010 x	0.008 x	0.009 x
	W.	0.112	0.121	0.112	0.094	0.094	0.139
Length of Oesophagus.		0.403	0.390	0.403	0.363	0.376	0.387
Length of tail		0.624	0.727	0.761	0.602	0.127	0.688
Diameter of eggs		0.136 x 0.068	0.113 x 0.079	0.124 x 0.090	0.102 x 0.056	0.113 x 0.056	0.117 x 0.069
Length of male worm		83.00	55.00	68.00	63.00	75.00	68.80
Width of male worm		0.340	0.420	0.390	0.306	0.295	0.350
Length of spicule		0.568	0.624	0.647	0.511	0.568	0.583
Width of spicule		0.079	0.090	0.102	0.079	0.113	0.092

REMARKS:

Yamaguti (1961) has listed 10 species of Dictyocaulus, namely D. arnfieldi (Cobbold 1984), D. bisonis Koffman 1942, D. cameli Boev, 1951, D. filaria (Rud., 1809) D. hadwenii Chopin, 1925 D.eckerti Skarjabin, 1931, D. khawi Hasii 1935, D. noerneri Railliet et-Hanry 1907, D. unegualis Bhalerao, 1932 and D. viviparus (Baloch, 1782).

For D. arnfieldi Sarwar (1957) has suggested a new genus Arnfieldia. Whether the erection of the new genus for the differences noted in this species is warranted or not, could not be ascertianed as we could not find any mention of the new genus in subsequent literature. D. arnfieldi D. unequalis has been reported from India from horses and Tibetan sheep respectively. D. vivparus is cosmopolitan in distribution and is reported from goat, while D. cameli is found in camel in Asia which may very well include the Indo-Pakistan Subcontinent. Baylis (1936) mentioned four species of Dictyocaulus occuring in different host in India namely, D. arnfieldi, D. filaria, D. viviparus and D. unequalis. D. filaria is found in sheep and goat. D. unequalis found in Tibetan sheep is a closely related species to D. filaria and can be distinguished from later due to smaller size of spicule and position of vulva in female.

Yorke and Maplestone (1926) mentioned five species of the genus namely, D. filaria, D. arnfieldi, D. hadwenii, D. viviparus and D. noainerі. The first one is reported from sheep and goats.

A comparison of the description of species in the present collection with other authors showed that in essential features it resembles the account given by different authors.

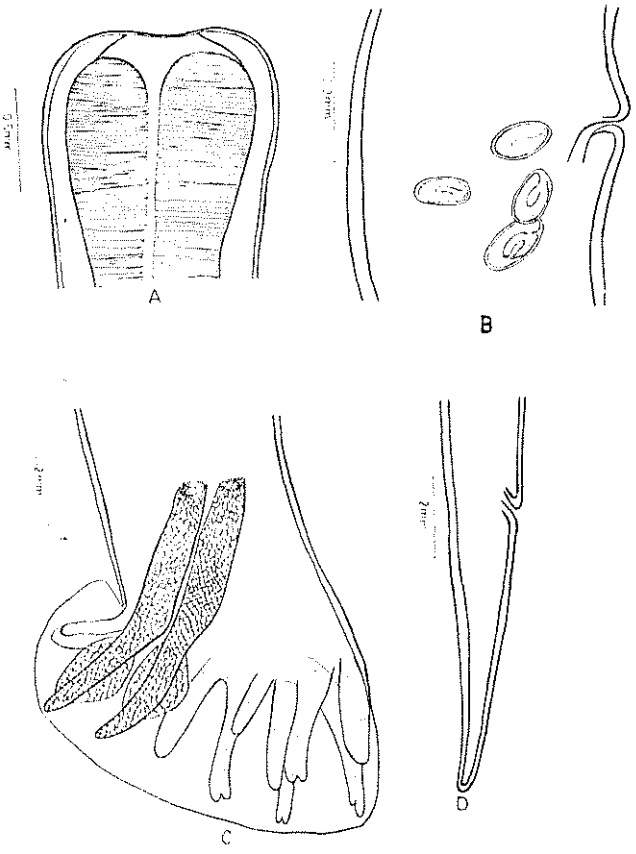


Fig. 30. Dictyocaulus filaria

A - Anterior end

B - Part of female showing vulva and eggs

C - Posterior end of male

D - Posterior end of female

Sub family : Protostrongylinae Kamensky, 1905 (Partim)

Genus : Pneumocaulus Schulz et Andreeva, 1948

Pneumoculus kadenazii Schulz et Andreeva, 1948.

(Fig. 31)

Host : Sheep and goats

Location : Large intestine

Locality : Peshawar.

Description : Head measuring 0.005-0.010 x 0.53-0.64 mm (average 0.007 x 0.058 mm) in diameter. No definite lips and buccal capsule present, oesophagus small, measuring 0.363-0.431 mm (average 0.406 mm) in length. Nerve ring just behind middle of oesophagus, cervical papillae anterior to nerve ring.

Male : Male body measuring 20-25 mm (average 23.6 mm) and width being 0.124-0.147 mm (average 0.135 mm). A pair of large masses of gland-like structures present in front of bursa. Bursa small, bilobed; ventral split at distal half; externo-dorsal short, divided into two bifid branches. Spicules tubular, allate equal, measuring 0.408 mm 0.681 mm (average 0.519 mm). Gubernaculum complex consisting of two separate plates; corpus rod-like, long and spilt distally into two branches, crura paired, elongated with dorsal border serrated.

Female : Body measuring 38-42 mm (average 37 mm) and width being 0.147-0.159 mm (average 0.149 mm). Tail elongated, conical, and measuring 0.090 mm - 0.136 mm (average 0.108 mm). Vulva lies near anus at a distance 0.249-0.306 mm (average 0.278 mm), provaginal flap present over vulvar region. Egg containing segmented ova, measuring 0.090-0.102 x 0.045-0.068 mm (average 0.094 x 0.051 mm) in diameter.

Table XXXVIII: Measurements of Pneumocaulus kadenazii Schulz et - Andreeva, 1948 found in sheep and goat$ from Peshawar (in mm).

	1	2	3	4	5	Average
Diameter of head	0.008 x 0.064	0.008 x 0.059	0.008 x 0.059	0.005 x 0.053	0.010 x 0.059	0.007 x 0.058
Length of female worm	38.00	41.00	34.00	30.00	42.00	37.00
Width of female worm	0.136	0.159	0.147	0.159	0.147	0.149
Length of oesophagus	0.363	0.374	0.408	0.454	0.431	0.406
Distance of vulva from tail.	0.295	0.249	0.249	0.306	0.295	0.278
Diameter of egg	0.090 x 0.068	0.090 x 0.056	0.102 x 0.045	0.102 x 0.045	0.090 x 0.045	0.094 x 0.051
Lenth of tail	0.090	0.102	0.136	0.113	0.136	0.108
Length of male body	25.00	20.00	25.00	23.00	25.00	23.60
Width of male body	0.136	0.147	0.147	0.124	0.124	0.135
Length of spicule	0.579	0.681	0.420	0.408	0.511	0.519

REMARKS:

According to Skrjabin et al. (1952) family Protostrongylidae was established by Leiper (1926) and includes parasites of respiratory or circulatory system of mammals. It is comparatively large family including six sub-families, namely Dictyocaulinae, Crenosomatinae, Troglostrongylinae, Protostronglinae, Metastronglinae and Angiostrongylinae.

The representative of Dictyocaulinae Dictyocaulus filaria is present in our collection and has been reported in the previous pages. Members of Angiostrongylinae are parasites of rodents and carnivores. Crenosomatinae is represented mostly in carnivors and Troglostrongylinae was created as sub family by Yamaguti (1961) and includes parasites of ruminants beside carnivores, Metastrongylinae includes two genera Metastrongylus and Choerostrongylus, the former is represented in sheep and goat by M. elongatus with distribution being cosmopolitan, while the later is found in pigs.

Sub family Protostrongylinae includes 14 genera and is well represented in ruminants including sheep and goats According to the key provided by Yamaguti (1961) genera having bursa supported at base by paired cuticular area include Protogrongylus, Cystocaulus, Pneumocaulus, Neostrongylus. Pneumocaulus can be distinguished from other genera included in the group due to the presence of large paired masses of glands present in front of bursa.

Pneumocaulus is a monotypic genus including P. kadenazii Schulz et- Andreeva, 1948 discovered from Moschus moschiferus from Russia. P. kadenazii from goat was previously reported by Siddiqi and Ashraf (1980) from Peshawar. Its occurrence in sheep constitute a new host record, Varestrongylus has been reported from sheep and goat from Indo-Pakistan Sub-continent. V. capricola Sarwar (1944) has been reported from sheep and goat from Pakistan. However, Varestrongylus differs in many

respects from Pneumocaulus, the principle difference being presence of large paired masses of gland in front of bursa in the later.

Pneumostrongylus ovis Sarwar, 1953 has been described from sheep and goat in Pakistan. This can be easily destinguished from the specimen present in our collection by bursal characters of male and absence of spine in female.

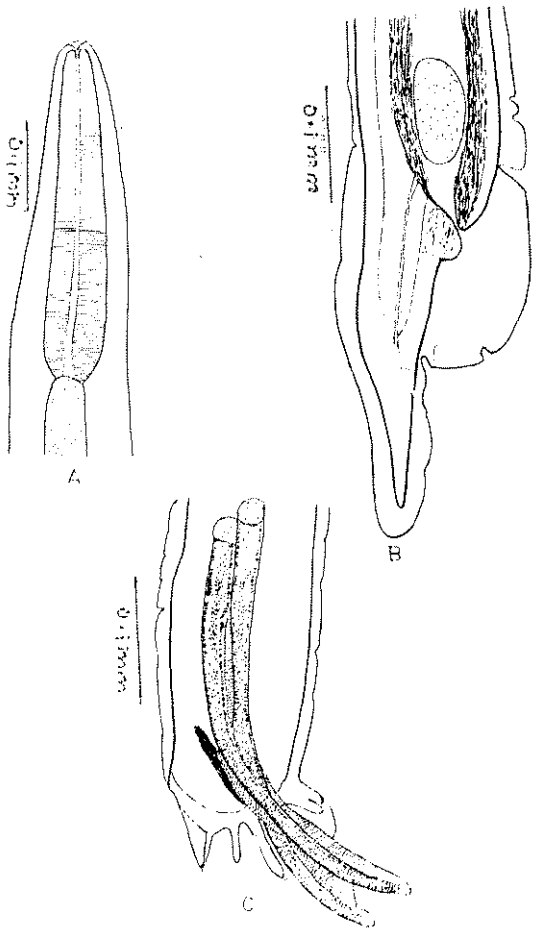


Fig. 31. Pneumocaulus kadenazii

A - Anterior end

B - Posterior end of female.

C - Posterior end of male.

Family : Oxyuridae Cobbold, 1864

Sub family : Syphaciinae Railliet, 1916

Genus : Skrjabinema Wereschtchagin, 1926

Skrjabinema ovis (Skrjabin, 1915) Wereschtchagin, 1926.

(Fig. 32)

Host : Goat

Locality : Peshawar

Description : Only female specimen present. Cephalic cuticle inflated; transversely striated lateral alae present. Mouth with three lips. Interlabia present. Mouth surrounded by three pair of papillae, one lateral and two sub median. Head measuring 3-4 x 7-8 mm (average 3.40 x 7.40 mm) in diameter, oesophagus cylindrical, with large spherical posterior bulb containing a vulvar apparatus. Cylindrical portion of oesophagus measuring 0.69-0.90 mm (average 0.87 mm) in length and oesophageal bulb measuring 0.17 - 0.19 x 0.17-0.19 mm, tail long tapering gradually to a blunt conical and measuring 1.07 - 1.24 mm (1.16 mm). Vulva in anterior half of body. Egg oval in shape having a diameter of 0.04 - 0.06 x 0.01 - 0.02 mm.

REMARKS:

According to Yamaguti, 1961 Genus Skrjabinema was established by Wereschtohagin in 1926. Monning (1932) divided the genus into two sub - genera, Skrjabinema and Chylocrypta depending on whether or not the lips protrude from mouth opening, Yamaguti (Loc cit.) included seven species in this genus S. ovis Skrjabin, 1915 Wereschtohagin, 1926, S. africanum Monning 1932. S. alatum Monning 1932, S. oreamni Swales, 1934, S. parvum Dikman 1942, S. rupicaprae Bohm, et Gebaurae, 1930, S. tarandi Skrjabin et Mitskevich, 1930, S. caprae Schad, 1959. Out of these 3 species

Table XXXIX : Measurements of Skrjabinema ovis (Skrjabin, 1915) Wereschtchagin, 1926 found in goat from Peshawar (in mm).

		1	2	3	4	5	Average
Diameter of head	L.	3.00	4.00	3.00	4.00	3.00	3.40
		x	x	x	x	x	x
	W.	7.00	7.00	8.00	7.00	8.00	7.40
Length of oesophagus		0.90	0.69	0.82	0.86	0.82	0.87
Diameter of oesophageal bulb		0.19	0.19	0.17	0.18	0.17	0.18
		x	x	x	x	x	x
		0.18	0.19	0.17	0.18	0.17	0.17
Length of female body.		6.00	7.00	9.00	7.00	7.00	7.00
Width of female body.		0.45	0.39	0.43	0.43	0.44	0.42
Length of tail		1.18	1.07	1.20	1.13	1.24	1.16
Size of egg	L.	0.04	0.06	0.05	0.04	0.04	0.04
		x	x	x	x	x	x
		0.01	0.02	0.02	0.02	0.02	0.01

S. ovis, S. alatum and S. caprae were found from sheep and goat of Europe, Africa, and India.

Beside Skrjabinema, Acanthoxynema lucknowense Khera, 1956 has also been found in goats of Peshawar (Siddiqi and Ashraf, 1980). It was first described from the intestine of goat by Khera (1956). Only females were known. Yamaguti (1961) placed it as an appendix to family Oxyuridae. Siddiqi and Shirin Nawaz (1981) provided the description of male for the first time. After discussion of the placement of this parasite. They came to this conclusion that it closely resembles with representative of sub family Aspicularinae and suggested that a new sub family may be created to accommodate this species alternatively sub family diagnosis of Aspicularinae may be modified to accommodate this species.

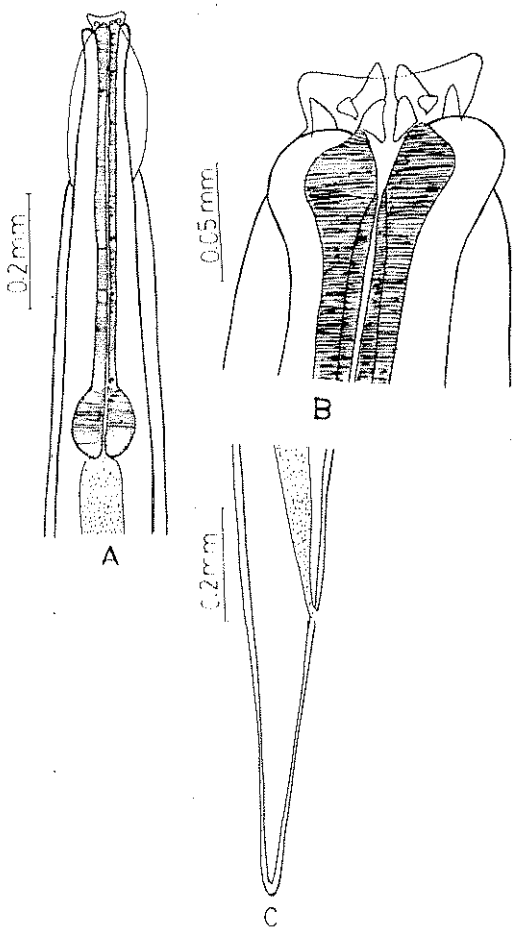


Fig. 32. Skrjabinema ovis

A - Anterior end

B - Anterior end (enlarged)

C - Posterior end of female.

CHAPTER II

Incidence and distribution

INCIDENCE AND DISTRIBUTION

Trematoda:

Fasciola hepatica: 203 livers attached to gastro-intestinal tract and 208 extra livers of sheep were examined for livers flukes infection. The over all infection in two years was 30.54% (Table XLIII) in the livers attached to gastro-intestinal tract and 70.19% in extra livers examined. (Table XLIX). The higher incidence in the case of extra livers was due to the fact that these livers were from older animals and were rather showing liver rot.

In case of goats 202 livers attached to gastro-intestinal tract and 190 extra livers were examined for liver flukes infection. The over all infection for two years was 26.24 (Table XLVI) in the livers attached to gastro-intestinal tract and 70.00 in extra livers examined. (Table LII). The highers incidence in the case of extra livers was due to the fact that these livers were from older animals and were showing liver rot as already mentioned in the case of sheep. In a study of the incidence and distribution of F. hepatica and F. gigantica in Pakistan, Kendall, (1954) found that F. gigantica is more dominant species. It was found throughout Punjab, East Bengal and North West Frontier Province. According to Kendall (Loc. cit.) the worst effected areas include some part of the Punjab and Sind Province, Dera Ismail Khan (N.W.F.P.) and East Bengal. He also quoted that diseases incidence varies within wide limits, throughout country. In Peshawar it is 70-80%, in Dacca 60% and in Sind Province 50%.

The only early reference of occurrence of liver fluke in this Province is that of Srivastva (1939) who recorded F. gigantica from the lungs of goat from N.W.F.P.

Wahid (1954) mentioned the status of liver fluke disease in N.W.F.P According to him the disease was present through out the year, but the

outbreaks have been sporadic and the disease was confined to areas, which are situated on the banks of river and canals or in waterlogged and flooded areas.

According to Kendall (1954) the distribution of F. hepatica and F. gigantica is related to the distribution of their snail vectors. Lymnea truncatula is the vector of F. hepatica in Pakistan and was never found below 4000 feet in Pakistan. Lymnea auricularia rufescens is the vector of F. gigantica and occurs throughout Pakistan, the two species of snail incriminated as vector F. hepatica and F. gigantica differ markedly in their geographical distribution.

The livers examined in the present survey were brought from slaughter house. As it has already been mentioned in the materials and methods the goats and sheep slaghtered in Peshawar are brought from almost all parts of N.W.F.P. If the distribution of F. hepatica and F. gigantica follows the distribution as suggested by Kendall (loc cit.) we should have found both F. hepatica and F. gigantica, but total absence of F. gigantica is intriguing. In the light of foregoing discussion the statement of Kendall (1954) does not seem to be valid for N.W.F.P, for which he emphatically advocated the presence of F. hepatica only in high lands. The only possibility is that all of the livers examined in the present survey might have come from high land region which cannot be confirmed, but seem to be highly unlikely. If both the species would have been present, it would have been a more logical situation in the light of Kendall's observation.

Inspite of its early record from Indo-Pakistan sub-continent there seems to be little work done on epidemiology, pathology and pathogenesis of natural infections or in experimental hosts. The information is more scanty for goats.

Gaiger (1910) provided a checklist of the parasites of domesticated animals of India and mentioned common occurrence of F.hepatica in Himalayas at 7000 feet. The same situation was also observed by Bhalerao,(1935). He mentioned that F. hepatica was found mostly in warmer areas and having a wider distribution throughout India.

The life history of F. gigantica was worked out in India in detail by Thapar and Tandon (1952). They observed that F. gigantica is widely distributed parasite of cattle, buffaloes in India. Beside cattle and buffaloes they also found this parasite in sheep and goats.

Varma (1954) studied Fascioliasis in Bihar (India) and found that Fasciola indica is prevalent species in this region of India.

Bhatia (1960) studied the gross and microscopic pathology of F. gigantica from Hill sheep and Tibetan sheep. Gross examination of livers showed a condition commonly known as 'piply liver'. The microscopical changes described were typical of those described in literature.

Yousaf et al. (1970) recorded 80% animals in East Pakistan (Bengla Desh) and 50% in West Pakistan which suffered from Fascioliasis resulting in mortalities, unthriftiness, indigestion, diarrhoea, and loss of weight, wool, milk and meat, and also reduced working capacity. They observed that disease was widely prevalent particularly in water logged and low lying areas, and highly irrigated and river tracts.

Sinha and Sahai (1973) during a survey in India (Bihar) found 11.8% of F. gigantica infection.

Sivanarayane (1975) studied acute fascioliasis in sheep in a village west Godavari district of India. He recorded 50 death of sheep during period of one months.

Survey in Sind by Mohiuddin (1976-77) showed no incidence of fascioliasis in any of the 233 goats and sheep examined. Perhaps examination of livers was not included in their schedule.

Majid and Hussain (1980) in a survey of tramatodes of sheep slaughtered in the abattoirs of Lahore found mixed infection of F. hepatica and F. gigantica in equal number of hosts.

Durrani et al.(1981) during a survey of helminth parasite of Azad Kashmir found 35% F. hepatica and 73.2% F. gigantica infection in Azad Kashmir by examining feacal sample of 1000 sheep and goats.

Maqbool and Irfan (1983) reported 66.6% infestation due to fascioliasis in sheep around Lahore. Chaudhry and Niaz (1984) reported 66.6% liver-fluke infestation in Bhawalpure.

Anwar and Chaudhry (1984) studied sample of 7700 sheep and goats of Faisalabad. They found 58.5% infestation with Fasciola hepatica.

Burriro, Phulan and Junejo (1984) studied Fascioliasis, District wise in Province of Sind. They found infestation rate as 50.88% in Hyderabad District, 37.96% in Tharparker, 26.50% in Sanger, 3.92% in Dadu and no infection was reported from Thatta district.

Malik (1984) also studied district-wise incidence of Fascioliasis in Livestock in Sargodha Division, he found 36.07% incidence in Jhang. 32.88% in Sargodha 25.00% in Faisalabad and 10.49% in Mianwali district.

Chaudhry and Niaz (1984 examined 22,773 faecal sample from ruminants from Bhawalpure and found 1749 samples positive for fascioliasis.

Sheikh et al. (1984) have collected data on climatic and biological factors, which may play some role in the spread of fascioliasis in Sind Province of Pakistan. They have quoted Sarwar (1956) for finding snail vector infected with Fasciola gigantica and F. hepatica in Thatta and Badin districts.

To conclude the distribution of the liver-fluke infections seems to be throughout Pakistan. There is no authenticated information about Baluchistan Province but one can presume that it will also be found throughout its range as in other provinces. Varying figures for incidence are expected and no valid comparasion can be made as it will depend on a number of factors principaly on method of sampling, age of the animals examined and season of the year when sampling is done.

Dicroceolium lanceatum:

D. lanceatum does not seem to be a common parasite in N.W.F.P. as well as in Pakistan. In sheep the incidence of infection was 2.00 in first year of survey. In second year, incidence of infection was 1.94 and for both years incidence of infection was 1.97 (Table XLIII).

In goats incidence of infection of D. lanceatum was 2.97 in Ist year and in 2nd year no infection was observed.

In extra liver examined in Ist year the incidence of infection was 1.06% in goats and 1.94 in sheep. In the second year no infection was found, in both hosts incidence of infection for both years was 0.53 in goats, (Table LII) and 0.96 in sheep. (Table XLIX).

Though the incidence is not very high, but a few which were found infected carried a large number of fluke in it as will be discussed in later chapters.

Bhatia (1960), found Dicroceolium dendriticum in three of seven Tibetan sheep examined. He provided a brief description of histopathology of natural infection. He mentioned that D. dentriticum infection is mostly found in hilly regions of India. It seems to be the case in Pakistan too as it is quite likely that the sheep and goats positive for this infection in our survey might have come from hilly region of N.W.F.P.

Muhiuddin (1976-77) did not report this parasite out of 233 sheep and goats examined from Sind Area. Siddiqi and Ashraf (1980) also reported a very low incidence from Peshawar, as out of 19 goats only one goat was infected.

Durrani et al. (1981) reported an incidence of 43% in 1000 sheep and goats in Jehlum valley (Azad Kashmir), which is mountainous region. As this survey was based on examination of faecal sample, therefore much is to be desired in accepting correct diagnosis on the basis of examination of faecal sample.

Majid and Hussain (1980) found only 3 sheep infected with this parasite, out of 320 sheep examined from Lahore. Their data seems to be reliable as full gastro-intestinal tract alongwith liver were examined. Our experience has been the same that out of almost four hundred sheep and goats examined for two years only a few carried Dicrocoelium infection

Cotylophoron ovatum:

C. ovatum does not seem to be a common parasite of sheep and goats in N.W.F.P. As seven sheep out of 203 and 11 goats out of 202 were found infected with C. ovatum. The incidence of infection was 3.45 (Table XLIII) in sheep and was 5.45 (Table XLVI) in goats. While in extra liver examined it was found only in one sheep out of 208 livers examined and in this way incidence of infection was 0.47 (Table XLIX). In sheep in

Ist year of survey incidence of infection was 2.00 and in second year incidence was 4.85, while in goats incidence of infection was 3.96 in Ist year and in second year incidence of infection was 6.93.

Literature survey showed that Cotylophoron ovatum is only found in N.W.F.P. in Pakistan. Siddiqi and Ashraf (1980) for the first time reported this parasite from 19 goats examined with an incidence of infection being 21.05. Other survey work in different region of Pakistan showed that an other species of genus Cotylophoron, C. cotylophorum is present in different Provinces of Pakistan.

Mohiuddin et al. (1982) found 34.1% sheep and 33.83% goats infected with Cotylophoron cotylophorum in the Province of Sind. Majid and Hussain (1980) found C. cotylophorum that 24.87% sheep were infected with C. coty-lophorum from Lahore. Durrani et al. (1981) found C. cotylophorum with an incidence of infection 16.0 from Azad Kashmir.

Harshey (1934) first reported this parasite (C. ovatum) from India during a survey of Desi variety of sheep and goats at Allabad (India). He found 100% infection in both sheep and goats examined. Beside C. ovatum he also found other two species of Cotylophoron, C. orientalis and C. elongatus with incidence of infection being 100 and 60 in sheep and goats respectively.

While, Moghe (1945) during a survey of sheep, goats and cattle in central provinces of Berar (India) found 51% of sheep infected with Coty-lophoron cotylophorum, and 76% goats were infected with C. cotylophorum and Gastrothylax crumenifer. Sinha and Sahi (1973) reported 47.5% infec-tion of Cotylophoron cotylophorum in goats in Bihar India.

Thapar (1956) surveyed sheep, goats, buffaloes and cattle in India for helminth parasite, Amphistome were abundantly found in all the four

ruminants examined. Gastrothylax crumenifer and Cotylophoron cotylophorum were very common and showed maximum degree of infection and heavy worm load per animal.

The question arises why we did not find C. cotylophorum and at the same time why C. ovatum has not been reported from other parts of Pakistan? It is likely that C. cotylophorum is a species more frequently distributed in plain areas of Pakistan and C. ovatum is restricted to N.W.F.P. Alternatively, it is also possible that C.ovatum may be present in other parts of Pakistan if the material found is evaluated more critically, especially if the taxonomic discrimination is based on adults alongwith eggs in the faecal sample.

Paramphistomum (E) explanatum:

The species of Paramphistomum recorded from sheep and goats as listed by Soulsby (1965) are Pharamphistomum cervi and P. explanatum which are cosmopolitan in distribution. Beside these species P. orthoceolium, Cotylophoron cotylophorum, C. indicum, Calicophoron calicophorum, C. ijimai, Ceylonocotyle streptoceolium and Gastrothylax crumenifer are reported from India.

From Pakistan P. cervi, P. (E) explanatum, Cotylophoron cotylophorum and Gastrothylax crumenifer have been reported. Genus Calicophoron seems to be apparently absent from Pakistan as no species of Calicophoron has been reported from sheep and goats if one analyses the species mentioned under this genus in Yamaguti's Systema Helminthum (Yamaguti, 1958). More-over, except C. raja Nasmark, 1937 from Sudan cattle all other species listed by him are either synonym of P. cervi or of P. explanatum. The point we are trying to emphasize is that the occurrence of Calicophoron in sheep or goat is at least doubtful in India or Pakistan.

Ceylonocotyle scoliocoelium has been reported from Capra hircus from Japan, while C. orthocoelium, C. streptoceolium have been found in hosts other than sheep and goats and outside Indo-Pakistan sub-continent.

P. explanatum alongwith P. cervi have been incriminated in outbreaks in sheep and goats by Katiyar and Varshney (1963) in Uttar Pardesh (India).

The situation in Pakistan is not very clear. Mohiuddin (1976) in their survey of sheep and goat reported comparatively high incidence of Paramphistomiasis upto more than 30%. The species incriminated were however, Cotylophoron cotylophorum and Gastrothylax crumenifer.

In a previous survey of goats in Peshawar, Siddiqi and Ashraf(1980) found Cotylophoron ovatum, Cotylophoron sp. and Paramphistomum (E) explanatum was found in gall bladder. The specimen from gall bladder were available for comparison with the material in the present survey and a critical analysis showed that the specimens are in agreement regarding morphometric studies and other diagnostic features. Horak(1971) mentioned one of his earlier studies (Horak,1967) that effect of massive infection of P. microbothrium in sheep and cattle may lead to its distribution beside intestine in to the gall bladder.

We have not been able to trace any reference of finding of P. E. explanatum from sheep or goats from Pakistan. The reason may be either due to lack of critical analysis of the Paramphistome material, which has been found or it may be due to restricted distribution of P. E. explanatum in this region of Pakistan.

It seems that incidence of infection is very low also in N.W.F.P. P. E. explanatum as it was found only in 5 sheep out of 203 sheep. In case of sheep in Ist year the incidence of this parasite was 3.00 (Table XLI). And in 2nd year incidence of infection was 2.91 (Table XLII).

In goats examined the incidence in Ist year was 2.97 (Table XLIV). In 2nd year incidence of infection was 1.98 (Table XLV). While incidence of infection for two years was 2.48 (Table XLVI).

In extra livers examined no infection was found.

Durrani et al. (1981) did not report this parasite, however Majid and Hussain (1980) mention another species i.e. Paramphistomum cervi with a higher incilence of infection (36.25). However, the survey was based on the examination of faecal material and exact specific diagnosis may be doubtful.

According to Soulsby (1965) adult parasites in the forestomach of sheep are non-pathogenic even though present in large numbers. The immature worms are responsible for marked irritation and inflammation of duodenal mucosa. A disease of sheep and goat in India named "giller" was recognised by Baldrey (1906) and Walker (1906) as quoted by Soulsby(1965). Walker (loc cit.) noted that giller was confined to low lying swampy area along the banks of rivers which were often flooded during rainy months. As most of the species of Paramphistomes are also found in cattle and seem to suffer to a lesser degree may play an important role in the epidemiology.

Gastrothylax crumenifer:

This parasite has been reported as early as 1910 by Stiles and Goldberger from India, Gaiger (1910). Maplestone (1923) and Baylis (1929) further confirmed its presence in India. Fischoeder (1903) Linstow (1906) Baylis (1929) reported it from Ceylon and Bhalerao (1926) reproted it from cattle and buffalo from Burma. All these early reports as mentioned by Bhalerao (1935) are from cattle and Buffalo. However, Yamaguti (1958) also included sheep and goats as its hosts in Asia. As already mentioned in the account of its taxonomy, Harshey (1934) recovered G. crumenifer from both

sheep and goat, though the material recovered from the former host was considered as G. elongatus. Srivastava, (1944) included G. crumenifer as one of the common amphistome in sheep, goats cattle and buffaloes in Northern India. According to him in heavy infections several thousands worms may be present in a single host. This has also been the experience of Mukherjee and Deorani (1962) who recovered 27,768 specimens of G. crumenifer from a single sheep in Bareilly (India). Sarwar (1962) mentioned amphistomes infection as the most important single disease in alluvial areas but did not further elaborate on species diagnosis.

Mohiuddin (1984) reported G. crumenifer from different parts of Sind. This seems to be the only authenticated report of finding this parasite from Pakistan from sheep and goat host. Siddiqi and Ashraf(1980) did not find it in 19 goats examined for gastro-intestinal helminths. Thus, our finding of this parasite from sheep and goat is the first one for N.W.F.P. and of course, second one for Pakistan. It was found in 13 sheep and 14 goats (6.4% and 6.93%) in two years though the number of each host infected per year differed. (Table XLIII-XLVI). One may conclude that the distribution and incidence of G. crumenifer is sporadic, but once found infected, may carry heavy worm burden, which will be discussed in the following chapter.

Watsonius capri sp.nov:

Genus Watsonius was reported from the Caprine host for the first time by Siddiqi and Ashraf (1980). At that time due to paucity of literature even the diagnosis of genus was considered to be tentative. In the present survey more specimen were recovered from caprine host. Examination of more than 200 sheep never revealed the presence of this parasite. The taxonomic discrimination and its placement in higher taxa has already been discussed in the previous chapter on taxonomy. A single goat host (18)

carried five specimen of Watsonius capri sp. nov.

No member of genus Watsonius have been reported from Indo-Pakistan Sub-continent. Sey (1984), while describing a new species of Watsonius as W. papillatus has reviewed the literature upto date. The presence of Watsonius in caprine host though intriguing, but not impossible as many amphistomes are found in a variety of hosts. Watsonius watsoni has been reported once in a human subject and other species are found in primate hosts.

Extending the range of distribution of Watsonius to ruminants and to this part of the world need further work to confirm both these points and this can be done by comparing the material already described as belonging to genus Watsonius.

Cestoda:

Monieza expansa and M. (B.) benedeni:

We have not been able to trace any published record of existence of Moniezia spp. in N.W.F.P. though it seems to be quite common observation of veterinarian of its finding in sheep and goats beside other ruminants. M. expansa and M. benedeni was reported by Siddiqi and Ashraf (1980) from goats of Peshawar. Shah (1985) also reported the same two species from young cattle from Peshawar.

In the present survey incidence of M. expansa was rather low as compared to what is reported in literature. In sheep it was 4.43 (Table XLIII) and for goats it was slightly higher (4.45) (Table XLVI). M. (B.) benedeni was more common (6.90) (Table XLII) in sheep and 6.93 in goat (Table XLV).

Monieziasis is caused by two species Moniezia expansa and M. benedeni in Indo-Pakistan Sub-continent. Earlier account of finding of

M. benedeni from sheep by Southwell and for M. expansa by Gaiger and Southwell are quoted in fauna of British India (Vol.II, cestoda) since then it has been reported from many parts of Pakistan.

Sarwar (1962) reported M. expansa from Sub-mountainous region and Palaeractic region of Kalat. The extreme northern tract in which he included Peshawar district was free from Moniezia infection.

Chaudhry and Durrani (1966) examined an impressive number of guts at Lyallpur (Faisalabad) and found that out of 32,845 guts examined over a period of three years 64% carried Moniezia infection. This seems to be the highest incidence ever reported. The species involved were M. expansa M. benedeni and M. lyallpurensis which they claimed to be a new species.

In Sind Province Mohiuddin et al. (1984) found 59.13% sheep and 24.5% goats infected with Anoplocephalids. It is not clear from their paper, whether it included other anoplocephalids beside M. expansa and M. benedeni.

In a recent publication Mohiuddin et al. (1984) found M. expansa, M. benedeni and M. denticulata in sheep and goats from Sind area. The incidence is not given in figures and their graphic representation to assess the incidence is difficult to read. However, at one place they mentioned incidence of anoplocephalids as 11.5% in Hyderabad as compared to 55% in the previous years (Mohiuddin et al.1977). This difference they have related to age difference in the two surveys.

Another point of interest in their work is the finding of M. denticulata, beside M. expansa and M. benedeni. Beside the controversy of validity of M. denticulata it is just possible that the range of its distribution may be restricted to Sind and Punjab. The reporting of it from Punjab is an old one by Southwell (1930) and Bhalerao (1934) as

quoted by Saxena and Deo (1964).

Avitellina centripunctata:

The incidence in the present survey was rather low as compared to what is reported by Yousuf and Barya (1968) or Mohiuddin (1976-1977) see Tables XLIII and XLVI. The incidence is related to the number of animal examined and the period of survey and is quite variable from year to year as has been the experience of Russian workers.

Following Yamaguti (1959) out of sixteen species of Avitellina, nine are reported from India and Pakistan, there by showing that this genus is fairly represented in Indo-Pakistan Sub-continent. Genus Avitellina is commonly found in herbivores, more specifically in sheep, goats and cattle. As is the case in most of such studies the validity of a particular species in a survey on helminth parasite is always open to question. The validity of species of genus Avitellina has already been presented in the section on taxonomy. Our purpose is now only to high light the distribution of Avitellina in sheep and goats of India and Pakistan and more specifically in the later region. The presence of A. centripunctata has been doubted as early as 1930 when Southwell (Southwell, 1930) mentioned, whether the presence of it in sheep in India is valid or not. However, it is taken far granted now that A. centripunctata (Rivolta, 1874) does exist in India and Pakistan. A. lahorea, A. goughi and A. centripunctata have been reported from Punjab as mentioned by Southwell (1930). After the establishment of Pakistan in 1947 all the reports of finding of Avitellina are for A. centripunctata due to the shape of the paruterine organ which is typically pear or sac-shaped.

Yousuf and Barya (1968) have claimed to find four species of Avitellina: A. lahorea, A. woodlandi, A. sudanea and A centripunctata in sheep and goats slaughtered in Lyallpur (Faisalabad) and reported a rather

high incidence upto 43%. We could not have access to their material to compare and confirm the validity of the species diagnosis as such. According to Spasskii (1951), Lopez-Neyra (1944) synonyomised A. sudanea with A. centripunctata and A. woodlandi, though considered a valid species found in sheep and goat in India has not been reported from amy part of Pakistan so far. Mohiuddin, (1976 and 1977) found A. centripunctata in 50% and 33.3% goats in Sind Area. Siddiqi and Ashraf (1980) found A. centripunctata in goats and Shah (1985) also reported it from cattle from Peshawar. Material from both sources conformed to A. centripunctata.

Stilesia vittata:

The incidence of infection in sheep in the present survey of S. vittata was 11.82 for two years (Table XLIII). In the first year it was 18 while in the second year it was 5.83. The level of incidence in goats was almost like sheep it was 10.89 for two years (Table XLVI), 15.84 in the first year and 5.94 in the second year.

Stilesia hepatica has been found in the bile duct of the sheep and goats beside other ruminants in many parts of Africa and Asia, However, inspite of an intensive examination of bile duct of more than 400 sheep and goats it was not found in the present survey. S. globipunctata has been reported from sheep and goats from Indo-Pakistan Sub-continent. Mohiuddin et al. (1984) has reported S. globipunctata from sheep and goats from Sind. It seems that S. globipunctata is replaced by S. vittata in N.W.F.P. Alternatively, it is just possible that the material examined by Mohiuddin et al.(1984) was not critically evaluated and may very well be S. vittata as the distinction between the two species required critical analysis of uterine loop and the variation thereof may lead to wrong identification.

Mohiuddin (1977) found higher incidence of S. globipunctata(42.7), while in the year preceding (Mohiuddin, 1976) the incidence was only 28.0 in sheep and 33.3 in goats. They also reported Thysaniesia giardi which has been synonymised with T. ovilla (Rivolta, 1878). This genus seems to be absent in N.W.F.P.

Southwell (1930) reported S. vittata from sheep of Lahore. According to him the species is exclusively known from camel and dromedary as it has already been discussed earlier and according to him the host was not labelled properly (See page 51). However, in an earlier survey (Siddiqi and Ashraf, 1980) has already reported the presence of S. vittata in goats in N.W.F.P. Bhelerao (1935) challenged the statement of Southwell (1930) and mentioned that he collected S. vittata on several occasions from the goats and sheep at Mukhteswar (U.P., India).

Stilesia is only found in sheep and goats. Young cattle have been recently examined for helminthic infection and did not show the presence of genus Stilesia, though Avitellina was found (Shah,1985).

Cysticercus tenuicollis:

The incidence of C. tenuicollis is shown in Table XLVI and XLIII. As it can be seen C. tenuicollis constitutes the most common cestods infection in goats as 17.33% were infected while in sheep it was slightly less (16.75%). It is interesting to note that higher incidence was found in livers attached to gastrointestinal tract rather then extra livers examined in the present survey. Two explanations may be given, one that the extra liver were from comparatively old animals, secondly, the extra liver as excised from the rest of the viscera had little amount of mesentry attached to it and therefore may have been lost alongwith mesentry.

Sweatman (1957) as quoted by Soulsby (1965) has shown experimentally that immunity to C. tenuicollis can be induced in sheep by feeding a small numbers of cystricerci. If same is the case in nature one can hypothesise that after initial infection the host may be immune for subsequent reinfection. Our data is indicative of such a situation as the number of cyst present ranged to less than 10 in most of the cases. Subsequent infection to build up the number of cysticerci might have been chec-ked due to development of immunity. This is simply conjectural and one needs experimental work to prove it conclusively. However, we are tempted to make this conjecture as the epidemidogical factors are very conducive for repeated infection, thus leading to build up of large number of cysticerci in infected hosts if there would not have been the possibility of development of immunity.

Ivenovo et al. (1950) as quoted by Abuladze (1964) observed high mortality upto 77% in 2-3 month old lambs in Ivanova area in U.S.S.R. Arundel (1972) reported that C. tenuicollis is extremely common in sheep in all states of Australia and is of considerable economic consequence due to rejection of infected carcasses exported to other countries.

Gemmell and Johnstone (1977) have mentioned a concept bf "Cysticercosis storm" when high cyst count are observed by introducing susceptible sheep onto pasture virtually saturated with eggs. Storms have also been observed for T. saginata in cattle maintained in feed lots or calves infected from attendants using hand-suckling techniques.

A "Cysticercosis storm" though theoratically possible in this area has not been observed or reported on indirect evidence from veterinary sources. However, it may also occur in N.W.F.P. or other parts of Pakistan due to different epidemiological reasons i.e close association of dogs with sheep and goat and easy access of dogs to offal of infected herbivores

According to Jensen (1974) Cysticercus tenuicollis infection is characterised by hepatitis. The disease has world wide distribution and frequently shows high incidence in most countries where sheep and dogs closely associate.

Gaiger, (1910) and Southwell (1930) reported Taenia hydatigena, the adult form of Cysticercus tenuicollis from dogs of India. While the cysticercus of T. hydatigena Pallas, 1766, according to Bhaleroa (1935) was reported from sheep and goats, Buffaloes, cattle, camel and rabbits from India and larval stages in herbivores in Ceylon by Southwell in 1912 and 1914 respectively.

Sinah and Sahai (1973) found 24.5% infection of C. tenuicollis from goats from India. Moghe (1945) and Thapar (1956) also found C. tenuicollis infection in sheep and goats in a survey of helminth parasite of sheep, goats, cattle and buffaloes in India.

In Pakistan since its establishment the first record of Cysticercus tenuicollis infection in sheep and goats seems to be in the present survey. Mohiuddin (1976-1977) in a survey in Sind area did not show presence of C. tenuicollis. Durrani et al(1981) examined only faecal sample from sheep and goats and therefore, missed the opportunity to find this larval stage. Postmartem examination of carcasses in the slaughter house is essential for ensuring the presence or absence of Cysticercosis. Siddiqi and Ashraf (1980) did not find C. tenuicollis in goats of Peshawar.

Hydatid cysts of Echinococcus granulosus:

The results of the present study are tabulated in tables XLI to LII. It showed that in goats the hydatid cyst was equally common in both years of survey (4.95%), though the worm burden varied. However, extra liver and lungs examined showed higher incidence for obvious reasons. The situation in sheep was a little different, in the first year incidence was

higher than goats (7%) but in second year the incidence was only 0.97%.

A comparison of the presence of infection in the present survey with studies done elsewhere in Pakistan and other countries shows that the hydatid infection is almost universal in distribution where ever it has been looked for in sheep and goats raising countries. However, one should be careful in comparing the incidence as our data clearly indicated.

Schantz and Schwabe (1969) in an article on worldwide status of Hydatid disease control has tabulated the occurrence of Echinococcus granulosus infection by geographic region. According to them worldwide incidence of Echinococcus granulosus in sheep and goats is shown in Table XL. The table clearly showed that very few surveys have been done in goats and secondly where ever they have been carried out showed lower incidence for goats than for sheep.

The history of Echinococcus (Hydatid cyst) in Indo-Pakistan in sheep and goats is quite old. The earliest reference to its presence is mentioned by Gaiger (1910) when he reported E. polymorphis from sheep and goat. Southwell (1930) mentioned it as a common parasite of sheep and goats in India.

According to Bhalerao (1935) it was reported by Gaiger (1910), Aggarwala (1925) Hutura and Merek (1926). Southwell (1912) reported it from Burma from cattle, horses, goats, camel, elephants, pigs, rabbits and men. Moghe (1945) found hydatid cysts of Echinococcus granulosus in sheep and goats in a survey of Berar (India). Thapar (1956) also found Hydatid cysts of Echinococcus granulosus in lungs and livers of sheep and goats examined during a study of helminth parasites of domesticated animals of India. Sinha and Sahai (1973) found 1.85% infection of hydatid of Echinococcus granulosus in goats in Bihar (India).

Table XL: Distribution of hydatid diseases in sheep and goats in the World (Shantz and Schwabe, 1969).

Name of Country:	Sheep:	Goats	Name of Country:	Sheep:	Goats
1	2	3	1	2	3
	Incidence			Incidence	
California (North America)	4.8%	-	Madagascar	Sporadic occurrence	-
EL. Salvador (Central America)	Low sporadic occurrence	-	Mauritania	Wide spread occurrence	-
Guatemala (Central America)	Low sproadic occurrence	-	Marocco Mozambique	2.3-80% 20% 0.6-5%	-
Argentina (South America)	90%	-	Portuguese	Sporadic occurrence	-
Buenos Aires (South America)	Limited Occurrence	-	South Africa	0.92%	-
Brazil (South America)	Limited occurrence	-	Sudan	19.4%	33.3%
Ecuador (South America)	Wide occurrence	1.4-15%	Tunisia	20-60%	-
Peru (South America)	40% 5.4-21.1%	-	Albania	Wide spread occurrence	-
Uruguay (South America)	60%	-	Austria	Sporadic occurrence	-
Victoria	30%	-	Belgium	Sporadic occurrence 50-70%	24.2%
Tasmania (Australia)	13-50.3%	-	Bulgaria	66.5%	21.2%
Algeria	21.8%	-	Cyprus	50-70%	50-70%
Angola	Wide spread occurrence	-	Basses France	25-30%	-
Cap verde Island	Wide spread occurrence	-	Landes France	0.03%	-
			Paris (France)	60%	-
Chad	Rare	-	Corsica (Germany)	Sporadic occurrence rare	-
Egypt.	1.3%	-	-	-	-
Ethiopia	Wide spread occurrence	-	Germany	Sporadic occurrence	-

1	2	3	1	2	3
Libya	Wide spread occurrence	-	China	Disease exist but prevalence is unknown.	-
Hungry	0.47-129%	-	India	21.75%	16.9%
Italy	23.9%	9.7%	Iraq	29.5%	26.6%
Sardinia	76.11%	23.6%	Isreal (occupied Palestine)	3.7%	-
Romania	Sporadic	-	Pakistan	15-45.51%	24%
Spain	10.8%	-	Syria	Wide-spread occurrence	-
Switzerland	Sporadic occurrence	-	Turkey	52%	-
United Kingdom	1.6-56%	-			
Yogosalvia	20.1%	5%			
Amu Darya (U.S.S.R)	52%	-			
Azad Badazhan (U.S.S.R)	40-60%	-			
Dagestan (U.S.S.R)	61.1%	-			
Afghanistan	Wide spread occurrence	-			
Burma	Sporadic occurrence	-			
Cambodia	Sporadic occurrence	-			
Ceylon	2.3%	-			

In central Utah sheep and dogs were examined by Loveless et al. (1978) for six years to determine the prevalence of Echinococcus granulosus infection among dogs and sheep. They found that out of 839 dogs 95 were infected with adult tape worm. Out of 8,994 sheep examined 877 sheep were infected with hydatid cysts.

Shamsul Islam (1980) reproted 8.29% infection in sheep and goats in Bengla desh. The first authentic report of presence of hydatid in Pakistan is that of Lubinsky (1958) who found 15% hydatid infection in sheep and 24% in goats in Pakistan.

In Pakistan, survey of helminth parasite of sheep and goats conducted by Sarwar (1962) Mohiuddin (1976-77) and Durrani et al. (1981) did not report any incidence of hydatid cysts of Echinococcus granulosus. This does not mean the absence of the parasite but method of examination (faeces) or lack of examination of the organs (lungs or liver). Munir and Anwar (1980) found 1.2% sheep and 0.2% goats infected with hydatid cyst in animals slaughtered in Faisalabad. They found that 24.13% cysts in sheep were fertile, while all the cysts in goats were sterile. Hydatid cyst had predilection for lungs in all species of hosts. Siddique and Hussain (1980) found 21.96% cattle and buffaloes infected with hydatid cysts in animals slaughtered in abattoirs of Lahore. There were more mature cysts in livers (59%) followed by lungs (42.6%) spleens (37%) kidneys (30%) and hearts (5%) in the case of cattle while in buffaloes the percentage of mature cysts were 61.7 in livers, 40.4% in lungs, 39.78% in spleen and 14.28% in kidneys. Siddique and Hussain (1980) found 61.6% fertile cysts in lungs and 25.8% in the livers of buffaloes in Punjab. Khan (1983) examined sheep, goats, cattle and buffaloes at Lahore. The incidence of the disease was 8.27% in sheep, 8.85% in goats, 9.59% in cattle and 12.25% in buffaloes. Riaz and Khalid (1986) during a study on incidence of hydatid disease in ovine and Bovines of Rawalpindi and Islamabad region (Pakistan) found

1.79% in goats, 5.30% in sheep and 31.05% in cattle. This review of information shows that hydatid infection is common in Pakistan and has been found wherever relevant organs have been examined from sheep, goat, cattle and buffalo.

A few reportings of hydatid infection may be due to the fact that most of surveys on helminthic infection in sheep and goats and other animal as well are based on merely faecal examination and therefore miss the presence of hydatid cyst. Secondly the incidence reported in literature is not a true picture of what would be the situation in nature as liver and lungs suspected for hydatidosis are examined or counted in the slaughter houses. In the present survey we had material from two sources. First, liver and lungs from the same animals which were examined for gastro-intestinal helminths and secondly extra liver and lungs which were of comparatively older animals and were in most circumstances found infected. The incidence was higher in sheep than in goats (Table XLIII and XLVI). Secondly, in extra liver and lungs both in sheep and goats the incidence was higher 2-3 times thus showing the bias in the data (Tables XLIX and LII). Therefore one may be careful in interpreting the data. If suspected livers and lung are examined the incidence will obviously be higher.

In literature a predilection for various organs shown by hydatid cyst is mentioned, The distribution of hydatid cyst in different organs of sheep and goats is shown in Table XVIII. This showed that in the present survey the most favoured site was the liver and lungs followed by spleen or mesentry in which it was rather rare.

It has been observed by many worker that all the cysts in a particular host may not be fertile and it may vary from host to host. In the present study a careful analysis of all the infected organs showed that the cysts were invariably fertile and there was no interhost difference

i.e both sheep and goat had fertile cyst contrary to the observation of Munir and Anwar (1980).

If random sample is taken from animals slaughtered in abattoris the incidence is rather low but if one really looks in older animals or emaciated animals the incidence is high. As there is a general practice in Pakistan to slaughter old and emaciated animals naturally the incidence will be high. Secondly, there is an interesting epidemological consideration in the spread of hydatid infection in Pakistan. The dogs stray around the butcher's shops. The fibrous tissue and infected portion of liver or lungs excised is thrown to the dogs. If infected portion is eaten by the dog infection is acquired. Herbivores like sheep and goats acquire the infection from infected faeces of dogs which are present around the pasture or close to house hold where the sheep and goats are kept.

Nematoda:

Trichuris Spp:

The incidence and distribution of the species of Trichurids found in the present study is discussed together. The relative incidence of four species namely Trichuris globulosa T. lani, T. indica and T. parvespiculum is presented in Table XLIII and XLVI.

In the previous study conducted in this laboratory on 19 goats Siddiqi and Ashraf (1980) recorded 8 species of Thrichuris namely T. globulosa, T. lani, T. indica, T. parvispiculum T. vondwei T. infundibulum, T. ovina and T. discolor. This was considered to be the largest number of species of Trichuris from a single host species (goat) to be reported from any part of the world as has already been mentioned.

T. discolor has not been found in the present survey. Remaining seven species have been recorded and were tentatively identified as such in the present survey as well. However, as we had the good opportunity to have a very large collection in the present survey and had also access to the collection made by Siddiqi and Ashraf (loc cit.) we made a critical analysis of the species composition. We have come to the conclusion after critical analysis of the material and evaluation of the relative merit of taxonomic characters used in the specific diagnosis that the species identified as T. vondwei, T. infundibulum and T. ovina are nothing but mere variation of P. parvispiculum.

According to Skrjabin et al. (1957) T. vondwei was originally described from cane rat (Thryonomys) swinderianus variegatus from South Africa by Ortlepp (1937). It seems that Siddiqi and Ashraf (1980) relied more on the observations of Ortlepp (loc cit.) that all the specimens examined by him had retracted spicular sheath. This was also the observation in the present work that there were number of specimens which were identified as

T. vondwei. However, when large number of specimens were critically examined for species specific characters mainly related to male and female reproductive system and length-width ratio of anterior and posterior part of body we came to the conclusion that what has been recognised as T. vondwei is nothing but mere variation of T. parvispiculum in which the spicular sheath remains retracted. Added to this is the difference of host and locality.

T. infundibulum was described as T. infundibulum from Porcupine (Hystrix cristata) from unknown locality. Though, the possibility of its occurrence in different host and locality is theoratically possible but it is unlikely that T. infundibulum exists in Indo-Pakistan Sub-continent.

T. ovina was originally described by Sarwar (1945) from sheep and goats from Punjab. According to him this species resemble the T. parvispiculum in general and particularly the males. This may be the reason that Siddiqi and Ashraf (1980) separated some of the material of T. parvispiculum and identified it as T. ovina.

Concluding from the foregoing discussion four species of Trichuris are found in sheep and goat of Peshawar nemely, T. globulosa, T. lani, T. indica and T. parvispiculum.

Trichuris globulosa seems to be the most common species in Pakistan. Sarwar (1962) reported T. globulosa and T. skrjabini from extreme northern tract of Pakistan which included Peshawar district and also from Rawalpindi Jhelum and Sialkot districts. T. skrjabini was also separated from Palaerctic region of Kalat, while a species of Trichuris which could not be identified, was reported from Murree, Abbottabad and Kaghan. He did not report any species of Trichuris from alluvial plains of Punjab. Though,

Gaiger (1910 and 1915) as quoted by Baylis (1936) recorded T. ovis from sheep and goats and cattle from Punjab. However, in his earlier papers Sarwar (1945a, 1945c, 1959) reported, T. globulosa from sheep and goat from Multan and Lahore (Punjab).

T. globulosa was found to be a common parasite of sheep and goat by Mohiuddin et al. (1976, 1977) when they found 24.5% sheep and 26.2% goats infected with this parasite in the first year and 23.7% and 22.4% in the subsequent year.

T. lani was not as common as T. globulosa as it was found in 28.08% sheep and 28.71% goats. T. lani was originally described by Artiukh (1948) from Fellow deer (Cervus dama). Other hosts mentioned were elk (Alces alces), spotted deer (Cervus hortulorum) and camel (Camelus bactrianus) from U.S.S.R. as quoted by Skrjabin et al. (1957). It was for the first time reported from goats by Siddiqi and Ashraf (1980) from N.W.F.P. Shah (1985) extended its host range to young cattle in N.W.F.P.

Both host and locality records show that T. lani is present in Pakistan and beside the hosts mentioned by previous authors it is also found in sheep, goats and cattle.

The most common species of Trichuris in the present survey was T. parvispiculum as it was found in 66.01% sheep and 64.36% goats (Table XLIII and XLVI). Sarwar (1945b) mentioned that this parasite as the most common encountered trichurid in sheep and goats in Sialkot, Multan and Lahore (Punjab). Siddiqi and Ashraf (1980) also found it the most common parasite of goats of Peshawar. Mohiuddin et al. (1976, 1977) did not find it in Sind area. It seems that the range of its distribution extends from N.W.F.P. to Punjab and not beyond to Sind area.

Trichuris indica was originally described from Bos indicus and B.

bulbalis from Mukteswar and Izathangar (India) and Sialkot (Punjab, Pakistan) by Sarwar (1945). Since its discovery it was reported for the second time by Siddiqi and Ashraf (1980) from goat in Peshawar. In the present survey only one goat (0.49%) was found infected. Summarising the information on trichurids in sheep and goats of this region four species out of six species so far reported from sheep and goats in the world literature have been found in the present survey. The most common being T. parvispiculum followed by T. globulosa, T. lani and T. indica. If we combine all species the most common nematode parasites were trichurids in both sheep and goats host.

Oesophagostomum spp:

Oesophagostomum is represented in our collection by four species O. venulosum, O. columbianum, O. asperum and O. brevicaudum. O.columbianum was the commonly encountered parasite both in sheep and goats showing an over all incidence of 44.83 and 43.56% respectively (Table XLIII and XLVI). This showed that goats and sheep are equally effected by this parasite. O. columbianum is considered to be a cosmopolitan parasite of sheep and goats. Siddiqi and Ashraf (1980) found it in 21.05% goat of Peshawar. Mohiuddin et al. (1984) reported this parasite from different parts of Sind. In an earlier study they found only 8.4% sheep and 8.9% goats were infected with this parasite. In the next year they found 17.5% sheep and 12.5% goats were infected. This incidence is comparatively low and may be related to climatological factors. A similar higher incidence as reported in the present survey has been found by Sinha and Sahai(1973) from Bihar (India) who mentioned 50% of animals in their survey were infected with O. columbianum. Durrani et al.(1981) found even higher incidence (59%) in Azad Kashmir. Shah et al. (1980) found 21.2% infection in sheep in Lahore.

Sarwar (1962) did not record O. columbianum from Peshawar, Kaghan, Abbottabad but recorded it from goats in Rawalpindi and salt range area of Punjab. In alluvial plains he observed that O. columbianum was found in "serious proportions" where the moisture contents of the soil were high and the soil was devoted to wheat growing. He further mentioned that infection appeared to be minor in areas which were either arid and where the irrigation had not yet resulted in higher water tables. No species of Oesophagostomum was found in Kalat division. Thus O. columbianum seem to be a common parasite in N.W.F.P. Punjab and Sind. However, except Kalat division the information is lacking for the Province of Baluchistan.

Next common species is O. venulosum. It was found in 8.37% sheep and 10.89% goats (Table XLIII and XLVI). Siddiqi and Ashraf (1980) has previously reported it from 5.26% goats from Peshawar. An earlier report of its finding in Peshawar is that of Sarwar (1962). He reported it from extreme northern tract including Peshawar District. It was not found in higher altitude of Himalayan tract, comprising of Abbottabad and Kaghan valley but it was represented in lower altitude tracts (Rawalpindi, Jhelum and Attock). Bhalerao (1935) Moghe (1945), Thapar (1956), Bhatia and Pande (1961) reported this parasite from different parts of India. Sinha and Sahai (1973) reported an incidence of 14.4 in goat in Bihar (India).

It seems that alongwith O. columbianum this species is equally distributed where ever the conditions are favourable but the incidence may be comparatively low.

O. asperum:

O. asperum is reported for the first time from sheep and goat in Peshawar in the present survey. Siddiqi and Ashraf (1980) did not find the goats infected with this parasite from Peshawar. It was not reported

by Sarwar (1962) from this area, however, he reported it from Abbottabad and Kaghan valley of N.W.F.P. In an earlier paper he reported it from Murree and Mirpure (Sarwar, 1955b), Bhatia and Pande (1961) collected it from Tibetan sheep from Nainital (India). Thapar (1956) also reported O. asperum from sheep and goats from India. In conclusion we can say that O. asperum is only distributed in N.W.F.P. and adjoining areas. In alluvial plains of Punjab and arid zone of Sind its absence may be related to climatological factors. Even in the present study it was found only in 4.43% sheep (Table XLIII) and only in 3 goats out of 202 examined for two years. The analysis of data showed that sheep may be infected more commonly than goats.

Fourth species of Oesophagostomum found in the present survey was O. brevicaudum which was originally found in swine in India and U.S.A. It is the first record of its existence in goats in Pakistan. It was found in goats (see Table XLVI) but no specimen was recovered from sheep. Concluding the discussion on distribution and incidence of Oesophagostomiasis in sheep and goats we found that O. venulosum, O. columbianum, O. asperum and O. brevicaudum were distributed in the host in that ranking order. O. asperum has not been reported from any other part of Pakistan except N.W.F.P. and adjoining areas. O. brevicaudum has been found for the first time from a goat host and for the first time in Pakistan.

Chabertia ovina

Chabertia is represented by two species namely C. ovina and C. rishati the incidence of C. ovina is shown in Table XLIII and XLVI. C. rishati is reported from camel from India. C. ovina species has been reported from hilly region of India by Bhatia and Pande (1961) and according to them it has not been found in subsequent surveys in India.

Chabertia ovina has a long history of its existance in India as it

was reported by Bhalerao (1935) from Punjab and Muktesar (India). Sarwar (1962) did not report it from Peshawar district but found it from Murree, Abbottabad and Kaghan. He did not report it from Plains areas of Pakistan or Kalat division. Shah et al.(1980) found it in 0.2% out of 500 sheep examined in Lahore.

In a previous survey Siddiqi and Ashraf (1980) found 10.52% goats in Peshawar infected with this parasite. The present survey showed that 3.94% sheep and 3.96% goats were infected with this parasite (Table XLIII and XLVI). The discrepency in the two studies may be due to larger number of animals examined in the present survey.

In some countries it has been found to be of major concern as its incidence may be comparatively high. Le Riche et al. (1973) reported 38% infection in sheep and goats in Cyprus and El-Moukdad (1977) found 23.3% sheep infected in Austria.

Concluding the information available on the existance of C. ovina in Pakistan it may be said that it was for the first time recorded from Peshawar by Siddiqi and Ashraf (1980) from goats. In the present survey it has been found from both sheep and goats. Shah et al. (1980) reported it from Punjab. There is also an early report of its finding by Bhalerao (1935) from sheep host. Its absence in Sind and other part of Punjab is worth investigating.

Bunostomum trigonocephalum:

In the present survey only sheep were found infected 2.46% (Table XLIII) though previously it has been found in 5.26% goats in Peshawar, (Siddiqi and Ashraf,1980).

The history of Bunostomum in Indo-Pakistan goes back to Baylis (1936) who reported four species from India. B. trigonocephalum,

B. phlebotomum, B. bovis and B. cobi. B. trigonocephalum which is also the type species has been reported from sheep and goats and B. phlebotomum from sheep, Ox and Zebra. Yamaguti (1961) added B. bovis, B. cobi for sheep host, the later one from N. Rhodesia. Sarwar (1962) in his survey reported B. trigonocephalum from Kalat division of Baluchistan and Abbottabad and Kaghan valley (NWFP), and Rawalpindi and Sialkot (Punjab). He also found B. phlebotomum from buffaloes. Mohiuddin et al. (1984) in their survey found Gaigeria pachyscelis but did not find Bunostomum. Siddiqi and Ashraf (1980) reported B. trigonocephalum for the first time from goat of Peshawar.

Haemoncus contortus:

Haemoncus contortus has been known from Indo-Pakistan sub-continent for a very long time. Gaiger (1910) recorded it from ox and sheep from Punjab. The most comprehensive report on nematode parasites of Pakistan is that of Sarwar (1962). According to him H. contortus is distributed in extreme northern tract (Peshawar district) where he considered that H. contortus was of minor epidemiological significance. He did not report it from Murree, Abbottabad and Kaghan, though he considered trichostrongyliasis, ostertagiasis and bunostomiasis as significant epidemologically. In sub-himalayian zone and salt range (comprising of Rawalpindi, Jehlum and Attock districts) H. contortus was found alongwith O. columbianum in submountains region (comprising of Sialkot and Rawalpindi districts). In alluvial plains he reported serious out-breaks of H. contortus. He also observed that H. contortus alongwith Oesophagostomum occurs twice in a year between April and October and caused 50% mortality in flocks of sheep. He further observed that Haemoncus alone occurs in mild summer in hill valleys where moisture is high. Palearctic region of Kalat showed that H. contortus is found in Khuzdar.

Mohiuddin et al. (1984) found H. contortus in various region of Sind from sheep and goats. In their earlier report (1976-77) they showed an incidence of 23.5% in the first year in goats and sheep and in second year 27.1% and 23.3% in sheep and goats respectively.

Siddiqi and Ashraf (1980) have previously established the presence of H. contortus in goats in Peshawar. A report of Shah et al. (1980) mentioned that 50% of sheep examined from various parts of Pakistan including Peshawar harboured H. contortus. Durrani et al. (1981) reported H. contortus from caprine and ovine host from Azad Kashmir.

Alongwith its cosmopolitan distribution in Pakistan other feature which needs special mention is its high rate of incidence. In the present survey the highest incidence of any individual species was that of H. con-tortus both in sheep and goat. In goats the incidence in first year was 59.41 and in second year it was 67.32. The infection was even higher in sheep as 76.00% of sheep were infected in first year and 72.82% in the second year and for both year 74.38% of the animal were infected (Table XLI to XLVI).

It showed that sheep are comparatively more prone to H. contortus infection than goats. This may be related to their feeding habits as sheep browse more on ground and therefore may afford more chances to become infected.

Summarizing the information on distribution and incidence of H. contortus one may conclude that this species is distributed throughout Pakistan and has a high incidence amongst the nematodes infecting sheep and goat. There are further aspects of H. contortus infection which will be considered in the next chapter.

Dictyocaulus filaria:

Dictyocaulus filaria was for the first time reported from Peshawar district by Sarwar (1962). He also found it in Sialkot, Rawalpindi,Attock and Jhelum districts but not from alluvial Plains of Punjab or Kalat division in Baluchistan or Kaghan valley and Abbottabad in N.W.F.P. Gaiger (1915) reported it from camels in Punjab.

In the present survey this lung worm was found in 13.79% sheep and 8.91% goats (Table XLIII and XLVI). Beside these lungs which were attached to the gastro-intestinal tracts examined for helminthic infections 208 lungs suspected for infection were examined and 23.92% sheep were found infected. This was not surprising as the lungs were from older animals suspected for infection. This finding must be kept in mind doing any survey on incidence. In goats 21.58% suspected lungs carried the infection. In a previous survey Siddiqi and Ashraf (1980) found 8% lungs of goats infected.

Mohiuddin et al. (1984) did not find any infection with lungworms in sheep and goats in Sind, though a very impressive number of hosts has been examined from different parts of Sind representing quite diversified ecological situations. Perhaps examination of lungs was not included in their protocol. However, Kaushik and Kalra (1971) have quoted Srivastava (1945) who reported Protostrongylus rufescens and Dictyocaulus filaria in 24 and 16% in sheep and 17 and 14% in goats of Punjab, N.W.F.P. and Sind. This means that D. filaria does exist in the province of Sind. They also mentioned that 40% goats and 21.3% sheep were infected with lung-worms at Karnal and Amritsar (Indian Punjab).

A higher incidence of D. filaria upto 53.5% was shown by Durrani et al. (1980) examining a very impressive number of faecal sample from sheep and goat from Azad Kashmir. However, our results are similar to Hayat and

Durrani (1965) who found eggs of D. filaria in 21.4% of lungs from sheep.

In a study of pulmonary nematodes of ruminants of Kazakhastan Boev (1954) found 11-50% domestic goat and above 50% sheep infected with D. filaria. Elzbieta (1982) found 25.6% lungs of sheep in Poland infected with D. filaria.

Pneumocaulus kadenazii:

Pneumocaulus kadenazii (Schulz et Andreeva, 1940) has been reported for the first time from Pakistan and also from sheep and goat host. This parasite was originally described from musk deer from U.S.S.R. and since then has not been reported from any other parts of the world or other ruminants. Its taxonomic discrimination has already been discussed previously. In sheep it was found 6.90 animals and in 2.48% goats (Table XLIII and XLVI). The number of worms ranged from 1-100. Thus we had a good opportunity to examine a large number of individual worms for confirmation of diagnosis. In suspected lungs of sheep 5.75% and those of goats 4.27% were found infected. This was a further proof of its existence in sheep and goat.

Skrjabinema ovis:

Skrjabinema ovis is common parasite of sheep and goats in many parts of the world. According to Bhatia and Pande (1961) Abdulsalam (1938) appears to have first recorded this parasite from India. He recovered 2 females from fat-tail sheep at Jahania (Punjab, Pakistan). Bhatia and Pande (1961) reported its occasional occurrence in sheep they examined. Sarwar (1962) found this parasite in Kharan, Mastung and Kalat region of Baluchistan and Rawalpindi, Jhelum and Attock in Punjab. Mohiuddin et al (1984) reported S. ovis from different regions of Sind. In earlier report Mohiuddin, 1976 did not report this parasite, but next year they found 1.7% sheep and 8.5% goat infected with this parasite. They claimed that it

was the first report of finding S. ovis from sheep and goat of Sind.

Siddiqi and Ashraf (1980) reported for the first time this parasite from goat (5.26%). In the present survey it has been found in goats only and the incidence was rather low (2.9%). A recent survey of young cattle in Peshawar also showed the presence of S. ovis in 3.72% animals (Shah, 1985).

Table XLI: The incidence of Helminth parasites found in 100 sheep from Peshawar examined for the year (1979).

	Name of Parasite:	Total Host: infected.	Incidence:
1.	Fasciola hepatica	28	28.00
2.	Dicrocoelium lanceatum	2	2.00
3.	Cotylophoron ovatum	2	2.00
4.	Paramphistomum (E) explanatum	3	3.00
5.	Gastrothylax crumenifer	3	3.00
6.	Moniezia (B) benedeni	10	10.00
7.	Moniezia expansa	4	4.00
8.	Avitellina centripunctata	9	9.00
9.	Stilesia vittata	18	18.00
10.	Cysticerous tenuicollis (Larval form)	15	15.00
11.	Echinococcus granulosus(Hydatid cysts)	6	7.00
12.	Trichuris globulosa	38	38.00
13.	Trichuris lani	27	27.00
14.	Trichuris parvispiculum	65	65.00
15.	Bunostomum trigonocephalum	1	1.00
16.	Oesophagostomum asperum	7	7.00
17.	Oesophagostomum columbianum	47	47.00
18.	Oesophagostomum venulosum	10	10.00
19.	Chabertia ovina	2	2.00
20.	Haemoncus contortus	76	76.00
21.	Dictyocaulus filaria	15	15.00
22.	Pneumocaulus kadenazii	9	9.00

Table XLII: The incidence of Helminth parasitesfound in 103 sheep from Peshawar examined for the year 1980.

	Name of Parasite:	Total Host infected:	Incidence:
1.	Fasciola hepatica	34	33.01
2.	Dicroceolium lanceatum	2	1.94
3.	Cotylophoron ovatum	5	4.85
4.	Paramphistomum (E) explanatum	3	2.91
5.	Gastrothylax crumenifer	10	9.71
6.	Moniezia (B) benedeni	5	4.85
7.	Moniezia expansa	5	4.85
8.	Avitellina centripunctata	6	5.83
9.	Stilesia vittata	6	5.83
10.	Cysticercus tenuicollis (Larval form)	19	18.45
11.	Echinococcus granulosus(Hydatid cysts)	1	0.97
12.	Trichuris globulosa	40	38.83
13.	Trichuris lani	30	29.13
14.	T. parvispiculum	69	66.99
15.	Bunostomum trigonocephalum	4	3.88
16.	Oesophagostomum asperum	2	1.94
17.	Oesophagostomum columbianum	47	44.66
18.	Oesophagostomum venulosum	7	6.80
19.	Chabertia ovina	6	5.83
20.	Haemoncus contortus	75	72.82
21.	Dictyocaulus filaria	13	12.62
22.	Pneumocaulus kadenazii	5	4.85

Table XLIII: The incidence of helminth parasites found in 203 sheep from Peshawar examined for two years 1979-80.

	Name of Parasite	Total host:	incidence:
1.	Fasciola hepatica	62	30.54
2.	Dicrocoelium lanceatum	4	1.97
3.	Cotylophoron ovatum	7	3.45
4.	Paramphistomum (E) explanatum	6	2.96
5.	Gastrothylax crumenifer	13	6.40
6.	Moniezia (B) benedeni	15	6.90
7.	Moniezia expansa	9	4.43
8.	Avitellina centripunctata	15	6.89
9.	Stilesia vittata	24	11.82
10.	Cysticercus tenuicollis	34	16.75
11.	Echinococcus granulosus(Hydatid cysts)	7	3.45
12.	Trichuris globulosa	78	38.42
13.	Trichuris lani	57	28.08
14.	Trichuris parvispiculum	134	66.01
15.	Bunostomum tribonocephalum	5	2.46
16.	Oesophagostomum asperum	9	4.43
17.	Oesophagostomum columbianum	91	44.83
18.	Oesophagostomum venulosum	17	8.37
19.	Chabertia ovina	8	3.94
20.	Haemoncus contortus	151	74.38
21.	Dictyocaulus filaria	28	13.79
22.	Pneumocaulus kadenazii	14	6.90

Table XLIV: The incidence of Helminth parasites found in 101 goats from Peshawar examined for the year 1979.

	Name of Parasite:	Total Host:	Incidence:
1.	Fasciola hepatica	18	17.82
2.	Dicrocoelium lanceatum	3	2.97
3.	Cotylophoron ovatum	4	3.96
4.	Paramphistomum (E) explanatum	3	2.97
5.	Gastrothylax crumenifer	5	4.95
6.	Watsonius capri sp. nov.	1	0.99
7.	Moniezia (B) benedeni	9	8.91
8.	Moniezia expansa	7	6.91
9.	Avitellina centripunctata	9	8.91
10.	Stilesia vittata	16	15.84
11.	Cysticercus tenuicollis (Larval form)	14	13.86
12.	Echinococcus granulosus(Hydatid cysts)	5	4.95
13.	Trichuris globulosa	38	37.62
14.	Trichuris indica	1	0.10
15.	Trichuris lani	28	27.72
16.	Trichuris parvispiculum	70	71.28
17.	Oesophagostomum asperum	3	2.97
18.	Oesophagostomum brevicaudum	2	1.90
19.	Oesophagostomum columbianum	36	35.64
20.	Oesophagostomum venulosum	12	11.88
21.	Chabertia ovina	6	5.94
22.	Haemoncus contortus	60	59.41
23.	Dictyocaulus filaria	9	8.91
24.	Pneumocaulus kadenazii	4	3.96
25.	Skrjabinema ovis	1	0.99

XLV: The incidence of Helminth parasites found in 101 goats from Peshawar examined for the year (1980)

	Name of parasite	Total Host:	Incidence:
1.	Fasciola hepatica	35	34.65
2.	Cotylophoron ovatum	7	6.93
3.	Paramphistomum (E) explanatum	2	1.98
4.	Gastrothylax crumenifer	9	8.91
5.	Moniezia (B) benedeni	5	4.95
6.	Moniezia expansa	2	1.98
7.	Avitellina centripunctata	6	5.94
8.	Stilesia vittata	6	5.94
9.	Cysticercus tenuicollis (Larval form)	21	20.79
10.	Echinococcus granulosus(Hydatid cysts)	5	4.95
11.	Trichuris globulosa	45	44.55
12.	Trichuris lani	30	29.72
13.	Trichuris parvispiculum	60	59.41
14.	Oesophagostomum columbianum	52	51.48
15.	Oesophagostomum venulosum	10	9.90
16.	Chabertia ovina	2	1.98
17.	Haemoncus contortus	68	67.32
18.	Dictyocaulus filaria	6	5.94
19.	Pneumocaulus kadenazii	1	0.99
20.	Skrjabinema ovis	5	4.95

Table XLVI: The incidence of helminth parasites found in 202 goats from Peshawar examined for two years 1979-1980.

	Name of parasite	Total Host:	Incidence:
1.	Fasciola hepatica	53	26.24
2.	Dicroccelium lanceatum	3	1.49
3.	Cotylophoron ovatum	11	5.45
4.	Paramphistomum (E) explanatum	5	2.48
5.	Gastrothylax crumenifer	14	6.93
6.	Watsonius capri sp. nov.	1	0.50
7.	Moniezia (B) benedeni	13	6.93
8.	Moniezia expansa	9	4.45
9.	Avitellina centripunctata	15	7.43
10.	Stilesia vittata	22	10.89
11.	Cysticercous tenuicollis (Larval form)	35	17.33
12.	Echinococcus granulosus(Hydatid cysts)	10	4.90
13.	Trichuris indica	1	0.49
14.	Trichuris globulosa	83	41.09
15.	Trichuris lani	58	28.71
16.	Trichuris parvispiculum	130	64.36
17.	Oesophagostomum asperum	3	1.90
18.	Oesophagostomum brevicaudum	1	0.50
19.	Oesophagostomum columbianum	88	43.56
20.	Oesophagostomum venulosum	22	10.89
21.	Chabertia ovina	8	3.96
22.	Haemoncus contortus	126	63.36
23.	Dictyocaulus filaria	15	8.91
24.	Pneumocaulus kadenazii	5	2.48
25.	Skrjabinema ovis	6	2.90

Table XLVII: The incidence of Helminth Parasites found in extra liver and lungs examined of 103 sheeps from Peshawar for the year 1979.

	Name of Parasite:	Organ Infected:	Total Host:	Incidence:
1.	Fasciola hepatica	Liver	2	1.94
2.	Dicrocoelium lanceolatum	"	82	79.61
3.	Cysticercus tenuicollis (larval form)	"	4	3.88
4.	Echinococcus granulosus (Hydatid cysts)	Liver lungs	14	13.59
5.	Dictyocaulus filaria	Lungs	26	25.24
6.	Pneumocaulus kadenazii	Lungs	4	3.88

Table XLVIII: The incidence of Helminth parasites found in extra liver and lungs examined of 105 sheeps from Peshawar for the year 1980.

	Name of Parasites	Organ Infected:	Total Host:	Incidence
1.	Fasciola hepatica	Liver	64	60.95
2.	Cotylophoron ovatum	Liver	1	8.94
3.	Cysticercus tenuicollis (Larval form)	Liver	2	1.00
4.	Echinococcus granulosus (Hydatid cysts)	Liver lungs	8	7.55
5.	Dictyocaulus filaria	Lungs	24	22.64
6.	Pneumocaulus kadenazii	Lungs	8	7.55

Table XLIX: The incidence of Helminth parasites found in extra liver and lungs of 208 sheeps from Peshawar examined for two years 1979 - 1980.

	Name of Parasite:	Organ infected	Total Host:	Incidence:
1.	Fasciola hepatica	Liver	146	70.19
2.	Dicrocoelium lancealatum	Liver	2	0.96
3.	Cotylophoron ovatum	Liver	1	0.47
4.	Cysticercus tenuicollis (Larval form)	Liver	6	2.88
5.	Echinococcus granulosus (Hydatid cysts)	Liver lungs.	22	10.53
6.	Dictyocaulus filaria	Lungs	50	23.92
7.	Pneumocaulus kadenazii	Lungs	12.	5.75

Table L: The incidence of Helminth Parasites found in extra liver and lungs examined of 94 goat from Peshawar examined for the year 1979.

	Name of Parasite:	Organ Infected:	Total Host:	Incidence:
1.	Fasciola hepatica	Liver	73	77.06
2.	Dicrocolium lanceolatum	Liver	1	1.06
3.	Cysticercus tenuicollis	Liver	2	2.13
4.	Echinococcus granulosus (Hudatid cysts)	Liver lungs	12	12.77
5.	Dictyocaulus filaria	Lungs	17	18.09
6.	Pneumocaulus kadenazii	Lungs	4	4.26

Table LI: The incidence of Helminth parasites found in extra liver and lungs examined of 96 goats from Peshawar for the year 1980.

	Name of Parasite	Organ infected	Total Host:	Incidence:
1.	Fasciola hepatica	Liver	60	62.60
2.	Cysticercus tenuicollis (Larval form)	Liver	2	2.08
3.	Echinococcus granulosus (Hydatid cysts)	Liver lungs	15	15.67
4.	Dictyocaulus filaria	Lungs	24	25.00
5.	Pneumocaulus kadenazii	Lungs	4	4.17

Table LII: The incidence of Helminth parasites found in extra liver and lungs of 199 goats examined from Peshawar for two years 1979-1980.

	Name of Parasite:	Organ infected:	Total Host:	Incidence:
1.	Fasciola hepatica	Liver	133	70.00
2.	Dicrocoelium lanceolatum	Liver	1	0.53
3.	Cysticercus tenuicollis	Liver	4	2.11
4.	Echinococcus granulosus (Hydatid cysts)	Lungs liver	27	14.21
5.	Dictycaulus filaria	Lungs	41	21.58
6.	Pneumocaulus kadenazii	Lungs	8	4.27

Table LIII: Group-wise incidence of Helminth parasites found in *Sheep and goats* examined from Peshawar for the year 1979-80.

Group Name:	*(203 Sheep and 202 Goats examined)						*(Extra liver lungs examined of 208 Sheep and 190 Goats examined)					
	Sheep			Goats:			Sheep			Goats:		
	1979	1980	1979-80	1979	1980	1979-80	1979	1980	1979-80	1979	1980	1979-80
Trematodes	31.00	38.83	34.97	22.77	39.60	31.18	97.08	66.98	81.81	37.50	38.54	70.83
Cestodes	50.00	33.98	40.39	36.61	34.65	36.63	13.59	9.43	11.48	13.82	16.52	15.10
Nematode	95.00	91.26	93.10	94.05	91.26	91.58	19.41	28.30	23.95	21.27	37.75	24.47

CHAPTER III

Worm burden and seasonal variation

WORM BURDEN AND SEASONAL VARIATION

Trematod:

Fasciola hepatica:Examination of more than 200 sheep and almost equal number of goats we have come to the conclusion that those animals which are brought to slaughter houses never carry infection which may be considered as outstanding. The number of flukes per host range from 1 to 120. The incidence though covered in the previous chapter may also be discussed as it can also be used as parameter for seasonal variation. Month to month data may not be a good indicator of seasonal variation, therefore, we divided the year of observation into four quarters (1-IV) 1: December-February, II: March - May, III: June - August, IV: September - November corresponding roughly to winter, spring, summer and autmn. We pooled the data for each month into these four quarters for incidence and worm burden (see Table LIV and LV) for both sheep and goats.

Table LIV show clearly that in first year in sheep lowest incidence was in the I quarter (December to February) and in the second year it was in III quarter (June to August). The worm burden also conforms to the situation of the incidence. However, the enigmatic situation was that alongwith incidence the worm burden was also higher except in the III quarter of the first year when the incidence was low but the worm burden was highest as compared to all quarters of the two years. June to August in N.W.F.P. corresponds to summer months when the temperature is very high and the precipitation is very low. It seems that Fasciola infection is found in sheep host throughout the year. However, in summer though the snails may be infected but may go in aestivation and may not be shedding cercariae.

In the goats host the situation was essentially similar as in sheep (Table LIV). The highest rate of infection was in September to November

(29.16%) and so was the average worm burden (6.60) while in second year December to February (I quarter) and March to May the incidence was highest (64.15 & 46.42). In first year the incidence and worm burden was lowest in March to May but in second year both were lowest in September to November. Situation in June to August was second lowest without much difference from the lowest.

Anwar and Chaudhri (1984) examined an impressive number of 7700 faecal samples from sheep and goats from 1977 to 1983. The break up of the data month wise showed that in May and June the infection was consistantly low and ranged from 5-55% while from August to December it was 73-96%.

Their data from August to December is more consistent for all four years of examination.

An extensive study of fascioliasis in Pakistan was done by Kendall (1954). According to him the disease is of outstanding importance in Pakistan. He also included Dera Ismail Khan District of N.W.F.P. in his study where he considered presence of liver fluke infection is the major factor limiting livestock development. Work oxen may have to be replaced every second or third year and husbandry of sheep and goats has proved impossible. He further mentioned that at Peshawar (NWFP) observations on cattle and buffaloes brought for slaughter showed an incidence of 70.80%. In certain district of Punjab it ranged 10 - 100% and in Sind out of three and a half million cattle 40% contracted fascioliasis and acute disease may cause 50% mortality.

According to Sarwar (1962) F. gigantica infection occurs in autmn but because of moderate climate, the infection in the deltoid south (Jhalawan-kalat) may continue to occur through the greater part of the year. F. hepatica occurs in Swat and Chitral but he did not mention its seasonal occurrence. Ollerenshaw (1974) presented a review on forcasting

liver fluke disease. A system of forcasting of liver fluke disease based on rain fall, temperature and evaportranspiration has been evolved which is applicable to England and adjoining countries. The climatological information needed for such forcast in Pakistan is lacking, however reading the article one may conclude that the disease even in comparatively severe climate prevailing in England is present throughout the year. In England it is considered to be a winter disease when the rate of infection is the highest.

Our data shows that the infection is present throughout the year, however in some months it is more than other months. The infection is lowest in some months of year but the same month in the next year may show considerably high infection (see Table LIV). For example, in sheep in December to February the infection was only 8.69% and average worm burden was 0.82 while in next year for the same period incidence was 34.62 and average worm burden was 4.42.

From this we conclude that in Pakistan we have yet to establish sound basis for the study of seasonal variation. Merely mentioning a higher or lower incidence in particular months of the year is not sufficient.

Beside livers attached to the viscera examined in the present survey we also included in our protocol to examine extra livers suspected for fascioliasis. These livers were comparatively from older animals. Two livers each from sheep and goats were examined on weekly basis.

These livers showed higher incidence and worm burden. The incidence was as high as 94.77% and the lowest was 29.62% in June and August. The lowest infection and worm burden in June and August was found in sheep in 2nd year. In first year from March-May in goat the incidence was the highest. There was also an indication in the livers attached to viscera that

June to August infection was invariably low. This may be an indication that March to May the infection in snails may be at its lowest in the snails. June to August months are the hot months in N.W.F.P. except the mountainous regions. Either the snails during March to May are not infected or if they are infected may not be shedding the cercariae. Though it has been shown that in snails during aestivation development of partheni-tae continue but emergence will be delayed till the advent of favourable season (Taylor, 1949, as quoted by Soulsby, 1965).

To summarise the whole information we have gained for seasonal variation and worm burden of Fascioliasis in sheep and goat one can say that the infection did not follow a seasonal pattern as some Pakistani authors like to suggest. For seasonal variation worm burden and incidence should be used together as parameter. Moreover lower incidence may not necessarily reflect lower worm burden (see Tables LIV and LV).

The source material for analysis also shows that if suspected livers are seen both incidence and worm burden is high while almost random sample as were the liver attached to the viscera in the present survey showed that the worm burden as well as incidence was low. If there was any consistent variation found during the two years of study it was found in June-August when the infection was low, in all other months on quarterly basis it fluctuated in a manner that no definite trends were noted.

Unless we work out the life cycle of Fasciola hepatica under our field condition in relation to the climatological factors, life history of snail, and epidemiological factors which effect both snails and vertebrate host any conclusion on this aspect of fascioliasis will only be conjectural.

Dicrocoelium lanceatum:

Dicrocoelium lanceatum has two intermediate hosts, the first being

Table LIV: Seasonal occurrence of Fasciola hepatica Linnaeus, 1758 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec - Feb	0.82	2.43	4.42	9.19	8.69	21.17	34.62	46.15
II-Mar-May	5.28	0.59	6.69	6.10	32.00	15.78	57.69	46.42
III-June-Aug:	7.97	1.19	1.26	2.77	24.00	17.64	11.54	22.22
IV-Sep - Nov:	4.83	6.69	6.84	0.85	45.83	29.16	28.00	20.00

Table LV: Seasonal occurrence of Fasciola hepatica (Linnaeus, 1758) of extra liversof sheep and goats of Peshawar examined for the year 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	22.21	18.06	13.78	11.36	78.26	81.25	69.69	80.00
II-Mar-May	19.41	16.53	11.00	10.34	94.77	81.25	83.33	82.60
III-June-Aug:	10.14	11.63	6.03	7.00	75.00	66.66	29.62	39.13
IV-Sep-Nov:	8.02	11.63	11.37	9.18	79.41	63.63	50.00	50.00

a snail and second an ant (Genus Formica). The eggs hatch when eggs containing miracidia are ingested by the snails. Though a large number of snails are incriminated as the first intermediate host, however Cionella lubrica and Zebrina detrita have been infected experimentally as quoted by Soulsby (1965). The rate of development is slow and it may take upto three months for development in the snail host. The cercariae 200-410 in number may clump together in pulmonary chamber of the snail and form slime balls. These slime balls are eaten by ants (Formica fusca). The cercariae wander to the abdominal cavity where metacercariae are produced 26-36 days are required at 28-30°C while at lower temperature it may take longer. Infection of definitive host occurs when ants are accidently ingested. The metacercariae are digested from the body cavity of the ant and then undergo migration to the liver via portal circulation and arrive in bile duct and mature. A period of 7 weeks is required from the time of infection to egg laying in the vertebrate host (Soulsby, 1965).

This information though from other areas shows that it may take at least 6 months to complete one generation from egg to mature flukes ready to shed next generation eggs.

The outstanding features of our data are summarised with special reference to seasonal variation and worm burden (see Table LVI).

The pooled data on quarterly basis showed that both in sheep and goats the infection was sporadic. In sheep host only two animals in each year were found infected. However, these two had an impressive number of 960 and 2553 worms. In goat host the situation was that only three hosts in June to August were found infected with an average worm burden of 0.77. This shows that infection is found seldom and the worm burden is also low, however sometimes a few may show large number of worms as in the case of sheep mentioned above. In a previous survey of Helminths of

goats in Peshawar Siddiqi and Ashraf (1980) found only one host infected carrying 152 worms.

In extra livers examined the situation was not very much different though we expected higher incidence of D. lanceatum. In goats only one host was found infected with single worm in first year while none in second year. In sheep host two host were found infected in first year out of which one carried 1348 worm while the other one carried only 3 worms. In second year there was no infection. Such high infection has also been noted by many workers. Soulsby (1965) mentioned that when such high infection occurs it may lead to general wasting, oedema, anaemia and enteritis. There is little or no immunity and with continous exposure the burden becomes increasingly additive (Soulsby, 1965). Soulsby (1965) is of the opinion that since heavy burden of the parasite may occur in animals without producing marked pathological and clinical signs the chances of infection of the intermediate host is high and it is likely that rapid expansion of the infection will occur when introduced in new area. He quoted an example from New York (U.S.A.) where in 1940 only two cattle with this parasite occurred but by the end of 1940 it was widespread to be considered of economic importance. We may expect a similar situation in N.W.F.P. We may also like to speculate that focal outbreaks may be occurring which normally may go unnoticed.

Sarwar (1962) in his extensive survey of worm parasite in Pakistan did mention liver fluke, amphistomes and schistosomes but did not mention any finding of Dicrocoelium lanceatum.

In conclusion, one may say that in D. lanceatum the worm burden is erratic, some of the hosts may carry very high infection while generally it is of low grade. Similarly the seasonal variation is unpredictable as the incidence and worm burden does not follow any trend.

Table LVI: Seasonal occurrence of Dicrocoelium lanceatum Stiles et, Hassall, 1898 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.00	0.00	44.23	0.00	0.00	0.00	3.84	0.00
II-Mar-May	38.40	0.00	0.00	0.00	4.00	0.00	0.00	0.00
III-Jun-Aug	0.00	0.77	0.00	0.00	0.00	11.11	0.00	0.00
IV-Sep-Nov.	0.62	0.00	102.12	0.00	4.16	0.00	4.00	0.00

Cotylophoron ovatum:

Since its discovery by Harshey (1934) no attmept has been made to study its life cycle. However, an allied species C. cotylophorum has been subject of life history studies in India (Srivastava, 1938; Sinha, 1950; Varma, 1961) as quoted by Horak (1971). Varma (1961) found that under laboratory conditions Indoplanorbis exustus will take miracidia and start producing cercaria from 26th day onward. Cercaria encysted on plants. Experimental infection of sheep with metacercariae showed that 180 days may be required for first eggs to appear in faeces. The information though scanty shows that about 7-8 months may be needed to complete the whole life cycle.

The data for seasonal variation based on incidence and worm burden is presented in Table LVII. In sheep no infection was found in first six months from December to May while June to November only two sheep were found infected with 9 and 28 flukes respectively. In the second year there was no infection from December to February while in II, III and IV quarters 2,2 and 1 hosts were infected with bare minimum of 10, 15 and 3 flukes respectively. More goat hosts were infected especially in March to May in the second year with an average worm burden of 3.39 (See Table LVI for details).

The information leads us to conclude that in case of C. ovatum low grade infection and incidence is the common observation without any definite trends towards seasonal phenomenon. Such low burden may not be important from pathological point of view but may have epidemiological significance that it may provide source of infection for susceptible host throughout the year. Cotylophoron ovatum has not been reported from any part of Pakistan but C. cotylophorum has been reported from Sind by Mohiuddin et al. (1984) who showed that it may be have seasonal variation merely on the basis of data only for one year. However the higher incidence (upto

33.7%) mentioned by them is of interest. Bawa as early as 1939 has reported an outbreak of amphistomiasis in Sind which occured after rain and floods. Moghe (1945) found 13.2% goats infected with C. ovatum with 2-7 worms in cold season. To best of our knowledge this is the only reference of C. ovatum worm burden and seasonal variation we could find. This information is for central provinces and Berar and Central India. There is not much difference between our studies and theirs. In sheep they found 2.6% infected with 3 flukes in cold season, no infection in dry season and 2.7% with 5 worm in wet season. As they examined lesser no of animals as compared to our survey it may account for variation in results.

Majid and Hussain (1980) found C. cotylophorum in 21.87% of 320 sheeps examined at Lahore according to them amphistomiasis is the biggest trematode malady of sheep in Pakistan. They also showed 12-285 worm load with an average 287 from October to January.

Paramphistomum (E) explanatum:

The only reference to the life history of P. (E) explanatum is that of an abstract of a paper read by Srivastava (1944) published in the proceedings of 31st Indian conference. He reported that this parasite occurred in the bile duct of cattle and buffaloes in massive number as to choke the bile duct. Indoplanorbis exustus could be infected experimentally. The complete work to best of our knowledge was never published. However, as it is a common knowledge that Paramphistome encyst on herbage, this parasite may also follow the same pattern. P. inchikawai takes 25 days for development in snail and 49 days for metacercaria to develop to sexual maturity in sheep (Kisilev, 1967 as quoted by Horak, 1971).

P. (E) explanatum was found in the present survey in sheep in all the months except March-May of the first year and December to February of of 2nd year. In all others single host was found infected with average of

Table LVII: Seasonal occurrence of Cotylophoron ovatum Harshey, 1934 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	0.00	0.04	0.00	0.07	0.00	4.34	0.00	3.84
II-Mar-May	0.00	0.29	0.38	3.39	0.00	0.27	7.59	14.28
III-June-Aug:	0.34	0.00	0.57	0.00	3.84	0.00	7.69	0.00
IV-Sep-Nov	1.16	0.125	0.12	7.45	4.16	8.33	4.00	10.00

Table LVIII: Seasonal occurrence of Paramphistomum (E) explanatum Crepl, 1847 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	0.17	0.08	0.00	0.26	4.34	4.34	0.00	3.84
II-Mar-May	0.00	0.33	0.61	0.03	0.00	4.40	3.84	1.00
III-June-Aug:	0.34	0.00	0.03	0.00	3.84	0.00	3.84	0.00
IV-Sep-Nov.	0.08	0.00	0.04	0.00	4.16	0.00	4.00	0.00

worm burden of 1-16. This shows a low grade infection and worm burden. As compared with sheep which showed no infection from March to May goats had 2 hosts infected for the same period June-August and September-November of both years did not show any infection in goats. In remaining months single host was found infected. The worm burden was low (1-9 per host) (Table LVIII).

Gastrothylax crumenifer:

Surprisingly, no detail information is available on the life cycle of G. crumenifer. Yamaguti (1958) has quoted Srivastava (1944) who experimentally infected Indoplanorbis exustus with the eggs of the parasite. Following the general pattern of other amphistome one presumes that metacercariae encyst on vegetation and there is no second intermediate host.

Our data on seasonal variation and worm burden showed (Table LIX) the presence of infection invariably in all quarters in sheep and goat host except I quarter in 1st year. In all other quarters infection seems to be of low grade incidence wise and also in worm burden except in isolated cases when the worm burden was high. This has been the experience of other workers as well. Mukherjee and Deorani (1962) found that in an experimental sheep beside other amphistomes 27,768 G. crumenifer were recorded Moghe (1945) in a survey of helminth infection in sheep and goats and cattle found that G. crumenifer was more common in winter as compared to dry or wet season and the number of flukes ranged from 1-10,000 in the case of sheep and goats.

In a recent survey of helminth parasites of sheep and goat Mohiuddin et al. (1984) found that incidence of G. crumenifer is high from May to July, falling down to low levels from August onward. However, the graph representing seasonal variation shows higher incidence from January to April.

Table LIX: Seasonal occurrence of Gastrothylax crumenifer (Crepl, 1847) Otte, 1896 in sheep and Goats of Peshawar examined for the year 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	0.00	0.00	6.69	386.15	0.00	0.00	7.69	11.53
II-Mar-May	0.64	12.29	13.73	1.78	4.00	3.70	11.53	7.14
III-June-Aug:	0.30	0.15	0.96	8.51	3.84	3.84	7.69	4.40
IV-Sep-Nov.	0.12	1.66	0.72	4.50	4.16	8.33	4.00	10.00

As one can see the infection rate as well worm burden was low both in sheep and goat without any seasonal trend. We pooled the data for all amphistome infections i.e Gastrothylax crumenifer, Cotylophoron ovatum and Paramphistomum (E). explanatum with a hope that we may get an over all picture of amphistomiasis in sheep and goat. The data is presented in Table LX. From this pooled data an interesting picture evolved that in the first year conditions were somehow less favourable for amphistomiasis in sheep and goats as compared to second year. In sheep in first year the incidence and worm load was consistently lower than second year for the same period. In goats the situation was the same except September to November of first year showed higher incidence than the same period of second year.

This led us to conclude that it is not a seasonal phenomenon in the sense it is interpreted by most workers especially in Pakistan. On the contrary, in some years the condition related to climate may be such that it may show higher or lower incidence. Though our data has also limited value as it is only for two years but we can speculate with reasonable confidence that if data is collected for a number of years for parasites as well as for climatological conditions favouring or otherwise for amphistomiasis there will be years of low grade infection and worm burden or vice versa.

Though we did not mention it in the case of F. hepatica but it seems to follow the same trend.

The picture which evolved from analysis of data on trematode infections in sheep and goats for two years showed that the number of species involved are the one which are commonly found in other places except Watsonius capri which has been described in this study for the first time. Variance in worm burden and incidence was used as indicator of seasonality

of the parasite. No clear cut summer or winter trends were found. Perhaps this kind of survey has limitations for the study of seasonal variation. More involved techniques and observations on all facets of bilogy of the parasite and snail vector have to be devised. Only conclusion is that invariably trematode infections are found throughout the year. In a particular month or months greater incidence or worm burden of a specific infection is merely an indicator of the more favourable conditions prevailing in that particular year. The same thing may be observed in the same months of the next year or following years.

Worm burden as an indicator of itensity is also very much variable. In helminthic infections the worm burden is a build up process. Each time animal is active in the infested area it may pick up a few parasitic stages. If examination of two hundred gastro-intestinal tract of sheep and goats is sufficient data to draw any conclusion then one may conclude that in sheep and goats trematode infections are invariably light except a few individuals which may show numbers, which may be relatively very high. Such individuals are important in two ways, firstly, these are the animals which have worms in a number to show clinical signs and symptoms, therefore need treatment. Secondly, they ensure the perpetuation of the infection in nature. Some times when the conditions, bilogical as well as climatological factors are favourable may lead to epizootics. Such epizootics are observed sporadically by veterinarian. However, they are seldom reflected in surveys like one conducted in the present study.

In Pakistan, such epidemics have not become a common occurrence due to husbandry practices in vogue. As mentioned in introduction big herd of sheep and goats and specific grazing ranges are very few. Therefore there is almost no concentration of big herds on specific pasture where the parasite has a chance to flare up in epizootic proportions.

Table LX: Seasonal occurrence of Paramphistomids in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	0.17	0.30	6.69	386.50	12.50	17.65	11.76	27.78
II-Mar-May	0.64	12.88	14.57	5.03	12.50	11.11	29.41	30.00
III-June-Aug:	0.30	0.15	1.88	8.51	11.76	11.11	22.22	22.22
IV-Sep-Nov.	1.37	1.79	0.88	11.95	12.50	22.22	28.57	15.00

Cestoda:

Moniezia expansa:

Moniezia expansa showed light infection and low worm burden both in sheep and goats (See Table LXI). In sheep June to August in the first year and September to November in 2nd year there was no infection. In the remaining period the incidence ranged from 3.84 to 8.00% and worm burden 1-5 (Average 0.08-0.11).

In goat no infection was found from December to May in the first and 2nd year and September to November in the second year. The infection was highest in June to August in both the years while infection was also found in September to November of first year. The worm burden on the average ranged from 0.9-0.29.

Moniezia expansa employes orbatid mites as the intermediate host in which it takes 15 weeks to develop. According to Soulsby (1965) it effects young lambs more than older animals and according to him the infection is highest during May to July.

In the present survey it could be seen that in goats the infection was highest from June to August while the sheep behaved as mentioned by Soulsby (1965) at least in the first year. The climatological factors and population of orbatid mites determine the higher or lower incidence. Mohiuddin (1984) showed that Monieziasis in sheep and goats in Sind involves M. expansa and M. benedeni and is more prevalent during winter months showing rising trends from September onwards.

Zakharevich (1937) as quoted by Spasski (1951) studied the dynamics of Monieziasis in sheep. Two species of Moniezia were encountered; M. expansa and M. benedeni. Up to the end of May sexually mature worms were found and in the last days of May young worms were found. Thus the sexu-

Table LXI: Seasonal occurrence of Moniezia expansa Rud; 1805 in sheep and Goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.21	0.00	0.11	0.00	4.34	0.00	3.84	0.00
II-Mar-May	0.08	0.00	0.11	0.00	8.00	0.00	7.69	0.00
III-June-Aug	0.00	0.19	0.11	0.18	0.00	15.38	7.69	4.70
IV-Sep-Nov.	0.08	0.29	0.00	0.00	4.16	12.50	0.00	0.00

sexually mature forms of M. expansa were encountered. According to the author M. expansa is more important in the epizootics of kids as compared to M. benedeni which is more important in cattle. However, our data showed that both species are present in sheep and goat. Moghe (1945) found that there was no infection of M. expansa in dry season in some parts of India while in cold and wet season low grade infection was present.

According to Rayski (1952) the mites on pasture are infected throughout the year, therefore, chances of infection in susceptible host are throughout the year. However Ershov (1956) reported an increase in mites over a number of years in Alfalfa pasture and open forest but in field of similar situation the fluctuation is very small (Spasakii, 1951).

Moniezia (B) benedeni:

The worm burden is presented in Table LXII, in sheep Moniezia (B) benedeni was found throughout the first year but highest infection was found from June to August (19.23%) with average worm burden of 1.11 and the lowest incidence was found in September to November. In the second year there was no infection from December to February. June to August the infection was highest for the second year but lower than the first year for the same period.

In goats there was no infection in September to November period in second year and lowest infection was found in the June to August period of the second year.

Moghe (1945) found that seasonal pattern of M. benedeni was essentially similar to that of M. expansa as there was no infection in the dry season. Thapar (1956) in a very comprehensive survey of helminth parasites of sheep and goats from India observed that M. expansa was very common while M. benedeni was rather rare. Speacht (1982) found M. benedeni rarely by post moretem examination of sheep and goat from South Mozambique from spring to early autmn.

Table LXII: Seasonal occurrence of Moniezia (B) benedeni(Moniez, 1879) in sheep and goatsof Peshawar examined for the year 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	1.13	0.00	1.13	0.07	8.69	0.00	13.04	7.69
II-Mar-May	0.08	0.03	0.07	0.39	4.00	3.84	7.40	7.14
III-June-Aug:	1.11	0.19	0.23	0.07	19.23	7.69	11.53	3.70
IV-Sep-Nov	0.16	8.00	0.20	0.00	8.33	4.00	4.16	0.00

Avitellina centripunctata:

The life cycle of Avitellina centripunctata is unknown (Soulsby, 1965). Therefore, it is difficult to assess when the tape worms will mature or will be found in sheep and goat host. The data for worm burden is presented in the Table LXIII. The data showed that it was consistently absent in sheep and goats from September to November. In both years highest infection and worm burden was found in December to February in sheep in the first year and June to August in the second year. In goats in the first year however, highest infection was found in June-August and in second year from December to February while no parasites were found in June to August. Comparing with Moniezia spp. it seems that September to November is unfavourable period for cestode infection found in the present survey. However, Mohiuddin et al. (1984) showed that A. centripunctata alongwith other species of anoplocephalid showed a rising trend from September which was maintained upto December-January period. The earlier study of Moghe (1945) showed that A. sudanea was found as low grade infection in dry, wet and cold season. Thapar (1956) in a more comprehensive survey of sheep and goats in India reported A. centripunctata in summer months (July to September) with higher incidence.

Stilesia vittata:

Incidence and seasonal occurrence of Stilesia vittata is presented in Table LXIV. In sheep host the infection as well as worm burden was more in the first year than in second year. In both years the incidence as well as worm burden was highest during the period December to February though infection existed throughout the year at low level.

The situation was not very much different in goatsexcept in the second year where from June to November no infection was found.

Table LXIII: Seasonal occurrence of Avitellina centripunctata (Rivolt, 1874) in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	1.39	2.00	0.19	1.03	21.73	17.39	7.69	19.23
II-Mar-May	0.12	0.37	0.19	0.46	8.00	3.70	3.84	3.57
III-June-Aug	0.07	0.30	0.07	0.00	3.84	15.38	11.53	0.00
IV- Sep-Nov.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table LXIV: Seasonal occurrence of Stilesia vittata Railliet 1898 in the sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	9.39	2.56	3.11	22.38	34.78	26.08	11.53	11.53
II-Mar-May	1.64	1.07	0.38	1.10	16.00	18.51	3.84	10.71
III-June-Aug	7.50	14.50	0.15	0.00	11.53	15.38	3.84	0.00
IV- Sep-Nov.	0.20	0.04	2.52	0.00	12.50	4.16	4.00	0.00

Mohiuddin et al. (1984) found that Moniezia expansa, M. denticulata, Avitellina centripunctata and Stilesia globipunctata showed rising trends from September which is maintained upto December and January period. According to them Avitellina centripunctata showed two peaks in a year. Their analysis of seasonal variation is based on incidence of infection for only one year. As it has been emphasised previously such data is rather inadequate for seasonal variation which is a very complex and involved phenomenon. For example, all anaplocephalids utilise mites as the intermediate host. The dynamics of population of mites will determine their magnitude of infectiveness, which in turn will be conditioned by a number of climatological factors. The significance of age, previous experience of infection and resistance and husbandry practices of the vertebrate host will further complicate the outcome of the process.

To sum up, like trematode infections, cestodes do not show clear cut seasonal variation. Whatever conclusions have been drawn by previous workers in Pakistan and else where are only conjectural.

As all the anoplocephalid have essentially a similar life cycle therefore we pooled the data for all the four species found in the present survey namely, M. expansa, M. benedeni, Avitellina centripunctata and Stilesia vittata for sheep and goats for two years of survey to see if a better picture of seasonal variation based on incidence and worm burden could be evolved (see Table LXV), one thing is obviously very clear from pooling of the data that both in sheep and goats the infection as per incidence and worm burden was more in the first year than in second year, secondly, September to November seems to be the time when the infection is at its lowest in sheep as well in goats. The polled data also showed that apparently conditions were more conducive in the first year than in second year as is evident from the incidence as well as worm burden.

Table LXV: Seasonal occurrence of Anoplocephalid of sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb	12.04	3.42	2.69	23.50	60.86	19.23	56.52	30.76
II-Mar-May	1.88	0.73	1.15	1.53	36.00	15.38	25.92	14.28
III-June-Aug	8.69	0.53	14.92	0.25	26.92	23.07	34.61	11.11
IV- Sep-Nov.	0.66	2.60	0.54	0.00	25.92	8.00	20.83	0.00

Cysticercus tenuicollis:

It is the larval stage of Taenia hydatigena. The adults are found in canids like dogs, foxes, coyotes and other wild forms. The ripe proglottids are shed which when swallowed by herbivores like sheep, goat and cattle lead eventually to form larvocyst (cysticercus) initially in liver and then in parts of peritonaeal cavity. Anishchenko (1954) as quoted by Abduladze (1964) described four phase of course of pathology which shows that from time to infection to potency of cyst may take about a month.

In the present survey cysts were found in liver and other parts of the body as shown in Table XVI. The data computed for different quarters showed that both in goat and sheep the infection was present in both years. In sheep the highest incidence was found in December to February (average 1.95). In second year the incidence was highest in March to May (30.76%) but worm burden was highest in June to August (average 0.38) while the incidence was lowest (8%) from September-November. In goats the incidence was highest in Ist year in December to February (21.73%) and so was the worm burden (average 0.39). In the second year incidence was highest in March to May (28.57%) Table LXVI.

Moghe (1945) reported C. tenuicollis from sheep and goat from Central Provinces and Berar and Central India. In goat no infection was found except in winter and the worm burden was extremely low while in sheep though it was found throughout season but the infection as well as worm burden was extremely low.

In the present survey in extra liver and lungs suspected for helminthic infection the Cysticercus tenuicollis was much less than in the liver and lungs attached to the viscera. In sheep no infection was found from March to May in the first year and March to August in second year.

Table LXVI: Seasonal occurrence of Cysticercus tenuicollus (Larval form) of Teania hydatigena Pallas, 1766 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	1.95	0.39	0.26	3.69	21.73	21.73	18.38	23.07
II-Mar-May	0.20	0.29	0.30	0.39	16.00	7.40	30.76	28.57
III-June-Aug	0.42	0.19	0.38	0.14	7.69	19.23	19.28	77.77
IV- Sep-Nov.	0.20	0.08	0.08	0.20	20.83	8.33	8.00	20.00

Table LXVII: Seasonal occurrence of Cyticercus tenuicollis (Larval form) of Taenia hydatigena Pallas 1766 in sheep and goats of Peshawar for extra lungs and liver examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats:
I-Dec-Feb.	0.13	0.03	0.06	0.00	8.69	3.03	6.25	0.00
II-Mar-May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
II-June-Aug.	0.03	0.00	0.00	0.30	3.57	0.00	0.00	8.69
IV Sep-Nov.	0.02	0.06	0.06	0.00	2.94	6.25	4.54	0.00

The average worm burden ranged from 0.02 to 0.13. In goats infection was found only in December to February and September to November in first year while in second year the only infection found was in June to August. The average worm burden was 0.3.

The difference in the liver and lungs attached to the viscera and extra liver and lungs may be related to the age group. It is assumed that Cysticercus tenuicollis effects the young animals as compared to old, perhaps due to development of resistance.

The situation seems to be in contradiction to that of facioliasis where we found more infection in extra liver. This again emphasises the need for evaluation of the material from different sources.

Hydatid cyst of Echinococcus granulosus:

Hydatid cyst (Echinococcus granulosus) was not found throughout the second year in sheep except in one host from December to February in which 1000 cysts were observed. In sheep in first year from September to November and December to February the incidence was comparatively high. In the goat host there was no infection from December to February and March to May while in the second year the infection was present during this period but not in June to August and September to November. The worm burden was highest from December to February (See Table LXVIII).

There is no clear cut indication of seasonal variation however, at a glance it seems that in the second year both in sheep and goat the infection with hydatid cyst was almost non-existent.

In the extra lungs and livers suspected for hydatid infection one consistant finding was that no infection was found in September to November period in both years in sheep. This was almost the case both in sheep and goat in 2nd year in liver and lungs attached to the viscera (See

Table LXVIII: Seasonal occurrence of Hydatid cysts (larval form) of Echinococus granulosus Batsch, 1786 in sheep and goatsof Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.08	0.00	38.46	4.07	8.69	0.00	3.84	15.38
II-Mar-May	0.08	0.00	0.00	0.14	4.00	0.00	0.00	3.57
III-June-Aug	0.11	0.77	0.00	0.00	3.84	7.69	0.00	0.00
IV-Sep-Nov.	0.12	0.33	0.00	0.00	8.33	12.38	0.00	0.00

Table LXIX: Seasonal occurrence of Hydatid cysts (Larval form) of Echinococcus granulosus Batsch, (1786) of extra liver and lungs examined of sheep and goats of Peshawar for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	4.95	4.00	6.75	2.90	17.39	12.50	0.09	16.60
II-Mar-May	1.41	0.59	12.86	0.47	17.64	9.37	10.00	26.08
III-June-Aug	4.03	0.10	1.59	1.56	25.00	3.33	7.40	13.04
IV- Sep-Nov	0.00	0.31	0.00	0.68	0.00	27.27	0.00	0.06

Table LXVIII and Table LXIX).

Secondly, in extra livers and lungs the worm load was higher as compared to those attached to viscera (See Table LXVIII). This was expected as the former were from older animals.

The results reported in literature regarding the seasonal variation and worm load of hydatid cyst is rather scanty. Moghe (1945) found hydatid cyst throughout the cold, dry and wet season in some parts of India.

As the animal which contracts hydatid infection will remain infected throughout life and the cyst may take many years to grow to large size one may expect that the infection will be found throughout the year, though our data suggests that younger animals which have not been exposed to hydatid infection previously, do not pick it up during the months from Septemoer to November. This result is so consistent that it may be of some significance in the epidemology of hydatid infection in this area.

Nematoda:

Trichuris spp:

Trichuris was represented by T. globulosa, T. lani, T. parvispiculum and T. indica. The last named was found in a very few cases.

T. globulosa was found less prevalent in June to August as compared to other parts of the year in sheep as well as in goat. This was the experience in both years. The worm burden was also lowest in the same period (See Table LXX). As compared to other nematode infections Trichuris globulosa showed a consistent higher incidence throughout the year. The average worm burden was however not of clinical consequence as mentioned in literature.

Table LXX: Seasonal occurrence of Trichuris globulosa (Linst., 1901) from sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	1.13	1.26	3.19	3.30	47.82	47.83	57.69	65.38
II-Mar-May	0.56	0.51	1.26	1.17	40.00	25.13	46.15	32.14
III-June-Aug	0.23	0.57	2.67	0.14	25.00	30.77	15.38	22.22
IV- Sep-Nov.	1.70	2.83	0.76	1.40	45.83	50.00	40.00	65.00

Trichuris lani showed a similar behaviour as T. globulosa in that the prevalence was lowest during June to August in sheep. However, in goats lowest prevalence was in March to May in both years. It is interesting to note that in sheep in the second year the highest prevalence was in March to May period (Table LXXI). What it means to us? it seems that per se trichuriasis is not a seasonal phenomenon in the strict sense but infection may shoot up any time of the year when all the ecological and other factors are conducive.

T. parvispiculum behaved the same way as two other species mentioned earlier. The highest prevalence in sheep in the first year was in December to February, though the highest worm burden (average 12.70) was in September to November. Both prevalence and worm burden was highest in December to February in the second year. The infection was maintained more than 40% throughout the four quarters. In the goat host the highest prevalence was like in sheep in the first year, that is in December to February period while the worm burden was highest in June to August. In the second year the highest prevalence and worm burden was in June to August period. In goat the level of infection remained more than 60% in all the quarters of the first year (See Table LXXII).

Table LXXIII shows the pooled data for all the four species of Trichuris. It indicated that trichuriasis stays at a very high level of infection throughout the year both in sheep and goat. The average worm burden is also comparatively high. Inspite of the pooling of data no clear cut seasonal trend was obvious. However, autmn and winter definetly seem to be period of high prevalence as compared to spring and summer. Mohiuddin et al. (1984) basing their information on data for one year showed higher prevalence in September-October period. There is no other information available on the seasonal variation or worm burden from Pakistan

Table LXXI: Seasonal occurrence of Trichuris lani (Artiukh, 1948) from sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	1.34	1.39	0.26	1.30	43.47	30.43	23.08	46.15
II-May-May	0.40	0.25	2.346	0.35	24.00	18.52	38.46	14.29
III-Jun-Aug:	0.11	0.42	0.23	1.00	7.69	23.08	23.08	25.93
IV - Sep-Nov.	2.55	2.20	3.68	1.90	37.50	38.46	32.00	35.00

Table LXXII: Seasonal occurrence of Trichuris parvespiculum (Ortlepp, 1937) from sheep and goats of Peshawar examined for the years (1978-79 to 1979-80).

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	7.34	15.00	11.80	11.65	78.26	78.26	84.61	69.23
II-Mar-May	2.28	2.40	6.50	4.89	56.00	70.37	65.38	39.28
III-Jun-Aug	5.88	19.57	9.19	16.92	69.23	65.38	42.30	81.48
IV- Sep-Nov	12.70	10.79	9.68	10.90	62.50	66.66	76.00	45.00

Table LXXIII: Seasonal occurrence of Trichuris spp. Roederer, 1761 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	17.65	9.82	16.26	19.85	78.26	78.26	84.61	76.92
II-Mar-May	3.44	3.00	6.92	9.39	60.00	77.77	69.23	39.29
III-Jun-Aug	20.57	6.23	19.38	9.66	61.53	65.38	42.30	62.96
IV- Sep-Nov	15.83	15.37	11.40	17.65	83.33	79.16	84.00	100.00

Skrjabin et al. (1957) have summarised russian and non-russian work done on climato and microclimatological factors effecting prevalence of trichuriasis. It is generally agreed that distribution of trichuriasis is directly related to the amount of precipitation and amount of water retained in the soil. It has been established that whipworm eggs are more sensitive to low temperature and less sensitive to desiccation.

Bunostomum trigonocephalum:

Bunostomum trigonocephalum was found only in sheep host in the present survey. In the first year a single host harboured 54 worms in September to November period. In the second year no worms were found in December to February and June to August period while in March-May three host out of 26 examined (11.53%) carried an average worm burden of 3.19 and September-November period one host carried 24 worms.

Sarwar (1962) reported B. trigonocephalum from higher altitude himalayan tract including Abbottabad & Kaghan valley, characterised by 50-100" rainfall, high altitude with occasional snow fall. Further down he reported it from submountane region, comprising of Sialkot and Rawalpindi districts with an annual rainfall of 30-50". It was also reported from Palearctic region of Kalat which is mainly arid region. Durrani et al.(1981) reported 33% incidence of B. trigonocephalum from Jhelum valley (Azad Kashmir) from sheep and goat. Le Richi et al. (1973) found 6% of goats and sheep infected with B. trigonocephalum with more spring and autmn prevalence but no clear cut pattern of seasonal distribution. El-Moukdad (1977) found that out of 60 sheep examined in Austria 26% were infected with B. trigonocephalum. As it is a summary of a paper it did not mention the worm burden or seasonal variation. Moghe (1945) found approximatly similar occurrence of B. trigonocephalum in dry, wet and cold seasons. The worm burden ranged from 10-80 in goat. In sheep host there

Table LXXIV: Seasonal occurrence of Bunostomum trigonocephalum (Rud, 1808) in sheep of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden		Incidence:	
	1979	1980	1979	1980
I - Dec - Feb	0.00	0.00	0.00	0.00
II - Mar - May	0.00	3.19	0.00	11.53
III - Jun - Aug	0.00	0.00	0.00	0.00
IV - Sep - Nov	2.25	0.96	4.16	4.00

was more infection in cold season than in dry or wet season. Thapar(1956) found that B. trigonocephalum occurred in sheep and goat in summer and winter months in many parts of U.P (India). No clear cut pattern of seasonal variation could be derived from their detailed but combersome tables. Crofton (1953) found that the eggs of this species were not detected until August and showed slight increase in autmn and winter in low land farms of England.

According to McCulloch and Kasimbala (1968) climatological factors exerted a noticeable influence on the distribution pattern of worm burden. There was marked drop, almost to zero in the incidence of B. trigonocephalum in the southern region of Tanzania which received a low rainfall.

Parnell et al. (1954) as quoted by Soulsby (1965) considered it most pathogenic nematode. He further quoted Demidova (1957, 1958) that in Moscow area all young lamb and adult sheep are infected with average worm burden of 112.4. Sarimsakov (1958) reported an incidence of 83% with average worm burden of 162 in foothill of Uzebekistan. Ershov (1956) noted occasionally from 60-68% of a flock dying from the effects of B. trigonocephalum. Five hundred to one thousand worms in young and old animal may lead to clinical pathogenicity according to Soulsby (1965). Judged from this criteria the worm load found in our survey is of a low magnitude and it seems that in this area it is not as common as in some other parts of the world.

Oesophagostomum spp:

In the present study four species of genus Oesophagostomum have been reported from both sheep and goats host: O. columbianum, O. asperum, O. venulosum and O. brevicaudum. Out of these four species life cycles of O. columbianum and O. venulosum have been studied in detail by Veglia (1923) and Goldberger (1951). Life cycle of O. columbianum takes about

32 days and O. venulosum about 31 days as quoted by Soulsby (1965).

In sheep O. asperum infection was absent from March-May in Ist year and from December to August in second year. In goatsinfection was absent from March-August in Ist year. In second year no infection was reported from the whole year. Higher infection was reported in both sheep and goats in Ist year from September to November (See Table LXXV).

O. columbianum infection was present constantly for both years in both sheep and goats host. Higher incidence of infection was reported in the months of December-February in both hosts for two years with higher average worm burden (See Table LXXVI).

O. brevicaudum was found only in two goats in second year with two worm in each goat in the months of July and November.

O. venulosum behaved some what in the same way as O. columbianum, infection was highest from December-February in both sheep and goat except in sheep in second year infection was not high in these months. Average worm burden was also highest in these three quarters. In both sheep and goat in second year from June-August and in sheep in Ist year from September-November. infection was absent.

The data for all the four species of Oesophagostomum pooled together for incidence & worm burden is presented in Table LXXVIII. For the first time one can see that a consistant seasonal phenomen is apparent. In both host the highest incidence & worm burden was found in March to May in the first year and June to August in the second year. This consistant result may be a mere co-incidence or show a seasonal phenomenon. If it is seasonal even then it may be different from year to year.

For example, in first year the lowest incidence & worm burden was in March to May while in second year it was in June to August when no

Table LXXV: Seasonal occurrence of Oesophagostomum asperum Railliet et Henry 1913 in sheep and goats of Peshawar examined for the year 1978-79 to 1979-80.

Quarter:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.04	0.04	0.00	0.00	4.34	4.34	0.00	0.00
II-Mar-May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
III-Jun-Aug	0.34	0.00	0.00	0.00	7.69	0.00	0.00	0.00
IV -Sep-Nov.	0.29	0.20	0.08	0.00	16.66	8.33	2.00	0.00

Table LXXVI: Seasonal occurrence of Oesophagostomum columbianum Curtice, 1890 in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	14.39	14.60	25.46	22.00	73.91	65.21	69.23	73.07
II-Mar-May	3.39	1.40	9.57	15.57	40.00	14.81	38.46	50.00
III-Jun-Aug	3.46	3.53	5.69	7.48	34.61	15.38	19.23	25.92
IV- Sep-Nov	6.41	13.33	6.88	18.25	45.83	54.16	56.00	60.00

Table LXXVII: Seasonal occurrence of Oesophagostomum venulosum (Rud, 1809) in sheep and goats of Peshawar examined for the years 1978-79 and 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	1.47	7.34	1.46	0.30	13.04	26.08	13.04	14.28
II-Mar-May	0.20	0.96	0.61	0.75	4.00	11.11	11.53	7.69
III-Jun-Aug	0.88	1.46	0.00	0.00	11.53	5.55	0.00	0.00
IV -Sep-Nov	0.66	0.00	0.08	1.70	12.50	0.00	4.00	20.00

Table LXXVIII: Seasonal occurrence of Oesophagostomum spp. Scheidegger et Kreis, 1934 in sheep and goats of Peshawar examined for the year 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	15.91	22.00	26.92	22.00	73.91	73.91	73.07	76.92
II-Mar-May	3.52	2.37	10.19	2.37	40.00	22.22	50.00	53.57
III-Jun-Aug	7.69	6.07	5.57	6.07	46.15	23.07	19.23	25.92
IV- Sep-Nov	7.37	13.62	7.04	13.62	50.00	59.16	54.00	70.00

infection was found in either host. This again emphassis our conclusion that from year to year conditions may vary, thus effecting the parasitism.

Chabertia ovina:

It has direct life cycle and takes approximately 48-54 days for development in the sheep host as worked out experimentally by Threlked (1948). This means that after infection of the host approximately two months are needed to complete the life cycle and theoratically six cycles at the maximum may occur in a year if there is no immunity or seasonal variation and pasture is being continously infected (Soulsby, 1965).

In sheep host only two hosts were found infected with an average worm burden of 0.52 in the December to February period. In the second year there was no infection in the same period (December to Fabruary) and in all other three quarters infection was present, the highest being in March to May with an average worm burden of 0.23. In goats the highest infection (21.73%) was in December to February period with an average worm burden of 3.13. There was no infection in March to May or September to November. In the second year there was no infection December to Febr-uary and September to November period while March to May and June to August infection was found in single host with an average worm burden of 0.14 respectively (See Table LXXIX).

The conclusion one may draw is that the worm burden is extremely low as compared to other strongyloid nematodes. Secondly, there is no clear cut seasonal variation either in goats or sheep host or even when the data is compared for two years in both hosts.

Le Rich et al. (1973) found that Chabertia spp. showed an autmn peak and a lower rate of infection in the summer for sheep and goat hosts in Cyprus in a two year study. One fact is clear from our data

Table LXXIX: Seasonal occurrence of Chabertia ovina (Fabricius, 1974). In sheep and goatsof Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.52	3.13	0.00	0.00	8.69	21.73	0.00	0.00
II-Mar-May	0.00	0.00	0.23	0.14	0.00	0.00	11.53	3.57
III-Jun-Aug	0.00	0.19	0.07	0.07	0.00	0.00	3.84	3.70
IV -Sep-Nov	0.00	0.00	0.16	0.00	0.00	0.00	4.00	0.00

that autmn (September to November) is comparatively free from infection in both years in goat and sheep. It seems to be more of summer infection with an indication of increase in spring (March to May).

Haemoncus contortus:

Haemoncus contortus is a parasite of abomasum of sheep and goat and has a direct life cycle. Martin and Ross (1934) found that H. contortus laid 5000 egg/day. It is generally considered to be the prolific egg-layer and outstrips other trichostongyles in egg production (Soulsby, 1965). The studies on the development of H. contortus under field conditions by Dinnik and Dinnik (1958) showed that infective stage reached in 8-12 days in temperature conditions where the diurnal fluctuations of air temperature was between a mean maximum of 24°C or more and a mean not less than 12.3°C. However, Soulsby (1965) warned that extrapolation of results of one country to another is dangerous.

Amongst the few studies done in Pakistan on biology of gastrointestinal parasites of sheep and goat is the one done by Rizvi and Barya (1967) who showed that the optimum temperature for the development of the eggs and larvae of H. contortus was 27°C and summer season was less favourable than spring and autmn. The optimum humidity for the development of the larvae of H. contortus was 75%. Abbasi (1987) studied the development of H. cont-ortus in this laboratory and found that the best development occured in tap water at 38°C & third stage larvae start appearing from 6th day.

Haemoncus contortus infection was one of the highest ever amongst the nematodes. In sheep in the first year highest infection was found from December to February with an average worm burden of 170.95 while lowest was found in September to November with an average burden of 41.12. In the next year the highest infection was again in December to February with an average worm burden 152.34 while lowest was in June to August

with an average worm burden of 24.

In the goat host the highest incidence and worm burden was again in December to February (average worm burden being 451.73) and the lowest infection and worm burden was in March to May (average worm burden being 34.60). In the second year the highest worm burden was in September to November however worm burden was slightly higher in December to February (average being 78.38).

We hoped that Haemoncus being present throughout the year and worm load being higher may show a clear cut seasonal phenomenon. Our hopes were belied as no clear cut trend of seasonal variation were seen as has been the experience of many workers in temperate climate.

In temperate climate, where there are severe winters Haemcncus contortus shows clear cut seasonal phenomenon called arrested development or hypobiosis. According to Schad (1977) hypobiosis is caused by three factors, namely host factors, parasite factors and environmental factors. Environmental factors are relevant to our discussion of seasonal variation.

As opposed to cold climate we expected that due to severe summer in this part of the world the hypobiosis may express itself in the summer months. However, our data did not reflect such a situation. This parasite was top ranking amongst all parasitic infection showing one of the highest incidence and worm burden throughout the year. Inspite of thorough search for inhibited fourth stage larvae no significant number were found either in summer or winter. This may be expected as hypobiosis in H. contortus and related genera of trichostrongyles is an adaptation to tide over unfavourable period. Perhaps, in our climate that threshhold (which forces the larvee to undergo hypobiosis) never reaches. Therefore, it is never expressed.

Table LXXX: Seasonal occurrence of Haemoncus contortus (Rud, 1803) in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		9180		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	170.05	451.73	152.34	78.38	91.30	65.21	96.15	69.23
II-Mar-May	84.40	34.60	43.50	35.92	76.00	40.70	61.53	50.00
III-Jun-Aug	143.32	24.42	24.00	76.11	80.00	57.69	42.30	62.96
IV- Sep-Nov	41.12	30.00	33.96	75.60	66.66	79.16	92.00	90.00

Dictyocaulus filaria:

Dictyocaulus filaria has a direct life cycle and considered geohelminth by russian workers (Soulsby, 1965). As the parasitic stages spend time in the external environment the environmental factors will be of considerable ecological consequence with special reference to worm burden and seasonal variation. The eggs or larvae are voided in the external envoronment. Six to seven days are required to reach the infective stage and about 4 weeks to attain sexual maturity. All age groups are susceptible and the disease runs a chronic course. Kauzal (1933) as quoted by Soulsby (1965) noted that continous low temperature slowed the development but helped to conserve the vitality and prolong survival. However, at high temperature (26-33°C) all larvae degenerated. The temperature plays a very important role in reaching the infective stage. In England, on pasture at least 6 weeks are required to reach infective stage during November and December but in June and August less than one week may be necessary. The longevity of larvae also depends on temperature. The young larval stages are more sensitive to higher temperature than the older or advance stages. In Great Britain the longevity of the larvae depends on the time of the year. A mixiмum survival of 23 weeks was noted from January to June and only 7 weeks from June to August. Clinical infections are seen more commonly during winter as compared to summer. Immunity to reinfection is well established.

In view of the above mentioned facts, let us now review our findings. In sheep host in the first year the highest incidence and worm burden was from September to November followed by in December to February while during spring and summer it was comparatively low. However, in the second year the incidence and worm burden was higher during December to May as compared to June to November. In goats, in the first year highest incidence and worm burden was found in December to February

Table LXXXI: Seasonal occurrence of Dictyocaulus filaria (Rud, 1809) in sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Shepp	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.78	3.39	3.50	0.92	13.04	26.08	23.07	15.38
II-Mar-May	0.60	0.00	0.92	2.96	8.00	0.00	11.53	14.28
III-Jun-Aug	0.53	0.30	0.11	0.00	7.69	3.84	3.84	0.00
IV- Sep-Nov	6.91	1.08	1.36	0.10	29.16	8.33	8.00	5.00

Table LXXXII: Seasonal Occurrence of Dictyocaulus filaria (Rud, 1809) sheep and goats of Peshawar for extra Lungs examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	6.47	65.21	4.87	36.36	3.37	31.25	4.33	30.00
II-Mar-May	0.82	11.76	2.06	30.00	1.90	15.62	5.08	43.47
III-Jun-Aug	0.57	6.09	0.25	11.11	0.06	6.66	0.17	86.95
IV -Sep-Nov	1.35	11.76	0.00	0.00	3.77	13.63	4.125	18.75

followed by September to November. This is more in line with the information reported in literature as mentioned in the begining of this account. The lowest worm burden and incidence was in March to May and June to August. In the second year highest worm burden was during March to May but incidence was from December to February and the lowest from June to August and September to November. Over all it seems that Dictyocaulus filaria is an infection of autmn and winter season in this area as compared to hot summer month of June to August. The data further showed that for a peak of infection to develop in December to February a rising trend was seen in September to November and then there was a declining trend from spring culminating into lowest incidence and worm burden in summer.

The extra lungs examined for Dictyocaulus filaria infection confirmed that this infection was a winter infection as it is highest during this period. However, March to May period was different in goat when it showed the maximum incidence (see Table LXXXII).

Dhar et al. (1972) studied the prevalence of lung worms infection in sheep in Kashmir. They found Dictyocaulus filaria to be more prevalent in October to November as compared to March to May period.

Pneumocaulus kadenazii:

Pneumocaulus kadenazii is also a parasite of lung, originally described from musk deer from Russia. This is for the first time reported from sheep and goat from this part of world. Worm burden and incidence was low both in sheep and goat in both years. In sheep the highest infection was in June to August period in both years, while in the case of goat highest incidence and worm burden was in September to November period while no infection was found in the second year except one animal in March to May period.

Table XXXIII: Seasonal occurrence of Pneumocaulus kadenazii Schulz et Andreeva, 1948 of sheep and goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters:	Average worm burden				Incidence			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.43	0.34	0.53	0.00	4.34	4.34	3.84	0.00
II-Mar-May	0.28	0.00	0.07	2.92	8.00	0.00	3.84	3.57
III-Jun-Aug	2.69	0.03	0.30	0.00	15.38	3.84	7.69	0.00
IV- Sep-Nov	1.00	2.00	2.12	0.00	4.16	8.33	4.00	0.00

Table LXXXIV: Seasonal occurrence of Pneumocaulus kadenazii (Schulz et Andreeva, 1984) in sheep and goats of Peshawar for extra lungs examined for the years 1978-79 to 1979-80.

Quarters:	Worm burden:				Incidence:			
	1979		1980		1979		1980	
	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats
I-Dec-Feb	0.00	0.68	3.45	0.30	0.00	18.75	12.12	6.66
II-Mar-May	4.25	0.125	0.93	0.04	11.76	3.12	10.00	4.34
III-Jun-Aug	0.35	0.00	0.18	0.00	3.57	0.00	3.70	0.00
IV- Sep-Nov	0.29	0.00	0.00	0.00	2.94	0.00	0.00	0.00

In extra lungs suspected of infection though the incidence and in some case worm burden was higher than in lungs attached to the viscera, however the difference was not as spectacular as in the case of Dictyocaulus filaria. Both in sheep and goat host a cursory look on the data (see Table LXXXIII) showed that there was no seasonal trend in the distribution. In goat it seems to be a winter infection while no such indication is apparent in the sheep host. As this parasite seem to be adopted to sheep and goat recently and has apparently been introduced from Russia it does not seem to be well adapted. If our taxonomic diagnosis is correct, then it is very interesting to study the behaviour of a parasite in a new host and new locality.

Skrjabina ovis:

Skrjabina ovis was found only in the goat host. It has a direct life cycle. The eggs are deposited in perianal region. The hatching occurred in the small intestine and by 25th day larva becomes adult (Soulsby, 1965).

In the present survey the goat host carried infection only once in the first year in March to May period. The infection was with single worm. In the second year the highest infection (10%) was found in the September to November period with an average worm burden of 5.2. In the rest period of second year single infection was found in each quarter with 0.07-0.96 average worm burden. Mohiuddin (1984) found peak of infection in February and again in June-July period. Sarwar (1962) reported this parasite from Rawalpindi, Jhelum and Attock districts which he termed as Sub-Himalayan zone and Salt Range. This range is characterised by hot valleys and slightly cooler regions. The annual rainfall averages 25 cm and does not exceed 50 cm. According to him this species is also encountered in great number in palaearctice region of Kalat with aridity as its characteristic feature of climate. Temperature ranges are greatly variable and rain fall

is scanty. Shah *et al.* (1980) found 14.6% of sheep infected with *S. ovis* in animals slaughtered at Lahore (Punjab). They noted a heavy worm burden in wet season. It seems that *S. ovis* is a parasite which is found in climatic conditions and topographic situations other than prevailing in N.W.F.P. This may account of finding a very low worm burden as well as incidence of this species. Chellappa and Gopalakrishnan (1977) considered *S. ovis* as a rare parasite of goat in India. Le Riche *et al.* (1973) found *S. ovis* in 9% goats in cyprus. The worm burden was considerable and mainly found in autmn.

The review of literature showed that *S. ovis* has not been studied for seasonal variation related to epidemiology to the same extent as other gastro-intestinal nematodes in countries where live stocks farming is established on large scale and on scientific basis, this may be due to the fact that principally this is a parasite of goats and this animal is not a traditional live-stock of such countries.

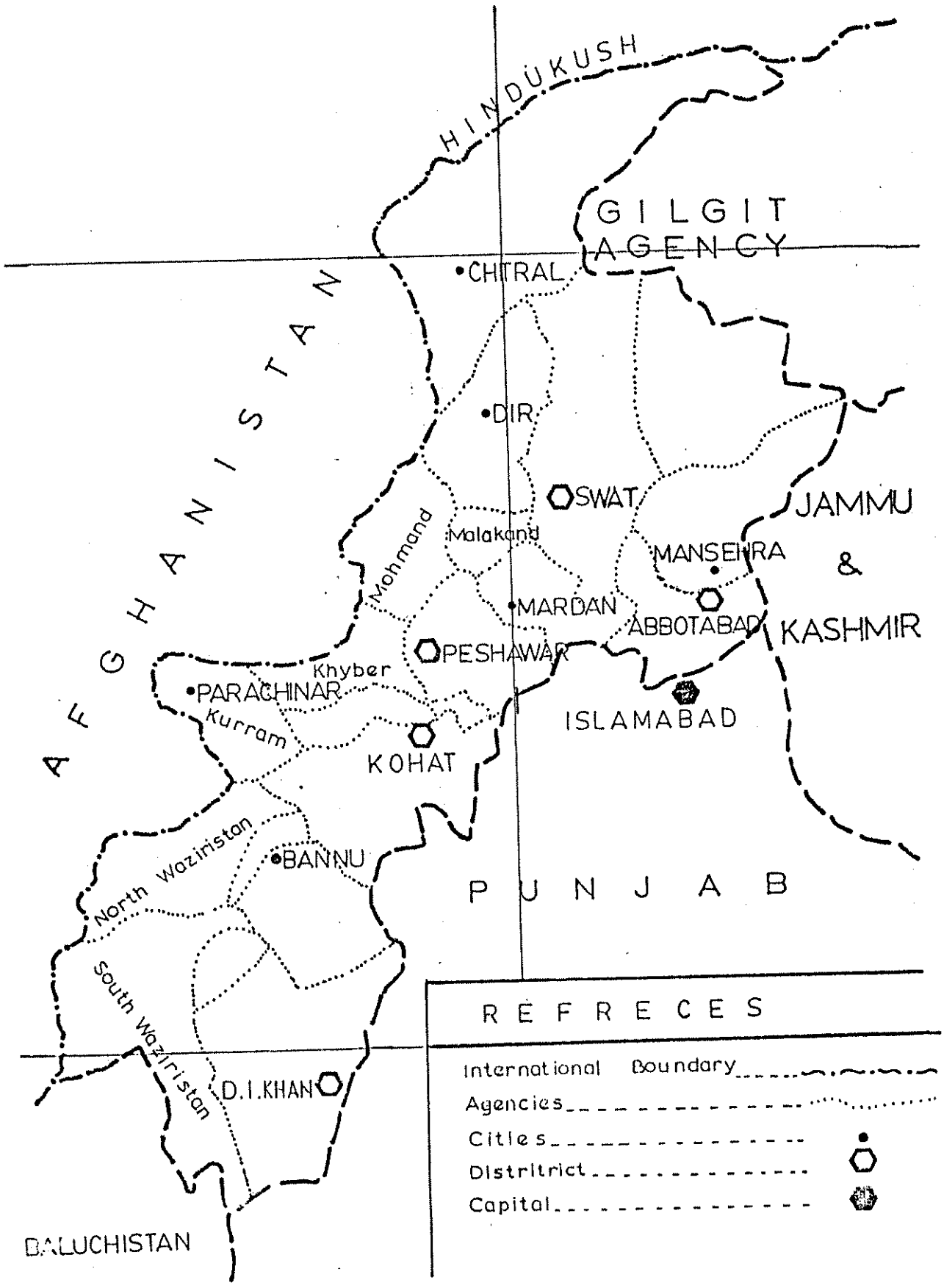
Table LXXXV: Seasonal occurrence of Skrjabina ovis (Skrjabin, 1915) Wereschitchagin, 1926 of goats of Peshawar examined for the years 1978-79 to 1979-80.

Quarters;	Average worm burden		Incidence:	
	1979	1980	1979	1980
I - Dec-Feb	0.00	0.96	0.00	4.00
II - Mar-May	0.03	0.07	3.70	3.57
III - June-Aug	0.00	0.81	0.00	3.70
IV - Sep-Nov.	0.00	5.2	0.00	10.00

CHAPTER IV

DISCUSSION.

NORTH WEST FRONTIER PROVINCE



DISCUSSION

The specified problems related to Taxonomy, incidence, seasonal variations and worm burden has been discussed in the relevant chapters.

The purpose of this discussion is to present an overall view of the parasitism of sheep and goat in N.W.F.P and to draw conclusions if there are any.

According to Van Veen (1982) "Parasitism is as much land use and management problem as a disease problem". He further elaborates,."This statement which is commonly accepted by veterinary epidemologist, indicates the importance of management in the occurrence of parasitic disease". However, according to him this is often forgotten in the case of parasitic problems and attention is only given to drug treatment which may result in poor efficacy but no question is asked about the parasite, host animal and the management systems.

Keeping the statement of Van Veen in mind a brief review of Phsiography of N.W.F.P., management of Goat and sheep and epidemological factors are presented.

N.W.F.P. (North West Frontier Province) lies between $31^{\circ}.4$ and $36^{\circ}.57$N & $69^{\circ}.16$ and $74^{\circ}.7$E. Its extreme length these parallels is 408 miles and its extreme breadth between these meridians is 279 miles. Approximate area of this Province is 38,665 square miles out of which 13,193 is said to be settled districts while remaining is known as tribel area. The territory falls into three main geographical divisions; the Cis-Indus Districts of Hazara; the comparatively narrow strip between the indus and the hills constituting the Districts of Peshawar, Kohat, Bannu and Dera Ismail Khan; and the rugged mountainous region on the north and west between those districts and the borders of Afghanistan.

The terrain of the province ranges from lofty mountains with rugged valleys, to undulating and dissected sub-mountain plateaux and flat plains. The northern and western parts of the Province are dominated by mountains, with the highest peaks perpetually snow-clad. East of Tirich Mir (8421 meter) the highest peak is Hindu Kush, the glaciers are an impressive sight. The Western mountains, on the contrary are dry with aridity increasing towards the south as the height decreases.

The most useful is the vale of Peshawar, a fertile plain covered with alluvium rimmed by predmont area in which surface gravel predominates. Kohat is a table land formed of sandstone and limestone and dissected by streams. Bannu is a plain underlain by sandstone and conglomerates and bordered by hills. Dera Ismail Khan is for the most part, a plain formed of alluvium, limestone and gravels and dissected where erosion by torrent is active. Hazara District in the north-east is generally mountainous, with small plains between the ranges in the southern part.

Because the terrain of the Province is so highly diversified, climatic conditions vary substantially. The mountainous areas are very cold in winter and remain cool during summer. In the plains the summers are hot and winters cool to cold.

Four season may be distinguished as in other parts of Pakistan cold weather (mid December to March), Hot weather season (April to June) Monsoon season (July to September) and Post monsoon (October to mid December).

The cold weather season is characterised by high barometric pressure, some what low temperatures and small precipitation from shallow western disturbances. The minimum temperature occassionally falls below freezing even in parts of plains. Rainfall during the months December to March increases North-wards and Westwards reaching upto 10" or more in north and northwest.

Hot weather is marked by high temperature and aridity. There may be diurnal difference in temperature, day temperature may be reaching upto 114°F. Rainfall is small only 4-5" in Himalayan sub mountain areas.

The monsoon period is characterised by rains and low pressure. While the post monsoon period is that of dryness, so much so that October and November are the driest months. The pressure begins to rise in the period reaching to its maximum in December to March period (Rose, 1979).

According to the classification of climate of Pakistan by Ahmad (1964) N.W.F.P. lies in subtropical continental highland with cold snowy winters, mostly arid, with summer rains. The outer Himalayan area wich also include Hazara receive rainfall throughout year, with two maximum, one in late summer and the other in spring. In Chitral and Swat the summer rains become scanty and two third of rains are from December to April. In the Kohat and Waziristan area the rainfall generally decreases towards south.

Main forest lie above 3000 ft. and below tree limit in Northern areas. The rainfall in this area is good and well distributed and ever green Coniferous trees flourish. Grassland in Patches, large or small are found in western hilly area.

At a glance one can conclude that the physiography of N.W.F.P. presents a varied picture.

Host:

Origin and History: Goats and sheep, together constitute the tribe of Caprini which belong to family Bovidae of hallow horned, ruminant in the sub order Ruminantia of the mammalian order of Artiodactyla. Much has been written on the origin of sheep and goat but there is always inadequate information on which to develop any final opinion. Sheep and goat

were perhaps the first ruminants to be domesticated around 10,000 BC sheep were probably first domesticated in Iran and Baluchistan (Pakistan). Demesticated sheep existed in Harppa and Mohenjodaro. Two oldest civilization known in Indo-Pakistan sub continant . Most of the present breeds of sheep have traces of Mediterranean as well as Asian wild sheep. The Pakistani breeds most prabably descended from Ovis vigei. The wild sheep of Baluchistan, Afghanistan and Soviet central Republics as well as from Ovis ammon, the marcopolo sheep of China (Hasnain,1985).

Goats are believed to have descended from two living races of wild goats Capra hircus aegagrus and Capra hircus blythi. These are the breeds of high mountains of Asia and the wild goats of Sind (Hasnain,1985).

Population and Breeds: According to cencus of 1988, There are 2.226 million sheep and 4.190 million goats in N.W.F.P. Twenty eight breeds of sheep and twenty five breeds of goats have been reported from Pakistan.

The breeds of sheep can be grouped on the basis of their tail, i.e. fat tail and thin tail. Goats on the other hand have been classified as hairy and smooth coated goat, some breeds of sheep and goats have been imported in Pakistan these include Angora goats, and Awassi, Rawbouillet and Karakul sheep. Seven breeds of sheep and three breeds of goats are found in N.W.F.P.

Range management: Rangelands are areas reserved for live stock production from natural or seminatural vegetation, Range management is concerned with the maintainance of range soil and vegetation reasources in a stable and productive state. Range lands are areas climatically or topographically unsuitable for economic cropping or sown pastures. Most of the world range lands are arid lands or cool lands, because the climate is too dry or too cold.

The total area of Pakistan, about 70% is rangeland. Parts of all Provinces contain both arid and mountainous rangelands.

According to range ecology and main grazing areas, parts from all prorinces of Pakistan are grouped in to four Main regions, Tropical, sub tropical, Himalayan and mediterranean. Rangelands from N.W.F.P. falls into subtropical and Himalayan and trans, himalayan zones. Subtropical region is further divided into two zones humid and subhumid. The humid regions, comprises of Abbottabad and Mansehra Districts. The average rain fall in this area is about 750 mm.

The forests are heavily grazad during the summer growing season most of the region is covered with cheer pine forest. In sub humid zone Haripur is included from N.W.F.P. The average rain fall is 550 mm. This is the most productive range land. However heavy grazing has resulted in invasion of undesirable species of plants.

Parts from N.W.F.P. included in Himalayan and Trans-Himalayan zones are Swat and Kaghan Valleys, annual rain fall 1000 mm and 500 mm, snow fall is heavy. Overgrazing is prominent which has adverselly affected ground vegetation and tree regenration, Alpine pastures provide forage during the summer growing season (Hasnain, 1985).

Grazing pattern and farm management: Ruminants in general are maintained on grazing, some cultivated foder, crop residues and under special situation some concentrates, mainly oil seed cakes. This is more true for large ruminants. Sheep and goat survive almost entirely on grazing and crop residues. These may be supplemented by shrubs tree leaves.

In Pakistan large sheep or goats farms do not exist. A few animals are kept by each family consisting of one or two buffaloes or cattle a few goats and sheep. According to Hasnain (1985) only 10.64% families

have herd of sheep numbering 200 or above. While in N.W.F.P. only 3.2% families have herd of sheep of 200 or above. The situation of goats is even more in favour of small herd as only 5-16% families have herd of more than 200 goats. In N.W.F.P. 3.04% families own herds of 200 or more goats.

Individual farmers may arrange grazing for their flocks but generally flocks are grazed together by a hired shepherd. The flocks are taken by these hired shepherd for grazing early in the morning to the shamleat, road sides, or to the canal banks, flocks also graze on stubbles after crop harvest, flock are brought back late in the evening. These flocks are kept in open places surrounded by mud or brick wall. Thorny bushes are also used to prevent the flock from getting out and the predators.

In range lands generally large flocks are kept by families and tribes which may move with the flocks, their migration routes have been established for centuries they generally follow water and grazing availability. In the two river valleys of Kaghan and Swat in the northwest, flocks of sheep and goats migrates down in winter as for as east as Islamabad and Jhelum but trek back in summer to their high alpine ranges.

Breeding of sheep and goats occurs all the season of the year. There are, however peaks of breeding activity in autmn and spring. Sheep and goats for disposal are taken to live stock markets or solds to traders who visits the village. Sheep are shorn twice a year in spring and early autumn. Goats are generally not shorn unless they are a hairy breeds (Hasnain,1987).

Marketing of sheep and goat in N.W.F.P.: Marketing of sheep and goat in N.W.F.P. takes place through many regular markets that are organized at weekly intervals on fixed days. Daily markets are also held in or around large cities. Annual livestock fair at several places in the

Province also serve as market but generally for breeding and show animals. A few days before Edul-Azha every year many additional markets spring up in town and cities. There are no specialized market for particular type of animal but most deal with all types of animal including sheep and goats. The markets may handle from few hundreds to thousand of sheep and goats each day. In daily markets the animals remains there until sold. All types of animals including sheep and goats are transported from remote corners of the N.W.F.P. to markets mostly on foots, by rail or in trucks. The journey is organized mostly at night to avoid heat during day time.

Simplest form of marketing channel in N.W.F.P. is when the producer sell their animals including sheep and goats to butchers who slaughter the animals and sell the meat to consumers in village or the producer take the animals for sale in local market, in towns and cities. In other form more intermediates (Beopories and Arthies commision agent) are required for the sale of animals (Hasnain, 1985).

There are two types of slaughter houses in N.W.F.P. and may be elsewhere in Pakistan, recognised and unrecognised. The recognised are constructed and supervised by the muncipal corporation or town committee. The animals are slaughtered in early hours of morning. The veterinary inspector is supposed to check the animals those found diseased are rejected for sale for human consumption. However, in Practice it does not happen. There is no scientific concept of farm management in Pakistan. Animals are not specifically bred or raised for milk or meat production. Any animal which is of no use for milk or as work animal is slaughtered.

The condition in unrecognised slaughter houses is not good. Animals are slaughtered anywhere by the butcher and the quality of animal slaughtered is mostly such that it may not even be good for human consumption, (Husnain, 1985).

From the foregoing Background information the following Picture Emerges:

1. The climate and physiography of N.W.F.P. is very diverse.
2. There are varities of sheep and goats distributed throughout N.W.F.P.
3. Inspite of a size-able population sheep and goats in N.W.F.P. the size of individual flock is very small.
4. Though, there are vast range land but the scientific management of range land and its utilization for sheep and goat grazing is not found as in the western world. Mainly the house holds owning sheep and goat graze them in the vicinity in fallow land and on the banks of canals and other water chanells.
5. Marketing, slaughtering has an indigenous system therefore an effective inspection system by the veterinary department to monitor disease is not very strong.
6. A disease monitoring system for parasites of animal origin does not exist, The department of animal husbandry vaccinate the animals for the diseases of bacterial or viral origin. However, for protozoan and helminthic disease the animal are treated if brought by the farmers to the veterinary hospitals. The treatment is mostly Symptomatic as the diagnositic facilities are not available except in Peshawar.
7. There is no system of maintainance of record of disease outbreak or endemicity of particular parasites.

Along-with this background of Physiography, climate, animals husbandary practices of goats and sheep and their breeds one may also keep in mind the available information on helminths of sheep and goats in Pakistan, more specifically in N.W.F.P. A comprehensive review of literat-

-ure has already been done (See page 3). From this review one thing is apparent immediatly that no systematic survey of helminthic infections have been done so far in N.W.F.P. What ever information exists is piecemeal and is only confined to the presence of a particular species of helminth observed casually. Even the species diagnosis is not valid as the work is not confirmed in future studies of the same or subsequent workers

In the present survey the parasites were collected from gastro-intestinal tract of sheeps and goats. The number of sheep and goats examined is sufficient to asses the mangnitude of parasitic problem in the hosts.

Amongst Trematoda 6 genera and 6 species were found. A new species of Watsonius capri has been described for the first time from a caprine host. In our collection Fasciola is only represented by F. hepatica inspite of the fact that Kendall (1954) mentioned that in plain areas F. gigantica is more common while in Highland of N.W.F.P. F. hepatica is more prevalent. This is not substantiated by our study. Employing the diagnostic tools available and examining literally thousands of specimens we never came across a single specimen of F. gigantica. Beside livers attached to gestro-intestinal tract more than 200 extra livers were examined from different sources even these failed to reveal any F. gigantica.

All the trematode species reported in the present survey constitute the first locality record. Cotylophoron ovatum has been reported for the first time from Pakistan, though C. cotylophorum has been reported from Sind (Mohiud Din et al. (1984) Moreover, the finding of C. ovatum from the bile duct is being reported for the first time, though it is not surprising as Paramphistomum cervi has been reported from the bile duct by many workers in the past. Paramphistomum (E) explanatum has been reported from buffaloe but not from sheep or goat thus constituting new host record.

To sum up the discussion on the taxonomy of the trematodes major taxa reported from the sheep and goats are represented in our collection. Schistosome were not reported as examination of blood was not included in the protocal. Beside the present studies two other surveys have been done in the recent past in N.W.F.P. Siddiqi & Ashraf (1980) examined full gastro-intestinal tract of 19 goats and found 3 species of trematodes namely Paramphistonum (E) explanatum, Cotylophoron ovatum and an unidentified species of watsonius. Marwat (1987 & 1988) conducted a survey of helminths of sheep & goats from different districts of N.W.F.P. Full gastro-intestinal tracts were examined. Examination of 246 animals in the first year revealed Paramphistonum E. explanatum & P. cervi from sheep and Gastrothylax crumenifer from one goats from Kohat. In the next year they examined 337 gastro-intestinal tracts from sheep and goats and did not find any trematode infection. This means that maximum taxa of trematode have been reported in the present survey.

Paramphistomum cervi has been reported by Marwat (1987-1988) but not found in the present survey. Mohiud Din et al. (1984) conducted a comprehensive survey of helminths of sheep and goats and found only two species of tremotodes namely Cotylophoron cotylophorum and Gastrothlax crumenifer. A world review of literature has been done (see page 3)which shows that in any given area trematodes are represented only by a few species. The only difference one may be find that a particular species may be replaced by another one.

Cestodes were represented in the present survey by three genera and four species namely Monieza expansa, M. (B) benedeni, Avitellina centripunctata, Stilesia vittata and two larval forms Cysticercus tenuicollis of Taenia hydatigena & Hydatid cyst of Echinococcus granulosus. Thus, in all we have six species of cestodes. Marwat (1987-88) reported them all from N.W.F.P. except Hydatid cyst of Echinococcus granulosus, perhaps for lack

of examination of liver and lungs.

Mohiud Din et al. (1984) reported Moniezia expansa, M. benedeni, Avitellina centripunctata, Stilesia globipunctata and Thysaniezia grardia from Sind.

The validity of M. denticulata & S. globipunctata has already been discussed (see pages 77 & 89). However we have not been able to find Thysaniezia giardia. It is possible that this species is found in more arid zone, perhaps due to its mite vector which may have restricted distribution.

The species of cestodes reported in the present survey were previously recorded by Siddiqi & Ashraf (1980) except Hydatid cyst of Echinoccus granulosus and Cysticercus tenuicollis of Taenia hydatigena. Both consitute the first locality record from N.W.F.P. However, Cysticercus tenuicollis constitute new locality record for Pakistan also as we have no published record of this parasite from Pakistan.

In taxa nematodes were represented by the maximum number, of the helminths found in the present survey. Seven genera and 14 species have been found. Trichuris was represented by T. globulosa. T. lani, T. parvispiculum & T. indica. The last species was not found in sheep, Oesophagostomum was represented by four species namely O. asperum, O. brevicaudatum O. columbianum & O. venulosum. Rest of the genera were represented by single species, Chabertia ovina, Haemoncus contortus, Dictyocaulus filaria, Pneumocaulus kadenzii and Skrjabenema ovis. The last named species was found only in goat and Bunostomum trigonocephalum was found only in sheep. Host-wise distribution of the taxa was essentially the same except mentioned above. Pneumocaulus kadenzii has been reported for the first time from goats and sheep in the present survey, thus constituting a new host record. Trichuris lani has been reported from fallow deer,

Elk and spotted deer from U.S.S.R. In present survey it is being report for the first time from sheep and goats. T. indica is also reported for the first time from goats, previously it has been reported from buffalo and cattle from India.

Oesophagostomum asperum has been reported from goats but not from sheep previously. Thus a new host has been added in the present survey. O. brevicaudatum is a parasite of pigs elsewhere but in the present survey it has been found in goats.

Thus present survey has revealed the maximum number of species of helminths from sheep and goats reported in a single survey from anywhere.

In a recent survey of helminths of sheep and goats in N.W.F.P. Marwat (1987 and 1988) has also reported four species of Ostertagia i.e O. trifurcata, O. circumcincta, O. ocidentalis, and O. ostertagia. Species each of Nematodirus N. spathiger and Trichostrongyles T. coluberiformis and Setaria S. papiollosus. The nematode collection was sent to Dr. Lichtenfels, Biosystematics parasitology laboratory, Beltsville, Marry land (U.S.A.). He confirmed his identification except he considered four species of Ostertagia as two and they are O. muraschkinzevi and O. nemorhaedi (minor species to O. muraschkinzevi). All the above mentioned species have been found mostly from single hosts in the first year. In second year he did not find any of them except O. trifurcata from single host. It shows that these nematodes are rather rare. similarly he did not find Oesophagostomum brevicaudum found in our survey.

In chapter II incidence & distribution has been described. Incidence or prevalence is percentage infection. However in such survey it has always been much variable. This variability has been more due to the number of hosts examined rather than inherent i.e. due to susceptiblty/ resistance or oppertunity to be infected.

In this survey we had the good fortune to examine reasonable number of hosts, almost equal in number for both sheep & goats & for two years for various helminthic infections and is provided in Table XLI-LIII.

The incidence of infection in goats was 94% in first year and 94.170% second year. Overall incidence being 94.08% similar was the situation in sheep as well, as the incidence was 91.08% for first year and 92.07% for second year & overall was 91.58%.

This means that invariably each sheep & goat is infected. Out of these it is of interest to see which group of parasites predominates. The Table LIII shows the group-wise incidence. Nematodes in goat were found in 185 out of 202 (91.58%) cestodes in 74 (36.63%) and trematodes in 63 (31.18%). In the case of 203 sheep nematodes were found in 189 (93.10%), cestodes 82 (40.39%) trematodes 71(34.97). This shows that the nematodes was the predominant group followed by cestodes & trematodes. There was not much inter-host difference or difference in the year-wise incidence (Table LIII).

The comparasion with other studies elsewhere is neither possible nor desireable as the number of host examined are always variable. If the number of hosts examined in a particular survey is limited the higher or lower incidence will be highly exgerrated. This is particularly true of the surveys done in Pakistan. In a recent survey of helminths of sheep & goats done by Marwat (1987-1988) out of 114 sheep examined over a year 78 or 75% were infected. His survey included examinination of goats & sheep from all the districts of N.W.F.P. & may account for the difference in the two surveys. In the second year they surveyed the same area & examination of 126 sheep & 213 goats showed 80% & 61% of the sheep & goats were infected. A similar comparasion can be made with incidence of individual species in two years in the present survey & their findings which is

provided in Table LXXXVI and LXXXVII. An overall assessment is that even in incidence of individual species it was lower in Marwat's survey as compared to ours. Secondly the ranking on the basis of higher to lower incidence the trend was also different. For example, in their survey in sheep host Trichuris parvespiculum ranks as the first, its incidence being 42% while in our survey Haemoncus contortus has the same position having an incidence of 76%. In their survey H. contortus occupies third position having an incidence of 23.68% in the first year & 13.49% in the second year. In the present survey O. columbianum has third position with 47% & 44% in first year & second year respectively while in their survey it occupies 2nd position with 28.07% & 19.04% in the first & second year respectively. T. lani occupies fifth position in our survey. However, an interesting thing is that amongst the two surveys the first three top ranking species are the same i.e H. contortus T. parvespiculum & O. columbianum. A similar comparasion can be made for goat host. In our survey T. parvespiculum, Haemoncus contortus, O. columbianum, T. globulosa and T. lani were top ranking incidence-wise in that order while in Marwat's survey T. parvespiculum, H. contortus, O. columbianum, T. lani & Bunostomum trigonocephalum were five top ranking parasites. Inter-host difference from the two tables can also be noted.

The conclusion drawn from the above mentioned discussion is that there are differences in the incidence from year to year in the same survey & host. Second conclusion is that amongst nematodes the individual species which matter & make the main bulk of nematode infection are those of Trichuris, Haemoncus, oesophagostomum.

In chapter II incidence & distribution were presented together. The incidence of different parasites has been discussed in the previous pages. The distribution of the parasite with reference to Pakistan is presented here. A complete picture of distribution of any group of animal

Table LXXXVI: A comparision of various species of Helminth found in sheep in the present survey with that of Marwat's survey 1987-88.

Name of Parasite	Present survey		Marwat's survey:	
	1979	1980	1987	1988.
Dicrocoelium lanceatum	2.00	1.94	Liver not examined	
Fasciola hepatica	28.00	33.01	Liver not examined	
Cotylophoron ovatum	2.00	4.85	....	....
Paramphistomum (E) explanatum	3.00	2.91	0.87	....
Paramphistomum cervi	....	....	0.87	....
Gastrothylax crumenifer	3.00	9.71	....	....
Moniezia (B.) benedeni	10.00	4.83	6.14	3.17
Moniezia expansa	4.00	4.85	8.77	3.17
Avitellina centripunctata	9.00	5.85	6.14	1.58
Stilesia vittata	18.00	5.83	2.63	0.79
Cysticercus tenuicollis	15.00	18.45	....	0.79
Echinococcus granulosus(Hydatid cysts)	7.00	0.97	Liver and lungs not examined.	
Trichuris globulosa	38.00	38.83	6.14	2.38
T. lani	27.00	29.12	9.64	6.34
T. parvespiculum	65.00	66.99	12.10	42.85
Bunostomum trigonocephalum	1.00	3.88	8.77	3.96
Oesophagostomum asperum	7.00	1.94	14.91	6.34
O. columbianum	47.00	44.66	28.07	19.04
O. venulosum	10.00	6.66	7.01	7.93
Chabertia ovina	2.00	5.83	19.29	13.49
Haemoncus contortus	76.00	72.82	23.68	13.49
Dictyocaulus filaria	15.00	12.62	Lungs not examined	
Pneumocaulus kadenezii	9.00	4.85	Lungs not examined	
Ostertagia trifurcata	....	....	....	1.58

(cont.)

O. occidentalis	....	....	....	2.38
O. ostertagi	....	....	....	0.79
O. circumcincta	....	....	....	3.17
Nematodirus spathiger	....	....	....	1.58

*240 sheep examined in Marwat's survey

*203 sheep examined in present survey.

Table LXXXVII: A comparision of various species of Helminth found in Goats in the present *survey with that of *Marwat's survey 1987-88.

Name of Parasite found	Present		Marwat's survey:	
	1979	1980	1987	1988
Dicrocoelium lanceatum	2.97	Nil	Liver not examined	
Fasciola hepatica	17.82	34.65	Liver not examined	
Cotylophoron ovatum	3.96	6.93	....	....
Paramphistomum cervi	....	....	....	0.97
Gastrothylax crumenifer	4.95	8.91	0.99	....
Watsonius capri	0.99	Nil	....	....
Moniezia benedeni	8.91	4.95	5.76	3.28
Moniezia expansa	6.91	1.98	8.65	2.81
Avitellina centripunctata	8.91	5.94	3.84	2.34
Stilesia vittata	15.84	5.94	1.92	....
Cysticercus tenuicollis	13.86	20.79	1.92	0.93
Echinococcus granulosus(Hydatid cyst)	4.95	4.95	Liver and lungs not examined.	
Trichuris globulosa	37.62	44.55	6.73	2.81
T. lani	27.72	29.72	21.15	16.90
T. indica	0.10	Nil	0.96	....
T. ovis	....	....	....	0.46
T. parvespiculum	71.28	59.41	48.07	40.37
Bunostomum trigonocephalum	Nil	Nil	17.30	7.04
Oesophagostomum asperum	2.97	Nil	8.65	4.22
O. columbianum	35.64	51.48	32.69	9.85
O. brevicaudum	1.90	....	....	....
Oesophagostomum venulosum	11.88	9.90	3.84	13.61

(cont.)

Chabertia ovina	5.94	1.98	14.42	8.92
Haemoncus contortus	59.41	67.32	35.57	12.20
Dictyocaulus filaria	8.91	5.94	Lungs not examined	
Pnumocaulus kadnezii	3.96	0.99	Lungs not examined	
Skrjabinema ovis	....	4.95	0.96	7.04
Ostertagia circumcincta	....	....	....	2.34
O. occidentalis	....	....	....	0.94
O. trifurcata	....	....	0.99	....
Nematodirus spathiger	....	....	....	1.40
Trichostrongylus coubriformis	....	....	....	0.46

*317 Goats examined in Marwat's survey

*202 Goats examined in present survey.

is difficult to present espacially that of parasites. In sheep raising countries like North America, England etc their helminth parasites & distribution is well recorded. However in countries like Pakistan, India & many asian & african countries systematic surveys involving a large number of animals is rather a rare phenomenon. From sporadic findings distributional patterns can hardly emerge. The animal husbandary practices has been mentioned in the begining of this chapter which emphasised that large sheep & goats farms are not found in Pakistan. The inter-regional migration of herds is a common phenomenon. Therefore possibility of helminth parasites to be introduced from one area into another is quite possible. Pakistan comprised of four Provinces nemely Punjab, N.W.F.P. Sind and Baluchistan. Due to work of Mohiud Din (1976, 1977) & Marwat (1987,88) we have distributional pattern districtwise for the province of Sind & N.W.F.P respectively. However, such data is not forth coming from Punjab & Baluchistan. Sarwar (1962) has described the distribution pattern of some parts of Punjab & Kalat division of Baluchistan (see pages 6 - 9).

According to Marwat (1987-1988) Trichuris parvispiculum, Oesophagostomum columbianum, Haemoncus contortus are distributed in all the division & districts of N.W.F.P. As previously mentioned that these parasites are the top ranking in incidence as well. A further comparasion of their data with ours shows that those parasites which are not found in our survey are also restricted in distribution in their survey as it has been found rarely from one or two districts. Furthermore there seems to be an apparent relationship between incidence and distribution those having higher incidence have a wider distribution as compared to those which have low incidence have also restricted distribution. This may also shows that our data is quite representative of the whole N.W.F.P.

For seasonal variation worm burden & incidence was considered together. In general, literature mentions only incidence as the sole criteria for seasonal variability. We consider that for a phenomenon to be seasonal worm burden should also be considered because if more or less animals are infected the worm burden should also follow the same trend, we are not trying to establish cause effect relationship, however, when conditions are favourable not only more susceptible host will be infected but also each of them may pick up infective stages repeatedly.

Study of worm burden has merit in its own right, it is an assessment of the intensity of infection. Every parasites has its own thresh-hold to show clinical sign & symptoms.

The data for worm burden has been provided in chapter III for all the parasites for sheep and goats for two years. As already mentioned in material and methods an attempt was to recover all the parasites from gastro-intestinal tract & associated organs. Therefore there is an element of reliability that even a bare minimum number present have been recovered as compared to those surveys which are based on "sample" or based on eggs in the faeces. Secondly, our data is reflective of intensity of infection in nature. In western world there is a misconception about this region that animals teem with worms. No doubt due to lack of scientific husbandary practices the quality of live stock is very poor, the role of parasite infection may be additive but may not be the exclusive culprit. The susceptiblity/resistance, nutritional status, wandering of animals thus leading to loss of energy, lack of disease monitoring are the main factors to be considered.

The pathogenicity of all the helminths found in the present survey is well documented in the literature. Discussion of pathogenicity and level of intensity which may lead to clinical sign and symptoms is avoided for the sake of brevity. The conclusion however, one can draw from the data

on worm burden is that in maximum number of hosts the worm burden was less than 10. In few cases the worm burden was of a magnitude that it may lead to clinical sign and symptoms. However when considered alongwith incidence which is very high for some of the trematodes like Fasciola hepatica, anoplocephalids amongst cestodes and Homoncus contortus, Trichuris spp. Oesophagostomum spp amongst nematodes the very presence of parasites acquires an epedemiological significance. One conclusion, which could be drawn is that all the conditions for the transmission are favourable and available. These may include availability of susceptible hosts, infective parasitic stages and climatological factors favouring transmission. This means that there is a high transmission pressure. If it is so then why such a low density of parasites in most of the animals? If an anology has to be drawn one may argue that low density infection confers immunity for incoming next generation of parasitic stages. In helminths the parasite does not multiply in the vertebrate host. The number of Parasites present or density is a build up process. Everytime when the susceptible host is in the vicinity of infective parasitic stages it may pick up a few of them thus building up its parasitic load. Though immunity to many helminthic parasites including those of sheep and goat is well documented whether a thresh-hold due to low density reaches to a level to ilicit immunological phenomenon is hard to prove.

Intensification of herds of goat and sheep into farms and grazing of them in restricted rangelands in future may lead to problem of intensification of parasitic infections as well. Another aspect of the problem is that why a few of the host carry a large number of parasites, thus following non-random or clustered pattern of distribution. This is a general trend in parasitic infections. However, one may also give due importance to such phenomenon in the outbreaks or epidemics. Such high density worm loaded individual hosts may provide source of infection to a large

number of susceptible hosts if other biological factors are condusive.

Another consideration beside worm burden per individual could be how many species of helminths per host? The data for sheep and goat is provided in Table LXXXVIII. It shows that sheep carried one to eleven species while goat carried one to 13 species. The Table also shows that almost half of sheep (out of 203) 106 carried 3-5 species while in goat approximatly half 103 (out of 202) carried 2-4 species. This means that mixed infections belong to the species of same genus or different genera of trematodes, cestodes and nematodes.

The seasonal variations was the most difficult problem to analyse. The detail discussion of the subject has been covered in chapter III. Considering worm burden and incidence as parameters we came to the conclusion that in strict sense assesments of seasonal variation with data for two years and without any data on climatological factors is an excercise in futility. Our data indicated that from year to year depending on biological and non-biological factors an upward or low trend may be seen. The same months in different years may have almost opposite trends. Though, we were blessed with data for two years for reasonable number of hosts and also applying complete counting of worms even then the results failed to depict a clear cut seasonal phenomenon. Though some trends have been noted which have already been discussed in chapter III. We strongly recommend that without sound and complete knowledge of all the climatological, epidemiological and biological factors effecting the seasonality of a particular parasite conjectural conclusion should be avoided.

This study has laid the basis for future work. Now we know how many species are involved in helminthiasis in sheep and goat in Peshawar region. In future studies on individual parasites may be initiated to work out the biology, epidemiology and seasonal variations.

Table LXXXVIII: The number of species of helminths in individual hosts 202 goats & 203 sheep.

Sheep:		Goats:	
No. of species of helminths per host:	No. of Host:	No. of species of helminth per host:	No of Host:
0	11	0	15
1	15	1	16
2	25	2	35
3	32	3	28
4	37	4	40
5	37	5	25
6	18	6	16
7	19	7	14
8	6	8	8
9	Nil	9	3
10	2	10	1
11	1	13	1
Total -	203	Total -	202

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