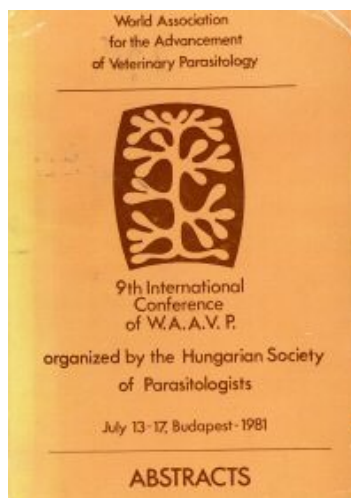


The 9th International Conference of the **WORLD ASSOCIATION FOR THE ADVANCEMENT OF VETERINARY PARASITOLOGY**

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ABSTRACTS OF

Invited papers II-I7

MECHANISMS OF SURVIVAL BY NEMATODE PARASITES WITH EMPHASIS ON HYPOBIOSIS

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Mechanisms involved in parasitic nematode survival must be considered with reference to their host and environmental interrelationships since these interrelationships ultimately influence any parasite adaptations aimed at survival.

The most important of the potential environmental constraints on survival are climatic, particularly temperature and humidity, since these can drastically influence larval development and survival.

One of the major host factors influencing successful parasite survival is the availability of suitable (susceptible) new hosts to the infective stages of the parasite at the appropriate time for transmission to be achieved.

Other host factors that influence parasite survival are those that affect the entrance, establishment and reproduction of the parasite within its new host; mainly problems of acclimatization to a parasitic way of life as well as the countering or adaptation to a variety of host resistance factors, both molecular and cellular, by the parasite.

Finally, in order for life cycles to be completed, the parasite must evolve a means whereby its larval forms can leave the host so that eventual transmission to a new host can be accomplished.

In this paper a number of adaptations which enable the parasite to overcome these constraints will be discussed. These will include such things as the development of larval resistance to environmental effects, the utilization of intermediate hosts or vectors for transmission, seasonally-increased fecundity rates in mature worms, anti-host immunity stratagems and hypobiosis.

This latter phenomenon, hypobiosis or seasonally related, arrested larval development, represents one of the most useful of life cycle adaptations to ensure parasite survival. Among its benefits, this adaptation which appears to be widespread among parasitic nematodes, enables the parasite to synchronize its life cycle to changing environmental or host conditions. It can thus be of major importance in ensuring survival of the parasite during periods of environmental adversity when conditions for transmission are poor and survival of free-living forms may be minimal.

Additionally, with certain species of nematodes, occurring as it does at times of the year when the numbers of infective stages may be high while host resources may be limited, oscillations in parasite biomass can be avoided. It thus serves as a highly adaptive mechanism for regulating populations of adult worms, lessening stress on the host and favoring parasite survival as a result.

LARGE SCALE MANAGEMENT SYSTEMS AND PARASITE POPULATIONS: PREVALENCE AND RESISTANCE OF PARASITIC AGENTS IN ANIMAL EFFLUENTS AND THEIR POTENTIAL HYGIENE HAZARD.

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Quantitatively Eimeria oocysts and eggs of gastrointestinal nematodes (if the animals had had access to pasture) constitute the prime contaminants in cattle effluents. Eggs of Trichuris and, locally restricted, of Fasciola and Toxocara are less abundant, but very resistant. - Pig manure contains always Eimeria oocysts and often eggs of Oesophagostomum, Ascaris and Trichuris. - Litter of broilers and hens is normally contaminated with Eimeria oocysts while helminth eggs may be rare in many management systems.

Due to their resistance to environmental conditions these parasitic stages constitute a hazard if brought into contact with their definite host or appropriate paratenic hosts after developing to the infective stage. Development is often interrupted by storage of the effluent but may be resumed after changing the conditions as e.g. spreading on farm land. Examples will be given how handling of manure or slurry such as storage, flushing, aeration or pelleting can modify the conditions for survival and further development and thus decrease or increase the risk of parasite transmission.

Guidelines for safe usage of manure or slurry include: Preferable application to tillage crops excluding crops for fresh consumption; restricted usage on grassland only after adequate treatment e.g. by composting or storage to ensure destruction of parasitic agents or usage on areas for silage or hay production.

LARGE-SCALE MANAGEMENT SYSTEMS AND PARASITE POPULATIONS. ECTOPARASITES.

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The eradication of hunger all over the world and the optimum provision of mankind with animal protein and raw materials are to be achieved through the way of an intensive animal husbandry. High populations of useful animals in very small areas carry the risk of the formation of high ectoparasite populations. From the epizootiological points of view the ways and the types of infections of the ectoparasites on the one hand and the favourable topical-nutritional conditions for the ectoparasites by concentrated useful animal keepings on the other hand form the crucial prerequisites for the high extensity and intensity of ectoparasite infestation. The ectoparasite infection as a disturbing factor in the useful animal husbandry is illustrated under 3 aspects: as disease - from subclinic-chronical-course forms with diminishing performances up to clinic-epizootical outbreak - as skins injurious problems and as Zoonosis. Apart from that the role of

some harmful arthropodes as vectors (for example ticks-Babesiosis; Musoidae - Corynebacterium pyogenes/Thelazia) by high host populations is emphasized. The lecture is based on the results of 20 years of experiences from the view of practice and research works on the ectoparasite infection in the intensive management of cattle, pig, sheep and fowl.

Ectoparasites are of less importance in the first 6 months in the cattle husbandry under the condition of stall keepings. In case of exclusive stall keepings clinical manifested scabies outbreak (Sarcoptes-, Psoroptes-, Chorioptes infections) and also sucking and biting lice infections particularly under the poor light conditions of winter periods both in the heiferbreeding and -fattening as well as in big diary cow enterprises (for example 1.000 or 2.000 diary cows) are not rare. Particular reference is made to the danger of the Sarcoptes-bovis-infection from the udder of the cow to the hands of human being as a main source for the endemic appearance of the so-called pseudoscabies. It has been proved to be expedient to keep big diary production enterprises free from ectoparasites through a complex antiepidemic measures. The Demodex-

bovis-population increases distinctly with increasing cattle concentration; it appears as a disturbing factor in the leather industry. By intensive cattle pasturing under central european conditions the ticks (as vectors!) and according to the territory simuliidae (as sources of animal diseases and zoonosis) are remarkable. Tabanidae-populations claimed conspicuously less attention in the last years. Hypoderma spp. are short-termed extinguishable by means of complex eradication measures.

In the pig husbandry high animal concentrations are being accompanied by high Haematopinus suis, Sarcoptes suis and (particularly in fattening enterprises) stall flies-populations; flea plague had been reported several times. - Sarcoptes suis is suitable as "indicator-parasite" for the SPF-pig husbandry. Besides the strength of the animal concentration in sheep, the length of the wool pile has decisive influence on the ectoparasite populations, aspecially by stationary permanent species like the wool parasites Bovicola ovis, Melophagus ovinus and Psoroptes ovis. In 1978 for the first time, the fodder mite Caloglyphus berlesei in the GDR and the beetle mite Euryparasitus emerginatus in West-

Siberia as enzootic, noteworthy wool parasites, which induced a Psoroptes-infection like clinical picture, were proved. Lice in sheep are usually rarely provable in Central Europe; Demodex ovis also plays a subordinate role. On the contrary Chorioptes-ovis-infection is widespread in big ram breeding stocks (insemination rams inclusive); particularly by races with marked woolled legs. It is remarkable that in the industrial-like lambs fattening even by very high animal concentration as a rule massive ectoparasite -populations could not be found.

In big poultry enterprises by standardized keepings and nutrition ectoparasite infection is unimportant in the broiler production. In the domestic fowl rearings and laying hens stocks the appearance of Mallophaga ist relatively often and also about Dermanyssus-gallinae-outbreaks are repeatedly reported. In ducks big stocks massive Lep-tosphyra-velata-infection with increasing death rates and impairing of the breeding performance appeared enzootic repeatedly. The factors by the development of the ectoparasites-populations under the conditions of high animal concentrations are showned. Reference is made the necessity of permanent

superintendence of the ectoparasites fauna and of the early diagnostical comprehension of the ectoparasites-populations. The relative great danger of ectoparasite infections by high useful animal concentrations (particularly under standardized stall keeping conditions) can however with prophylactic measures be effectively counteracted.

LARGE SCALE MANAGEMENT SYSTEMS AND PARASITE POPULATIONS: COCCIDIA IN RABBITS

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If Dobell's assumption on oocysts of Eimeria stiedai might have been seen in a rabbit liver by Loewenhock in 1674 is accepted, it is amazing how many questions have remained unrevealed particularly in rabbit intestinal coccidiosis. The efforts of many prominent protozoologists yielded valuable details mainly on the morphology and life cycle of various species of Eimeria in rabbits, the large scale production of broiler rabbits triggered off more exact studies and renewed interest mainly in the pathogenic effect and prophylaxis.

Post-weaning diarrhoea and peak mortality at the age of 4 to 7 weeks were frequently ascribed to intestinal coccidiosis. However, the occasional absence of specific lesions in the gut, the presence of high amounts of oocysts in apparently healthy rabbits, the association of this condition with other infective agents, such as Escherichia coli, Clostridium perfringens, Bacillus piliformis

/Tyzzler's disease/, less frequently salmonellosis, vibriosis, chlamydial-, rotavirus-, adenovirus-infection, fungi, nutrition cast recently doubt on the pathological significance of the ubiquitous coccidia as causative agents of this rather multifactorial enteritis complex. The conflicting views on the pathogenicity of various species of Eimeria and the inconsistent results of experimental infections pressed for more sophisticated experiments that were undertaken mainly in France and U.K. on coccidia-free and/or SPF rabbits using lines of Eimeria species derived from single oocyst infections. These resulted in more precise redescription of E. magna, E. irresidua, E. flavescens and E. perforans, clarified some of the taxonomical controversies, provided basis for allocation of widely recognized intestinal coccidia into 3 main categories as follows: a/ most pathogenic E. intestinalis /the main lesions in the ileum/ and E. flavescens /caecum and colon/; b/ intermediate pathogenic E. magna /ileum/, E. irresidua /jejunum and ileum/ and E. piriformis /colon/; c/ relatively harmless E. perforans /duodenum/, E. media /jejunum/ and E. coecicola /caecum/. Recent epidemiological surveys confirmed the synchronous occurrence of 2 to 5 or more spe-

cies with variable predominance and hence pathogenicity in individual rabbitries.

In several trials, experimental infection with E. coli isolated from rabbits died of colibacillosis or with large numbers of E. magna and E. perforans oocysts failed to reproduce diarrhoea and death in weanlings which could, however, readily be produced using both E. coli and coccidial inoculum.

Multifactorial nature and nutrition-physiological background is suggested by the observation, namely, that E. coli multiplies mainly in the final stage of diarrhoea. Non-dissociated molecules of volatile fatty acids in caecal contents of healthy rabbits may be related with the inhibition of E. coli multiplication.

Although the role of coccidia in the intestinal disorders is far from being clear, there is an increasing demand for safe anticoccidials in the broiler rabbit husbandry. Of the poultry anticoccidials only several sulphonamides alone or in combinations for therapy /sulphaquinoxaline, sulphadimethoxine, sulphadimidine, sulphachlorpyrazine, formosulphathiazole/, and for prophylaxis Ierbek, robenidine, salinomycin or narasin seems currently most promising.

THE ECOLOGICAL BASIS OF PARASITE CONTROL: NEMATODES

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As veterinary parasitologists, our major interest is in what may be termed production ecology, in which we concentrate on those aspects of the interaction of host, parasite and environment which determine the size of the host's parasite population and thus the risk to the production process. Control aims at reducing this population by breaking the life cycle in two ways:

- a) at the host level - by anthelmintic treatment to eliminate the parasite and perhaps more importantly to remove the source of environmental contamination.
- b) at the environmental level - by segregating susceptible hosts from the infective stage of the parasite.

The key question is when should these control measures be applied and to answer it in both cases requires an understanding of the parasite population pattern. The adult parasite population in the host is largely controlled by immunity factors which tend to stabilise the population, whereas the larval population outside the host is controlled by environmental factors which show wide fluctuations and therefore tend to destabilise the population. Thus the pattern of the larval population in the external environment is of crucial importance. While a great deal of information has become available in recent years regarding the seasonal larval pattern of the nematodes of grazing ruminants, the current challenge in developing improved control measures is to identify the key factors influencing the pattern. Contamination factors are responsible for the potential larval population and development and transmission factors for translating potential into actual numbers, and if these factors can be separated out and quantified then the host-parasite system can be analysed and modelled. Such a model could be used in simulation studies on

control strategies, and to indicate productive lines of research.

The grazing situation

Contamination factors: In the annual cycle of build up of the pasture larval population of ruminant nematodes in temperate regions two major sources of initial contamination are identified. The first source is overwintered larvae from eggs deposited the previous year, the importance of which depends on the species of parasite, the class of stock and the timing of grazing. The second is fresh egg deposition in Spring - early Summer, in which the periparturient rise in egg output plays an important role, particularly in sheep. However, surprisingly little attention has been paid to the variability of the rise and the factors which affect it.

Development and transmission factors: Egg and larval survival, development, hatching and migration are all components of the host-to-host transmission system, and are all subject to a range of environmental influences. Fortunately the critical effects appear to be those of temperature and moisture which have been quite well documented, but the influence of faeces composition, herbage type and management, and soil type need to be evaluated, together with the role of the soil as a reservoir for larval stages.

The housed situation

Under housed conditions the same essential components of contamination, development and transmission govern the build up and availability of the environmental infective population, but the variables involved should be fewer and more controllable. As a result the dynamics of parasite populations should be much better understood. In practice the reverse is true, probably because control by anthelmintic usage is much more easily effected, and production ecology has largely been ignored.

THE ECOLOGICAL BASIS OF PARASITE CONTROL: TICKS AND FLIES

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Grazing animals provide a readily available means for the conversion of plant material into animal protein, and hence into food for man. In many developing countries animals are valued more for their quantitative prestige than for the quality production of meat, milk and skins, and the survival of these animals is constantly at risk from major enzootic and parasitic diseases.

Ticks cause enormous losses both directly and by the transmission of various diseases, such as theileriosis, babesiosis, anaplasmosis and heartwater. They are probably the single most important group of parasites of livestock throughout the world. Ecological methods of tick control are usually masked by the more rapid results gained from sprayed and dipped chemicals, although these results are often short-lived and chemicals may have to be changed because of acaricide resistance problems. Biological control of ticks now includes the use of tick-resistant cattle, zero grazing and careful quarantining, as well as immunization against the transmitted micro-organisms. Immunity against the ticks themselves has been also developed experimentally as far as the injection of antigenic tick material, including harvested tick cell lines.

Among the flies of veterinary importance, screw-worm control with the sterile male technique (SIRM) has been very successful in the USA, despite a setback in 1972, and huge numbers of flies are now being produced in the next target area, Mexico. SIRM has had less success on a large scale against sheep blowfly, Lucilia, although the technique itself is very effective. Good results have been

obtained in Australia with dung-burying beetles against larvae of the buffalo fly, and SIRM has also been used against tsetse in East Africa, where large laboratory colonies have been established. Bush clearing, selective game eradication and traps incorporating animal odours have also been successful against this insect. Great care must be taken to integrate population movements and use of reclaimed land in tsetse control projects.

In Britain a large warble fly (Hypoderma) eradication scheme is now in progress, and SIRM has been considered against this species also, although it seems unlikely that Hypoderma can be reared in the necessary large numbers to make this form of biological control effective.

R and D costs for new insecticides are now in excess of £10m per compound, hence ecological control of ectoparasites is keenly under investigation. Considerations of pesticides pollution are also stimulating work on ecologically-based measures of ectoparasite control.

THE ECOLOGICAL BASIS OF PARASITE CONTROL:
TREMATODES

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Abstract not submitted

SESSION A1

Nematoda of cattle and sheep I
Papers 1-10

HYPOBIOSIS OF HAEMONCHUS CONTORTUS - Resumption of development.

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Two experiments were conducted each involving two groups of lambs infected with defined larvae. In 1978 the groups grazed simultaneously in September. Group 1 acquired first generation larvae, on pasture since June. Group 2 acquired third sequential generation, developed in September. Larvae therefore differed in generation, age and the time at which they were sensitized but were similar in the date of onset of Hypobiosis. In 1979 both groups grazed the same paddock Group 1 in September and Group 2 10 weeks later. Both recieved 2nd generation larvae developed in July. Larvae were the same generation and sensitized at the same time. They differed in age and the date of onset of hypobiosis. Soon after infection, non hypobiotic worms were killed with phenothiazine. The lambs were followed using egg counts and faecal cultures until PM.

Results showed that the maturation of larvae was asynchronous both within individuals and groups, beginning in February and continuing until May. The majority of larvae in all the animals underwent maturation in April. It is concluded that the maturation of H. contortus is not related to the duration of hypobiosis or to factors in its induction but depends on a seasonal stimulus of host origin.

POPULATION BUILD-UP OF *HAEMONCHUS CONTORTUS* FROM LOW PASTURE INFECTIVITY LEVELS.

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As overwintering of the free-living stages of *H. contortus* is very poor in the Netherlands, it might be possible theoretically to control this very important pathogen by a single treatment of the ewes at parturition. On the other hand *H. contortus* is a very prolific worm and seemingly insignificant pasture infectivity levels in spring or in early summer might be sufficient for the build-up of high populations in sheep in summer and autumn. That both possibilities can occur is proved by some of our experiments on control of gastrointestinal helminthiasis.

H. contortus remained strikingly absent in a group of lambs grazing a pasture with an overwintered infection of sheep nematode larvae, whereas build-up to high *H. contortus* populations in autumn in another group of lambs probably was based on overwintering of *H. contortus* eggs deposited on pasture between October and January and in yet another group of lambs on contamination with low numbers of *H. contortus* eggs or larvae from an adjacent pasture in June-July. As in the last two cases high *H. contortus* populations did not occur before mid August, these populations predominantly consisted of inhibited larvae and clinical signs were only slight. Nevertheless, the potential danger of low infectivity levels of *H. contortus* is very well demonstrated.

FARM MANAGEMENT FACTORS IN RELATION TO TRICHO-STRONGYLOSIS IN CALVES

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In 1978 and 1979 a survey was carried out on about 100 farms in the Netherlands. Faecal examinations were done for egg counts 5 weeks after introduction into pasture and again in the autumn.

In 1817 calves heat girth was measured and related to the age (days) at the moment of measuring. In this way growth and development of calves per farm were calculated.

In order to assess which management factors are of importance and can be easily determined as a basis for preventive measures by veterinarians, the following were determined by survey: stocking rate, age of calves, age distribution, supplemental feeding, anthelmintic treatment, rotation to aftermath, date of introduction to pasture and use of pasture by older animals, as well as several other factors.

A very large variation between farms in growth performance was found. The growth was negatively correlated to egg counts at 5 weeks. Stocking rate, rotation to aftermath, anthelmintic treatments, date of introduction into pasture were related to either growth performance or egg counts and are therefore worthwhile surveying.

OBSERVATIONS ON ARRESTED DEVELOPMENT OF *OSTERTAGIA*
OSTERTAGI IN THE NETHERLANDS.

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Over a period of five years (1976-1980) the arrested development of *Ostertagia ostertagi* was investigated in permanently grazing calves and tracer calves. The post mortem observations in these studies showed that under the circumstances of our experiments with the local strain of *O. ostertagi* arrested development was found in tracer calves at the end of the grazing season only. The percentage of arrestment never exceeded 10.

So the environmental stimuli, known to be of influence on the "programming" of infective larvae in the field in other countries, were not important with regard to the induction of arrest.

On the contrary, high percentages of inhibited larvae (sometimes more than 90%) were seen in the post mortem results of the permanently grazing calves after stabling. Highest percentages were found at the end of the stabling period, so it was concluded that adult worms were expelled at a faster rate than larval stages. However, the final conclusion of this study was that in our situation arrestment of development of *O. ostertagi* was mainly due to the (previous) presence of a large wormburden and the reactions of the host thereupon.

ARRESTED DEVELOPMENT OF SHEEP TRICHOSTRONGYLID LARVA IN NIGERIA

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For the study of arrested development of sheep trichostrongyles under Nigerian conditions, groups of ewes, lambs that grazed continuously on pasture and tracer lambs were necropsied monthly for a period of one year and worm counts made on them.

Results revealed that Haemonchus and Trichostrongylus species are capable of undergoing arrested development, the former at the early larva 4 and the latter at the larva 3 stages. From August to March, the number of adult Haemonchus decreased progressively. Few developmental stages were seen while the number of arrested larva increased. From April to July, the number of arrested larvae decreased while adult and developmental stages increased sharply. The 3 stages of development were seen in high proportions during July and August. Adult form of Trichostrongylus was found in large numbers from June to June and the number of arrested L3 were low from April to June and higher from July to March. There were no significant differences in the numbers of arrested larvae between the 3 groups of sheep used. Arrested larvae resume normal development in large numbers as from April during the transition from the dry season to the rainy season.

STUDIES ON THE BEHAVIOUR OF DIFFERENT 'STRAINS' OF
OSTERTAGIA OSTERTAGI

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Field and laboratory observations had indicated a considerable variability in the pathogenicity of Ostertagia ostertagi strains. Those such 'strains' were isolated and experimental and field studies made to assess the relative infectivity, fecundity and pathogenicity of each strain.

Clear differences were obtained in the infectivity of each 'strain' irrespective of the magnitude of infecting dose. However, the results were complicated by the fact that the most highly infective 'strain' contained not only O. ostertagi but O. leptospicularis.

Similar differences were obtained when the fecundity and pathogenicity of infections with the different strains were studied in the field with a corresponding effect on the epidemiology of each strain. The effect of O. leptospicularis on the infectivity of O. ostertagi was further studied by isolating a pure strain of the former and then comparing the worm burdens established from pure and mixed infections of both species.

The possible implications of these results to control measures are discussed.

ECOLOGICAL OBSERVATIONS ON THE PREPARASITIC STAGES OF
O. CIRCUMCINCTA IN BULGARIA.

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Experiments which examined the effects of macroclimate and microclimate on the preparasitic stages of *O. circumcincta* were conducted both in the field and in the laboratory. Under the climatic conditions which prevailed in South-East Bulgaria in 1977/80, third stage larvae of *O. circumcincta* survived for 9 months on pasture. *Ostertagia* eggs passed in July and August were of particular significance for the survival of the free-living stages over winter since small numbers of the third stage larvae which developed from these eggs survived until the start of the next grazing season. Per cent survival of *O. circumcincta* larvae over winter was 2% in the fields and 0.4% in the uplands. Sufficient larvae overwintered to initiate infections with *O. circumcincta* in grazing sheep in the spring.

Survival and development of *O. circumcincta* eggs excreted with faecal material was studied under laboratory conditions. Eggs kept at -25°C lost the ability to develop within 24 hours; at -10°C the eggs survived for 43 days; and at -5°C to -2°C the eggs survived 130 days. At 0° to 5°C the percentage of eggs which developed to infective larvae was 52% and the time required for development was 53 days. At 10°C the respective figures were 36% and 21 days; 15°C - 48% and 9 days; 20°C - 90% and 116 hours; 30°C - 83% and 64 hours; and up to 35°C - 51% and 62 hours.

BEHAVIORAL OBSERVATIONS ON CALVES AND TRICHOSTRONGYLE INFECTIVE LARVAE ON PASTURE

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At three times along the grazing season, we estimated the pad density in a calf paddock and collected the grass on 10 cm wide rings around 8 to 14 dated pads for larval recollections. At the same time, we did observations on grazing location of the animals to the nearest pad.

The pad density on the paddock increases from June to October, and the feces disappear in 6 to 8 weeks during the summer.

The larval population is higher on August 20th than on June 10th or October 7th. The main species are *Ostertagia* in June and October, *Cooperia* in August ; *Trichostrongylus* and some *Nematodirus* are present in June. The main part of the larval population is located at 20 to 100 cm from the pad in June.

In August and October, peaks of larvae are inside the pad for 2-3 weeks old pads, on the first ring for 4-5 weeks pads and on the 2nd or 3rd ring for *Ostertagia* around some pads.

Calves graze far from pads in June and, in August as in October, very near the fresh and old pads, and 15 to 20 cm from 4 to 6 weeks pads.

The numbers of larvae near and far from the pad, as preconised in the sampling technique of GRUNER and RAYNAUD (1980) associated with grazing location give a better understanding of animal infection.

RELATIONSHIPS BETWEEN THIRD-STAGE LARVAE INFECTIVITY AND ADULT FECUNDITY, EPIDEMIOLOGICAL CONSEQUENCES.

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Studies realised with gut *Trichostrongyle* parasites allowed to specify the conditions of the course of third-stage larvae infectivity with ageing.

Data demonstrated that a maturation period was required for maximum infectivity and pointed to the fact that the storage temperature exercise an important influence over the rate of evolution of infectivity.

The examination of the physiological characteristics of adult worms developed from larvae of different ages showed that there is an inverse relationship between the infectivity of larval populations and the fecundity of the resulting adult worms. A low infectivity results in greater fecundity and vice versa.

The original phenomena may explain some epidemiological observations, in particular the inefficacy of some rotational grazing management systems in reducing parasitism or some rises in the egg-output which are recorded at different times of the year from the parasites of grazing animals and cannot be understood by the worm burden fluctuations. They can be important for epidemiological studies.

EPIDEMIOLOGY OF GASTRO-INTESTINAL AND LUNG NEMATODES IN CATTLE OVER A FOUR-YEAR PERIOD IN FRANCE

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Experiments have been conducted on grazing cattle and pastures in various production areas. A full protocol covers pathology, performances, egg/larvae counts, pepsinogen levels on animals and/or tracers, and herbage larvae counts on the pastures. The parasites found are ranked from the most to the least important/pathogenic.

1. WEST DISTRICT

1.1 Eure : 3 successive years with full protocol on 1st and 2nd year animals and tracers. Parasites : Ostertagia, Cooperia and Dictyocaulus.

1.2 Manche : Full protocol during 2 successive years 1st year animals. Parasites : Ostertagia and Cooperia.

1.3 Mayenne : Full protocol on 1st year animals. Parasites : Dictyocaulus and Ostertagia (+ Cooperia)

1.4 Sarthe : Full protocol on 1st year animals. Parasites : Nematodirus and Ostertagia.

1.5 Cotes du Nord : No herbage, 3 successive years on 1st year animals. Parasites : Ostertagia - Cooperia.

2. EAST DISTRICT

2.1 Haute Saone : Full protocol. 1st-2nd year animals Parasites : Ostertagia, Cooperia and Dictyocaulus

3. CENTER DISTRICT

3.1 Haute Vienne : No herbage, full protocol in Limousin cow/calf system : 3 successive years on calves, heifers and cows. Parasites : Ost, Coop (+ Nem)

4. MIDI PYRENEES DISTRICT

4.1 Aveyron : Full protocol in dairy herds, 2 first-, 3 second-year and pregnant heifers, + 2 experiments with heifers transferred to mountains in summer. Parasites : Ostertagia, Cooperia, Dictyocaulus

Epidemiology follows the same pattern as in northern France except in the Midi Pyrénées where the mid season rise was not found (to be confirmed).

SESSION A2

Nematoda of cattle and sheep II
Papers 11-20

INVASIONS AND INFECTIONS IN CONDITIONS OF POLY-PARASITISM IN SHEEP AND IN CATTLE.

OLTEANU, GH. Central Laboratory of Veterinary Diagnosis, Bucharest, Romania.

These experiments studied the epizootological, clinical and anatomopathological effects of poly-parasitism in sheep and cattle. The following results were obtained:

SHEEP: Infection with *Moniezia* and other Anoplocephalata, *Eimeria*, *Strongyloides*, Strongylata and other parasites had an important effect on the pathogenicity of *Clostridium perfringens* and the pathogenesis of anaerobic enterotoxaemia, contagious ecthyma and chronic copper poisoning; infection with *Coerurus*, *Nematodirus*, *Strongyloides* and other parasites modified infections with *Listeria*, *Diplococcus*, *Streptococcus* and others; *Dictyocaulus*, *Echinococcus*, *Bunostomum*, Protostrongylidae, cestodes, Strongylata, Trematoda, *Linguatula* and other parasitic infections produced important changes in the pathogenicity of *Pasteurella*, *Salmonella*, *Mycobacterium paratuberculosis*, *Corynebacterium ovis*, *Streptococcus* and entero and pneumoviruses, including PI3.

The economic losses due to, and the incidence of, anaerobic enterotoxaemia, listeriosis, contagious ecthyma, entero and pneumoviruses (including PI3) and other diseases including chronic copper poisoning were decreased after the complex antiparasitic treatment of 800,000 animals on 26 industrial farms.

CATTLE: Similar results were obtained. Poly-parasitism produced important changes in the pathogenesis and pathogenicity of salmonellosis, pasteurellosis, slow virus diseases, leucosis virus, entero and pneumoviruses (including PI3), *Mycobacterium paratuberculosis* and other infections.

SURVEY OF HELMINTH INFECTION IN CATTLE UNDER LARGE SCALE AND SMALL FARM MANAGEMENT SYSTEMS.

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The levels of infection with gastro-intestinal nematodes were compared in cattle maintained under two different management systems: large and small farms. Although the feeding system was the same, dairy cattle on large farms were more heavily infected than those on small farms. In May and August, respectively, the incidence of infection was 61% and 52.6% on large farms and 43.2% and 34% on small farms. Similar results were seen in young cattle: 85.6% and 73.1% were infected on large farms and 60.2% and 56.9%, respectively, on small farms. The intensity of infection was higher on large farms (199.1 and 166.1 eggs/gm of faeces) than on small farms (122.2 and 101.2 eggs/gm). However, in younger cattle the intensity of infection was higher on small farms (163.8 and 160.3 eggs/gm) than on large farms (127.1 and 133.5 eggs/gm).

On small dairy farms two different feeding systems were associated with differences in the prevalence and intensity of infection. Both a higher prevalence (43.3% and 34.1%) and intensity (121.2 and 102.2 eggs/gm) of infection were seen in pasture grazed cattle than in cattle housed in a closed system (26.7% and 22.4%; 90.7 and 63.9 eggs/gm, respectively).

The above results demonstrate that high stocking rates and poor pasture management favour an increase in infection.

PASTURE HYGIENE AND CONTROL OF HELMINTHIASIS IN RUMINANTS

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The hygiene of pasture grounds is a significant factor in controlling helminthiasis in ruminants. We could observe that under our conditions parasitic bronchitis and gastroenteritis occur and develop mainly: in young cattle pastured year by year on the same grounds, in lambs running grounds occupied by adult sheep last year, overcrowding of runs, unhygienic watering and excessive rain in the course of spring and summer. Such factors provide favourable conditions for development and concentration of infective larvae. Treatment, even by highly effective anthelmintics, does not suffice to control parasitic infestation of animals. It is necessary to improve the hygienic situation of the run. Of particular importance is the agrotechnical preparation of the ground prior and in the course of running (preparation of the surface, cutting of grass rests), hygienic watering of the animals and the correct cycle of running. By effective anthelmintic treatment and improved pasture hygiene, it was possible to stop clinical forms of infestations, raise the weight-gain by 23% in cattle and the wool production by 26%, the marketing value of the wool by 9,2% and mutton by 17,4% in sheep.

CONTROL OF TRICHOSTRONGYLOIDES IN SHEEP.

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Institute V.Tirnov, GEORGIEV, B. District Veterinary
Institute Plovdiv, Bulgaria.

Mixed infections with nematode species in the genera *Haemonchus*, *Ostertagia*, *Nematodirus*, *Cooperia* and *Trichostrongylus* are common in sheep in Bulgaria. These widely distributed and common infections usually cause heavy losses to the sheep industry. Successful control of such mixed infections and superinfections is developed only on the basis of well organized, scientifically designed experiments. Experiments were performed to examine the development and survival of the larval stages of *Haemonchus*, *Ostertagia*, *Nematodirus*, *Cooperia* and *Trichostrongylus* species. Development was studied under both field and laboratory conditions and the larval stages were continuously incubated in 154 copro-cultures. The migration, localisation and survival of the preparasitic stages and development of the infection into adults was examined in 65 lambs. Based on these results a complex plan for prophylaxis and control of these parasites has been developed.

SEASONAL DYNAMICS OF GASTRO-INTESTINAL AND POUIMONARY HELMINTHIC INFECTIONS IN SHEEP FROM THE MOUNTAIN REGION OF SOUTH POLAND

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The studies were carried out in the years 1976-1979 in the mountain region of South Poland. The seasonal dynamics of the gastro-intestinal and pouimmonary helminthic infections were followed in 3 groups - ewes, 1-2 years old animals and lambs. Each experimental group consisted of 100 animals. The extensity and intensity of infection was established once a month by using the coproscopic method. The gastro-intestinal nematods infection in ewes and 1-2 years old animals was very high through the all year /90-100% infected animals/. In lambs the first possitive results were found in April and from June-July to the end of the year the extensity of infection was 90-95%. The strongest extensity of lung nematods infection in ewes and 1-2 years old animals was found in the period between July and December. In lambs the first lung-nematods were found in July and in the remaining months the extensity of infection was 30-38%. The strongest extensity of Moniezia spp. infection was observed in all experimental groups from July to October /25-45% infected animals/. In the next months the infection decreased to about 5% of infected animals. Panacur /Hoechst/ and Nilverm /ICI/ were used to control the helminthic infection of sheep in our studies. In a dosis of 5 mg./kg. Panacur was in 95-100% effective against gastro-intestinal and lung nematods and in 90-95% against Moniezia spp. Nilverm /15 mg./kg./ was effective only in about 75% against gastro-intestinal nematods and D. filaria.

THE EPIDEMIOLOGY OF GASTROINTESTINAL NEMATODES IN
AWASSI SHEEP IN IRAQ.

ALTAIF, K.I. Department of Veterinary Parasitology,
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The pattern of infection with gastrointestinal nematodes in ewes and lambs on two farms, each in a different ecological area has been followed by faecal egg counts and post-mortem worm counts. The results of this study reveal the following.

1. Two peaks of infection were recorded, the first peak was reported during spring and the second during autumn, the latter coincides with parturition.
2. Self-cure was noticed in both ewes and lambs, but this phenomenon was very clear in ewes.
3. *Ostertagia* spp and *Trichostrongylus* spp were dominant in lambs, while *Haemonchus contortus* was dominant in ewes.
4. Hypobiosis was recorded in lambs, grazing for the first time, it appears that desiccation may be responsible for this phenomenon.

THE EFFECT OF DIFFERENT TYPES OF PASTURE ON HELMINTHIC INFECTION OF COWS AND CALVES

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The experiment was performed to compare the degree of gastrointestinal parasitism which occurred in beef-cows and calves grazing seven different types in Minas Gerais State, Brazil. The pasture plants were:

Group I - Jaragua grass (*Hyparrhenia rufa*)

Group II - Jaragua grass + mixture of legumes
(*Phaseolus atropurpureum*, *Stylosanthes humilis* and *Centrosema pubescens*)

Group III - Gordura grass (*Melinis minutiflora*)

Group IV - Gordura grass + mixture of legumes

Group V - Pangola grass (*Digitaria decumbens*)

Group VI - Pangola grass + mixture of legumes

Group VII - Mixture of grass + mixture of legumes.

There was a significant difference ($P < 0.05$) between the calves in Group V and Group VII.

It was found also that in all groups where Pangola grass was tested the difference between the means approached significance more closely than did the differences between the means for others pasture combinations.

TRICHOSTRONGYLID CONTAMINATION IN CATTLE SLURRY

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In a 3-year survey involving over 100 farms, 87% of slurries originating from young cattle were found to contain appreciable numbers of viable trichostrongylid eggs when sampled at the end of the winter storage period. Persistency studies showed that in slurry which accumulated from November to March, the concentration of viable eggs remained fairly constant up to March/April and then declined to a low level in May/June.

Grazing experiments were undertaken in which trichostrongylid-contaminated slurry was applied to pasture in the spring of 2 successive years. A pasture (plot A) fertilized in this manner showed consistently higher infection in the first year compared with control (plot B). Faecal egg counts of calves grazing in plot A were significantly higher than in control calves. In spring of the following year, plot A again showed heavier infection, confirmed by tracer calves, and this resulted in clinical parasitism in calves in early June. Subsequently in the second year, faecal egg counts and blood pepsinogen levels were significantly higher and weight gains significantly lower in plot A calves up to August/September. In late season, the control herbage showed the normal increase in infection, obscuring treatment effects.

In further experimentation, application of contaminated slurry to pasture once more increased infection in the first year as denoted particularly by calves' significantly higher egg counts. Calves grazing this pasture in the second year also showed significantly higher egg counts than controls and their weight gain was reduced ($P < 0.01$). The latter effect was clearly due to parasitism and not to a difference in herbage palatability since slurry, uncontaminated with trichostrongylids, was applied to the control pasture.

THE INFLUENCE OF LIQUID MANURE ON INFECTION OF THE ENVIRONMENT WITH PARASITES.

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At five farms faeces, liquid manure, soil and green crops fertilized with liquid manure were examined for the presence of oocysts, eggs and larvae. Lysimetric examinations were carried out in the field and the laboratory in order to determine the possibility of displacement of parasite eggs in the soil and the survival of oocysts and eggs in liquid manure as well as in fertilized soil. Despite the low prevalence and intensity of parasitic infection in the cattle on the industrial farms, developmental stages of parasites were found in all the liquid manure samples. Fertilization of fields with fresh liquid manure carries with it the danger of infecting the crops grown. These in turn become the source of infection for the animals. Storage of the cattle liquid manure for two-and-a-half months completely prevented contamination of the environment with the developmental stages of gastrointestinal nematodes which are the most frequent parasites of cattle on these farms.

CHEMICAL INACTIVATION OF INVASIVE FORM OF PARASITES IN LIQUID MANURE. EFFECT OF INCICOC PREPARATION ON EGGS OF INTESTINAL NEMATODES OF PIGS

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In liquid manure from the large scale feed-lot farms oocysts, eggs and larvae of parasites occur in quantities significant in respect to environmental pollution. Effect of 6% of Ciba-Geigy INCICOC in liquid manure on eggs of Oesophagostomum dentatum, Ascaris suum and Trichocephalus suis and 0.1 to 6.0% water solutions of the drug on the eggs of A. suum and rye seed germination was examined. It was found that 6% of the liquid manure INCICOC solution impaired vitality of germs and larvae in eggs of the above nematodes, that 0.5% solution of INCICOC inactivated invasive eggs of A. suum, and that 1.0% solution prevented rye seed germination. If liquid manure is to be applied on the cultivated fields, concentration of added INCICOC should be lower than 1.0%.

SESSION A3

Morantel sustained release bolus

Papers 21-34

THE SLOW-RELEASE-DEVICE (SRD) IN THE CONTROL OF GASTRO-INTESTINAL NEMATODIASIS OF CATTLE

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The SRD (Pfizer), a metal tube covered at both ends with permeable membranes, contains morantel tartrate. After application to cattle the SRD remains in the rumen and releases small doses of the drug during 90 days.

End of May 1980 SRD's were applied to 45 cattle, mainly >12 months old, grazing on prealpine pastures. Further 47 cattle of the same farm were kept separately and remained untreated. Both groups had been vaccinated against lungworms with Dictol (R).

Egg counts were low and not different in both groups. Average serum pepsinogen levels remained <1 Unit Tyrosin/1 in the SRD group until September, they were slightly higher (maximum 1.6 U) in the controls. Up to 50 % of the control animals excreted Dictyocaulus larvae, but only one of the SRD group. The daily weight gain was 260 g in the controls and 431 g in the SRD animals.

In a second experiment 9 SRD treated calves (1 st grazing period) and 11 controls had to be kept on the same highly contaminated pasture. Egg counts and serum pepsinogen values were low in the treated group until August, i.e. during SRD protection, but increased thereafter. These parameters indicated clinically significant infection in the control group which had to be treated 3 times during the grazing period. Weight gains in the latter group were lower than in the SRD group.

Ostertagia and Cooperia species were prevailing in both the cattle and calf groups.

AN EVALUATION OF THE MORANTEL SUSTAINED RELEASE BOLUS (MSRB) FOR THE PROPHYLAXIS OF PARASITIC GASTRO-ENTERITIS AND BRONCHITIS IN CALVES.

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The MSRB is an intraruminal bolus which provides an anthelmintic environment in the gastrointestinal tract of cattle for a targetted three month period. Three controlled field investigations involving a total of 156 calves were performed in the south of England during the 1979 and 1980 grazing seasons. With one exception, MSRBs were administered immediately before turnout with a view to preventing worm acquisition from overwintered larvae, thereby preventing future pasture contamination. Control animals received a placebo bolus, were left untreated or received conventional therapy. Pastures were divided equally, one half being grazed by treated animals the other by controls.

Use of the bolus at turnout successfully prevented outbreaks of PGE in calves in set-stocked paddocks and also in a rotational grazing system on two of the studies. Weight gain advantages over matched controls of 19.0 kg. and 34.3 kg., respectively, were recorded at the end of the grazing period. In the third study, on a farm with a severe lungworm problem, the pre-turnout use of the MSRB delayed and considerably ameliorated clinical signs. No advantage was gained by applying a second MSRB in mid-season. Detailed parasitological observations enabled the epidemiological events leading to each outbreak of disease to be described.

THE USE OF A MORANTEL SUSTAINED RELEASE BOLUS
IN THE SEASONAL CONTROL OF PARASITIC GASTRO-
ENTERITIS IN SECOND-SEASON CATTLE

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The effects of anthelmintic medication at the start of the grazing season were investigated in the course of a large field experiment. This included the oral application of a morantel sustained release bolus to three groups of cattle being on pasture for their second grazing season. The bolus was designed to release a total of 13.5 grams of morantel base continuously over a period of about 90 days. It was given to 15 oxen, 11 steers and 15 heifers shortly before turnout in spring. The animals were set-stocked on permanent pasture grazed by cattle the previous years. 17, 11, and 12 untreated control animals were kept on adjacent pastures on the same farms. Faecal gastrointestinal nematode egg output, herbage infestation of the pastures and body weights of the animals were monitored throughout the grazing season. The average daily weight gains from turnout to the termination of the experiment in autumn were 1118, 1015, and 741 grams per animal per day in the treated cattle versus 1095, 897, and 689 grams/animal/day in the controls.

THE USE OF A LONG TERM ANTHELMINTIC (MORANTEL
SUSTAINED RELEASE BOLUS) ON COMMON GRAZING PASTURE IN
THE PRE-ALPINE REGION OF AUSTRIA.

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Cattle rearing in the pre-alpine region of Austria is conducted mainly on communal grazing pastures at 1200 metres above sea level. Mostly, cattle are turned out in early season near the farmsteads then simultaneously transferred to mountain pasture after snow melt. Such conditions lend themselves to the use of the morantel sustained release bolus (MSRB) where treatment, which provides continuous release of morantel for a period of about 3 months, can be given upon arrival on the mountain pasture.

In 1980 157 animals from four mountain pastures received the MSRB whilst 124 cattle from similar pastures served as control groups. Faecal and grass samples were examined monthly and bodyweights recorded three times during the trial period.

These investigations demonstrated that the Trichostrongylid larvae overwintered on pasture in significant quantities but then disappeared by the end of July. Contamination reappeared toward the end of the grazing period on the control pastures but not on pastures grazed by treated cattle.

The rate of egg excretion in the treated animals was significantly lower than in the control animals. Weight gain varied considerably from pasture to pasture so that it was not always possible to determine significant differences between experimental groups. However, clear gains in productivity over previous years were observed in all groups treated with MSRB.

A TWO YEAR STUDY ON THE ANTHELMINTIC EFFECT OF THE PRE-GRAZING TREATMENT WITH A MORANTEL SUSTAINED RELEASE BOLUS IN FIRST YEAR GRAZING CATTLE

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Parasite larval contamination was markedly reduced on pastures grazed by cattle treated with a morantel sustained release bolus (MSRB), when the MSRB, delivering drug for about 90 days, was administered at the time of turnout onto spring pastures. A two year period of successive use was monitored in first season grazing calves, which were maintained each year on the same pastures in order to determine the subsequent effects of treatment on both pasture contamination and weight gain performance.

During the first year (1979), selected pastures were equally divided in separate grazing areas, fenced to accommodate two groups of trial calves. One group was treated with the MSRB two days before turnout, while the other group remained non-treated. Faecal and herbage samples were taken at fortnightly intervals while bodyweights were monitored monthly. Worm counts were recovered from tracer calves placed periodically on pasture during the grazing season. At housing, three calves from each group were slaughtered for further worm counts.

In 1980, three groups of first year grazing calves were used. One group was treated with the MSRB and grazed the same pasture as calves treated the previous year. The second group remained non-treated and grazed the same pasture as the control calves the previous year. The third group of calves received the MSRB and grazed an adjacent control pasture. The same data as the previous year were recorded except for the use of the tracer calves.

As a result of the MSRB treatment the first year, the number of overwintering larvae the following spring was considerably lower on the pasture grazed by treated animals, compared to the number recorded on the pasture grazed by non-treated animals. In the second year the larval contamination was lower on the pasture grazed by animals treated in both years compared to the pasture grazed by animals treated only the second year. These differences were also reflected by improved weight gains.

AN EVALUATION OF A MORANTEL SUSTAINED-RELEASE BOLUS FOR THE CONTROL OF NEMATODES IN GRAZING CALVES

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Prophylactic (summer) and/or therapeutic (autumn) administration of a 90-day sustained-release bolus (SRB), containing morantel, were compared for the control of nematodes in grazing dairy calves over an 8 month period (December to August).

Treated and untreated groups of calves all grazed separate replicated pastures. Both groups of calves receiving the SRB at the beginning of summer showed a significant liveweight gain response (17.7 kg and 20.7 kg for the summer and summer/autumn treated groups respectively) at the end of the trial period, when compared with untreated calves or calves receiving the SRB in autumn only. The summer treatment reduced faecal egg contamination to a low level (maximum mean egg count 33 e.p.g.) and as a consequence the autumn larval peak was eliminated (maximum <100 larvae/kg herbage). The absence of a significant liveweight response to the autumn SRB is attributed to an abnormally low larval availability during autumn (maximum 1100 larvae/kg on pastures grazed by untreated calves and 1200 larvae/kg on pastures grazed by animals receiving an autumn SRB only).

Both the summer and autumn administrations of the SRB prevented the accumulation of Pre-Type II burdens of Ostertagia spp.

Retention of the SRB was high and chemical analysis of faecal samples indicated that the release of the anthelmintic was relatively constant over the predicted 90-day period.

The results indicate that the SRB is potentially useful for the control of gastro-intestinal nematodes and, particularly, for the production of 'safe' pastures.

EFFICACY OF MORANTEL SUSTAINED RELEASE BOLUS (MSRB) IN A LARGE DAIRY CATTLE OPERATION IN MIDI-PYRENEES REGION OF FRANCE

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I - Experiments on dairy herds in pasture (turning out April 15) were conducted in Aveyron Department.

(A) Animals less than 1 year old :

(A1) 2 X 15 = 30 heifer calves (h.c.) 181 kg l.w.

(B) 2 months on pasture previous year, about 1 yr old

(B1) 2 X 13 = 26 h.c. 264 kg (B2) 2 X 12 = 24 h.c. 237kg

(C) 2nd year on pasture, pregnant heifers

(C1) 11 + 10 = 21 ; 473 kg.

The pastures were split and reference animals were compared to animals receiving MSRB at turnout.

RESULTS : (A1) 2 treatments when symptoms for reference

No symptoms and + 17 kg l.w. at housing for MSRB

(B1) 1 systematic treatment for reference. No symptoms and + 21 kg l.w. at housing for MSRB.

(B2) 1 treatment when symptoms for reference. No symptoms and + 17 kg l.w. at housing for MSRB.

(C1) 1 treatment when symptoms for reference. No symptoms and + 25 kg l.w. at housing for MSRB.

Decontamination of herbage was demonstrated by larvae counts in all MSRB pastures.

II - Heifers transferred to mountain pasture in summer. Levels of L3 in herbage very high just after melting of snow.

E1 : Start and finish in same pasture in plain. 12 + 11 = 23 animals, 346 kg at start.

RESULTS : 1 systematic treatment mid season for reference, no symptoms and + 17 kg at housing for MSRB.

E2 : Two mountains, one with 128 heifers receiving MSRB on arrival, the other with 172 heifers and two treatments, arrival + midseason. + 13 kg l.w. for MSRB.

CONCLUSION : In varied practical conditions, MSRB was effective when given on turning out or (mountain transfer) on arrival in highly contaminated pasture.

PRELIMINARY INVESTIGATION IN THE USE OF THE MORANTEL
SUSTAINED RELEASE BOLUS (MSRB) IN THE CONTROL OF
PARASITISM IN BEEF SUCKLER HERDS IN EUROPE.

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The MSRB is a sustained anthelmintic delivery system designed to be applied on a herd basis at turnout with the object of controlling parasitic gastrointestinal infection in grazing cattle by producing parasitologically "safe" pasture. This paper reports the results of studies using the MSRB in beef suckler herds investigating the influence of the cow on the ability of the MSRB to produce "safe" pastures for the calves and improve their performance.

Three different methods of use of the MSRB were tested; 1. cows and calves treated at spring turnout in autumn calving herds, 2. cows treated at turnout and calves treated later in the season in spring calving herds, 3. cows only treated at turnout in spring calving herds. The MSRB treated group and an equivalent group of untreated cow/calf pairs grazed equal areas of divided pastures on each site. Three trials of each design were conducted. 1) Fifty-four calves and their dams received an MSRB. The faecal egg outputs were reduced in the MSRB treated group and a significant build-up of infective larvae on pasture over the grazing period was prevented resulting in mean weight gain advantage of 14.0 kg. ($p < 0.1$). 2) Forty-eight cows and their calves received MSRBs. The faecal egg outputs were lower in both cows and calves following MSRB treatment, and some reduction of pasture larval contamination was seen. However no effect on the performance of the calves was observed. 3) Forty-five cows received an MSRB. The faecal egg output was lower in the MSRB treated cows but pasture larval contamination was not affected because of egg deposition by calves. No difference in performance between treated and control calves was observed.

THE EFFECT OF THE REPEATED USE OF THE MORANTEL
SUSTAINED RELEASE BOLUS (MSRB) ON THE SUSCEPTIBILITY
OF OSTERTAGIA OSTERTAGI TO MORANTEL.

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The MSRB is an intraruminal device for oral administration to cattle designed to release morantel continuously for a period of about 90 days. It is recommended for use immediately prior to turnout in the Spring for the seasonal control of parasitic gastrointestinal infections in grazing animals.

The effect of the repeated use of this form of continuous anthelmintic medication on the susceptibility of Ostertagia to morantel has been investigated in a laboratory study. The efficacy (ED_{90}) of morantel tartrate as a single oral dose against a laboratory strain of Ostertagia was determined by dose response titration in controlled experiments before and after five passages in calves in the presence of MSRBs modified to release drug at rates sub-lethal to the parasites. There was no significant difference between initial susceptibility (ED_{90} 2.7 mg./kg.) and final susceptibility (ED_{90} 3.3 mg./kg.).

In a field study, the MSRB was administered (at turnout) to separate groups of ten cattle that were grazed on the same half of a divided pasture for three consecutive seasons. Equal groups of untreated cattle grazed the other half of the pasture. Three weeks after removal from pasture at the end of the third season, half of each group were treated orally with 2.5 mg./kg. morantel tartrate (MT) and all the animals slaughtered 5-6 days later. Comparisons of worm counts between MT treated and untreated animals from the MSRB group and between MT treated animals and untreated animals from the control group demonstrated that the efficacy against the population of Ostertagia exposed to the MSRB for 3 seasons was identical to the efficacy against the unexposed population.

Under the conditions of these studies the susceptibility of Ostertagia to morantel was not altered by the repeated application of the MSRB.

AN ECONOMIC AND EFFICACY COMPARISON BETWEEN MORANTEL
(WHEN ADMINISTERED FROM A SUSTAINED RELEASE BOLUS) AND
CONVENTIONAL ANTHELMINTIC TREATMENT PROGRAMMES IN
GRAZING CATTLE.

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In the present series of field studies the economics and efficacy of conventional treatment was compared over a three year period with a new sustained anthelmintic delivery system designed to prevent the establishment of parasite infections such that, when given at turnout, parasitologically "safe" pastures could be produced and maintained for the entire grazing season.

A total of 471 first season grazing calves received the morantel sustained release bolus (MSRB) at spring turnout in 27 trials conducted in the United Kingdom, France, Netherlands, Belgium, West Germany, Denmark, Norway and Sweden. In each trial, an equal number of control calves were maintained on divided pastures. In 15 of the field trials, only those control animals exhibiting signs of parasitic gastroenteritis received therapy with conventional anthelmintic, whilst in the other 12 trials the control animals received strategic anthelmintic treatment during the grazing season.

Significant reductions in faecal worm egg output and subsequent herbage larval contamination developed on MSRB treated pastures such that, overall, the MSRB-treated calves out-performed the medicated control calves by a mean of 16.3 kg. ($p < 0.05$). Labour and management costs (for animal treatment and handling) were substantially reduced with the MSRB compared with conventional anthelmintic use.

EFFECT OF MORANTEL SUSTAINED RELEASE BOLUS (MSRB) APPLICATION ON THE BUILD UP OF THE PASTURE CONTAMINATION WITH INFECTIVE TRICHOSTRONGYLE LARVAE.

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The build-up of the pasture contamination with infective trichostrongyle larvae was found to be a valuable indicator for the anti-parasitic effect of the Morantel sustained release bolus (MSRB) in trials carried out in Denmark. Even under conditions where clinical disease did not develop or where weight gain differences did not become significant during the course of one grazing season, the L_3 contamination was markedly reduced on pastures grazed permanently by young cattle given MSRB either at turning out or in mid-season.

The results therefore also indicate that under conditions where differences in the pasture contamination appear not to be reflected in the grazing bovines, a full appraisal of control measures may require extension of the period of observation to include grazing of the same pastures with new susceptible stock the following season.

AN EVALUATION OF AN ANTHELMINTIC SUSTAINED RELEASE
BOLUS FOR THE CONTROL OF PARASITIC GASTROENTERITIS
UNDER MEDITERRANEAN CONDITIONS.

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The efficacy of an intraruminal morantel sustained release bolus (MSRB) with an effective release period of about 90 days was assessed in grazing cattle on the Island of Crete.

Forty-five, four month old Polish Friesian bull calves were allotted into three equal groups on the basis of bodyweight. One group received the MSRB at the time of turnout, the second group also received the MSRB at turnout followed by the administration of a second bolus in mid-season while the third group remained as non-medicated controls. The pasture area was divided into six equal paddocks. The calves were rotationally grazed between two assigned paddocks for each group at three to four week intervals during the grazing season.

Despite the long grazing period in Crete, successful control of gastrointestinal parasitism was achieved as measured by reduced faecal worm egg counts, weight gain and worm counts recorded at trial termination. The calves receiving two boluses had slightly fewer worms recovered at necropsy and gained slightly more weight than those calves receiving only one bolus. The twice treated calves outgained the control calves by a mean of 20.5 kg. ($p < 0.01$) while the single treated calves outgained the controls by a mean of 14.3 kg. ($p < 0.05$).

STUDIES ON THE INTERACTION BETWEEN IMMUNITY TO
DICTYOCAULUS VIVIPARUS AND A MORANTEL SLOW RELEASE
RUMEN DEVICE.

GRIMSHAW, W.T.R., BONNAZI, E. AND ARMOUR, J.
University of Glasgow, Scotland.

The interaction between immunity to the lungworm
Dictyocaulus viviparus and anthelmintic treatment
was studied in 16 calves vaccinated on two occasions
at an interval of one month with an irradiated
larval vaccine.

To simulate field conditions the vaccinated calves
were subjected to a low level of challenge with
lungworm larvae over a 90-day period from 2 weeks
after vaccination. At 2 weeks post-vaccination 8 of
the calves also received a rumen device which
contained morantel tartrate and was programmed to
release drug over a 90-day period at a level
sufficient to suppress the establishment of the
lungworm larvae.

The vaccinated calves, together with 9 controls were
challenged at 3 months post-vaccination with
D. viviparus infective larvae at a rate of 22 L₃/kg
bodyweight. The effect of the anthelmintic device
on immunity was assessed by monitoring the clinical
and serological response, and at post-mortem the
pathological changes and the numbers of lungworms
present.

APPLICATION OF MORANTEL CITRATE IN A CONTINUOUS MEDICATION PROGRAM FOR GROWING PIGS ON FARMS IN FRANCE

CONWAY, D.P., and RAYNAUD, J.-P., Pfizer International Inc., 235 E. 42nd St., New York, N.Y. 10017 U.S.A.

Three trials were conducted in France to test the efficacy and utility of continuous medication with morantel citrate in pigs raised under commercial conditions. Pigs were allotted by random process on a basis of sex and initial weight to yield seven pens of 20 pigs each per treatment in one experiment, and six pens of 15 pigs each per treatment in two experiments. This provided a total across the three trials of ten pens of female and nine pens of male pigs per treatment. The treatments were either nonmedicated control or morantel citrate fed in the daily ration at a level of 30 ppm. Rations were fed semi-*ad libitum* based on live weight according to normal farm practice. The average initial weight over all trials was 22.6 kg (range, 19 to 26.5 kg). Pigs were sold upon reaching an average live weight of 101 kg (range, 96.8 to 105.4 kg). Liver condemnations were checked at the slaughter house, and worm counts were completed at the Pfizer Laboratory in Amboise.

Worm counts at finish demonstrated that morantel citrate was highly effective in preventing *Ascaris* (100%) and *Oesophagostomum* (75.8%) infections. Liver condemnation (partial + total) due to *Ascaris* lesions was reduced by 86% for pigs given morantel citrate. A total of 94 livers were either partially (61) or totally (33) condemned from control pigs compared with only 13 livers either partially (9) or totally (4) condemned from pigs given morantel citrate. Since pigs were fed to a common final weight in each trial, the differences in performance were observed in relation to feed consumption and feed:gain ratios. The mean feed:gain ratio for the three trials for pigs given morantel citrate was 3.44, and for control pigs it was 3.59. The difference was a 4.4% improvement in feed efficiency for pigs given morantel citrate.

SESSION A4

Immunity
Papers 35-45

ANTIBODY DEPENDENT AND INDEPENDENT ACTIVATION OF THE
ALTERNATIVE PATHWAY OF SHEEP COMPLEMENT

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Trichostrongylus vitrinus larvae were incubated with buffer or immune sheep serum, washed and then incubated with foetal lamb serum (FLS) as a source of sheep complement (C). Unsensitized and antibody sensitized larvae activated C in FLS containing Mg^{2+} -EGTA and in FLS which had been heated at 50 °C and then supplemented with sheep factor B. Antibody sensitized larvae activated more C than did unsensitized larvae. Analysis of guinea-pig antisera to *T. vitrinus* or *Haemonchus contortus* treated with FLS or FLS after heating or chelation or with immune sheep serum also indicated that the alternative pathway of sheep C was involved.

INFECTION WITH GASTRO-INTESTINAL HELMINTHS. EFFECT OF LACTATION AND MATERNAL TRANSFER OF IMMUNITY.

SHUBBER, A.H., LLOYD, S., SOULSBY, E.J.L. Dept. of Clinical Veterinary Medicine, University of Cambridge, Madingley Rd., Cambridge CB3 0ES, England.

Lactation in sheep and mice was associated with a marked increase in susceptibility to infection with *Haemonchus contortus* and *Nematospiroides dubius*, respectively. A relaxation of the protective immune response was evident in immunized mice infected during lactation with *N. dubius*. However, coincidental with this peri-parturient relaxation of immunity mice were capable of inducing a marked passive transfer of immunity to their offspring. In sheep, increased susceptibility to infection with *H. contortus* occurred in late pregnancy and during lactation and was seen when the ewes were infected with both a single large dose of infective larvae or a "trickle" infection of larvae of *H. contortus*. Ewes whose lactation had been terminated were able to reject the parasites which had been acquired in late pregnancy.

THE INDUCTION OF PARTIAL RESISTANCE TO
COOPERIA ONCOPHORA BY REPEATED INTRADERMAL
TESTS

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This experiment was a repetition of an incidental finding in a combination of two previous experiments. A group of fifteen FH calves (age 3 months) was divided into:

- treatment 1: 5 calves; injected intradermally (IDT) (at 2-week intervals, 6 times) with a saline-extract of adult C. oncophora.
- treatment 2: 5 calves; infected at the age of 3 months with 100,000 infective larvae; reinfected with 350,000 infective larvae 4 weeks later.

- treatment 3: 5 calves; control group.

After treatment with anthelminticum of all calves, they were challenged with 200,000 larvae. At the age of 7 months the calves were slaughtered.

The following measurements were made: an ELISA-test on antibody titers against C. oncophora (weekly), egg-counts in faeces (three times a week), the number of worms and their various characteristics at necropsy, the area of the elliptical wheal at the IDT injection site.

The egg counts of the IDT group were extremely low and comparable to treatment 2. The analysis of other measures of resistance had still to be done at the time of preparation of this abstract.

OESOPHAGOSTOMUM COLUMBIANUM: IRRADIATED
THIRD STAGE LARVAE FOR IMMUNISATION IN
LAMBS.

SHARMA, R.L. & DH R, D.N. Regional Centre,
Indian Veterinary Research Institute,
Rawalpura, Srinagar-5, Kashmir (INDIA).

40-kR gamma irradiated third stage larvae of Oesophagostomum columbianum were used for the immunisation of Kashmir Merino lambs. Male lambs, eight-12 weeks old, received immunising infections of 500 followed 21 days later with 2000 irradiated larvae (Group I) and 1000 followed 21 days later with 2000 irradiated larvae (Group II) per lamb. A group of lambs received no irradiated larvae and served as control (Group III). Judging by the establishment of worms in the respective groups of lambs following challenge infections, Group I lambs showed 71.9% protection as against Group II and III which showed 36.4% and 0% respectively. More nodules established in the immunised lambs in comparison to control. A high percentage of nodules from immune lambs were positive for the histotrophic stages of O. columbianum.

RELATION OF THE THYMUS TO THE DEVELOPMENT OF
ANGIOSTRONGYLUS CANTONENSIS IN NONPERMISSIVE HOSTS

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The current study was conducted to assess the possible role of the thymus in the development of Angiostrongylus cantonensis in nonpermissive host (mouse). When athymic nude mice and neonatally thymectomized mice were exposed to this parasite, some A. cantonensis were found migrated to the pulmonary arteries of these mice. The pulmonary arterial migrations of the worms did not occur in heterozygous littermates of the nude mice and thymus reconstituted nude mice. A. cantonensis migrated into the mouse lungs, however, could not develop to sexual maturity. The worms developed in the mouse brains (mouse worms) and corresponding rat worms were surgically transferred into the pulmonary arteries of recipient rats to determine the occurrence and nature of functional damages in the mouse worms. This study revealed that the degree of damages differed depending on mouse strains and that spicular abnormality or the absence of the spicules occurred in some mouse worms recovered from the rats. These data suggest that inability of A. cantonensis to develop in nonpermissive hosts would be, at least in part, due to thymus dependent immune mechanisms but most likely to genetically determined, non-thymic factors.

**ADOPTIVE IMMUNITY IN MICE TO ANCYLOSTOMA
CANINUM LARVAE AFTER REPEATED THYMUS CELL
TRANSFERS.**

**KOLHE, N.P. and JOHRI, G.N. School of Studies
in Zoology, Vikram University, Ujjain, INDIA**

Adoptive immune response in female Swiss albino mice (6-8 wk old and 15-20 gm body wt) to infective Ancylostoma caninum larvae after repeated transfer of thymus cells was studied. donors and recipients were randomly grouped into 3 respective groups each. The donor groups I and II were divided into 2 subgroups having an infection interval of 7 days. Each mouse of Ia and Ib was given a single oral inoculation of 500 larvae while 2000 larvae were administered to each donor of IIa and IIb. Mice of III acted as uninfected control donors. All the recipients of groups 1, 2 and 3 were injected ip with 1×10^6 thymus cells/mouse from donors Ia, IIa and III respectively 16 days after infection to these donors. The same number of thymus cells from subgroup b donors was again injected ip into the same mice of respective recipient groups 7 days after first cell transfer. All recipients were orally challenged with a single dose of 500 larvae 7 days after second cell transfer. The immune response was assessed by the number of actively motile larvae recovered at 6, 12, 18, 24, 48, 72, 96, 120 and 144 hr after challenge. The experimental recipients were found to be more competent in expelling and/or destroying the challenge worm burden than the controls. No significant difference was, however, observed in the adoptive immune response when compared to single cell transfers carried out previously.

INHIBITORY ROLE OF PROMETHAZINE HYDROCHLORIDE
IN THE REJECTION OF ANCYLOSTOMA CANINUM
LARVAE FROM THE GUT OF SWISS ALBINO MICE.

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The mechanism of acquired resistance of female swiss albino mice (6 to 8 weeks old) to infection with Ancylostoma caninum was investigated by transfer of mesenteric lymph node cells from resistant (immunised and promethazine treated), immunised and untreated and unimmunised and untreated donors to non-immune recipients of the same isogeneic strain. Mesenteric lymph node cells from immunised, promethazine treated donors were greatly effective in bringing about appreciable reduction in the recipient's capacity to reject worms from the gastrointestinal tract and to immobilise a threshold larval burden in muscles too as compared to cells from other two donor groups. The mechanism of worm expulsion being diphasic (VARDHANI and JOHRI, 1980), it is beleived that the drug possibly exerts an inhibitory action either at the specific lymphoid or at non-specific amine levels.

EFFECT OF IMMUNOSUPPRESSION ON INFECTION WITH
TOXOCARA CANIS.

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The factors which mediate somatic rather than tracheal migration in the dog and which mediate reactivation of dormant second stage larvae of *Toxocara canis* in the pregnant bitch are unknown. However, immunosuppression (pregnancy and lactation; corticosteroid therapy) permitted intestinal infection with *T. canis* in adult dogs. Infection of the bitch during pregnancy and lactation with embryonated eggs of *T. canis* resulted in a heavy intestinal infection with adult *T. canis* which was eliminated at the end of lactation. The eosinophilic response to infection with *T. canis* seen in non-reproductive animals was suppressed during pregnancy and lactation and *in vitro* mitogen-induced lymphocyte transformation was suppressed in pregnant and lactating bitches from 3 to 5 weeks prior to, until several weeks after parturition. Corticosteroid therapy mimicked the immunosuppressive effect of pregnancy and lactation: eosinophilia was eliminated; *in vitro* mitogen-induced lymphocyte transformation was suppressed; and intestinal development of parasites occurred. These experiments suggest that the route of migration of second stage larvae of *T. canis* might be under immunological mediation.

INTRACULAR IgE ANTIBODY INDUCED IN GUINEA PIGS BY *ONCHOCERCA*

DONNELLY, J.J., ROCKEY, J.H., BIANCO, A.E. and SOULSBY, E.J.L. Department of Clinical Veterinary Medicine, University of Cambridge, Madingley Road, Cambridge.

Onchocerca cervicalis (obtained from horses) and *Onchocerca gutturosa* (from cattle) are being used to study the roles of the various immunopathologic mechanisms in onchocercal eye disease and the ocular inflammatory reaction which occurs following treatment with DEC. A single intracorneal infection of inbred Strain 2 guinea pigs with microfilariae of *O. cervicalis* or *O. gutturosa* produced mild eosinophilic conjunctivitis which cleared in 4-6 days. Intravitreal injection of microfilariae produced mild transient eosinophilic choroiditis. IgE antibody against *Onchocerca* microfilarial antigens was not detected in serum or aqueous humor following a single ocular infection. DEC (15mg/kg per os) did not alter the clinical or histopathologic inflammatory reactions of these animals. Systemic sensitization of guinea pigs by subcutaneous and intradermal injection of microfilariae elicited serum IgE antibody in one-fourth of those sensitized. Intracorneal injection of microfilariae into sensitized animals resulted in some instances in IgE antibody in the aqueous humor by 8 days after challenge, in the absence of the detectable serum IgE antibody. All animals developed serum IgE antibody by 15 days post-challenge. A dense eosinophil and mononuclear cell infiltrate was present in the limbal cornea and bulbar conjunctiva 48 hr after challenge, and eosinophils and plasma cells were present in the ciliary body by day 8.

THE EFFECT OF NORMAL AND IMMUNE HOMOLOGOUS SERUM ON
THE DEVELOPMENT OF *TRICHINELLA PSEUDOSPIRALIS*
(GARKAVI, 1972) IN RATS.

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Some experiments were performed using the experimental animal model of rats infected with *T. pseudospiralis*. The experiments investigated the effects of homologous immune and normal serum given 0, 5, 7, 14 or 20 days prior to infection with *T. pseudospiralis*. Four-week old male rats were infected "per os" with 100 larvae of *T. pseudospiralis*.

Rats were passively protected against infection with *T. pseudospiralis*. The most effective treatments were normal serum given on day 0 (average 47.9 larvae) or immune serum given 7 days prior to infection (average 5 larvae). Comparable control mice contained an average of 337.8 larvae/gm of diaphragmatic muscle.

The antibody titre of the donor serum was detected by a number of tests: complement fixation, haemagglutination, double diffusion.

THE EFFECT OF IMMUNE AND NORMAL ALLOGENEIC CELLS AND SERUM ON THE DEVELOPMENT OF *TRICHINELLA SPIRALIS* (OWEN, 1835) IN RATS.

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These experiments examined the effect of serum, spleen cells and mesenteric lymph node cells from infected and non-infected rats on the development of *T. spiralis* in recipient rats. The recipients were infected with 100 larvae and received serum and leukocytes on day 0. The serum and cells from individual rats were unrelated in their protective capacity. Immune serum and spleen cells were the most effective at inducing a passive transfer of immunity and recipients contained an average of 196.3 larvae/gm of diaphragmatic muscle. Rats which received immune spleen cells contained an average of 366.5 larvae and those which received both normal serum and normal spleen cells contained an average of 512.6 larvae. Control rats contained an average of 1037.7 larvae. The results demonstrated that both serum and lymphoid cells from actively immunized and from non-infected rats induce a passive transfer of immunity against infection with *T. spiralis* in recipient rats. The antibody titre of the donor serum was measured by a variety of tests: complement fixation, haemagglutination and double diffusion.

SESSION A5

Parasites of game and fish

Papers 46-52

HELMINTHIC INFECTIONS IN WILD RUMINANTS AND
DOMESTIC SHEEP MOVED TO ALPINE PASTURES IN FRENCH
ALPS.

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The authors carried out a 3-year survey in french alps, checking helminths in Chamois (Rupicapra rupicapra) and in young Sheep (Ovis aries) born in alpine pastures and grazing along with Chamois during summer time. They lay out the results of this survey and compare helminthic burden in the two concerned species. From this survey, they conclude that ovine and chamois infections do not match together, either from a qualitative or from a quantitative point of view. In a given biotope, lambs borne in alpine pastures, while sharing some helminths with chamois, harbour their own parasites and are much more infected than chamois. So helminthic infections evolve according to a proper way in sheep and chamois. No interference and no reciprocal infection occur between parasitic helminths in these two species of Ruminants.

**DYNAMICS OF PARASITIC INFECTIONS IN YOUNG CHAMOIS
(RUPICAPRA RUPICAPRA) IN FRENCH ALPS (NATURAL PARC
OF LES BAUGES).**

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The authors carried out a 3-year survey in a french Natural Parc, designed to find out the dynamics of parasitic infections in young chamois. These animals, that were born in may, were followed up till 12 months old. One animal of the bevy was killed every month from may onwards and examined post mortem as for its parasitic burden. The results of the above survey shows that, as a rule, the infections occur very early in the life time of the animals : from the very age of 2 months as far as helminths are concerned and three weeks when coccidia are involved. The main parasites concerned are Protostrongylinae, which may be responsible for very severe broncho-pulmonary lesions, sometimes complicated with bacteria or viruses. As for infections of digestive tract, Ostertagiosis is the most common one ; it starts at 2 months with O. circumcincta, which, later on, culminates in late summer, then in late winter. - Nematodirus spp. are not very common, and a infestation peak occurs in late winter, in animals 8-10 months old. No Trichostrongylus were found in the concerned biotope.

As a rule, with the exception of parasitic broncho-pneumonia, helminthic infections are not involved as causes of mortality in young chamois. However, they contribute to weaken the animals so making them more susceptible to other diseases.

From a practical point of view, it may be necessary to make treatment available to young animals from september for Protostrongyles and from november for Nematodirus.

INTERRELATIONSHIP BETWEEN DEER AND THEIR PARASITES

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Since 1972 the endo- and ectoparasites of more than 350 roe deer, 200 red deer and 60 fallow deer have already been examined. In relation to roe deer the age, body and carcass weight, weight of the organs and endocrine glands, the body and skull measures as well as kidney-fat index have been examined.

It was found that the size of the parasite burden appears to be dependent on individual susceptibility of hosts rather than from the general intensity of exposure to parasitic infections. At certain species /Taenia and Moniezia spp./ only primary infenctions can establish themselves and the growth and reproduction of other species /Mallophaga, Anoplura, Hyppoboscidae/ is restricted by the sound host organism. In case of reduced host resistance /juveniles, old or injured animals in bad condition/ further infections may be conceived resulting massive infection consisting of more species of parasites.

Among the parasites of deer in Hungary there is no clearly pathogenic species. Their direct role in inducing mortality or reducing the vigor, growth and production cannot be proved.

The size of parasitic burden /e.g. Trichostr. ongy-lidae, Mallophaga, etc./ is good indicator of the ecological relations /availability of biotop and food, ethological, population-dinamical conditions/ of the host-population. The direct protection /chemotherapy/ is generally considered to be useless and disguises attention from the problems of more ecological significance.

TICKS (IXODIDAE) OF SIKA DEER

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Sika deer is a rare species in nature and is bred in a special deer park. Therefore the study of ectoparasites of tamed and wild deer has a certain veterinary importance.

In 1966-1968 years 24475 ticks (Haemaphysalis japonica douglasi Nutt. et Warb., H. longicornis Neum., H. concinna Koch, Ixodes persulcatus Schulze, Dermacentor silvarum Ol.) have been collected from 28 wild deer in Lasovski Nature Reserve and Askold Island, Soviet Primorye Territory. H. longicornis, the common tick of tamed deer have been found only in Askold Island. We suppose, that deer in the Island have received this parasite when coming in contact with tamed deer from nearby deer parks. In winter dominating tick on deer was H. japonica (mainly the wintering males of tick) with abundance index: 1600 - on adult deer males, 559 - on females in Nature Reserve; 2480 - on adult deer males and 1016 - on females in Askold Island. The invasion of Sika deer with wintering ticks H. japonica is much higher than invasion of other Artiodactyla in the Soviet Far East.

TRANSFER OF FASCIOLOIDES MAGNA INFESTATION
BETWEEN DOMESTIC AND WILD ANIMALS

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In Czechoslovakia, Fascioloides magna is spread through the Cervidae. Infected members of this family, either free-roaming or living in wild-animal reserves, pose a particular hazard when in their search for food or during the breeding season they migrate to distant areas and contaminate meadows and pastures, which are the source of green forage for cattle. Fascioloidosis may be a problem not only among grazed cattle, but also among housed animals fed hay or forage contaminated with F. magna metacercariae. In one barn the percentage of F. magna-infected stall-fed cattle was as high as 60 per cent. The infestation causes considerable economic losses due to condemnation of the entire liver at meat inspection, a reduction in body mass gain by as much as 150 g per animal per day and a prolonged fattening period required for these animals to reach slaughter mass. During a two-year period we reduced F. magna infection among cattle to a minimum by treating them with Bithionol sulphoxide of the Czechoslovak origin /chemically bis (2-hydroxy-3,5-dichlorophenyl) sulphoxide/, by treatment of intermediate host snail biotopes with Frescon (n-tritylmorpholine), by a modification of the grazing system and by adherence to technological procedures in harvesting hay and forage.

UNUSUAL FISH PARASITES IN NORTH AMERICAN CULTURED FISH

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During the past several years the following unusual dangerous parasites have been found in North American cultured fishes. Parvicapsula sp. (Protozoa: Myxosporea) causes chronic kidney disease of pen-reared coho salmon in the North Pacific. The spore is elongate, bent and asymmetrical. Valves appear twisted slightly. Suture line barely discernible along the edge; spore is $10.7 \times 5.7 \mu\text{m}$; polar capsules 1.5×1.5 enclosed in a headlike structure. The only sporoblast seen contained four spores unlike P. asymmetrica Shulman, 1953 which contains two. The "kidney bloater", Mitraspora cyprini, of goldfish is a lethal agent causing massive enlargement of goldfish kidneys (sometimes only one). Previously it was known only from Japan. External signs appeared in September/October when infected fish were swollen as in bacterial dropsy but some fish were swollen unilaterally. All infected fish died before the parasite had reached the spore stage. We could recognize early trophozoites in kidney squashes and sections in October/November and polytrophozoites in December/January. None of our infected fish survived till spore stage but unusual clinical signs, histopathology, trophozoites and polytrophozoites were distinct enough for diagnosis. A severe epizootic of fathead minnows (Pimephales promelas) was caused by unusually high intensity of Posthodiplostomum minimum metacercariae. There were so many present that the body wall burst, releasing many parasites, and killing many fish. We reported the Asian tapeworm, Bothriocephalus acheilognathi from golden shiners, fathead minnows, grass carp, and mosquito fish in the USA in 1976. Initially the morbidity was very high in golden shiners but good management has reduced the problem greatly.

THE ROLE OF UNBRED FISH IN SPREADING OF PARASITIC INFESTATIONS IN BREEDING FISH

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The parasites circulation between an
unbred fish and a breeding fish was observed
in pond farms. This conclusion was given
after an examinations of about 600 fishes
from 4 pond farms near Warsaw. The three
species of breeding fish and 10 species of
unbred fish was examined. This investigation
showed a big role of unbred fish in spreading
the following parasites: Ichthyophthirius
multifiliis, Chilodonella cyprini,
Trichodina domerguei f. acuta, Trichodina
epizootica, Eimeria carpelli,
Diplostomum spathaceum /metac./,
Bothriocephalus gowkongensis, Argulus
foliaceus, Piscicola geometra and others.

SESSION B1

Protozoa I
Papers 53-62

THE IMMUNOLOGICAL RESPONSE IN ACUTE TRYPANOSOMIASIS
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Using ⁷⁵Se-labelled trypanosomes, experiments were conducted to investigate antibody production in mice with acute fulminating T. brucei infections. As measured by the hepatic uptake of radiolabelled parasites, we were unable to demonstrate any evidence of antibody-mediated uptake by the liver in such mice.

It was concluded that this was not due to impaired macrophage function but was caused by the inability of antibody production to cope with the massive parasitaemias produced by rapidly replicating infections so that effective opsonisation of the parasites did not occur. In contrast, a strain of trypanosome which causes a more chronic infection, although initially having a similar replication rate, subsequently switched to a slower one and thereby allowed antibody to reach levels which permitted effective opsonisation.

There was no evidence that the parasite caused any significant suppression of antibody response in these acute infections.

THE EFFECT OF TRYPANOSOMA CONGOLENSE INFECTION IN
RABBITS ON ACQUIRED IMMUNITY TO TICK INFESTATION

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Rabbits infested with Rhipicephalus appendiculatus developed immunity to a secondary infestation with R. appendiculatus, as evidenced by lower engorged weights. However, when rabbits were infected with T. congolense before the secondary infestation, the expression of immunity was blocked. Although the mean engorged weight of ticks from the secondary infestations was lower than from the primary infestations, the weights of ticks from the secondary infestations on infected rabbits were significantly higher than those of ticks from secondary infestations on uninfected rabbits.

IMMUNE RESPONSE OF CATTLE TO *TRYPANOSOMA THEILERI*.

TOWNSEND, A.J. and DUFFUS, W.P.H. Department of Clinical Veterinary Medicine, Cambridge Veterinary School, Madingley Road, Cambridge, U.K.

Colostrum deprived calves were experimentally infected with *Trypanosoma theileri*. Using the micro ELISA specific IgM was detected from 5 days post inoculation, followed by increases in specific IgG₁ and IgG₂. Parasitaemia, as detected by blood culture, occurred between 7 - 19 days post inoculation. A second challenge with the parasite resulted in much higher levels of specific IgG₁ and IgG₂.

Bovine neutrophils, mononuclear phagocytes, and eosinophils, but not lymphocytes, were shown to be cytotoxic to ³H - Uridine labelled epimastigotes *in vitro*. Cytotoxicity was antibody dependent, with bovine IgM being the most effective isotype. The most effective cytotoxic leukocyte was the neutrophil, which killed 90% of target cells with 60 minutes. Electron micrographs showed that all three leukocytes phagocytosed *T. theileri*, and that neutrophils can damage epimastigotes before closure of the phagosome.

Preliminary studies indicate that serological cross reactivity occurs between *T. theileri* and salivarian trypanosomes. For example bovine antisera against *T. theileri* cross reacted with *T. brucei* and *T. vivax* antigen using micro ELISA. This cross reactivity was lost following immunoabsorption with *T. theileri* and *T. brucei* antigens.

DEPRESSION OF HUMORAL IMMUNE RESPONSE TO INFLUENZA VIRUS IN MICE SUFFERING FROM CHRONIC AFRICAN TRYPANOSOMIASIS

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We have measured serum and pulmonary influenza virus neutralizing antibody titres in mice suffering from chronic African trypanosomiasis.

Eight to ten week old deer mice (Peromyscus maniculatus) were inoculated with Trypanosoma equiperdum or Trypanosoma brucei; each animal receiving 10^4 trypanosome organisms. After a period of five weeks, animals showing trypanosome infection, along with a suitable, trypanosome-free control group were intranasally instilled with 7.5×10^4 PFU of influenza A_o WSN virus.

Serum as well as pulmonary influenza virus neutralizing antibody titres were assayed by microtiter plaque technique for 35 days post virus inoculation in the case of T. equiperdum and 14 days in the case of T. brucei.

T. equiperdum markedly ($p < 0.001$) depressed serum neutralizing antibody to influenza virus in deer mice. Similarly, pulmonary neutralizing antibody titer was significantly depressed ($p < 0.01$) in these mice.

T. brucei infection resulted in a profound but statistically significant ($p < 0.05$) depression in the serum and pulmonary immune response of the mice to influenza virus. Our study has provided initial evidence for the immunosuppressive potential of trypanosomes to influenza virus infection.

HISTOPATHOLOGY OF RABBIT SKIN INOCULATED WITH METACYCLIC AND BLOOD FORMS OF TRYPANOSOMA CONGOLENSE

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Tsetse transmitted Trypanosoma congolense produces a characteristic local skin reaction in domestic animals and in rabbits (1). Metacyclic forms of T. congolense grown in vitro at 28°C (2) also produce local reactions when inoculated into rabbit skin. In contrast, blood forms of T. congolense do not produce such reactions (3).

This paper describes the cellular changes in the skin of rabbits inoculated intradermally with metacyclic and bloodstream trypanosomes. Tissues from the inoculation sites were examined from 1-7 days after injection. Skin samples were carefully removed, fixed in Zenker-formol, sectioned at 5-6µ, stained by H and E and the Giemsa colophonium technique and the cell types present were categorised and counted.

There was a marked difference in the tissue response following inoculation with bloodstream and metacyclic trypanosomes. There was only minor cellular infiltration at sites inoculated with bloodstream trypanosomes dominated by basophils and macrophages whereas there was massive cellular infiltration with mononuclear and polymorphonuclear cells particularly eosinophils into local reactions caused by metacyclic forms.

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EXPERIMENTAL SURRA IN PONY'S: CHANGE IN
THE IMMUNOGLOBULINS

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14 Shetland pony's were each infected subcutaneously with 1 *Trypanosoma evansi* per g of body weight. The animals died between the 24th and the 79th day. Undulating parasitaemia's, fever and a progressive anaemia were the main clinical symptoms of the disease. Rising antibody titers against *T. evansi* and *T. brucei*-antigen were first detected 10-14 days after infection using the ELISA and the CFT. Differentiation and quantification of serum IgG and IgM were performed using the one dimensional rocket electrophoresis. A change in the immunoglobulins and in the protein levels of serum were observed.

AN APPRAISAL OF ISOMETAMIDIUM CHLORIDE (Ic)
AFTER LONG TERM STUDIES FOR THE CONTROL OF
ANIMAL TRYPANOSOMIASIS IN AFRICA AND ASIA.

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Within the framework of the 40 year eradication programme of African Trypanosomiasis - launched under sponsorship of F.A.O. and with support of other Intergovernmental Organisations- trypanocidal drugs (TD) have to be used as long as tsetse flies are not eradicated.- In Africa the regular use of Ic (^R TRYPAMIDIUM) proved its efficiency as a curative or a preventive drug in cattle infected with Trypanosoma congolense, T. viva and T. brucei (breeding and slaughter cattle and draught oxen).- According to the Recommendations by the Joint FAO/WHO Expert Consultation issued in 1979 the drug has to be administered by deep intramuscular injection (I.M.) or intravenously (I.V.) : 0.25mg/Kg b.w. is curative; 0.50mg/Kg b.w. provides a protection time of 2-4 months if I.M. or 45-60 days I.V.

Comparative data with other TD in ranching cattle suggest better profitability with Ic.

T. evansi infection:-Several field and practical trials carried out -or still in development- in infected camels, cattle and donkeys in Africa (Egypt, Ethiopia) and in Asia (India, Indonesia, U.S.S.R., Vietnam) are reported and discussed with particular reference to the greater susceptibility of suramin resistant strains and the variability in their pathogenicity.- Strains of T. evansi could be exchanged under supervision of International Organisations in order to clear up these particular aspects.

CHARACTERIZATION OF THE ANTITRYPANOSOMAL ACTIVITY OF SOME ANTIBIOTICS.

SHIBALOVA, T.A., LUBIMOVA, L.K., TERESHIN, I.M., MARTYNCHIK, Y.K., LADINO, J.-R. Leningrad Veterinary Institute, Leningrad, USSR. and All-Union Research Institute of Antibiotics, Leningrad, USSR.

Cultivation of *Trypanosoma lewisi* has been compared in a variety of organic and synthetic culture media. The dynamics and growth curves of the trypanosomes in each of 6 media were determined by the conductometric method and by the integral and differential dependence of the cell distribution divided according to size over 8 days at a constant temperature.

Culture media were selected for the development of the biomass of trypanosomes and used to screen anti-trypanosomal drugs and for biochemical and electron microscopic investigations. The biological activity of a group of polyene and non-polyene drugs was investigated *in vitro* in medium 199. The minimum concentrations which caused inhibition were determined and morphological changes were examined by light microscopy.

Data on the ultrastructural changes and some aspects of energy metabolism in the trypanosomes following exposure to such inhibitors will be presented.

INCIDENCE OF BOVINE TRICHOMONIASIS
IN NIGERIA

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ABSTRACT:

Investigations were conducted into the incidence of Trichomonas fetus in 960 trade cattle slaughtered at the Ibadan abattoir between June 1979 to May 1980. Specimens were taken from the preputial sheath and orifice of the male and the vagina of the female cattle. A total of 144 positive cases were recorded by the method of direct examination of slides stained with both Leishmann and Giemsa.

A similar investigation was conducted in 200 heads of static herd at the Cattle Ranch, Upper Ogun, Oyo State and 142 positive cases were recorded using similar method of examination.

SURVIVAL OF TRICHOMONAS FOETUS IN FROZEN BULL SPERM

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Gödöllő, Hungary.**

The author examined the viability of *Trichomonas foetus* subcultures after they had been frozen with bull sperm. The sperm samples were stored at -196°C for 30 days. After thawing, samples were inoculated into culture media.

The results demonstrated that *t. foetus* survived freezing. However, the recovery of protozoa is different in the paillettes.

SESSION B2

Protozoa II
Papers 63-72

IMMUNIZING EFFECT OF LOW DOSES OF SPOROCYSTS
OF SARCOCYSTIS SUICANIS

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Two groups of four 8 weeks old pigs each were inoculated with 10 (group 1) or 1000 (group 2) sporocysts of Sarcocystis suicanis per animal. Four pigs (group 3) served as controls. All pigs received a lethal dose of 9 million sporocysts 40 days later. All animals of group 3 and 3 of group 1 died 12 to 13 days after challenge. Sarcocysts originating from the primary infection were detected in the muscles of the succumbed animals of group 1. The 4th pig of group 1 developed acute sarcocystosis after challenge but survived. All pigs of group 2 survived the challenge without showing severe clinical symptoms. The IFAT did not become positive in pigs of group 3 and group 1 until their deaths due to challenge. Titres became positive in 3 animals of group two 21 to 39 days p.i. In all surviving pigs titres became positive or rose significantly 6 to 13 days after challenge.

IMMUNBIOLOGICAL INVESTIGATIONS IN SARCOCYSTIS
MURIS AND S.DISPERSA INFECTED MICE

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Cellular reactions were detected in the musculature of black mice (crossbreed of white NMRI and wild *Mus musculus*) after oral inoculation with Sarcocystis muris sporocysts from day 69 onwards and with S.dispersa sporocysts from day 51 onwards. Cysts were gradually surrounded, invaded, and finally destroyed.

A complete immunity to homologous reinfection was observed 90 days p.i. in S.muris and 100 days p.i. in S.dispersa infected mice, whereas heterologous infections were successful.

In S.muris and S.dispersa infected mice antibody titres could be demonstrated by means of the enzyme-linked immunosorbent assay (ELISA) and the indirect haemagglutination (IHA). Homologous or heterologous reinfections had no influence on the antibody formation.

SPECIFIC ANTIBODIES IN SHEEP AS INDICATORS OF STAGES OF INFECTION BY *SARCOCYSTIS* SPP.

O'DONOGHUE, P.J. Institute of Medical and Veterinary Science, Frome Road, ADELAIDE 5000, South Australia; and Institut für Parasitologie, Bünteweg 17, D-3000 HANNOVER 71, West Germany.

The suitability and specificity of the CFT, IFAT, IHAT & ELISA in the diagnosis of *Sarcocystis* infections was examined in experimentally- and naturally-infected sheep. Cross-match antigenic studies revealed the antibodies detected by all tests as genus-specific but not species-specific.

Sarcocystis-specific antibodies developed sequentially in experimentally-infected sheep. Firstly, a transitory CFT response occurred 15-35 days post-infection; closely followed respectively by more stable IFAT, ELISA & IHAT responses. The transitory CFT-titre peaks were not only good indicators of recent infections and re-infections, but were also useful in diagnosing the acute 'Sarcocystosis' disease syndrome accompanying parasite schizogenous proliferation. The CFT may therefore be used in screening programmes on weaner illthrift. Chromatographic and electrophoretic studies enabled the immunoglobulin typing of the primary response as predominantly IgM and the secondary responses as predominantly IgG. It is also possible that a host/parasite relationship exists between the host humoral response to infection and the onset of parasite cyst formation.

Synchronous serological and histological examinations of naturally-infected sheep revealed a good correlation between the presence of IFAT-antibodies and parasitic cysts; thereby indicating the suitability of the IFAT in detecting chronic 'Sarcosporidiosis' infections. Apparent false reactions rendered the other tests as less exacting sero-epidemiological tools. No correlations were found between antibody and parasitic cyst intensity; suggesting non-maintenance of active antigenicity.

LIGHT AND ELECTRON MICROSCOPIC STUDIES ON
GAMOGONY, FERTILIZATION AND SPOROGONY OF
SARCOCYSTIS SUICANIS AND SARCOCYSTIS MURIS.

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many

In Coccidia-free dogs and cats, experimen-
tally infected with muscle cysts, the intes-
tinal development of S. suicanis and S. muris
was studied. Merozoites penetrated the gob-
let cells of jejunum and ileum 6 hs p.i.
These intracellular stages were contained
within a parasitophorous vacuole. By lobula-
tion of the nucleus at 12 hs p.i., up to 16
microgametes were formed. Each contained a
nucleus, a tubular mitochondrion, a perfora-
torium, basal bodies and flagella. Between
12 and 18 hs p.i., macrogametes appeared
with polar caps of microgametes. During fer-
tilization one microgamete lay between the
thickened membranes of the parasitophorous
vacuole at one pole of the macrogamete.
Fertilization occurred by fusion of the mem-
branes of macrogamete microgamete and para-
sitophorous vacuole and the transfer of nuc-
lear material. At this time microtubules of
the axoneme of flagella were observed in the
microgamete. These studies imply, that the
intact microgamete of Sarcocystis does not
penetrate the macrogamete's pellicle during
fertilization. The zygotes lay extracellular-
ly between the epithelium and the lamina
propria. Unsporulated and sporulating oocysts
were found 3 days p.i. Sporocysts found at
12 days p.i. showed a sporocyst wall consis-
ting of a thin outer and a thick inner layer.
Thicker "fracture points" were observed only
in the inner layer.

LIGHTMICROSCOPIC IDENTIFICATION OF SARCO-
CYSTIS SPECIES IN DANISH PIGS AND ROE DEER
BY INVESTIGATION OF THE CYST WALL IN
STAINED SLIDES.

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Due to the lack of time and laboratory facilities, in this investigation the normal histological preparation was used.

In pigs three types of Sarcocystis cysts were found. One with a wall 3.6μ thick with uprigh standing villi, the second with a wall 1.8μ thick with sloping villi and the third with a thin immeasurable wall.

Only experiments on dogs, cats and man can secure a proper identification.

In roe deer two different types were identified. The first as an unknown Sarcocystis species with a $3.6-5.4\mu$ thickwalled cyst with cystozoites measuring 8.6μ and the second as Sarcocystis gracilis with an immeasurable thinwalled cyst with cystozoites measuring 12.4 times 3.6μ having dog as final host.

PROTOZOAL DISEASES ON SHEEP FARMS: THEIR THERAPY AND PROPHYLAXIS.

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In many regions of the Soviet Union, sheep farming is developing on an industrial basis.

Eimeriosis and sarcocystosis often occur under conditions of intensive production. Eimeriosis occurs in lambs of one to three months of age. Sarcocystosis is diagnosed at slaughter by the presence of endozoites and micro- and macrocysts in the muscles of the heart and other organs. The prevalence of infection is 70-86%.

Many drugs have been tested for therapy and prophylaxis. Chimccoid, given twice for 5 days at an interval of 3 days, at a dose rate of 30 mg/kg body weight and sulphadimethoxine given in a similar manner at a dose rate of 50 mg/kg appeared to be the most effective treatments.

PRELIMINARY RESULTS OF PERACETIC ACID IN VITRO CHALLENGE WITH BOVINE EIMERIA SP. NON SPORULATED OOCYSTS.

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The in vitro activity of peracetic acid in the presence of bovine Eimeria sp. non sporulated oocysts was tested at 1, 2 and 5% concentrations at temperatures of 35°C and 45°C during 10, 20 and 30 min. exposures.

Peracetic acid at 1 and 2% concentrations, both at 35°C and 45°C during 10, 20 and 30 min. exposures was not effective against non sporulated oocysts of Eimeria sp.

The 5% concentration of peracetic acid at room temperature during 10, 20 and 30 minutes produced no sporulation in 60% or more of the oocysts. At 35°C and 45°C during 10 and 30 minutes a 100% effectiveness was obtained.

DYNAMICS OF ISOSPORA VULPINA (COCCIDIA) IN
BREEDINGS OF ALOPEX LAGOPUS (CARNIVORA)

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The breedings of A. lagopus in 3 farms were examined regularly once monthly by means of Breza's flotation method in the period of 1975-1978. In the total, 5 728 samples were examined; I. vulpina was found in a new host (cf. Pellérdy, 1974). Significant results of parasitation in different age classes of the host: in yearlings 19-50%, in two years' 12-55%, in three years' 19-75%, in four years' and older animals 22-50% (ext. invasion). Seasonality of I. vulpina, occurrence in breedings: The highest number of faeces samples, including different stages of I. vulpina was recorded in all farms in the period May-July (27% in average), in two farms, moreover, during September and October (16%); in the other months the values were 0.1-15%. The species I. vulpina occurs in the highest intensity in the untreated breedings of yearlings and two years' animals. As to the seasonal occurrence, it has two peaks during a year.

STATISTICAL STUDY OF ISOSPORA LACAZEI FROM THREE
DIFFERENT POPULATIONS OF PASSER DOMESTICUS.

MARTINEZ-GOMEZ, F., NAVARRETE, I. and LOPEZ-RODRIGUEZ,
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University of Córdoba. Córdoba. Spain.

We study three populations of Passer domesticus from three different ecosystems of our Province: the city of Córdoba, the Gualdalquivir Valley and the mountainous zone of the North of the Province ("Sierra").

In each of these populations we investigate the presence of I. lacazei, finding the following index of parasitization: "City", 50 p.100; "Valley", 63.33 p.100 and "Sierra", 40 p.100.

We investigate a set of data of I. lacazei: length and width of the oocysts and length and width of the sporocysts, carrying out a statistical study of them in order to know the maximum, minimum, mean and standard deviation of each of these parameters, and to analyse the variance among groups and within groups.

We found very significant differences, with an error less than 1 p.1000, between the length of the oocyst, the width of the oocyst, the length of the sporocyst and the width of the sporocyst.

By comparing the means using the "t-test", we found significant differences, error less than 1 p.100, and very significant differences, error less than 1 p.1000, between the studied parameters of the three investigated populations of parasites, "City", "Valley" and "Sierra".

It seems to be some significant influences of the environmental factors upon the parasite populations.

CHEMOPROPHYLAXIS OF TOXOPLASMOSIS.

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Since *Toxoplasma* has recently been demonstrated to be closely related to the coccidia, we have investigated 18 anticoccidial drugs, with activity against avian coccidia. These were tested for efficacy against *Toxoplasma*. Chimcoccid was shown to be the most effective drug against toxoplasmosis in animals (Krylov *et al.*, 1973). In this paper we present data on the efficacy of Chimcoccid against the developmental stages of *Toxoplasma* in poultry. In addition, the drug was tested in chickens infected with both *Toxoplasma* and coccidia. Acutely affected chickens were treated with 12-24 mg/kg of Chimcoccid given for 7-10 days. Chickens with chronic disease were treated for 15-25 days beginning 6, 12 and 45 days after treatment and examined for the presence of *Toxoplasma*. The results depict the therapeutic and prophylactic effect of Chimcoccid in birds.

SESSION B3

Cestoda
Papers 73-87

STRAIN VARIATION IN *ECHINOCOCCUS GRANULOSUS* IN AUSTRALIA

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Several proven criteria, which include developmental studies both *in vivo* and *in vitro*, biochemical techniques, as well as detailed morphological observations, have been shown to have great potential for the discrimination and characterisation of strains of *E. granulosus*.

The simultaneous application of these criteria to populations of *E. granulosus* in Australia have demonstrated the existence of different biological strains of the parasite. Two strains are primarily perpetuated in a typical domestic sheep/dog cycle whereas the third is perpetuated in a sylvatic cycle involving dingoes and macropods.

Such studies need to be initiated in other parts of the world in order to determine the biological characteristics of the particular form of *E. granulosus* present, particularly in areas where the potential for intra-specific variation exists and where the occurrence of different strains may be of significance from the point of view of control.

SUPERINFECTIONS IN EXPERIMENTAL ECHINOCOCCUS

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NMRI-mice were infected by intraperitoneal or subcutaneous injections of *Echinococcus multilocularis* cyst material. Four, 8 and 16 weeks after infection the mice were superinfected by the injection of cyst material by the alternate route. Post-mortem examination demonstrated that, when mice were infected intraperitoneally and superinfected subcutaneously, there was a reduced growth rate of the subcutaneous cysts when compared with the worm burden in control mice. In contrast there was an increase in intraperitoneal cyst weight, as compared with that in control mice, in mice which were infected subcutaneously and superinfected intraperitoneally. An existing infection with *E. multilocularis* stimulated development of proto-scolices since more protoscolices were found in the parasites in superinfected mice than were found in the parasites in the corresponding control mice. Highest antibody titres were found in the intraperitoneally infected, subcutaneously challenged group and in these animals an increase in antibody titre, lasting 2 - 4 weeks, was seen after subcutaneous superinfection. Significantly higher levels of total serum proteins, due to an increase in β_2 - and γ - globulin, were seen in superinfected animals. In addition, superinfection resulted in a leukocytosis, neutrophilia and monocytosis. Eosinophil and lymphocyte numbers remained constant.

IMMUNOREACTIVITY IN EXPERIMENTAL SECONDARY
ECHINOCOCCOSIS OF MICE

TODOROV, T. Institute of Infectious and
Parasitic Diseases, Sofia, Bulgaria

Abstract non received.

IMMUNODIAGNOSIS OF ECHINOCOCCOSIS IN SHEEP
TODOROV, T. Institute of Infectious and
Parasitic Diseases, Sofia, Bulgaria

Abstract non received.

THE BIOLOGICAL BASIS FOR PROPHYLAXIS AGAINST ECHINOCOCCOSIS IN ANIMALS IN UZBEK REPUBLIC

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The development of *Echinococcus* varies, according to season, in the hot climate of Central Asia. We examined the association between climatic and geographical factors and the growth rate and development of adults of *Echinococcus*. In the intestine of dogs the time required for maturation of adult *Echinococcus* is 31 days in summer; 39 days in autumn; 83 days in winter; and 69 days in spring. Thus, in winter, patency of the infection is delayed more than 2.5 times.

On the basis of these results the following dates are recommended as optimum for the anthelmintic treatment of dogs for *Echinococcus* infection: Dogs should be treated once, at the end of March, in the first quarter of the year; two treatments, 45 days apart (10-15th May and 25-30th June), should be given in the second quarter of the year; three treatments, each one month apart should be given in the third quarter (25-30th July; 25-30th August; 25-30th September); while two treatments, 45 days apart (10-15th November; 25-30th December) are recommended for the last quarter of the year.

This new scheme for the anthelmintic treatment of dogs against infection with *Echinococcus* is based on the biology of the parasite in the hot climate of Uzbekistan.

ROLE OF THE HOST, GEOGRAPHICAL AND CLIMATIC FACTORS IN THE DEVELOPMENT AND MORPHOLOGY OF ALVEOCOCCUS MULTILOCULARIS INFECTION

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Investigations were carried out on the morphology of larval cyst masses (LCM) as well as on the tissue reaction of the host in five species naturally infected with Alveococcus multilocularis: Microtus nivalis, Clethrionomis glareolus, Meriones unguiculatus (experimental infection), cattle and men. The specimens were selected from the Alps, southern Germany, north part of the Pirin Mountain and the Balcan (West Bulgaria). Variation in degree of susceptibility and morphological characteristics of LCM in the hosts studied was observed. A relationship between the size of LCM and their localization was evident. In M. unguiculatus and M. nivalis (liver localisation) well developed LCM with metastatic foci were observed. In C. glareolus and cattle (liver localisation) the larvae had undergone severe regressive changes and their development was suppressed. In men (brain localisation) the infection was characterized by moderate development. Protoscolices were found in M. unguiculatus and a single one in M. nivalis only. Our results support the early findings of OHBAYASHI et al. (1971) who found that the developmental characteristic of echinococcus infection and the tissue reaction evoked could be correlated with its occurrence in different species.

COMPARATIVE MORPHOLOGICAL INVESTIGATION ON
THE BODY WALL OF ECHINOCOCCUS UNILOCULARIS
AND ALVEOCOCCUS MULTILOCULARIS

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Sofia, Bulgaria

The ultrastructure of the body wall of the echinococcus and alveococcus bladders is quite similar. In general their structure is identical with the tegument of Echinococcus granulosus. The brush border is composed of microvilli with electron-dense tips, which are more sharpened in the alveococcus bladder. The distal cytoplasmic layer is a syncytium rich in cellular organelles. In unilocular echinococcus the distal cytoplasm is much denser due to the great number of granules; in multilocular cyst vesicular structures predominate which makes this layer lighter, foamy in appearance. The basal and muscular layers are comparatively less developed in Alveococcus multilocularis unlike the more stronger musculature of Echinococcus unilocularis. Lots of mitochondria with specific structure are found in the cytoplasmic protuberances. The tegument cells in both species are quite alike, astereous cells with organelles with dense structure and contents. Amidst them many myelin figures are to be found. Deeper in the perinuclear zone another type of tegument cells are observed, which have characteristic tubular structure, typical both for the unilocular and multilocular bladder.

ECOLOGICAL ASPECTS OF CATTLE CYSTICERCOSIS

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The studies were carried out in 5 voivode-ships of Wielkopolska region in Poland. The localization of the cysticercosis was based on the actual lists of the found and indentified cases of the disease in cattle. The studies have shown that cysticercosis in the cattle is found mainly in the villages in which farmers have the pastures, field etc. localized near communication ways or larger urban agglomerations. The highest percentage of cysticercosis was found in the villages along coastal superficial waters. In Wielkopolska region total 58% of villages with cysticercosis of cattle were found. Along Warta river flow to Poznań /600.000 inhabitants/ cattle cysticercosis was found in 77%, while between Poznań and the Baltic Sea in 100% of villages. Along Prosna river flow to the city Kalisz /120.000 inhabitants/ cysticercosis of cattle was found in 72%, while along its down-stream in 95% of villages. In the sewage systems in Poznań and Kalisz invasive eggs of Taeniidae were found in the amount of 1 egg per 1 litre of sewage.

Conclusion: superficial waters, especially rivers into which city sewage systems are drained off, are an important factor spreading cysticercosis of cattle in the rural environment.

THE IMMUNOLOGICAL FACTORS WHICH CAN INFLUENCE
DESTRUCTION OF *CYSTICERCUS BOVIS*.

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The immunological and immunochemical properties of the fluid from *Cysticercus bovis* were examined using antisera to *C. bovis* and *Taenia saginata*. The fluid contains components identical to those in bovine serum. These are albumin and IgG globulins. Haemolytic complement is also detected in *C. bovis* fluid. Fluid samples taken 1, 4 and 10 months after infection differed in their antigenic activity and in their protein composition. Fluid from older cysticerci was less antigenic and contained less protein than did that from the younger cysticerci.

The presence of specific antigen, antibodies and complement in *C. bovis* fluid are considered to be the cause of the destruction of the parasite, thus limiting its life span.

AN EXPERIMENTAL STUDY OF BOVINE CYSTICERCOSIS.

ALFEROVA, M. Uzbek Research Institute of Veterinary Medicine. Samarkand, USSR

The clinical signs, immunology and pathogenesis of bovine cysticercosis was examined in 50 calves and 21 cows. Calves were more susceptible to infection and therefore the clinical signs of cysticercosis were manifested in calves. During infection the calves showed a temperature rise, mild fever and disturbances in fluid balance. These clinical signs lasted for 8-16 days. Infected animals lost weight. Indirect haemagglutination and latexagglutination were highly sensitive in the diagnosis of Cysticercus bovis. Anatomopathological changes in cysticercosis were: wrinkling of the spleen, haemorrhages, oedema of the mesenteric lymph nodes and kidney infiltration. The level of infection with C. bovis depended on the infective dose and number of infections. C. bovis was found in all the organs and tissues but was most prevalent in the muscles of the shoulder and pelvic joints and in the masticatory muscles. Dead cysticerci were first seen in the muscles of the tongue and heart. Cysticerci survived for over 52 months. 39.4% of the infective dose developed when the animals received a single dose of 100 to 8,000 oncospheres while 7.0% developed from 2 doses of infection.

EFFECT OF ALBENDAZOLE ON INFECTION WITH *TAENIA SAGINATA* IN CATTLE.

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Albendazole, given as a single oral dose of 50mg/kg, was effective in the treatment of 10-week-old metacestodes of *Taenia saginata* in cattle. In two separate experiments treatment resulted in a highly significant 86% and 78% reduction in the number of viable metacestodes found in such treated animals along with a reduction in the total number of metacestodes visible in treated carcasses. Single or multiple doses (3 times at 3 week intervals) of albendazole administered at a dose rate of 15mg/kg or 7.5mg/kg did not have a similar marked effect. Treatment with albendazole, given at a dose rate of 15mg/kg/day for 14 days, did induce a significant 80% reduction in the number of viable metacestodes found in heavily infected calves. However, if the calves were lightly infected, any effects of the anthelmintic were masked by the low levels of infection seen in the animals.

SOME FACTORS AFFECTING THE SURVIVAL AND TRANSMISSION OF *TAENIA MULTICEPS* EGGS

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Eggs and gravid proglottids of *T. multiceps* are shed by infected dogs approximately 41 days after infection. The highly motile proglottids shed most of their eggs prior to expulsion from the anus and these remain highly aggregated in the faeces, causing single sample faecal examinations to be highly variable.

Evidence is presented which suggests that freshly shed eggs require a short period of maturation before being infective to a fresh host, but viability then falls. Various environmental factors, including U.V. light, temperature and humidity, affect the viability.

Viability of different batches of eggs has been assessed following the activation of onchospheres by the method of Heath and Smyth (1970).

Few eggs ingested by the sheep host are able to develop into a mature coenurus. Some are able to develop into an early cyst stage at sites other than the CNS but no scolices have been seen in these. Coenuri survive several days in the carcass of a dead sheep and a high proportion of scolices develop, in the dog, into adult tapeworms.

A COMPARISON AMONGST TAENIA TAENIAEFORMIS ANTIGENS
FROM SOMATIC EXTRACTS, CYST FLUID AND METABOLIC PRO-
DUCTS OBTAINED FROM METACESTODES IN VITRO.

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During the maintenance in vitro of Taenia taeniaeformis metacestodes, antigens, which are commonly described as metabolic or excretory and secretory (ES) antigens are released into the medium.

The present study is concerned with establishing whether these ES antigens were materially different from somatic antigen or were merely the result of progressive disintegration of the worms in vitro. Immuno-electrophoresis, ELISA for detecting antibodies and ITAS-ELISA (Indirect triple antibody sandwich-enzyme-linked immunosorbent assay) for detecting antigen each allowed the metabolic and somatic antigens to be distinguished. The former appeared to be similar to cyst fluid, in so far as precipitating antigens were concerned, whereas in the ELISA and ITAS-ELISA studies ES antigens seemed to give more specific results.

Cyst fluid or antigens extracted from larval or adult somata gave less specific reactions with sera from mice infected with T.taeniaeformis or Taenia crassiceps. Furthermore as the level of somatic antigen increased in culture fluids, which was inversely related to the well being of the larvae in vitro, so did the specificity decrease.

THE SPECIFICITY OF MOUSE AS THE HOST OF TAPEWORM
HYMENOLEPIS DIMINUTA.

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The experiments were conducted to determine the mechanisms of host specificity to infection with *Hymenolepis diminuta*. Previous research has demonstrated that the mouse is a nonspecific host for *H. diminuta* since the infection is of short duration. Data from the literature and our own experiments has shown that the expulsion of *H. diminuta* from mice is influenced by such factors as the age of the host, the intensity of infection and the genetic composition of the host. Specific antibody and cellular immunity are the effector mechanisms responsible for the immune response in normal mice infected with *H. diminuta* causing destrobilation and expulsion of the parasites. It is concluded that the majority of inbred strains of mice are nonspecific hosts of *H. diminuta*.

ULTRASTRUCTURAL INVESTIGATIONS ON THE
TEGUMENT OF DREPANIDOTAENIA LANCEOLATA
AFTER DRONCIT TREATMENT

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An electron microscopic investigation has been carried out on specimens of D.lanceolata isolated from geese treated with a single doze of 10 mg of Droncit per kg body weight. The treatment caused ultrastructural changes both in tegument surface and in the deeper layers. The brush border was most seriously affected. The microvilli were rarefied and significantly reduced in number in comparison with those of controle specimens (isolated from untreated hosts). Among the microvilli cytoplasmic debris was to be seen which probably represented remnants of destructed microvilli. Large translucent vesicles were observed in the distal cytoplasm. The structure of the tegument cells was also changed. In them most heavily affected was the endoplasmic reticulum, especially its granular component. A general reduction in the number of cell organelles was noted. The mitochondria were dense, polymorphous. Many large lipid droplets lied in the cytoplasm and the intercellular spaces.

The described changes lead to the conclusion that Droncit is highly toxic to D. lanceolata.

SESSION B4

Nematoda I
Papers 88-100

MEASURES FOR CONTROL OF HELMINTHOZOOSES IN CONDITIONS OF INTENSIVE ANIMAL HUSBANDRY

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Social-economic changes in the world alter the epizootic process, favouring or preventing the spreading of helminthozoses. Corresponding regulations in the technology of animal management are required. Technological methods such as indoor management of animals, paddock grazing on cultural pastures without dogs, underground irrigation of cultured pastures with town sewage waters, thermic methods of preparation of grass and other feeds are quite perspective as they provide eradication of echinococcosis, cysticercoses (C.cellulosae, C.bovis) and trichinellosis. Perfection of veterinary prophylactic programmes has in the first place a concern introduction of more sensitive methods of diagnostics (IFT, ELISA, group diagnostics of trichinellosis), to the search and introduction of anthelmintics acting effectively on the larval and adult stages of taeniids and T.spiralis (prasiquantel, benzimidazoles and others), more accurate determination of dates and numbers of treatments of animals (E.granulosus-infected dogs) and man.

OCURRENCE OF HELMINTHS IN PIGS BRED IN DIFFERENT TYPES OF LARGE SCALE UNITS.

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We examined 7,500 faecal samples collected from pigs of different ages and maintained in different types of large scale pig units. Eggs and larvae of 8 helminth species were demonstrated: *Oesophagostomum dentatum*, *Ascaris suum*, *Trichocephalus suis*, *Strongyloides ransomi*, *Hyoststrongylus rubidus*, *Toxocara cati*, *Capillaria* spp and *Metastrongylus* spp. The results demonstrated that the technology used in the units greatly influenced both the qualitative composition of the infections and the prevalence and intensity of infection. In modern large scale units 3 species of helminths are considered to be important parasites of pigs: 1) *O. dentatum* is important primarily in older pigs in which its prevalence may be 100% but the intensity of infection is relatively low. 2) *A. suum* occurs primarily in piglets and sucking pigs. 3) *T. suis* also occurs more frequently in the young age groups. The other species of helminths were found sporadically.

We presume the presence of eggs of *T. cati* and *Capillaria* spp was due to contaminated feed. These eggs would then pass unchanged through the intestines of the pigs.

Our results indicate that, from the helminthological aspect, the most profitable technology for the production of piglets is that used in large scale pig units of the types PM-013-AGP and PM-014-AGP of the Czechoslovak norm.

EFFECTS OF SALMONELLOSIS ON SUBSEQUENT INFECTIONS
WITH ASCARIS SUUM IN SWINE

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Weaned pigs were separated into two groups, one designated the Salmonella-Ascaris (SA) group and the other the Ascaris only (A) group. The SA group was inoculated, per os, with the bacteria and salmonellosis developed. At sixteen days post-Salmonella inoculation each pig in both groups received 100,000 infective A. suum eggs per os. At necropsy comparisons were made on the severity of hepatic fibrosis, tissue eosinophilia, adrenal gland weight and numbers of A. suum in the small intestine.

Pigs in the A group had relatively more hepatic fibrosis and tissue eosinophilia and lighter adrenal glands than the SA pigs. There was no consistent differences in numbers of A. suum recovered from the small intestine.

Large numbers of larvae may have been able to migrate through the livers of the Ascaris only pigs and due to the relatively larger number of returning worms to the intestine a "self cure phenomena" may have been elicited. Alternatively the Salmonella-Ascaris group may have been unable to mount as great a cellular response as the A group to similar numbers of migrating Ascaris larvae.

EXPERIENCES ON PREVENTION OF HELMINTHIC DISEASES IN LARGE PIG FARMS OF ESTONIA

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Transition to the industrial type of keeping pigs in Estonia created ecological conditions for the application of new methods for control of helminthic diseases and resulted a considerable decrease of the number of infected pigs.

The complex method of preventing helminthiasis consists in the prophylactic dehelminthiasation of pregnant sows, in the conduction of round farrowing and in isolated rearing of single age groups of piglets. In this work sanitary and prophylactic measures are of special importance keeping of different age groups of pigs in isolated sections of the piggery, simultaneous filling in of the piggery sections by animals, mechanical cleaning and disinfection of empty sections.

In the control of pregnant sows the best results were achieved by the application of tetramisole (1 g daily per head for 5 days) and suiworm (50 g per head daily for 3 days). Pregnant sows are treated two weeks before farrowing. If the piglets are weaned later than at the age of 1 month the treatment must be repeated after 3 weeks. The method of treatment presented do not exercise toxic influence on pregnant sows.

Using this method helminthiasis were eliminated from the largest pig farm of Estonia as far back as 1976.

HEARTWORM DISEASE IN THE DOG

POWERS, K.G., FURROW, R.D., WEIL, G.J. and OTTESEN, E.A.

Twenty-two Beagles, 3-11 months, were injected with 17, 35, or 70 infective Dirofilaria immitis larvae.

Immunologic studies were performed during the chronic phase of infection before diethylcarbamazine (DEC) treatment. Necropsies were performed when dogs died from infection or 2 years after injection of larvae.

Adverse reactions were similar in dogs treated one or several different times with 3 or 25 mg/lb DEC.

Reactions occurred in all treated microfilaremic dogs. Severity was not related to numbers of microfilariae (MF). Clinical signs included emesis, diarrhea, ataxia, collapse, tachycardia, blanched membranes, and salivation. Blood chemistry changes included marked increases in SGOT, SGPT, LDH, and hematocrit, and decreases in platelets and WBC. Changes corresponded with onset and severity of clinical signs. Pathologic changes were consistent with Type I hypersensitivity (anaphylactic shock), consisting of stagnation of blood in viscera, swollen congested liver with centralobular necrosis, edematous hepatic lymph nodes, hemorrhage, and edema around the gall bladder and between the liver and diaphragm, and congestion of the intestine with hemorrhage into the lumen. No reactions were seen in uninfected or amicrofilaremic (occult) dogs treated with DEC.

Dogs with chronic infections had significantly higher IgG (ELISA) and IgE (PCA) antibody responses to adult D. immitis antigens than controls. Cellular responses to these antigens in infected and uninfected dogs did not differ. In distribution and immune clearance studies, Cr⁵¹ labelled MF injected into microfilaremic, occult, and uninfected dogs were concentrated in the microcirculation, mainly in the pulmonary capillaries. A relatively small portion was in extracapillary blood. Occult dogs rapidly cleared injected MF from the blood. Immune clearance and destruction of MF primarily takes place in the lungs.

OBSERVATIONS ON THE EPIDEMIOLOGY OF UNCINARIA
STENOCEPHALA INFECTIONS OF BRITISH GREYHOUNDS.

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The prevalence of U. stenocephala in racing greyhounds varied from 67% in 15-24 month old dogs to 11% in older animals. A major source of infection is the grass exercising paddock. In racing kennels where the daily deposition of eggs onto the herbage is a fairly constant factor, seasonal fluctuations in the number of infective larvae resemble those described for the trichostrongylids of grazing animals. Plot experiments confirmed how well this parasite is adapted to cold climates. Third stage larvae developed from eggs within a week in summer, while smaller numbers reached infectivity, although less quickly, even in the early winter months. Overwintered larvae sometimes persisted into May, while new larvae appeared as early as June. Transmission can, therefore, take place at any time of the year. Observations at breeding kennels showed that patent infections appeared in pups within 4 weeks of being put onto grass pens. A similar pattern of faecal egg-counts was seen in all litters irrespective of the time of year. The transient deposition of large numbers of eggs by successive litters produced distortions in the "stereotyped" pattern of herbage larval counts.

HELMINTH PARASITES ON DOGS ON THE JOS PLATEAU, NIGERIA,
WITH REMARKS ON MEDICAL AND VETERINARY IMPORTANCE.

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Dogs have been a subject of extensive screening for helminth parasites on the Jos Plateau to assess the role that helminths of dogs play in the production of disease in dogs and other domestic animals as well as their importance in relation to public health in the area.

The results as assessed by faecal worm eggs and worm recoveries and associated lesions, indicate *Spirocerca lupi*, *Ancylostoma caninum* and *Toxocara canis* to present serious health problems in dogs in the area. Pathogenic infections of *Dipylidium caninum* have also been seen. While *Taenia hydatigena* and *Trichuris vulpis* are not usually sufficiently numerous to be important, infections of such proportions as to be possibly pathogenic have been observed.

Having regard to the close association of dogs with man especially children *A. caninum*, *T. canis*, *T. vulpis* and *D. caninum* may be of significance as zoonoses in the area. Of possible importance as a zoonosis may also be *S. lupi* from the point of view of extensive consumption of meat of poultry and game birds, which may act as secondary intermediate hosts for *S. lupi*.

There is also a possibility that dogs may be involved in the epizootiology of a number of helminths that also affect other domestic species in the area. These include *Cysticercus tenuicollis* the cystic stage of *Taenia hydatigena* and *S. lupi*.

NEWS ABOUT OLLULANUS TRICUSPIS (LEUCKART, 1865), THE STOMACH WORM OF THE CAT

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In our country O. tricuspis occurs in 40% of those cats which could get infected with vomited parasitic stages of other cats.

The stomach worms, less than 1 mm of size, are macroscopically not recognizable, they have to be diagnosed microscopically. Suitable post mortem demonstrations are a) examination of scrapings of the stomach mucosa, b) of mucus and c) peptic digestion of the stomach wall. For an intra vitam diagnosis vomitus was stimulated by 0,1 ml Rompun®/kg KGW. Samples of vomit, mucus, and digested stomach wall contained 60% 00ⁿ and 00 in a ratio of 2:3 and 20% of each 3. and 4. larvae.

Experimental infections with adult O. tricuspis, only, showed that 1. the transmitted worms remain alive in the new host, 2. a low infection increases and 3. all developmental stages in vomited material can distribute the infection.

The trial to demonstrate on O. tricuspis infection in 4 positive cats by means of coproscopy carried out daily for one month was not successful. Used to the acid milieu of the stomach the developmental stages apparently die and are digested with increasing pH values.

Since there is a lack of information about the occurrence of O. tricuspis much more attention should be put on this feline parasite.

HELMINTH PARASITES AND PATHOLOGY IN DOG AND CATS IN ENDEMIC NEPHROPATHY (MAN) REGION OF BULGARIA

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The frequency of helminths and pathological lesions in the organs of 165 dogs and 66 cats were studied. 150 dogs and 56 cats originated from villages with human endemic nephropathy in Bulgaria. A total of 12 species of helminths in 144 dogs were found: Taenia crassiceps in 1, Taenia hydatigena in 33, Taenia pisiformis in 1, Multiceps sp. in 1, Echinococcus granulosus in 3, Dipylidium caninum in 57, Mesocostoides lineatus in 7, Toxascaris leonina in 1, Toxocara canis in 43, Ancylostoma caninum in 2, Uncinaria stenocephala in 34 and Trichocephalus vulpis in 62 dogs.

In 62 cats 7 species were established: Taenia crassiceps in 1, Hydatigera taeniaeformis in 50, Dipylidium caninum in 3, Joyeuxiella pasqualei in 3, Ancylostoma tubeforme in 7, Toxocara cati in 60 and Aelurostrongylus abstrusus in 22 cats.

Pathomorphological lesions characteristic for visceral larva migrans and/or larvae themselves were observed in almost all organs of the host. In the lymph organs hyperplastic changes involving all components of these structures were observed. The results obtained suggest that the parasites founded should play a role in the epidemiology and epizootology of the helminthoses in animals and man.

No correlation between the helminth invasion and human endemic nephropathy were observed.

HELMINTH FAUNA OF THE GOAT *CAPRA HIRCUS* IN THE VICINITY OF BITOLA (MACEDONIA-YUGOSLAVIA).

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From 1968 to 1980 we were able to examine, periodically, some individuals of *Capra ibex* L. from different areas in the vicinity of Bitola and the surrounding villages. In 21 individuals we found the following species of helminths: *Fasciola hepatica* L., 1758, 14.27%; *Dicrocoelium lanceolatum* (Stiles and Hassal, 1896), 19.04%; *Moniezia expansa* (Rudolphi, 1810), 33.33%; *Echinococcus granulosus* (Batsch, 1786), lar. 4.76%; *Skrjabinema ovis* (Skrjabin, 1915), 9.04%; *Ostertagia ostertagi* (Stiles, 1892), 4.76% and *Haemonchus contortus* (Rudolphi, 1898), 4.76%.

In the region examined this host is found individually or in small groups. Those kept as domestic animals do not browse in the woods but are fed by their owners. Sometimes several goats are kept with sheep and cows.

The helminth fauna of this host in this region is very similar to that in sheep and other herbivores. This is not the case on the open steppes where this host lives in large groups and the infection rates are much higher.

This is the first examination of the helminth fauna of the goat in this region.

STUDIES ON ONCHOCERCA OF BRITISH CATTLE IN THE
INTERMEDIATE AND DEFINITIVE HOSTS

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The detailed course of development and migration route of Onchocerca sp. have been studied in 30 experimentally infected calves. The final moult takes place about 2 months after infection, with patency, as measured by first finding microfilariae in the skin, occurring after 10.5-11 months.

The distribution and specific identification of microfilariae in the skin of naturally and experimentally infected animals has been studied and methods for recovering large numbers for infection experiments have been developed. Microfilariae have also been successfully cryopreserved in ethanediol as protectant with a subsequent infectivity to the vector of over 79%.

Techniques have been developed for the large-scale production of infective larvae in the intermediate host (Simulium ornatum) by means of an intrathoracic injection technique and up to 15,000 larvae have been produced in one batch. Survival of infected flies was between 30-70% with average yields of 10-20 larvae per fly.

Improvements have been made in rearing and maintenance methods for Simulium and development in various other insects (e.g. mosquitoes, Culicoides, and other Diptera) has also been obtained.

MODELS IN EXPERIMENTAL FILARIASIS

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Subcutaneous infections of Mastomys natalensis with four filarial species, Litomosoides carinii, Dipetalonema viteae, Brugia malayi and Brugia pahangi revealed that the prepatency amounts to 52, 56, 107 and 75 days p.i., respectively, when the animals were inoculated with 40 L3, 50 L3, 85 L3 or 70 L3. The parasitaemia reached maximum values at day 120 (Litomosoides carinii), 190 (Dipetalonema viteae), 180 (Brugia malayi) and 170 (Brugia pahangi) p.i..

At necropsy 150 days p.i. 80 %, 47.6 %, 19.8 % and 33.1 % respectively, of the inoculated larvae could be recovered as adult worms. Litomosoides carinii and Dipetalonema viteae were localized in the pleural cavities and connective tissues, respectively, and adults of Brugia malayi as well as of Brugia pahangi were primarily isolated with 88.1 % and 78.5 %, respectively in the heart and lungs. Only 9.5 % for Brugia malayi and 3.4 % for Brugia pahangi could be detected in the testes and 2.4 % and 18.1 %, in the lymphatics.

A direct correlation between the number of microfilariae in the circulating blood and adult worms, recovered subsequently from the host, could not be determined.

HISTOPATHOLOGICAL ALTERATIONS IN EXPERIMENTAL FILARIASIS

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Histopathological alterations in Litomosoides carinii infected Mastomys natalensis were followed over a period of 400 days p.i. in different organs of the host (liver, spleen, lung, kidneys, thymus; mediastinal, hepatic, intestinal and inguinal lymph nodes).

The local reaction consisted in finally extensive proliferations of the pleural cavity wall. Subepithelial infiltrations showed a distinct sequence of polymorphonuclear cells (prepatency), lymphoid cells (early patency) and plasma cells (later phase of patency), accompanied with striking amounts of mast cells in the patent period.

In addition, plasma cell proliferation was a common feature in microfilaraemic animals, concerning all organs, particularly the heavily (up to the twenty-fold size) enlarged spleen. The cortex and the medullary cords of most of the lymph nodes showed strong proliferations. However, thymus dependent areas (i.e. the paracortical region of the lymph nodes and the periarterial areas in the spleen) appeared reduced in size and cell content.

As a further remarkable characteristic of the patent phase serious endothelial alterations and numerous thromboses were observed in lung and liver.

The results are discussed together with findings on serum IgG-levels, soluble immunocomplexes in the sera and the capacity of mast cells to resist degranulating agents in the course of the infection.

SESSION B5

Nematoda II
Papers 101-107

POPULATION DYNAMICS OF NIPPOSTRONGYLUS BRASILIENSIS

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Aspects of the population dynamics of the interaction between Nippostrongylus brasiliensis and the laboratory rat are examined under controlled experimental conditions. Extraneous variables such as host age, sex and strain are standardized as far as possible and methods are being developed by which a specified infective larval dose may be administered with a known level of accuracy. In addition, the use of purified isoeenergetic diets enables the metabolizable energy available to the animals to be monitored and controlled. These techniques are presently in use in an attempt to make quantitative measurements of the effect of parasite dose on host condition, including factors such as weight, fecundity, survival, food intake and nutrient utilization.

OBSERVATIONS ON HUMAN TRICHINELLOSIS

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Between 1962 and 1980, the authors studied and treated 50 cases of human trichinellosis. They draw attention to the thorough questioning of the anamnestic data, so that the patients might be treated as soon as possible. The latency period oscillated between 3 and 32 days. In 38 cases the clinical symptoms occurred suddenly. In the patients under investigations in addition to the gastrointestinal symptoms a lot of allergic symptoms were observed. The cardiovascular changes are discussed in detail. In 56% of the cases the EKG was pathological, 40% of which got normal during hospitalization, the remainder became negative only after 3-6 months. In 6% of the cases the EKG modifications even after one year subsisted. Mintezol was used successfully in the aetiological treatment, and there was no death cases. In the paper the authors discuss in detail the ratio-incidence of various clinical symptoms, as well as their observations on the course and treatment of the disease.

METAPHERETIMA ELONGATA (ANNELIDA, MEGASCOLECIDAE) AS A PARATENIC HOST OF STEPHANURUS DENTATUS (DIESING, 1839) UNDER NATURAL CONDITIONS IN CUBA.

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In annelid samples from a swine rearing unit with a high infestation of Stephanurus dentatus, the role of Metapheretima elongata as a paratenic host of the swine kidney nematode was investigated.

Annelids previously washed with sterile water and 20% ethanol solution were crushed between glass slides.

The L₃ of the parasite were observed through the digestive tract, ensheathed larvae of the brown bodies of the annelids being observed. The binomial test applied, taking the ratio of positive earthworms found as a theoretical probability (5/25), showed that the probability of finding a lower proportion is low, and the likelihood of finding any annelids without this characteristic is almost zero. The viability of the L₃ found in the brown bodies was verified by experimental infestation in Guinea pigs (Cavia porcellus).

**AMINO ACID COMPOSITION OF PROTEINS WITH
DIFFERENT MOLECULAR WEIGHTS IN MATURE
ASCARIDIA GALLI**

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Water soluble proteins extracted of mature A.galli were fractionated by consecutive gel filtration on Sephadex G-100 and G-200. The molecular weights of the fractionated proteins were established by using standard proteins. Following an acid hydrolysis the amino acid composition of the different protein fractions was determined by ion-exchange chromatography on a Beckman-Union automatic amino acid analyser.

On the basis of the established differences in the amino acid composition the individual protein fractions of both helminth sexes were characterized. Quantitative differences were defined as well as by grouping of the amino acids as: unpolar, polar but uncharged, acidic and basic.

CHARACTER OF SECRETION IN THE INTESTINE OF PARASITIC NEMATODES.

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The secretory processes in the intestine of some species of nematodes in the Strongylata and Ascaridata have been described previously. This study examined the morphofunctional features of the digestive system of 31 species of zooparasitic nematodes belonging to 8 suborders. Histological, histochemical and electron microscopy techniques were used.

Secretions in the intestines of different nematodes are produced in different ways.

Microapocrine or apocrine secretion occurs in the Trichocephalata, Rhabditata, Strongylata and Oxyurata while the Ascaridata, Spirurata, Camallanata and Filariata are capable of merocrine, apocrine and holocrine secretion.

The intestinal cells of nematodes of different taxons are multifunctional (absorptive, secretory and excretory functions) irrespective of their localization and the character of their nutrition and metabolism.

STUDIES ON CAROTENOIDS WITHIN A PARASITE - HOST SYSTEM

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By means of columnar and thin-layer chromatography, the presence of carotenoids in the system: aurochs (Bison bonasus) lungs - Dictyocaulus viviparus (Bloch) was studied. The investigations revealed the presence of the following carotenoids:

in Dictyocaulus viviparus: zeaxanthin, isozeaxanthin, mutatochrome, -apo-2'-carotenal and -apo-8'-carotenal;
in lungs of aurochs: hydroxyechinenone, lutein, zeaxanthin, isozeaxanthin, adonixanthin, -apo-2'-carotenal and -apo-8'-carotenal.

The total carotenoid content of the examined ranged from 0.286 (lungs) to 2.374 $\mu\text{g/g}$ fresh mass (D. viviparus).

NICHE BIOLOGY OF ENDOPARASITES HAVING COMPLEX LIFE CYCLE

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The analyses of the niches of a parasite can be regarded as an exercise of ecological or evolutionary significance. Endoparasites occupy a peculiar position in the ecosystem as they enjoy the internal environment of the host which not only provides shelter but also food (thus energy) to the former. A heteroxenous parasite occupies several niches in its life cycle during its passage from host to host. All these heterologous niches of a parasite can, therefore, be regarded as polyniche. A parasite enjoying polyniche system may thus have three to ten interactions in its total life cycle depending upon the number of components which may vary from two to five. Of these interactions some are positive while some are negative. It is proposed that among all these interactions, only one interaction in a niche at one time is the most dynamic and induces microevolutionary changes in the parasite. Furthermore, the parasites always tend to develop positive interaction with the host from a negative position (Misra and Sarkar, 1979) and thus the negative interaction between the host and the parasite tends to become positive through evolutionary changes which cause the breakdown of the genetic equilibrium of the parasite.

Misra and Sarkar (1980) analysed the evolution of pathogenic mammalian trypanosome (including human) and proposed that the microevolutionary changes always occur through the negative interaction in one environment (niche) and at that time the other interactions do not seem to play a major role in the evolutionary process.

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SESSION C1

Parasites of poultry

Papers 108-115

INVESTIGATION OF GENETIC MARKERS OF DUCK BLOOD SERUM IN RELATION TO THE IMMUNITY TO SOME HELMINTHOSES

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The isoenzymes of esterases of duck blood serum were determined in 7.5% polyacrylamide phoregrams by utilizing α -naphthylacetate as a substrate. The globulin allotypes were investigated by immunoelectrophoresis and double diffusion in agar gel. In the population of domestic ducks 4 phenotypes of carboxylesterase (CE) have been revealed: AC, BB, BS, ABC. 3 allotypes of duck blood serum A_1 , A_2 , A_3 having a codominant character of inheritance have been ascertained. The obtained preliminary results indicate the interrelationship between some CE genotypes and allotypes and the resistance to helminthoses.

The results will be discussed.

HELMINTHOSES IN THE INDUSTRIAL POULTRY COMPLEXES OF ARMENIA

MOVSESSIAN, S.O., CHUBARIAN, F.A., PKHRIKIAN, L.V., KURBET, A.V., NIKOGHOSSIAN, M.A. Institute of Zoology, Armenian Academy of Sciences, Yerevan, USSR

Helminthological investigations were carried out on 3995 hens of different ages, from 2 to 18 months old. Six helminth species were detected: Ascaridia galli, Heterakis gallinarum, Raillietina echinobothrida, R. tetragona, Choanotaenia infundibulum and Skrjabinia cesticillus.

In the earthworms (Eisenia foetida and Nicodrilus caliginosus) collected on the territory of the poultry farms from May to October, larvae of Ascaridia galli were detected (2-4 larvae in 3-5% of earthworms).

The natural infection of ants (Formicidae) was established with cysticeroids of Raillietina (R.) echinobothrida, R. (R.) tetragona and Skrjabinia (S.) caucasica.

In the beetles (Gonocephalum rusticum, G. pusillum, Ocenebra setosa, Saprinus semipunctatus, Tenebrio obscurus) larval forms of the helminths were not detected. The soil and litter samples taken from the range territories contained eggs of A. galli and H. gallinarum.

ON THE INTRASPECIFIC STRUCTURE OF HETERAKIS
GALLINARUM (SCHRANK, 1788)

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The intraspecific structure of H. gallinarum has been investigated by studying the peculiarities of individuals of the population using a complex of morphological, biological and genetic methods. The basic factor affecting the morphological (tail length and number of caudal papillae) and biological diversity of heterakids is egg aging and the temperature at which this process takes place.

Host age and reactive state and the passage of heterakid larvae in earthworms for more than 48 hs also influence the phenotypic composition of the population. Hybridological analysis showed that the character tail length breaks down after the laws of quantitative characters. The phenotypic and genotypic parameters of the population were determined by the method of analysis of variance. It was found that the diversity in tail lengths is genetically determined and it is determined by polygenes and in considerable measure by environmental factors.

ON SOME CESTODES OF POULTRY IN INDIA

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An extensive collection of cestodes from various poultry birds from North India was made. Of the eleven species of the genus Raillietina Fuhrmann, 1920, three were found to be new - two representing the subgenus Raillietina Stiles and Orleman, 1926 and one Paroniella Fuhrmann, 1920. The new species has been discussed thoroughly. New host for R. (R.) kantipura Sharma, 1943 and first report in India for R. (R.) penetrans (Baczynska, 1914) Artyukh, 1966 and R. (R.) tetragonoides (Baer, 1925) Artyukh 1966 are given. Variations for other known species have been recorded.

**BLOOD COAGULATION CHANGES IN CHICKENS EXPERIMENTALLY
INFECTED WITH SPIROCHAETES.**

NICKOLOV, N.D. and DJANKOV, IV.T. Regional Veterinary
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The blood coagulation system was examined in
chickens experimentally infected with spirochaetes of
the species *Borrelia anserina*.

The tests used were: cephalin caoline and pro-
thrombine time, protaminsulphate test and determination
of the levels of fibrinogen degradation products. The
quantity of fibrinogen and number of thrombocytes,
erythrocytes and leukocytes were recorded and thrombo-
elastogrammes prepared from thromboelastographs.

The results demonstrated an accelerated blood
coagulation time in the first 72 hours of infection
while the coagulation time was increased for the next
48 hours. These changes, plus increased fibrinogen con-
sumption and the presence of fibrinogen degradation
products, possibly have a role in the pathogenesis of
disseminated intravascular coagulation in spirochaetosis
in chickens.

DETERMINATION OF INTERMEDIATE HOSTS OF DAVA-
INEA PROGLOTINA (DAVAINE, 1860) UNDER CUBAN
CONDITIONS

TOLEDO, R., ESPAINE, L., MEIRELES, T.,
DEMEDIO, J. ISCAH, Finca Guayabal, Jamaica,
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During a one-year period, molluscs of various species from a holding on the outskirts of Havana were collected. This holding was known to be infested by the cestode D. proglotina.

The molluscs were classified by the Dept. of Malacology of the Academy of Sciences of Cuba. One-hundred specimens of each species were investigated monthly by the crushing technique, and were then observed microscopically. Cysticercoids with morphological characteristics of D. proglotina were found in the following species of molluscs: Paraticulella griseola, Subulina octona, Bradebaena sp. and Veronicella floridiana.

Biological confirmatory tests were carried out, revealing the accuracy of the morphological diagnosis of the cysticercoids and their invasiveness.

The importance of these findings in relation to the movement of this cestode in our country is discussed.

A NEW COTUGNIA SPECIES FROM POULTRY IN INDIA

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During the course of survey of cestodes from poultry, a large number of specimens were recovered from the intestines of farm and domestic fowls. Three whole worms and a few unattached strobilae were recovered from the intestines examined at Chandigarh that on identification were found to be new. No other helminthic infection was found but for the lesions at different points of attachment. The validity of the new species has been discussed. Intraspecific variations in respect to C. januaria Johri, 1934 and C. cuneata var. tenuis Meggitt, 1924 and new host record for the latter species is given.

THE ROLE OF C.LECTUARIUS IN THE EPIZOOTIOLOGY OF PSEUDOPLAGUE IN BIRDS.

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Experiments were carried out to clarify the role of the bugs C. lectuarius as carriers of the pseudoplague virus. C. lectuarius were examined for the presence of Newcastle virus, for transmission of the infection and for their role in contaminating healthy birds with the virus.

Under laboratory conditions Newcastle virus could be washed off the surface of C. lectuarius for up to 6 days and could be recovered from the internal structures for up to 11 days. Transovarial transmission did not occur.

When a suspension of infected C. lectuarius was fed to healthy birds 15% developed the clinical signs of the disease.

It is recommended that the various control measures against Newcastle disease in poultry should include obligatory measures for the erradication of C. lectuarius from poultry farms.

SESSION C2

Lungworms
Papers 116-126

CONTRIBUTION TO THE EPIDEMIOLOGY AND CONTROL OF THE CATTLE LUNGWORM

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We find in approximately 10% of young cattle, which were infected with *Dictyocaulus viviparus* in their 1st pasture period, a new patency in the following spring after the arrested lungworms had developed to adults. In a field trial with 100 yearlings on 2 farms this new patency could be prevented by a 5-day administration of Fenbendazol in a dosage of 1.5mg/kg bodyweight daily. A previous controlled test showed already the efficacy of such a treatment scheme against *Dictyocaulus viviparus*.

The calves of both farms were put in May resp. June on grassland used by infected yearlings until late autumn of the previous year. No lungworm infection could be detected. As during the stable period possibility of infection could not be excluded, the calves were treated with Fenbendazol in the same way as above before they were driven out. A 2nd treatment of the calves followed during summer to control trichostrongylid infection.

Feecal samples of test animals were examined in monthly intervals. In 1 farm 2 yearlings, which were on high pastures together with cattle from other farms, excreted few *Dictyocaulus* larvae in November.

BOVINE DICTYOCAULOSIS: PATHOMORPHOLOGICAL
LESIONS IN ATYPICAL INTERSTITIAL PNEUMONIA.

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Forty-two animals of different breeds, aged between 6 and 9 months and exhibiting a pneumonic syndrome positive to Dictyocaulus viviparus (Bloch, 1782) were investigated. In 11 cases the most significant pathomorphological changes were edema, emphysema and bronchopneumonia associated with variable numbers of worms. Occasionally, disseminated interstitial fibrosis was found. Microscopically, a characteristic acidophilic exudate was observed in alveoli and terminal bronchial branches with hyaline membrane formation, as well as marked swelling and hyperplasia of the bronchial and alveolar lining cells, characteristic of atypical interstitial pneumonia. Larvae and eggs were found in bronchial branches and alveoli, and inflammatory infiltrate with eosinophils, mainly at the level of interalveolar septa, showed varying degrees of fibrosis.

EPIZOOTIOLOGICAL KNOWLEDGE ON BOVINE DICTYOCAULOSIS IN CUBA. SEASONAL DYNAMICS OF THE CLINICAL ONSET OF THIS DISEASE.

DELGADO, A. and JURÁSEK, V. IMV, La Habana, Cuba. Escuela Superior Veterinaria, Kosice, Checoslovaquia.

During 1970-1976 there were registered 270 715 cattle clinically affected with dictyocaulosis in Cuba, and the seasonal behavior of the onset of the condition was studied.

Highest frequency of clinical onset of dictyocaulosis was observed in January (20,0%), and lowest frequency in June (3,5%), evidencing an increasing trend of frequency during the rainy season and a decreasing trend during the dry season.

The dynamics of the onset of this helminthiasis is associated mainly with the rainy season and changes in the physical status of the animals.

EVALUATION OF A METHOD OF ROTATIONAL GRAZING AS PROPHYLAXIS IN BOVINE DICTYOCAULOSIS.

DELGADO, A. and JURÁSEK, V. IMV, La Habana, Cuba. Escuela Superior Veterinaria, Kosice, Checoslovaquia.

The rotation of pastures using 12 lots with grazing over 3 days and 33 days spelling was evaluated as a prophylactic method against bovine dictyocaulosis under Cuban conditions. A group (E) of 93 affected calves was kept under this system during 21 weeks, and the results were compared with those of three control groups (T_1 , T_2 and T_3) from the same premises. In group E, the infection rate was reduced from 72.0 % to 4.6 %, which gives a prophylactic efficacy of 93.6 %.

Mortality owing to this condition was restrained, while in the control groups both indicators remained high during the experimental period.

BOVINE DICTYOCAULOSIS. SUMMARY OF RESULTS FROM RECENT STUDIES ON THE EPIDEMIOLOGY AMONG SET-STOCKED CALVES.

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When calves were turned out in spring on pasture contaminated the previous year, the establishment of new infections was found to be influenced by the time of turning out. In addition the number of animals in the group is likely to play a significant role. Three distinctly different situations were observed, i.e. all calves acquired patent infections initially, only some acquired initial infection or the infection failed to become patent in any of the individuals of the group. Following the first two situations, a basic pattern was observed during the early phase of infection. Excretion of larvae from calves with patent infection gave rise to pasture contamination during the second month following initial infection. In dry periods the larvae were recovered near the faecal pats only. When conditions for the fructification of Pilobolus fungi were favourable, the first larvae were recovered after 4 weeks of grazing, the larvae were well distributed in the herbage and they increased in numbers after the 5th and 6th week and gave rise to pathogenic superinfections where the first clinical symptoms were observed as early as after 6 to 7 weeks of grazing. Large between-calf variations were observed and discussed. Field-to-field transmission to susceptible animals turned out onto aftermath was observed in connection with an outbreak.

ON THE RELATIONSHIP BETWEEN PILOBOLUS FUNGI
AND THE SPREAD OF DICTYOCAULUS VIVIPARUS
INFECTION TO CATTLE

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Calves artificially infected with D. viviparus were stabled Pilobolus free. Some of the calves were given Pilobolus spores daily. The faecal production containing D. viviparus larvae plus P.-spores and D. viviparus larvae but no P.-spores, respectively, were deposited on separate plots of pasture. The spread of larvae to the surrounding pasture and to grazing tracer calves was greatly reduced in the absence of Pilobolus spp. as evidenced by the examination of pasture samples, by monitoring the larval excretion and other clinical symptoms of the tracers and by post-mortem findings. It is suggested that Pilobolus fungi play a decisive role in the transmission of the disease in grazing cattle and that they may also be of importance in the acquisition of the infection among cattle housed for the winter.

THE ROLE OF PILOBOLUS SP. (ZYGOMYCETES,
MUCORALES) IN THE SPREADING OF THE INFECTIVE
LARVAE OF DICTYOCAULUS VIVIPARUS (BLOCH,
1782) IN CUBA.

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The presence of Pilobolus sp. as a spread-
ing agent of the infective larvae of Dictyo-
caulus viviparus in Cuba is reported.
Laboratory tests revealed a high extension
(95%) of the fungus in different animal
premises, and under natural conditions the
shedding of sporangia of the zygomycetes
serves as transport for the L₃ of the para-
site.

The infective stages of the helminth can
reach maximal distances of 1 m from the
fecal masses lodging them by means of the
dispersion mechanism of the fungus.
The spread of L₃ of D. viviparus in this
manner is of vital importance in the epi-
zootiology of the nematode, since these
preparasitic stages lack great motility and
may disseminate throughout the fields.

STUDIES ON THE SUSCEPTIBILITY OF IRAQI SHEEP BREEDS
TO *DICTYOCAULUS FILARIA* INFECTION.

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Parasitic bronchitis due to *D. filaria* infection is one of the most important diseases among sheep in Iraq. The relatively greater susceptibility of certain breeds of sheep to *D. filaria* has been reported by several workers (Michel, 1967, 1968 and Al-Samarrae and Sewell, 1977). This study was designed to investigate the susceptibility of three breeds of sheep (Awassi, Hamadani and Arabi) to *D. filaria* infection.

Eight 2-3 months old lambs from each breed were divided into the principal group (5 lambs) and the control group (3 lambs). The principal group received an initial infection of 50 L_3 /Kg. B.Wt. orally and 77 days later all lambs in the principal and the control groups were challenged with 100 L_3 /Kg. B.Wt. The clinical signs, body weight gain, eosinophil counts, faecal larval counts and worm counts showed that the Hamadani lambs were more susceptible to *D. filaria* infection than Awassi and Arabi lambs under experimental conditions. However, the Arabi lambs were least susceptible to the infection.

THE FAECAL OUTPUT OF LARVAE OF PROTOSTRONGYLIDS OF SHEEP AND ITS RELATION TO ENVIRONMENT.

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From October 1977 to May 1978 the faecal output of first stage larvae (L_1) of Protostrongylids was studied on 32 identified animals from 4 farms located near Rabat (Morocco). The output of L_1 in abomasum was also recorded during two years on 72 sheep from the slaughter house of Moulay-Bouazza (Middle Atlas of Morocco).

The cumulative values (origin being in October) of the outputs of larvae and of the rainfalls were related in both regions. The total output of L_1 is strongly correlated with the mean value of the rainfall of the year. The output was uneven along the year and two peaks could be observed. The first peak occurs in January - February. The lambing takes place from October to March and this peak seems to facilitate the transmission of parasites from one generation of sheep to the other. The second rise in L_1 is noticed in July - August - September. Usually stubble fields are grazed by sheep from June up to August - September; they then become fallow fields until next autumn. The second peak permits the transfer of infestation of Protostrongylids from one pasture to another.

THE INFECTION BY PROTOSTRONGYLIDS LARVAE OF THE LAND-SNAIL *CERNUELLA VIRGATA* (DA COSTA) ON A PERMANENT PASTURE.

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The study was realized on a permanent pasture near Rabat from October 1979 up to September 1980. The pasture was grazed by an infected flock. *C. virgata* was the dominant species of land-snail and was used as an indicator for the contamination of the pasture. The density of the snails and their degree of infection by Protostrongylids were established monthly.

The density of snails was high (6 to 10 per sq. m) from May to September; the population consisted then of young individuals. The average infection of *C. virgata* presented a maximum in December and January, i.e. at the spent-period. The number of larvae per snail extended from an average of 0.10 to 1.21 along the period of study.

The number of larvae in snails available per square metre fluctuates from 0.79 to 2.37. Two peaks are observed: one in December (few adult snails highly infected), the second in Summer (numerous juveniles weakly infected).

NEW DATA ON EPIDEMIOLOGY AND LIFE CYCLES OF PROTOSTRONGYLINAE IN SPAIN.

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4,625 snails (11 spp. of Helicidae) were studied -- for natural infection by Protostrongylinae. 7 Cerme-
lla & Helicella spp. were found infected by C.o., -- M.c., N.l. & Protostrongylus spp. Experimentally the most convenient hosts were: Cerme-
lla (C.) virgata for C.o.; Monacha (A.) granulata for M.c.; Cochlicella -- barbara for N.l.

By infecting Cerme-
lla (X.) cespitem arigonis with dosis from 50 up to 1,000 L1/snail it was proved that penetration and evolution up to L3 was function of -- dosis with C.o. In N.l. penetration into the snail was density dependent in a quadratic function, and evolution to L2 gave less larvae than to be expected in -- proportion to the dosis, while still density dependent. Practically all L2 passed to L3. M.c. was highly dependent on the density of larvae for penetration (a 3rd - degree function). Evolution from L1 to L2 above a certain dosis goes down and the same for L2 to L3.

Internal migration of N.l. was studied in 19 lambs infected by 5,000 L3 and killed from 24 hours up to - 60 days p.i. Larvae were present in the wall of caecum and colon during the first 24 h, but 48 h. p.i. they - had disappeared from the enteric contents. From 3-5th days they were in the liver. The arrival in lung started on 3rd day and by 10th day p.i. all had already - reached the lungs. The first L4 were found on 8th day and L5 from 16th day onwards. The main migration route is haematic, but some larvae follow the lymphatic system through caeco-colic glands. Patency began from 44-55 days p.i.

SESSION C3

Arthropoda
Papers 127-140

CONTROL OF ECTOPARASITES IN SHEEP - STRATEGY AND METHODS.

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Infestation with ectoparasites causes marked economic loss particularly through damage to skins and wool. In the People's Republic of Mongolia these infestations are controlled prophylactically in the summer (mites), metaphylactically in the autumn (larvae of *Oestrus ovis*) and in the spring (ticks) and therapeutically in the winter (fleas)... The climatic conditions and methods of sheep management mean medicants and equipment must meet special requirements. Recommended treatments are spraying and dipping for mites; dusting for ticks and fleas; and aerosol treatment for the larvae of the nasal bot fly.

These control measures are intended to reduce losses due to infestation with ticks and fleas and to eradicate *O. ovis* and scabies.

PERMETHRIN FOR THE CONTROL OF CATTLE LICE.
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One hundred and thirty three cattle, from a herd of 237 eight to twelve month old friesian bulls carrying a mixed infestation of lice, were treated twice, 10 days apart, with 0.25 to 0.5 litres of spraywash containing 0.5%^w/v permethrin (Stomoxin - Wellcome). The remaining 104 cattle served as untreated controls and, for the duration of the study, were kept under the same conditions as the treated cattle. All cattle were examined for lice at 15, 30, 60 and 90 days post-treatment and they were weighed at 30, 60 and 90 days post-treatment.

Prior to treatment the following species of lice were seen: *Haematopinus eurysternus* (on 63% of all cattle): *Damalinia bovis* (on 52%) and *Solenoptes capillatus* (on 45%). The skin of all cattle showed typical signs of louse infestation.

After treatment no lice were seen on treated cattle but all of the untreated control animals continued to carry mixed louse infestations. The treatment also resulted in an improvement of skin condition and general health. The average daily weight gain of treated cattle was 280 g per head greater than that of untreated controls. The treatment was not associated with any adverse reactions.

BIOLOGICAL AND PATHOGENIC ASPECTS OF THE RHIPICEPHALUS EVERTSI EVERTSI-PARALYSIS

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In respect to interactions between paralysis inducing R. evertsi evertsi and vertebrate hosts, experiments have demonstrated, that a distinct parallelism exists between incubation, course and intensity of this tick paralysis and the repletion-process of female ticks. Their toxicity is confined exclusively to the initial active sucking phase, which becomes pathogenetically effective always and immediately after copulation between day 4 and 5 p.i. and is limited to a very small repletion-sector, when female ticks have reached an average weight of 15-21 mg. Furthermore the interrelations are characterized, that the degree of severity of clinical symptoms is related directly to the size of infestation and is inversely correlated to the weight of the animals. After preinfestation of male ticks and subsequent deposit of females, their pathogenicity is diminished for approximately 50 %. In preaffected sheep an antitoxic immunity takes influence, the protective effect after 1 exposure, however, is limited to 4 weeks only. In respect to the pathomechanism a marked decrease of the amplitudes of evoked compound muscle action potentials as well as a significant reduction in nerve compound action potentials are involved. The maximum motor conduction velocities are only slightly reduced and the encephalogram, the slower conduction velocities and the amplitude pattern by repetitive nerve stimulation with high frequencies are unchanged.

THE INCIDENCE AND SEASONAL BEHAVIOUR OF TICKS OF CATTLE IN MOROCCO.

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(I) Geographical distribution of ticks:- Eight species of ticks were encountered. *Hyalomma marginatum marginatum* (Kock 1844) and *H. lusitanicum* (Kock 1844) were found in sub-humid to humid zone (Rabat), semi-arid to sub-humid zone (Gharb), semi-arid zone (Settat) and arid zone (Marrackech). *H. detritum* (Shulze 1919) was encountered in Settat, Marrackech and Gharb and *Boophilus annulatus* (Say, 1821) in Settat, Gharb and Rabat. *H. anatolicum* (Kock 1844), *Rhipicephalus sanguineus* (Latereille, 1806), *R. turanicus* (Pomerancev & Matikashvili 1940) and *R. bursa* (Canestrini & Fanzago 1877) were less frequent than the other four species mentioned above.

(II) Seasonal activity of ticks:- Three species were encountered. *H.m. marginatum* represents 45% and *H. lusitanicum* 37% of tick population. Both these species in adult stage are found on animals throughout the year except January and February; the maximum being in the month of May.

R. turanicus is a common tick for cattle and sheep living in the same farm and it is 18% of the total tick population.

The two species of *Hyalomma* feed particularly in the mammary gland (or testicular) region (59%) and the internal aspect of the thigh (32%). *R. turanicus* is more frequent in the region of ears (80%) and it attaches to other body parts only during the period when its population is very high.

Infection relates to the animal management system. The animals at pasture are most infected and animals less than one year old are least infected.

SOME ECOLOGICAL OBSERVATIONS ON 2 EAST-MEDITERRANEAN SPECIES OF HAEMAPHYSALIS TICKS PARASITING DOMESTIC STOCK.

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Haemaphysalis cretica seems to be limited to the Eastern Mediterranean area, but H. otophila has a wider distribution in South-Eastern Europe and the Middle East. The adults of both species feed during the cold season mainly on sheep and goats and occasionally on cattle and camels. H. cretica prefers the hind parts and H. otophila the neck and the head of hosts.

Eggs are deposited under stones in a relatively favourable micro-climate. Larvae and nymphs of both species feed during the hot season, so that there is only one generation per year.

The pre-imaginal stages of H. cretica prefer reptile hosts but attach also to small mammals and birds; those of H. otophila feed on rodents and other small mammals. All stages are very sensitive to dryness and, off the host, die in a few days, if not kept in nearly saturated air.

Under simulated natural conditions, an engorged female of H. cretica, taken off its host in mid-December, started ovipositing in April; the first larvae hatched in June. Larvae and nymphs feed, on rats, for about a week. At 27°C and 90% RH, the larval and nymphal quiescences last 2-3 and 3-4 weeks respectively. Adults emerging in the summer are assumed to estivate, the first ones to be found on live stock in November. The pre-oviposition period lasts 28-81 days, but combined with the duration of embryonic development it becomes fairly constant: the sum of the two varies in general only from 120 to 140 days.

THE EXTINCTION OF PSOROPTES RUBBERS OF SHEEP BY MEDICAL TREATMENT AFTER THE FIRST OUTBREAK OF THE DISEASE IN THE GDR

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After a first outbreak of Psoroptes rubbers in four sheep livestocks of the GDR through importation of brood-sheep and non-timely diagnosis of the disease in quarantine, various acaricides were used to combat it. All degrees of concentration of the agent of Butanate proved to be unefficient against Psoroptes ovis. The laboratory test showed that other organophosphates such as Metrifonat were inferior to γ -HCH (Lindan) or - if sufficiently concentrated - had a toxical effect on the sheep (Naled). Therefore, γ -HCH was used in a concentration of 0,5 % in bathing treatment. By other forms of treatment (with spray or powder) only clinical improvement was achieved, no extinction of the disease. A total of 15 000 sheep were bath-treated (and dipped) 4 times for 1 to 2 minutes with intervals of 8 - 9 days and at a bath temperature of 32 - 37 °C. The treatment included desinfection and veterinary-police measures. By these complex steps to combat the disease the Psoroptes rubbers of sheep were extinguished. Sanitation was verified 18 months after the last treatment.

GASTEROPHILUS FROM EQUINES IN MOROCCO AND THEIR
RELATION TO CLIMATIC FACTORS.

PANDEY, V.S. and OUHELLI, H. Institut Agronomique et
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During 1977 and 1978 the stomach of 166 donkeys and 96 horses were examined and all were found infested with *Gasterophilus* larvae. The frequency of infestation for *G. intestinalis* and *G. nasalis* was 98.7% and 94% respectively. The ecological niche of *G. intestinalis* was oesophageal part of stomach and of *G. nasalis* the pyloric part. In heavy infestations some *G. intestinalis* were found in the fundic part of stomach as well. The degree of infestation by second (L_2) and third (L_3) stage larvae was maximum in December and minimum between June and September. The adult flies appear during spring and summer months and there seems to be only one generation a year. The egg laying *G. nasalis* starts in April and by *G. intestinalis* in May. The first peak of L_2 larvae (mainly made by *G. nasalis*) appears in July and the second peak (mainly made by *G. intestinalis*) in December. From February to May very few L_2 are in stomach as there is no new infestation during winter months. During the same period L_2 of *G. nasalis* are found deep in pockets of hypertrophied mucosa of pylorus and this seems to be like a phenomenon of arrested development. In winter and spring big ulcerated areas are observed in the oesophageal part of stomach which seem to have some relation to *Gasterophilus* infestation.

DISTRIBUTION OF FLIES ON CATTLE PASTURES IN AUSTRIA AND THEIR CONTROL WITH CYPERMETHRIN EAR TAGS

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Studies on the dipterous fauna of pasture cattle in alpine and prealpine regions in the provinces of Lower Austria, Salzburg and Styria have shown that Musca autumnalis and Haematobia stimulans are the most common symbovine flies in these areas. Both species are often found in large numbers on cattle. M. autumnalis occurs mainly in the head and H. stimulans on the rump and legs. Hydrotea irritans is also common, but of lesser importance due to a lower rate of infestation. Simuliidae were found only on some mountain pastures in Styria mainly on the underside of the abdomen. The main species were Odagmia ornata and Simulium reptans. Tabanidae were rare.

Cypermethrin ear tags were tested on a herd of 75 young cattle on a mountain pasture 1300 m above sea level in Styria. The ear tags were attached to the lower part of the outer side of the ear. A control herd was located on a pasture at the same level 5 km away. The experimental animals with 0 - 15 flies per head had a far lower degree of infestation during the first six weeks of the grazing period than the control animals with 20 - 100 flies per head. The rate of infestation on rump and legs was equally low in both herds during the entire grazing season. Only blackflies strongly irritated both herds during the whole of the grazing period.

CGA-72662 : A NOVEL DIPTEROUS LARVICIDE

STEIGER, R. F., SOMERVILLE, J. M., von ORELLI, M.
CIBA-GEIGY Ltd. AG 9.52, 4002 Basle, CH &
ALLEMANN, D. V. CIBA-GEIGY Co.,
Greensboro, NC 27409, USA

A new insect growth regulator, CGA-72662, a melamine congener developed by CIBA-GEIGY, is specifically active against dipterous larvae with no known effects on adult flies or arthropods other than Diptera. Strains resistant to conventional insecticides are fully susceptible to the action of CGA-72662.

The product has successfully been used in Australia for the control of blowfly strike in sheep.

This new larvicide also controls all major manure-breeding nuisance flies affecting domestic animals when applied as a floor treatment in animal houses. It can safely be administered in animal feed leading to suppressed larval development in the dung : dosage levels of 1.5 - 5 ppm, 10 ppm and 15 - 30 ppm completely block fly development associated with manure of poultry, pigs and cattle, respectively.

The product is stable, rapidly excreted and has favourable toxicological properties which make it suitable for feed-through application or water medication in large intensive poultry and livestock units.

Preliminary data also indicate systemic activity of CGA-72662 which could lead to new dosage forms for the control of parasitic Diptera.

REPELLANTS FOR THE PROTECTION OF ANIMALS AGAINST BLOOD-SUCKING FLIES.

BRYUSHININA, G.T. All-Union Research Institute for Veterinary Science, Zvenigorodskoje shosse, 5, Moscow, USSR.

In the USSR benzymin, carbozide and diethyl-toluamide are the most commonly used repellents for the protection of animals against blood-sucking flies. Recently a new and highly effective repellent - oxamate - was synthesized. This preparation is a mixture of aliphatic ethers of N,N-diethyloxaminic acid. The toxicity of oxamate for warm-blooded animals is slight. The repellent is not stored in the organs or tissues, it is rapidly destroyed in the tissues and it is not excreted in the milk. Oxamate may be used as a spray or as an aerosol treatment. The durations of the efficacy of oxamate is 14-24 hours.

THE EFFECT OF THURINGINE ON THE DEVELOPMENT OF BLOOD-SUCKING MOSQUITO VIRUS INFECTION.

ERMAKOVA, G.I. and TONKONOSHENKO, A.P. All-Union Research Institute of Veterinary Sanitation, Moscow, USSR.

A study of interactions between viruses and insecticidal agents is important when examining the theoretical basis of virological methods of mosquito control. We investigated the effects of thuringine and an iridescent virus on individuals and populations of *Aedes aegypti*. We examined the lethal effect of these insecticidal agents on first generation mosquitoes and their progeny.

Iridescent virus and thuringine, the latter being given in sublethal or 1:10 doses, were synergistic provided the mosquitoes were infected with virus prior to the thuringine treatment. Combined treatment with irridscent virus and thuringine resulted in a greater mortality rate of first generation mosquitoes and their progeny than did either treatment alone.

ECOLOGY AND METHODS OF CONTROL OF CATTLE WARBLE FLIES.

NEPOKLONOV, A.A. All-Union Research Institute for Veterinary Sanitation, Zvenigorodskoje shosse, 5, Moscow, USSR.

A study was conducted on the zone features of warble fly ecology. Data established included: the terms of pest flying; the dynamics of larval parasitization of animals; the correlation between prevalence and intensity of infection; and prophylaxis and treatment of hypodermatosis. It was found that the dissemination and maintenance of warble fly populations was due to the presence of animals infected with *Hypoderma*. The instigation of planned control measures against warble flies decreased the levels of infection of cattle in our country from 29.6% to 0.7% over the last 15 years. These control measures resulted in the saving of more than 495.000.000 roubles per year.

**EXPERIMENTAL DATA ON THE INFLUENCE OF
HELMINTHS ON THE INTESTINAL MICROFLORA
IN ANIMALS**

AYUPOV, KH.V. and YANGURAZOVA, Z.A. UFA

Abstract not received

EFFECT OF HYPODERMIN-CHLORFOS INSECTICIDE ON THE DEVELOPMENT OF WARBLE FLIES.

METELITSA, V.K. All-Union Research Institute for Veterinary Sanitation, Zvenigorodskoje shosse, 5, Moscow, USSR.

The effect of hypodermin-chlorfos on the movement of surviving larvae to the back and the development of such larvae under the skin of the back of the animal was investigated. The pupation process, after the emergence of larvae into the environment, was examined. The following indices were examined: the weight of the larvae; the per cent emergence of adult warble flies from pupae; the ratio of males to females; the life span of the flies; and the potential fertility of the females. The experiments demonstrated that the treatment of animals with the insecticide resulted in an inhibition of the migration of larvae to the skin; the formation of warbles changed; and fewer larvae emerged to pupate.

SESSION D1

Chemotherapy I

Papers 141-150

THEORETICAL STUDIES OF THE CONTROL OF DIRECT LIFE
CYCLE HELMINTHS BY CHEMOTHERAPY

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Recent theoretical work on the population dynamics of direct life cycle helminth parasites will be described. The concepts of 'transmission thresholds' and 'breakpoints' in the dynamics of parasitic species will be described with particular reference to (a) their relevance to the epidemiology of helminth parasites and (b) their estimation from epidemiological data. These concepts will then be applied to the problem of designing optimal control policies based on the application of antihelminthic drugs.

CHEMOPROPHYLAXIS OR STRATEGIC TREATMENT ?
EXPERIMENTS WITH FENBENDAZOLE (PANACUR^R) IN CATTLE

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The aim of each control measurement is the reduction and possible prevention of helminth-induced damage in domestic animals and game. During the last decades innumerable studies have been performed to find out whether this goal can be achieved through pasture hygiene, pasture management, by strategic or tactic de-worming or by chemoprophylaxis. Latest biological findings and modern wide-range anthelmintics have improved the chances for an effective helminthiasis control.

Chemoprophylaxis seems to be economically justified despite a larger drug consumption, but it is not yet ready to be used in general practice as, among other things, questions regarding the problem of residues and possible development of resistance have not been clarified completely. - The activity of 0.2 mg FBZ/kg b.w. per day for 60 days via blocks was examined in pilot studies conducted under laboratory conditions. Prior to or during treatment the cattle were artificially infected with O. ostertagia and D. viviparus. At the end of the study period the chemoprophylactically treated cattle showed a weight gain of 33 - 43 kg/animal as compared to untreated controls (p 0.05).

In strategic de-worming with FBZ clinical helminthiasis are prevented, and weight gains as compared to untreated controls are achieved. In 5 farms, cattle received a therapeutic FBZ dose twice during the grazing period. In the case of a natural infection with Ostertagia spp./Cooperia spp. and, in a lesser degree, with Trichostrongylus spp./Nematodirus spp. and in some cases with D. viviparus, no clinical helminthiasis was observed. At the end of the grazing period the treated cattle showed a weight gain of 9-21 kg/animal as compared to untreated animals; after 3-month stabling period the difference in weight between groups which had received the same feed had increased to 31-49 kg per animal in favour of FBZ-treated animals (p 0.05).

THE INFLUENCE OF PANACUR AND THIBENZOLE ON INCREASE OF COWS' LACTESCENCE IN DIFFERENT PHYSIOLOGICAL CONDITIONS OF ANIMALS

GRZYWIŃSKI, L., STADNICKI, T. Institute of Infectious and Invasive Diseases, Agricultural Academy, Norwida 29, 50-375 Wrocław, Poland

Experiments were carried out with 125 cows free of parasites /extensiveness of infection with gastrointestinal nematodes was 0.5%/, divided into 5 groups. The animals of group 1 were treated with Panacur one week before parturition /at dose of 7.5 mg/kg body weight of Fenbendazole/, group 2 - treatment with Panacur up to one week after parturition, group 3 - treatment with Thibenzole in dose of 50 mg/kg b.w. up to one week after parturition, group 4 - treatment with Panacur 3 months after parturition and group 5 - control /untreated animals/. Experiments lasted for 9 months /3 terms/ and the mean lactescence of cows in each group every term was determined. The mean lactescence of cows during the whole period of observation /274 days/ was higher in cows which received Panacur or Thibenzole than in the control group.

STUDY OF THE LARVICIDAL AND ANTHELMINTIC ACTIVITY
OF NITRAMISOLE, CLOSANTEL and LEVAMISOLE IN PONIES

GUERRERO J. and ROHOVSKY M.W. Pitman-Moore Inc.,
Washington Crossing, NJ 08560, USA (presented by
DE KEYSER, H., Janssen Pharmaceutica, Beerse, Belgium)

Nitramisole is an anthelmintic that has shown larvicidal activity against certain stages of S. vulgaris larvae. Closantel is an anthelmintic with long-lasting larvicidal effect against sheep nematode parasites. In a previous pilot trial conducted in 1978, closantel gave indications of possible larvicidal effect against S.vulgaris larvae. Levamisole is a known potent anthelmintic that in horses is known to be effective against adult S.vulgaris. The larvicidal activity of levamisole against this nematode parasite has not been studied.

In an experiment the activity of the three compounds was studied against S.vulgaris larvae and other common internal parasites in pony foals. Closantel was clearly superior in efficacy.

TREATMENT OF INFECTION WITH LARVAL *DELAFONDIA VULGARIS* IN FOALS.

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Tselinograd, Pobeda St. 116, U.S.S.R.

The infection of 6 foals with infective larvae of *Delafondia vulgaris* produced a clinical picture of thromboembolic colic. The initial clinical signs were: depression, anxiety, subfebrile intermittent fever and eosinophilia. Sometimes the clinical signs became more severe and signs of colic developed. Animals shifted their weight from foot to foot, laid down and got up and turned their heads towards their abdomen. The foals were treated with Mebenvet (10% mebendazole). Two foals received two doses of 120 mg/kg given 24 hours apart on days 50 and 51 after infection; 2 foals were given one dose of 150 mg/kg 22 and 40 days after infection; and 2 foals remained untreated (controls). Clinical signs disappeared within 10-12 days of treatment while the severity of the clinical signs increased in the untreated animals. The foals were killed 10-18 days after treatment. At post-mortem examination pathological changes (thickening of the wall, increase in connective tissue, small aneurisms up to 12 cms in diameter in the artery, fibrin deposits on the intima) were seen in the anterior mesenteric artery and its branches, particularly the cranial mesenteric, and in the abdominal aorta. No larvae were found in the anterior mesenteric artery of the foals treated twice; 2-69 dead, deformed larvae were found in the foals treated once; and 54-248 live larvae, 6-15 mm long, were found in the controls. Slight pathological changes were present in the auricle of the control foals.

Summary Mebenvet had larvicidal activity against the migrating larvae of *Delafondia*. It was not toxic to the host.

A STUDY OF EFFICACY AGAINST GASTROINTESTINAL NEMATODES IN SHEEP WITH ALBENDAZOLE

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M. CHATON-SCHAFFNER - SmithKline - Cidex A 156 16 - Z.A. les Petits Carreaux - 94380 BONNEUIL/MARNE - FRANCE

Studies were carried out on Texel-Southdown cross lambs maintained on pastures previously contaminated by artificially infected lambs.

After an eight week grazing period (mid-september) animals were allocated to 3 groups of 12 animals : controls Albendazole treated and reference benzimidazole treated.

In each group 3 animals were necropsied 7 weeks after treatment and parasitological examinations were made. The weight gains of remaining animals were calculated and used to estimate the economic consequences of treatments

Severe disease with high mortality followed the parasitic infestation : 6 animals died before the day of treatment. Subsequently 3 animals died in the control group. Following treatment the symptoms decreased.

In the control group, weight gain ceased in mid-september whereas the weight gain of the treated group continued to increase, particularly 2 to 4 weeks after treatment.

These differences were reflected in the slaughter weights 7 weeks after treatment ; average differences of 5 to 7 kg were observed between control and treated groups.

After treatment reinfestations were slight and very heterogeneous. However a significant difference ($P < 0,05$) was noted between control and treated groups in the average number of worms found when the second group were slaughtered. Albendazole at a dosage of 3,8 mg/kg showed 100 per cent efficacy against intestinal roundworms: ostertagia, haemonchus and trichostrongylus and increased weight gains. Under the conditions of this trial, results obtained with Albendazole group and a reference anthelmintic were similar.

EFFICIENCY OF ALBENDAZOLE IN THE TREATMENT OF GASTRO-INTESTINAL NEMATODES IN SHEEP AND CATTLE, AND OF THE LIVER FLUKE IN CATTLE

DŽAKULA, N., RAPIĆ, D., ŽUKOVIĆ, M. Department of Parasitology and Parasitic Diseases, Veterinary Faculty, University of Zagreb, Yugoslavia

Sixty sheep with pasture-acquired nematode infections with Haemonchus contortus, Ostertagia spp., Trichostrongylus axei, Nematodirus spp. and Strongyloides papillosus were allocated in three groups of twenty animals each. The animals of two groups were medicated with albendazole "Smith Kline" at dose levels of 3.8 or 4.75 mg/kg body weight. The third group served as nonmedicated control. Twelve days later the efficacy was assessed by faecal egg-count of all animals and by P.M. examination of 10 slaughtered animals from each group. The dose of 4.75 mg/kg removed 100% of adult mentioned species. At the dose of 3.8 mg/kg, the efficiency was 99.78%.

Forty cows with pasture-acquired gastro-intestinal nematodes (Ostertagia spp., Coope-ria spp., and Trichostrongylus axei) and liver fluke infection were treated with albendazole at dose levels of 7.5 or 10 mg/kg body weight. Twenty cows infected with the same parasites served as nonmedicated controls. According to faecal examinations, the dose of 7.5 mg/kg albendazole removed 100% of adult nematodes. Against adult Fasciola hepatica, albendazole at the dose of 10 mg/kg produced 65% extensefficacy and 94.21% of intensefficacy.

PRELIMINARY OBSERVATIONS ON THE ECONOMICS OF DEWORMING MILKING COWS IN BRAZIL

GRISI, L. and LIMA, M.M. Dept. of Animal biology
University Federal Rural of Rio de Janeiro, Brazil

Three hundred and forty clinically healthy dairy cows from one commercial dairy herd in the state of Rio de Janeiro were randomly divided into control and treated groups. The treated cows were dewormed with albendazole (Valbazen^R) at a dose level of 5 mg/kg of body weight. The deworming program consisted of a single treatment of cows in lactation at the beginning of the experiment. Cows that calved during the 90 day study were also randomly included in the control or treated group which were then dewormed on the day after parturition. The average faecal worm egg count of cows before and after 30 days of treatment was 21 eggs/5g and 2 eggs/5g, respectively. Based on the average production of both groups 30, 60 and 90 days after implementation of the deworming program. The treated cows showed an increase of 577 g milk/cow/day, or 51.9 kg of milk/cow during the 90 day period and the difference was significant ($P = 0.01$). The cost effectiveness of the deworming program was highly satisfactory.

FEBANTEL - A BROADSPECTRUM ANTHELMINTIC FOR HORSES, RUMINANTS, PIGS AND POULTRY

by WILL, R.

BAYER AG, Leverkusen, Federal Republic of Germany

FEBANTEL is a new product of Bayer Leverkusen that incorporates an aromatic substitute Guanidine derivative. Febantel can be used for all domestic animals. Febantel proved itself effective against:

The most important horse parasites, namely the large and small Strongylides, Ascarides and Oxyuris. - All the important parasites effecting cattle such as Dictyocaulus viviparus and Ostertagia ostertagi. Also included are inhibited larvae of Ostertagia ostertagi. The Nematodes of sheep and goats including the "problem worms" of the Protostrongylides family, in addition to other Nematodes such as Trichostrongylides as well as Strongylides, Ancylostomatides and Cestodes of the genus Moniezia. - The most important Nematodes of the pig. - The roundworm of poultry (Ascaridia, Syngamus, Heterakis, Capillaria) in addition to Cestodes. - The recommended therapeutic dosage for horses is 6mg/kg bodyweight for cattle 7,5mg/kg bodyweight, for sheep, goats and pigs, 5mg/kg bodyweight and for poultry 25mg/kg bodyweight. As has been shown in other long-term trials with poultry 60 ppm administered in the feed over a period of 5 - 6 days is very effective. This latter form of medication even excels the single dose method.

ANTHELMINTIC EFFICACY OF FEBANTEL AGAINST GASTRO-INTESTINAL NEMATODES IN SHEEP

DIMITROV, G. High School of Zootechnics and Veterinary Medicine, 62 Dimitar Blagoev Str. Stara Zagora - 6000 Bulgaria

The anthelmintic efficacy of Febantel was tested against the most important nematodes of the gastro-intestinal tract of sheep under Bulgarian conditions in a total of 1012 naturally infected eight months old ewes, using a 5% suspension at a oral dose of 10 mg/kg body weight. In the field trials Febantel proved to be very well tolerated at a dose rate of 10 mg/kg. It was 100% efficient against immature and adult forms of O. circumcincta, H. contortus, T. colubriformis, B. trigonocephalum, Cooperia spp. and O. venulosum. The anthelmintic efficacy on N. spathiger and S. papillosus was 98-99% and against Trichuris ovis - 52%. Although the trial and control sheep were kept on same pastures, there was a marked difference in the egg excretion in favour of the treated animals in the 3rd months after treatment. The average weight increases were significantly higher in the treated sheep. The profile of most excretion curve indicates that a twoford treatment, the first in the 2nd month after the start of the grazing season and the second one 8-10 weeks later, is sufficient. Severe illness or chronic damage due to gastro-intestinal nematodes may be prevented by this treatment.

SESSION D2

Chemotherapy II
Papers 151-159

GENERAL SURVEY ON OXIBENDAZOLE TOLERANCE

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Marcy l'Etoile - 69260 CHARBONNIERES-les-BAINS -FRANCE
CHATON-SCHAFFNER M. - SmithKline - Cidex A 15 & 16 -
Z.A. les Petits Carreaux - 94380 BONNEUIL/MARNE(FRANCE)

Oxibendazole (Loditac ND) is the generic name for
N(Propoxy-5, benzimidazolyl)-2, carbamate de methyl.

Oxibendazole is a broad spectrum anthelmintic used
in cattle, sheep, horse, pig and dog.

Versus others chemicals of the benzimidazole class,
acute and subacute toxicities (5 days - 21 days -
3 months) of Oxibendazole in laboratory animals (mice,
rat and dog) and in target animals (cattle, sheep, pig
and dog) are very low and especially favorable to
Oxibendazole.

In mice, rat, cattle and sheep, no teratogenesis could
be detected until following doses :

- Mice 30 mg/kg body weight.
- Rat 150 mg/kg body weight.
- Cattle 75 mg/kg body weight.
- Sheep 150 mg/kg body weight.

The principal metabolite of Oxibendazole is the
N(Hydroxy-5, benzimidazolyl 2, carbamate de methyl
(OH-MBC)) that is not teratogenic in rat.

Taking in consideration toxicologic and residues
studies of Oxibendazole, this anthelmintic can be used,
in fattening and milking animals without any risk for
consumers.

ANTHELMINTIC ACTIVITY OF OXIBENDAZOLE AGAINST STRONGYLOIDES RANSOMI

STOYE, M., a. H.-J. BÜRGER, Institute of Parasitology, Hanover School of Veterinary Medicine, Bünteweg 17, D 3000 Hannover 71, Federal Republic of Germany.

Oxibendazole was tested as a 5 per cent pre-mix formulation (Loditac P5) against experimental infections with 100 000 larvae of Strongyloides ransomi involving a total of 16 pigs of 17 kg average weight. Two regimes of application were used: 1) a single dose of 15 mg pure substance per kg bwt against 9 day old S. ransomi. 2) 40 ppm of oxibendazole in 900 g of food per day from day 5 through 9 after infection. Six animals remained untreated. Daily McMaster counts revealed a substantial reduction of egg output in the 5 pigs treated once with 15 mg/kg bwt. The arithmetic mean of their worm burdens (4 672) was 93 per cent lower than the mean of the controls (65 283). No reduction (62 066 worms) was seen after treatment with 40 ppm for 5 days. No adverse effects or toxic symptoms were registered during the course of the experiment.

EFFICACY OF OXIBENDAZOLE AGAINST GASTROINTESTINAL PARASITES OF SWINE

GRISI, L. and LIMA, M.M. Dept. of Animal Biology
University Federal Rural do Rio de Janeiro - Brazil

A total of thirty pigs naturally parasitized by Ascaris suum, Oesophagostomum spp., Trichuris suis were treated with oxibendazole (methyl-5n-propoxy-2-benzimidazole-carbamate) given at 3 dose levels: 15 mg/kg of body weight given via the feed as a single dose; medicated feed at a concentration of 100 ppm fed for 6 days and medicated feed at a concentration of 15 ppm for 50 days. Efficacy against Ascaris suum, and Oesophagostomum spp. was 100% for the 3 treatments. Efficacies for the 3 dosage regimens against Trichuris were 74.5, 100 and 80.4%, respectively. Medicated feed at a concentration of 15 ppm showed a significant ovicidal effect against Ascaris eggs. The percentage of fully developed Ascaris eggs in cultures obtained from controls and from treated pigs that have been on medicated feed for 5 days was 92% and 3%, respectively. The low level medicated feed (15 ppm) was used continuously on a farm which previously had 56% of the pig livers condemned at the abattoir. Without any changes in farm management liver condemnations related to the presence of "milk spots" had decreased to 10% after a six month period of prophylactic treatment. No signs of toxicity or alteration in feed intake were seen in pigs treated with oxibendazole medicated feed.

TRIALS FOR THERAPY OF MUELLERIOSIS IN GOATS.

BANKOV, D.E. Central Veterinary Research Institute,
Bul. P. Slaveikov 15-a, Sofia, Bulgaria.

Muelleriosis in goats is widespread in Bulgaria and usually the clinical picture is complicated by concomitant infection with gastrointestinal strongyles. The therapeutic effect of increasing doses of levamisole, cambendazole, fenbendazole and febantel was examined in 160 goats. The results were recorded by faecal larval examination.

Faecal larval numbers fell to minimal levels after treatment with levamisole (20, 25 and 30 mg/kg) but this decrease was only temporary and the number/gm of faeces increased once more by 20 days after treatment. Cambendazole given at a dose rate of 20, 30 and 40 mg/kg had an efficacy of 56.5, 48.2 and 59.4% against *M. capillaris* and 94.3, 97.0 and 98.5% against gastrointestinal nematodes, respectively. Fenbendazole (10, 20, 30 and 40 mg/kg) was 100% effective against gastrointestinal nematodes and had an efficacy of 71.5, 86.5, 76.7 and 95%, respectively, against *M. capillaris*. Febantel (10, 20, 30 and 40 mg/kg) also had 100% efficacy against gastrointestinal strongyles and a 68.9, 75.1 and 99.6% efficacy, respectively, against *M. capillaris*. Febantel, administered in the food at a dose rate of 3-4 mg/kg for 6 successive days, had high efficacy (95-100%) and resulted in complete remission of clinical signs.

INCIDENCE OF LUNGWORMS IN IRAQ AND THE
ANTHELMINTIC EFFICACY OF FENBENDAZOLE AND
OXFENDAZOLE AGAINST DICTYOCAULUS FILARIA
INFECTION IN SHEEP

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Four species of lungworms were recovered
in Iraq in a survey of sheep for natural
infection. D. filaria was the most common
species in all regions, the average
incidence being 11.4%. Müllerius capillaris,
Cystocaulus ocreatus, Protostrongylus sp.
were reported from Iraq for the first time
showing 4.7, 5.5 and 1.1 % incidence,
respectively. Fenbendazole and Oxfendazole
were given orally at a dose rate of 5mg/kg to
lambs experimentally infected with
D. filaria. Eighteen male Awasi sheep, aged
4-5 months, were used in this investigation
to compare the anthelmintic efficacy of the
two drugs 45 days postinfection. Results
showed that both drugs were 100 % effective
in eliminating the worms.

PROPHYLAXIS OF PROTOSTRONGYLIDOSIS OF SHEEP AND MARALS IN KAZAKHSTAN

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Institute of Zoology, Academy of Sciences
of Kazakh SSR, Alma-Ata, USSR

Scientific workers of the laboratory during 20 years had been testing several anthelmintics against Elaphostrongylus and Varestrongylus in marals (C.elaphus sibiricus) and against Protostrongylus, Cystocaulus and Varestrongylus in sheep. Reassuring results were achieved after approbation of derivatives of benzimidazole: thiabendazole, parbendazole and mebendazole. The most effective was mebendazole including Mebenvet granulate 10% at the dose for marals 30 mg per 1 kg every 24 hours during 7 days, and for sheep 30 mg per 1 kg three times only with interval of 48 hours. As a result the reproductive capacity of nematodes came down. This method is being used now for prophylaxis of protostrongylidosis in Kazakhstan.

ANTHELMINTHIC ACTIVITY OF JATROPHA CURCAS AGAINST STRONGYLOIDES INFECTION IN GOATS.

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In the laboratory the faecal samples of Nubian goats 1-4 years old, were examined by the sedimentation and flotation methods and the eggs were counted using the modified McMaster technique. 12 of these goats were found naturally infected with strongyloides worms. Jatropha curcas seeds, selected, were powdered, suspended in water and were administered as single oral doses to 9 goats at 100mg/kg. body weight. The 3 remaining goats were left as infected controls. Egg counts of the treated animals, 7 days after dosing commenced, were negative. This finding, as shown by the figures of the controls and treated animals presented in the table, indicates that egg production was totally suppressed. This has been confirmed by the removal of worms during post-mortem examinations of some of these animals. Hence Jatropha curcas seed at a dose rate of 100 mg/kg. was 100 per cent effective in treating a naturally acquired strongyloides infection in goats.

DEVELOPMENT OF A MODEL FOR THE TRIAL OF DISINFECTANTS UPON ECTOGENIC PARASITIC DEVELOPMENTAL STAGES IN THE GERM CARRIER UNDER SIMULATED CONDITIONS OF PRACTICE.

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A germ carrier model for the trial of disinfectants against ectogenic parasitic stages is introduced. It permits test plans which correspond with the practical requirements of the animal husbandry. The trial model can be inserted in the gradual examinations procedure In-vitro-test (Suspensionstrial/screening principle) - germ carrier trial (simulation test) - field trial and thereby allowing the effective simulation of the conditions of practice. Solid (concrete, aluminium) as well as loosed structured (sand, earth, sawdust, excrements) germ carriers with superficial contamination and according to the penetration principle can be included; chemical analysis of the disinfectant substrates are possible. The recovery rate of the used test objects for example on the coccidial oocysts lie between 77 and 95 %. The germ carrier model allows an extensive standardization of the examinations procedures.

HABITAT INVESTIGATIONS OF THE NORWAY RAT
/RATTUS NORVEGICUS/ POPULATION AFTER
ERADICATION

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In Budapest having two million inhabitants a rat eradication project of global method was effected after thorough and extensive preparation 1971-1972. Initially 33 per cent of constructions were rat infested. As a result of effective work infestation level decreased below 0,5 per cent.

Rat eradication of Budapest resulted in a remainder of rat population that was very small compared with the carrying capacity of the environment. Hence Norway rats are theoretically free to conquer any empty space /habitat/ exempt from intraspecific competition.

From investigations it appeared which of the 5061 micro-habitats within the 3355 complex-habitats rats would prefer. Consideration of the ethological particulars revealed will intensify efficacy of the fight against rats.

SESSION D3

Trematoda I
Papers 160-173

THE POPULATION DYNAMICS OF FASCIOLA HEPATICA:
A MATHEMATICAL MODEL

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Populations of Fasciola hepatica are subject to density-dependent and density-independent processes which determine at any instant the prevalence and intensity of infection in the primary host. These processes have been incorporated in a simple mathematical model of fascioliasis consisting of five, coupled differential equations.

In accordance with traditional views, the basic reproductive rate (R) of the parasite as estimated from the model varies seasonally and is greatest in those regions which stay wet and warm. Control measures reduce R , and the model can be used to assess the likely impact of any particular control procedure prior to its implementation in the field.

HAEMOGLOBIN POLYMORPHISM IN CHRONIC BOVINE FASCIOLIASIS

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The observed frequency of haemoglobin genotypes was compared to the expected frequency in a field population of fluke-infected and uninfected White Fulani Cattle.

There was a significantly lower frequency of HbAA type cattle among the infected animals / $P < 0.05$ / and this was compensated for by an increased frequency of the heterozygote HbAB type.

Parasitological observations also indicated a lower fluke burden among HbAA type cattle compared to the heterozygotes. However, the differences in faecal egg count could not be so related to genotype.

This preliminary evidence may be an indication that homozygote HbAA cattle are more capable of self-curing infections than the heterozygote HbAB.

UPON BIOCOENOSIS BETWEEN *FASCIOLA HEPATICA* AND
PARAMPHISTOMUM DAUBNEYI.

STOIMENOV, K. and STEFANOV, S. A District Veterinary
Medicine Centre, Shumen, Bulgaria.

The biocoenosis between *Fasciola hepatica* and *Paramphistomum daubneyi* in sheep was studied from 1971-1980 in Shumen county and in Targoviste county. In the first years of the study faecal examination for eggs demonstrated that the intensity of infection with *F. hepatica* was higher than that of *P. daubneyi*. Then the intensity of infection with *P. daubneyi* increased and became equal to that of *F. hepatica*.

Seasonal variation in the intensity of infection with the two trematodes was observed. This is associated with their different prepatent periods, with the types of anthelmintic with which they are treated, the time at which sheep are treated and other factors.

No antagonism was found between *F. hepatica* and *P. daubneyi*.

BIOLOGY AND ECOLOGY OF PARAMPHISTOMIDS OCCURRING IN BULGARIA

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The studies revealed that: L. truncatula is of greatest epizootological importance for the paramphistomosis in the country; spreading of P. microbothrioides in Europe is possible since this species can develop in L. truncatula; P. planorbis is intermediate host of P. cervi; mature invasion with P. c. f. daubneyi in L. truncatula can be found during the whole pasture period of the final hosts; P. c. f. daubneyi eggs retain their developing capability for at least 5 months when kept at 4-10°C; P. c. f. daubneyi miracidia can invade L. truncatula within a temperature range 1-35°C; part of the miracidia can invade snails 24 and 48 hs after being stored at 10 and 1°C respectively; the productivity of a miracidium is 16-18 rediae and 200 cercariae on an average; the parasite development is slower in snails with smaller dimensions; invaded snails reach greater maximum sizes than uninvaded ones and do not lay eggs after most of the rediae migrate to the digestive gland and ovotestis; P. c. f. daubneyi develops to mature cercariae at 20-24°C in 33-40 days; it reaches the same stage at 10 and 15°C but the development is strongly delayed; at 15°C the cercariae leave the snails and encyst; P. c. f. daubneyi metacercariae live for a long period of time in water but left dry even at high humidity they die within several hours; silage kill the metacercariae; an immobilizing effect of some leaves' extracts on P. c. f. miracidia was established; buffers at pH 5-6, the same as of leaves' extracts, do not affect significantly the longevity of the miracidia and shedding of cercariae.

FORECASTING OF FASCIOSIS AND PARAMPHISTOMOSIS IN UKRAINIAN POLESYE

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It was established close correlation between of morbidity animals from one side and rainfall and temperature from other in critical development period of infestation in June-July. The years when mean air temperature is higher than usual by 2 and more degrees in May, meteorological data must be taken into consideration for May-June. When forecasting fasciolosis it must be taken into consideration rainfall and temperature for current year, and when forecasting paramphistomosis for previous year. Warm, sunny weather in May of the current year promotes mass output of paramphistome cercariae from overwintered snails and as consequence intensive infestation of animals.

ECOLOGICAL BASES OF STRUGGLE AGAINST FASCIOLIASIS AND DICROCOELIOSIS.

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The helminth research examined naturally and artificially infected sheep, goats and cattle and involved a malacological investigation of the environment.

Fasciola hepatica and *Dicrocoelium lanceolatum* were the dominant hepatic trematodes in the pre-mountain - mountain zone. In irrigated areas *Fasciola gigantica* became dominant due to the changes in ecological conditions for the host.

Sheep were the most susceptible to *D. lanceolatum* while cattle were the most susceptible to *F. gigantica*. In sheep, *D. lanceolatum* grew well, adults were large and contained a great number of developed eggs. The prepatent period of infection was 47 days. *D. lanceolatum* in cattle and goats were often smaller in size, contained fewer eggs and patency occurred 50-52 days after infection.

Cattle and sheep were the most suitable hosts for *F. gigantica*. The prepatent period of infection in cattle and sheep was 91-117 days as compared with 98-170 days in goats.

An intensive nidus of infection with *D. lanceolatum* is created primarily by sheep and that of *F. gigantica* by cattle. A nidus is formed not only because of the host species high degree of susceptibility to infection but also due to ecological considerations.

ECOLOGICAL ASPECTS OF MASS PRODUCTION OF
METACERCARIAE OF PARAMPHISTOMUM DAUBNEYI

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Observations on production of metacercariae of P. daubneyi, the most common rumen fluke of cattle in Central Europe show that the number of cercariae emerged is higher and mortality of intermediate host Lymnaea truncatula is lower when about three- week-old snails are infected with 3-6 miracidia. Mature cercariae are usually developed by the 30th day post infection but cercariae do not emerge until snails are staying on the mud slope of culture dishes. Of several environmental conditions tested, immersion of infected snails in fresh pond water and illumination are the principal factors governing emergence. Snails with 3-4 day interval exposures shed 800-1300 cercariae each in the course of its life. Behaviour of infected snails observed in culture dishes /leave the mud slope and aestivate from 40th day post infection/ suggests that under field condition, the alteration of drying and flooding periods in the habitat of snails has an important bearing on the epidemiology of the disease.

FURTHER OBSERVATIONS ON THE LIFE CYCLE OF
FASCIOLA SP.

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Specimens of Lymnaea sp., collected from
Priyadarshani Jheel, district Unnao, U.P.
were found infected with a gymnocephalous
cercariae. They encysted on plant leaves.
Cysts fed to clean guinea pigs and hamsters,
yielded Fasciola sp. in various developmental
stages from the liver. Eggs obtained from
the mature worms were kept for hatching.
Miracidia hatched and penetrated the snails
of the genus Lymnaea. Intra molluscan stages
were obtained by dissecting the infected
snails. Some more information is added, to
the existing knowledge on the life cycle of
Fasciola sp.

PRELIMINARY REPORT ON THE ROLE OF LYMNAEA
COLUMELLA AS INTERMEDIATE HOST OF FASCIOLA
HEPATICA (LINNÉ, 1758) IN CUBA.

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The role of some fresh water pulmonated gastropods as intermediate hosts of Fasciola hepatica L. has been determined by numerous workers. AGUAYO (1938); PÉREZ VIGUERAS and MORENO (1938); MITTERPÁK (1966); and MITTERPÁK and MAURI (1971) reported Lymnaea cubensis as intermediate host of Fasciola hepatica in Cuba.

The recovery of liverfluke metacercariae from experimentally infected snails classified as Lymnaea columella by the Malacology Group of the Academy of Sciences of Cuba and the reproduction of the parasitic disease in four rabbits by the oral administration of this organism are described in the present paper.

GALBA TRUNCATULA ON FERTILIZED PASTURES

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Investigations were carried out on a pasture where four times a year high doses of mineral fertilizers were applied. The snails (*Galba truncatula*) were collected from twenty selected spots during one year and searched for larvae of *F. hepatica*. The larvae were found in 17.9% of 1,705 totally collected snails (Table below).

Month	Number of snails		Larvae of <i>F. Hepatica</i>		
	collected	infected	sporocysts	rediae %	cercariae
V	50	0,0	0,0	0,0	0,0
VI	50	0,0	0,0	0,0	0,0
VII	35	28,5	50,0	40,0	10,0
VIII	200	24,4	14,6	25,0	60,4
IX	200	24,4	12,3	26,4	61,3
X	200	22,0	45,5	54,5	0,0
XI	150	13,3	55,0	45,0	0,0
XII	200	37,0	59,5	35,2	5,3
III	210	18,6	13,3	70,5	15,9
IV	410	11,2	52,6	21,0	26,4
	1705	17,9			

It was found that fertilization of the pastures without simultaneous amelioration did not exert significant influence on the number of snails.

INCIDENCE OF CERCARIAE AND EVALUATION OF CERTAIN CHEMICALS AS CERCARICIDES

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Three species of snails, Lymanaea acuminata (Lymanaeidae), Thiara (-Melanoides) tuberculata (Thiaridae-Melanidae) and Viviparus bengalensis (Viviparidae), are frequently found in and around Jodhpur, Rajasthan. Of these only T. tuberculata was found infected. The snails, collected from Takhatsagar, were put singly in separate tubes having three-fourth water and capped with muslin cloth and exposed to light for 20 hrs. The emerged cercariae comprised Furcocercous, Lophocercous and Xiphidiocercaria, the infection percentage being 60.90 (8.18 with furco-, 25.45 with lopho-, 23.64 with xiphidio-, 2.73 with furco- and lopho- and 0.90 with furco- and xiphidio-).

In vitro evaluation of copper sulphate, zinc chloride and extracts of leaves of Margosa and Tobacco showed that copper sulphate was most potent cercaricides and zinc chloride the least. Extracts of Margosa and Tobacco were fatal in 50-60 mins.

CHEMOPROPHYLAXIS OF FASCIOLOSIS IN SHEEP AND CATTLE

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The anthelmintic efficiency and safety of a novel benzimidazole compound, CGA-89317 was tested in sheep and cattle artificially infected with *Fasciola hepatica*. The drug showed an exceptionally high efficiency against all stages of the parasite from as early as 1 day after infection.

Against adult fluke the dose rate of 2 mg/kg was highly efficient and when used at the dose rate of 5 mg/kg the efficiency was 91%, 98% and 100% against fluke aged 4, 8 and 12 weeks respectively. The dose rate of 10 mg/kg removed 75%, 95% and 99.5% of the fluke burden when the sheep were treated 1 day, 1 week and 4 weeks after inoculation respectively and it was 100% efficient against fluke aged 6 weeks or older. When the sheep were treated at a dose rate of 15 mg/kg 24 hours after inoculation a 98% efficiency was achieved.

The maximum tolerated dose was found to be 200 mg/kg, giving a Safety Index of 100 when the drug was used efficiently against adult fluke and 20 at a dose rate highly efficient against immature fluke as early as 1 week after infection.

The efficiency and safety of CGA-89317 in calves was found to be similar to that in sheep.

In suspected outbreaks of acute fasciolosis an early diagnosis and confirmation of drug efficiency can be obtained by plasma enzyme tests.

Very effective chemoprophylaxis can be achieved by strategic use of the drug at an extremely safe dose rate and the eradication of the disease in a closed epidemiological system is theoretically possible.

EFFECTIVITY OF TWO DOSES OF OXYCLOZANIDE
IN CATTLE NATURALLY INFECTED WITH FASCIOLA
HEPATICA (LINNÉ, 1758).

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Treatment of animals affected by Fasciola hepatica is a problem not totally solved due to the fact that some of the drugs used are very effective but toxic to the host, while other less toxic drugs have low efficacy on immature forms of the parasite. In this experiment, 60 hybrid Holstein cows were treated orally with Oxyclozanide pellets. The cows were divided into three groups with 24, 24 and 12 animals in each. The drug was administered in single doses of 3,4 g/cow and 20 mg/kg body weight to the first two groups, the third serving as an untreated control.

The animals were slaughtered post-treatment, and incomplete helminthological autopsy of livers was carried out.

The results were analyzed by Chi square test. Significant differences were found ($P < 0,02$) between the two doses used and between these and the control group, which shows that Oxyclozanide at 20 mg/kg was more effective.

FURTHER TRIALS WITH ALBENDAZOLE AGAINST
DICROCOELIUM LANCEOLATUM IN SHEEP

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In a previous trial, two treatments with albendazole with a week's interval had showed a 90% reduction in the egg production of D. lanceolatum. We wanted to see if only one treatment could produce similar results, and a single dose of 10 mg/kg bodyweight was given to 24 sheep in mid-November, 10 sheep were kept as control.

The results were based upon egg counts of faeces collected 6 times during the housing period.

One month after treatment the egg counts of the treated group were 82,8% lower than for the controls. On 25 April the counts were 69,6% lower in the treated sheep, however, both groups had increased counts in February.

To improve the result, two treatments of 7,5 mg/kg were given to all the previously treated sheep, on 25 April and one week later. The counts now decreased markedly for the treated as well as the controls, but the counts of the treated were 77,5% lower than in the other group on 2 May.

The results confirm that two treatments with albendazole is more efficient than a single dose against D. lanceolatum, and a dose of 10 mg/kg bodyweight given twice with a week's interval in the autumn is now recommended.

SESSION D4

Trematoda II
Papers 174-189

ELECTRON-MICROSCOPIC AUTORADIOGRAPHIC INVESTIGATION ON THE INCORPORATION OF ^3H -TRYPTOPHAN IN THE INTESTINAL WALL OF FASCIOLA HEPATICA

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An electron-microscopic autoradiographic study on the incorporation of ^3H -tryptophan in the intestinal wall of mature Fasciola hepatica has been carried out. It was established that distribution of traces depended on the incubation period of flukes in the medium with the labelled amino acid. The isotope was incorporated in the rough endoplasmic reticulum, as well as in the muscle layer, mitochondria, secretory granules and microvilli. An assumption was made that a protein or glycoprotein synthesis was carried out in the intestinal wall of Fasciola hepatica by means of a mechanism similar to that in the cells of vertebrates.

LIVER INJURY IN PROTEIN-ENERGY MALNUTRITION
AND FASCIOLIASIS. A LIGHT-MICROSCOPIC STUDY.

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Liver injury was studied after infection with F. hepatica and malnutrition of female rats "wistar", 150 $\pm$ 10 g, after 10, 30, 90, 180 and 240 days, divided into 4 groups: 26 rats fed on a.l.a standart diet; 50 rats fed on 60% of the st. diet; 50 rats fed on st. diet and infected with 15 metacercariae; 50 rats fed on 60% of the st. diet and infected with 15 metacercariae. The hepatic lesions observed in the groups 3 and 4 included extensive haemorrhagic necrosis on 30th day, and early development of cirrhosis. Cholangiohepatitis persisted in the malnourished group. Diffuse cellular atrophy and fatty degeneration showed the livers of the malnourished rats. The interaction of malnutrition and fasciolosis was regarded in respect to the liver injury found in the different periods of the experiment.

CHANGES IN THE QUANTITIES OF RNA AND DNA IN
THE LIVER DAMAGED BY THE FASCIOLA HEPATICA
INFESTATION

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The experiments on guinea-pigs, each infected with 20-25 F. hepatica metacercariae were carried out. Samples were taken from the damaged liver foci between the 2nd and 70th day p.i. at intervals of several days. The quantity of RNA was determined according to the spectrophotometric method of SCHMID et al. (1945) and that of DNA -to the colorimetric method of BURTON (1968).

From 18 determinations of the quantities of RNA and the same number for DNA, statistical significant differences were obtained in 5 cases for RNA and in 7 for DNA. In all these 12 cases the quantities of RNA and DNA diminished. A decrease of RNA and DNA was not established at the end of the experiment (on 58th and 70th day p.i.) suggesting the begin of regeneration.

Some differences between our biochemical results and histochemical ones are due to the fact that in the histochemical investigations the damaged nuclei give a more intensive staining for DNA but quantitatively less DNA for the biochemical investigations.

The causes for the diminished quantities of RNA and DNA in the invaded livers could be attributed to the degenerated liver tissue and disturbed synthesis of these compounds due to the excreted helminths' toxins.

COMPARISON OF PROTEASES FROM MATURE FASCIOLA HEPATICA AND PARAMPHISTOMUM MICROBOTHRUM

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Isolated and partially purified proteases from mature F. hepatica and P. microbothrium with respect to their specificity to substrates and inhibitors have been characterized. The protease from F. hepatica degraded optimally denaturated haemoglobin at pH 3.0. The proteolytic activity was inhibited by diazoacetylornleucin methyl ester, pepstatin, the pepsin inhibitor from Ascaris suum and phenylalanine. The tested cathepsin D inhibitor from potatoes, EDTA, mercaptoethanol and the inorganic salts had no inhibitory effect.

The leavage of the B-chain of oxidized insulin by the aforementioned enzyme was studied and compared with the digestion of the same substrate by chicken and pig pepsin.

The isolated active enzyme fraction from P. microbothrium represents a complex of proteolytic enzymes having an optimal activity on casein substrate at pH 6.2 - 8.4. EDTA, Ca^{++} , and Mn^{++} ions inhibit the enzyme activity, while mercaptoethanol stimulates the enzyme activity.

The differences in activity and the other characteristics of those proteases are probably in close connection with the localization and nutrition of the helminths in the host.

IMMUNOLOGICAL STUDIES OF ACIDIC
PROTEASE FROM FASCIOLA HEPATICA

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Sera against acidic protease from F. hepatica, partially purified by gelfiltration on Sephadex G-100 were obtained in rabbits.

The specific antienzymatic effect of IgG of these sera was studied. It was found that the complex of enzyme with antibodies inhibited its enzymatic activity and protected the enzyme against heat inactivation at 65°C.

Immunodiffusion of the protease from F. hepatica gave two precipitin lines against IgG of appropriate serum and did not reveal any precipitation with anti-A. suum and anti-T. spiralis-sera and IgG of serum to protease from Paramphistomum microbothrium.

IMMUNOLOGICAL STUDIES ON THE SPECIFICITY OF SOMATIC
ANTIGENS FROM *PARAMPHISTOMUM* SPP AND *FASCIOLA* *HEPATICA*

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The relationships between the whole worm somatic antigens of the trematodes *Paramphistomum* spp and *Fasciola hepatica* was examined by immunodiffusion in agar (Ouchterlony, 1962) using hyperimmune rabbit antisera.

Six antigen arcs were detected when the soluble extract from *Paramphistomum* spp was reacted with its respective rabbit antiserum. Immunodiffusion of rabbit antiserum of *F. hepatica* produced 4 precipitin bands when reacted with antigen of *F. hepatica*.

No cross reaction was detected when antigens from the two parasites were reacted with rabbit antiserum to the heterologous species using the technique of Zilber and Abelev, 1962. This demonstrates that the two trematodes have no antigenic relationship.

SEROLOGICAL STUDY DURING FASCIOSIS AND MALNUTRITION IN RATS

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The production of specific antibodies was studied in Wistar rats following infection with Fasciola hepatica combined with 40% malnutrition for 8 months.

It was established that on the 30th and the 90th day the production of complement-fixation-antibodies was significantly increased as compared with the controls. No remarkable difference was observed in the production of precipitins and reagins (IgE antibodies) in animals with fasciolosis combined with malnutrition and the control ones.

ALTERATIONS IN THE REPRODUCTIVE SYSTEM OF FEMALE AND
MALE MICE IN SCHISTOSOMIASIS MANSONI

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mans),

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Morphology and function of the reproductive organs were investigated in schistosomiasis mansoni on young female and male, infected and control mice. Macroscopic and histological examinations, hormone determinations in the blood sera with radioimmunoassay and an experiment on fertility were applied.

In infected females atrophy of the corpora lutea and formation of ovarian interstitial cells into "wheel cells" were observed. The progesterone serum levels were significantly lower in infected mice than in non-infected controls. A considerable atrophy of the uterus and the vagina were the consequences of these ovarian alterations. The LH levels in the serum of infected intact and infected ovariectomized mice were not different from those of the controls.

In infected males a decreased number of Leydig cells was found in histological preparations of the testicles. Testosterone in the serum and in the testicles and dihydrotestosterone in the serum were lower in infected mice than in non-infected controls. The values of LH and FSH in the serum of infected males were very low in comparison with those in the controls.

The fertility of infected females and males has decreased.

Exploration of the pathogenesis needs further examinations. The pituitary gland seems to be an important mediator in the alterations of reproductive organs in males. An open question remains whether these pathological changes observed in mice have any importance in schistosomiasis of man and livestock.

SCANNING ELECTRON MICROSCOPY OF INTEGUMENTAL SURFACE OF
SCHISTOSOMA SPINDALIS AND *S. NASALIS*.

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The integument of two cattle schistosomes, *Schistosoma spindalis* and *S. nasalis*, was examined for the first time by scanning electron microscopy. The results are compared with the structure of the integument of other cattle schistosomes and human schistosomes. The integument of male *S. spindalis* has numerous rounded depressions from which sensory cilia-like protruberances emerge. In contrast, the integument of male *S. nasalis* has numerous papillae protruding from the dorsal surface. These also appear to be sensory in function. The gynecophoric canals also show some differences in structure, i.e. the presence of spiny structures in *S. spindalis* and rod-like structures in *S. nasalis*. There was no marked variability in the structure of the integument of the females of both species. In general, the structure of the integument of *S. spindalis* and *S. nasalis* is similar to that of the human schistosomes and other cattle schistosomes. Some variation occurs i.e. the structure of the gynecophoric canal and the presence of sensory structures which vary with the species.

NEUROENDOCRINE COMPONENT IN DIGENETIC TREMATODES OF VETERINARY IMPORTANCE

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Neurophysiology and neuroendocrinology of digenetic trematodes is an area remaining largely neglected. Neurons, nerve-endings, neurosecretory cells in such parasites evaded detection for long till AChE, silver impregnation and thionine besides AF, PAVB and CHP techniques were applied. Neurosecretory cells (NSC) in cerebral ganglia and commissure; cirrus sac and Mehlis' gland complexes shown whereas their axonal pathway transporting NSM to target organ in oesophageal region was visualized in Ceylonocotyle scoliocoelium, a digenetic trematode from ruminants. For the first time bulk staining of neuroendocrine component in NSC, in situ, was adopted successfully. Variable cytoarchitectural nature of perikaryon in NSC shown, the latter indicating existence of periodicity in physiological activity of NSC, setting at rest the possibility of occurrence of A & B or α & β type of NSC. This stresses transformation of phases from one to another in the same NSC. Elaboration of nutrients needed for developmental growth is the role attributed to NSC. Possibility of hosts hormone - a factor influencing NSC activity also postulated.

PYGARGINEMOSIS OF CATTLE.

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The anatomic structure and life cycle, including development in the intermediate and definitive host, of *Pygarginema* and the aetiology of the disease, pygarginemosis, have been investigated. *Geotrupes stercorarius* Z. and *Gastercorarius amoenus*, Jacobs, were found to be the principal intermediate hosts. The possible existence of reservoir hosts for *Pygarginema* was established. Experiments are being performed to investigate the epizootiology, pathogenesis and clinical signs of the disease; pathologic-anatomic changes; *in vivo* and post-mortem diagnosis; and treatment and prophylaxis of the disease.

DEVELOPMENT OF EURYTREMA COELOMATICUM IN MICE

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Ten metacercariae of Eurytrema coelomaticum were orally given to each of 10 heterozygous nude mice (BALB/c:nu/+), 5 normal BALB/c mice (BALB/c:+/+), and each 20 mice of ICR-, dba- and SL-strain. Three to 10 of the flukes were found in the pancreatic duct of all of the BALB/c:nu/+ mice. Only one worm was found from one of the BALB/c:+/+ mice. No parasite was found from the mice of ICR-, dba- and SL-strain. The body-sizes of 112-, 130-, 153- and 265-days-old flukes obtained from BALB/c:nu/+ mice are 2.70~3.16, 2.78~4.74, 3.96~4.82, 4.80~6.44 and 6.55~10.20 mm, respectively. The size of 130-days-old fluke from BALB/c:+/+ mouse is small, 2.66 X 1.12 mm. The dimensions of the flukes collected from the experimentally infected mice were morphologically compared with those of the flukes from the infected goats. Twenty of the metacercariae which were sterilized by soaking in the saline solution containing antibiotics, were orally given to each of 7 nude mice (BALB/c:nu/nu) and 10 heterozygous nude mice. All of the mice were not infected with the flukes. It is conceivably possible that the metacercariae were changed to be infertile by the treatment.

EXAMINATION OF *ECHINOSTOMA* SPECIES FOUND IN EUROPE.

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Seventeen *Echinostoma* species, each with 37 collar spines, have been reported as parasites of birds and mammals in Europe. The majority of these echinostome species, isolated in Germany, Austria and England, have been described primarily by the morphological characteristics of the adults. Species such as *E. revolutum* and *E. paracolum* are considered well known and are recorded in almost all the European countries. However, their complete life cycle has not been studied.

The life cycles of echinostomes with 37 collar spines from Bulgaria, Poland, CSSR, DDR, Austria and England were completed experimentally and compared. These experiments were performed using standardized methods and laboratory reared intermediate and definitive hosts of similar age, size and origin. The results demonstrated: 1) There are definitely 2 independent *Echinostoma* species with 37 collar spines in Europe. 2) All the developmental stages of these two widely distributed species are entirely similar to those of *E. lindoense* and *E. audyi*. These latter two species have not been reported in Europe. Studies to answer these questions are in progress.

HIMASTHLA MILITARIS (TREMATODA ECHINOSTOMATIDAE) :
EFFECT OF LIGHT AND DARK ON THE TRANSMISSION-PHASE
MIRACIDIUM-FIRST-INTERMEDIATE HOST, HYDROBIA STAGNORUM.

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Himasthla militaris is a digenean which lives in the gut of the black-headed gull and the herring gull. The eggs of this parasite were obtained from adult trematodes which were isolated from the intestine of captured gulls, 2-3 weeks after experimental infection of these birds with metacercariae.

Eggs were incubated at room-temperature (20-25° C) under natural conditions of light and dark and in constant light and constant dark conditions.

70-90 % of the eggs develop to fully grown miracidia after 14-17 days, but concerning miracidial emergence this process seems to be stimulated by light, as under constant light conditions after 33 days of egg-incubation 80 % of the miracidia has emerged, while after the same period under normal circumstances and in constant dark respectively 33.3 % and 37.5 % of the larvae has left the egg.

In a 24 hour period the miracidia emerge between 9.00 and 16.00, with a peak at noon (11-12 : 42.40 %), and under conditions of artificially alternating light and dark almost all of the larvae are liberated during the light periods.

The presence or absence of light also influences the infection of the first intermediate host, Hydrobia stagnorum; for the infection-experiments of this snail with a miracidium we used laboratory-raised, parasite-free snails. Snails were infected in test-tubes -1 snail/1 miracidium - under constant light and constant dark conditions, with the snail either free-moving or isolated at the top or at the bottom of the tube : in the light, the infection-percentage was respectively 60 %, 15 % and 10 %, while in the dark the snails never became infected.

DETERMINATION OF INTERMEDIATE HOSTS OF POSTHARMOSTOMUM GALLINUM (WITEMBERG, 1923) UNDER CUBAN CONDITIONS.

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During a one-year period, molluscs of various species from a holding on the outskirts of Havana were collected. This holding was known to be infested with Postharmostomum gallinum.

The molluscs were classified by the Dept. of Malacology of the Academy of Sciences of Cuba.

One-hundred specimens of each species were investigated monthly by the crushing technique, and were then observed microscopically.

Certain larval stages with biological characteristics pertaining to P. gallinum were found in the following species of molluscs: Paraticulella griseola, Subulina octona, Succinea sagra, Sachrysia auricon, Bradebaena sp. and Varonicella floridae.

Biological confirmatory tests were carried out, revealing the accuracy of the morphological diagnosis of the larval stages and their invasiveness. An assessment is made of the importance of these findings in relation to the movement of the trematode in our country.

LIFE CYCLE STUDIES ON DIPLODISCUS AMPHICHRUS
TUBANGUI, 1933

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Life cycle of Diplodiscus amphichrus Tubangui, 1933 has been completed in the laboratory. Specimens of Segmentina sp. were found liberating cercaria of Diplodiscus amphichrus. They encysted on the skin castings of frog. Cysts were fed to clean Rana cyanophlyctis Schneider and adult D. amphichrus were obtained from their gut. Miracidia hatched from the laid eggs and penetrated clean specimens of Segmentina sp. Rediae were obtained from hepatopancreas of infected snails. Life history stages viz., miracidium, redia, cercaria, metacercaria and adult were studied in detail.

SESSION D5

Protozoa III
Papers 190-198

THE ULTRASTRUCTURE OF THE SPOROZOITES OF BABESIA MICROTI IN SALIVARY GLANDS OF NYMPHAL IXODES RICINUS TICKS. - A CONTRIBUTION TO THE TAXONOMY OF "NUTTALLIA"-TYPE PIROPLASMS

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Salivary gland stages of a "Nuttallia"-type piroplasm were examined by electron microscopy for the first time. Unfed nymphs of Ixodes ricinus were collected in the field and fed on rabbits in the laboratory. The resulting adults were fed on cattle. Specimens of the succeeding larvae generation were applied to a Golden Syrian hamster which had been infected with Babesia microti (strain "Hannover I") by inoculation of parasitized blood. Nymphs of the 1st laboratory generation were fed on a rabbit for about 30 hours and then dissected. Their salivary glands were removed, embedded for electron microscopy and examined for stages of Babesia. Mature schizonts consisting of abundant differentiated sporozoites were found in very small numbers. The sporozoites have a triple-membraned pellicle of the coccidian type, the inner double-membrane of which shows different-size discontinuities. Micropores, subpellicular microtubules, a polar ring, and a conoid are lacking. There are numerous small rhoptries and a single, very large rhoptry. Eventually, a few spherical bodies which might be micronemes are present. A mitochondrion was observed in most sporozoites.

The ultramorphological findings are compared with those in sporozoites of other piroplasm species. The sporozoite is regarded as a taxonomically characteristic developmental stage in this parasite group. According to the morphology of its sporozoites B. microti is a Babesia-type piroplasm. However, because of the obvious lack of transovarial transmission in the tick vector, it is proposed to remove this parasite from the genus Babesia.

THE RESPONSE OF THE POSTERIOR SUPERFICIAL CERVICAL (PRESCAPULAR) LYMPH NODE OF THE CATTLE TO BABESIA BIGEMINA

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The primary and secondary responses of the prescapular lymph node were studied following the injection of *B. Bigemina* intradermally, subcutaneously or directly into the afferent lymphatic vessel. Cannulation of the afferent and efferent lymphatic vessels of the node allowed direct injection into the node and collection of lymph over long periods of time from the conscious animal.

An immunological reaction characteristic of many parasitic infections is an increase in levels of total IgG and of IgE specific for parasitic antigens. There is evidence that immediate hypersensitivity reactions may be associated with the pathology of parasitic infections but the mechanisms of such reactions have not been investigated conclusively.

When the prescapular lymph node was challenged by injecting infected blood by the several routes mentioned above, there was usually an immediate increase in erythrocyte count and haemoglobin concentration in the efferent lymph. This was generally followed by a decrease in output of all cells, SHUT-DOWN PHENOMENON, which may last up to 2 hrs, after which there was an increase in rate of flow of lymph. The small and medium size lymphocyte numbers increase for the first two days, after which there was a conspicuous increase in blast cells.

The lymph node shows considerable enlargement due /of primarily to increased concentration/plasma cells in the medulla and pyroninophilic blast cells mainly in the paracortical zones, associated with the appearance of germinal centers especially at the time of secondary response.

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ROLE OF SOME MICROELEMENTS IN THE EPIZOOTIOLOGY OF
CATTLE PIROPLASMOSIS.

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It was established that the occurrence of the tick vectors of cattle piroplasms and the presence of parasitized and susceptible animals did not always result in a clinical picture of piroplasmosis. Analysis disclosed a deficit of certain microelements in the soil of all areas where clinical cases of bovine babesiosis were seen (Kolabski, 1978).

In East Georgia disease in cattle due to the piroplasms, including *Theileria*, is often recorded. However, in West Georgia, where the tick vectors of *Theileria* and parasitized cattle both occur, disease is not recorded. Therefore, we investigated the levels of microelements in the soil, water and feed of cattle in different areas of Georgia. The results demonstrated an acute deficit in manganese, cobalt, copper and zinc in Signakhi (East Georgia). The levels of these microelements were much greater in Abkhazia (West Georgia).

ROLE OF BLOOD-SUCKING ARTHROPODS IN THE
TRANSMISSION OF EPERYTHROZON SUI IN
SWINE

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Transmission of Eperythrozoon suis was attempted in splenectomized pigs by hog lice (Haematopinus suis) and stable flies (Stomoxys calcitrans). Transmission of E. suis was not accomplished after several replications of taking hog lice and stable flies fed on carrier pigs and transferring them to susceptible pigs. However, lice and flies previously fed on a carrier pig were dissected and E. suis parasitized erythrocytes found in their midgut. In addition, successful transmission was accomplished by taking ground, fed lice mixed with physiological saline and injecting the suspension into a susceptible pig. Transmission with injections of ground, fed stable flies was not successful, however. Further trials were being conducted with hog lice and stable flies. In addition, E. suis transmission studies were being made with Culex sp. mosquitoes.

BLOOD PROTOZOAN PARASITES OF PIGS IN NIGERIA

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The most important parasitic diseases of domestic livestock in Nigeria are probably the blood parasites. Although hidden losses in helminthiasis and ectoparasitism also constitute a problem, the obvious losses arising from blood parasitism appear to be more important. Apart from trypanosomiasis, little information is available regarding the clinical manifestation of other blood parasites of pigs in Nigeria.

Sporadic outbreaks of pig trypanosomiasis occur commonly in the Eastern and Western States of the country. T. simiae cause per-acute to acute disease while T. brucei and T. congolense cause sub-acute and chronic disease respectively. Mixed infections frequently occur. Okon (1976) recorded an incidence of 17.8% of Babesia trautmanni and 55.6% of Eperythrozoon suis infections, with a higher incidence of the latter in older pigs. Recently blood protozoan parasites of pigs was investigated in Ibadan, Babesia perroncitoi and Eperythrozoon suis were identified. Although no clinical disease was recorded, Eperythrozoon spp are probably responsible for unthriftiness in pigs in Nigeria. The importance of these parasites in Nigerian pigs is currently under assessment. A crucial task aimed at restricting losses attributed to these important blood parasites lay ahead in Nigeria and the adoption of a comprehensive control programmes seems to be the answer.

EXAMINATIONS ABOUT CRYPTOSPORIDIAL INFECTION IN THE CALF

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The feces of 320 calves aged from 1 to 35 days post partum were examined for Cryptosporidia. The rate of infection was 5% in clinical healthy calves, 25% in calves with diarrhoea, and 58% in calves perished by acute enteritis. In Giemsa-stained smears of feces the protozoan appear mainly as round not stained organisms of approximately 5 μ m in diameter.

A connection between the occurrence of Cryptosporidia, Rotavirus, and enteropathogenic Escherichia coli strains could not be proved in calves with diarrhoea. In positive animals there could be demonstrated stages of the endogenous development of Cryptosporidia in the whole area of the small intestine especially in the ileum. Differentiable are schizonts with 2,4,8 nuclei, ripe schizonts with banana-shaped merozoites, micro- and macrogamonts, and oocysts.

ACQUIRED RESISTANCE TO SUPERINFECTION IN CUTANEOUS LEISHMANIASIS

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Previous studies on the spread of Leishmania mexicana amazonensis in intracardially inoculated (i.c.) hamsters have shown the presence of nests of amastigotes in the spleen, established a few hours post-infection and persisting 3-4 months, as well as metastatic cutaneous lesions (OCHOA and ARCAY, 1978).

Four groups of 6 each month-old hamsters were treated as follows: I) inoculation i.c., followed by dorsal subcutaneous inoculation (d.s.c.) 15 days later; II) i.c. inoculation; III) d.s.c. inoculation; IV) Control: s.c. inoculation in the paw. On sacrifice of 1 animal from each group at intervals of 4 and 15 days and 3 and 4 months post-inoculation, nests of amastigotes were seen in the spleen in Groups I, II and III, but not in control group. Group II (i.c. inoculation only) showed metastatic lesions in the paws, tail, muzzle and scrotum at 1 month post-inoculation, while Groups I, II and IV showed no cutaneous lesions for a period of 6 months, and only 1 hamster from Group III showed a papule on the muzzle after this time. Mortality after 10 months was 4/6 in Group I, 6/6 in Groups II and IV, and 0/6 in Group III. The inocula consisted of 0.2 ml each of a suspension of 4×10^6 amastigotes in sterile saline, derived from a homogenate of a leishmanial granuloma from the paw of an experimentally infected hamster, plus penicillin and streptomycin. The viscera of the sacrificed animals were fixed in 10% formol, sectioned at 4 micrometers, and stained with Gomori's Trichrome.

**IMMUNOLOGICAL STUDIES ON TRYPANOSOMA EVANSI IN RATS
BY THE TREATMENT OF DEXAMETHAZONE.**

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The present investigation is an attempt to study the role of Dexamethazone in the immune response of the experimental albino rats by a most virulent pleomorphic strain of *trypanosoma evansi* collected from the naturally infected cattle. The administration of dexamethazone at a dosage of 0.5 mg/250 g body wt., showed that the prepatent period was very much reduced and the parasitemia was higher than the controls. When the rats were administered with the sera collected from the rats treated with berenil, antrycide prosalt and also the hyperimmune sera, the prepatent period was slightly extended but in all, the infection reached to the peak on the 4th day. When the rats were given the drug treated sera without dexamethazone the prepatent period was highly extended and in hyperimmune serum the infection never appeared.

The results offer a basis to explain the early higher level of parasitemia and the delayed antibody formation to permit the infection and to kill the host by the dexamethazone treatment. Partial resistance was developed by the drug treated rats sera but the infection appeared due to the alteration in the parasite protein. The protective immunity was acquired by the hyperimmune serum.

AN EVALUATION OF THE PROTECTIVE IMMUNITY TO
TRYPANOSOMA EVANSI INFECTION.

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The experiment was designed to evaluate the protective immunity in the albino rats to Trypanosoma evansi infection by injecting sera collected from the T. evansi infected cattle, dogs, rats and also sheep red blood cells, spleen cells of the normal rats and the killed trypanosomes. The sera were showing different agglutination titers against the trypanosomes. Each rat was given 0.5 ml of the above mentioned sera and cells intraperitoneally. After 24 hours washed trypanosomes at a concentration of 5×10^7 ml were inoculated ip. The rats treated with cattle and dog sera showed no change in the prepatent period but the survival time prolonged to 10 days and 5 days respectively. However, the hyper-immune sera has given total protection. In contrast the SRBC, spleen cells and killed trypanosomes treated rats showed prolonged prepatent period but the survival time was similar to the control.

The results of this investigation suggests that there is an agglutinating antigen and a separate protective antigen in T. evansi which produced separate antibodies in different animals because the agglutination titers were not directly associated with the increased survival time. Similarly the different cells treated rats were producing antibodies which are prolonging the prepatent period but giving the protective immunity.

POSTERS

Miscellaneous
P1-P7

SENSITIZATION AND ITS CONSEQUENCES IN ANIMALS INFECTED WITH HELMINTHS.

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Helminths sensitize animals and thus potentiate the danger of immediate and delayed type hypersensitivity reactions in animals. This hypersensitive state may persist for many months in the absence of any clinical signs. It is detected by a variety of tests which detect reaginic (IgE) antibodies. These have a specific protective role and at the same time induce pathogenic processes in animals. Allergic reactions are associated with antigen-antibody reactions and the release of histamine and histamine-like substances. Histamine levels in the visceral organs (liver, lungs) of infected animals are usually much higher than those of normal animals. Reaginic antibodies peak 10 days after infection and considerable disorders in histamine metabolism occur when reaginic antibodies appear in the serum.

THE ENZYME LINKED IMMUNOSORBENT ASSAY(ELISA)
IN THE SERODIAGNOSIS OF TRICHINELLOSIS IN
NATURALLY INFECTED PIGS

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The sensitivity and reliability of ELISA was studied in natural trichinellosis of pigs and was compared with those of the IFAT (tube test), trichinelloscopy and the digestion method. In ELISA a crude saline extract of T. spiralis larvae served as antigen. The conjugate (sheep antiporcine IgG, labelled with horse radish peroxidase) was obtained from N.I.P.H, Bilthoven, The Netherlands. The substrate was 5-amino salicylic acid. The results were assessed by eye. Studied were 14 naturally infected pigs, originating from an outbreak of T. spiralis infection in a village in Croatia. Antibodies were detected by ELISA in 8 pigs. The highest titer was 1:1280, and the lowest 1:40. The IFAT gave positive titers (1:10 - 1:40) in 7 pigs. One IFAT-positive animal was parasitologically negative, and one IFAT-negative animal was parasitologically positive. Trichinelloscopy yielded positive results in all ELISA-positive animals. With the digestion method larvae were demonstrated in 8 ELISA-positive animals.

SEASONAL AND SPATIAL COEXISTENCE OF CAPILLARIA OVOPUNCTATA AND CAPILLARIA EXILE IN THE ALIMENTARY CANAL IN BLACKBIRD - TURDUS MERULA.

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In the 1973-80 years parasitological sections were carried out on 447 individuals of T. merula of different age: 107 nestlings /pullus/, 97 young birds /juvenis/ and 243 adult.

In the Capillariidae family the most frequent threadworms were C. ovopunctata /38,2%/ and C. exile /10,7%/.

The dependence of age, seasonal changes and localization in the alimentary canal of T. merula has been analyzed. A clear tendency toward substitution of the threadworm species in hosts has been detected.

C. ovopunctata has been found with highest frequency in adult birds /extensiveness 50,6%, mean intensity 35,2/ and with the lowest in pullus /ext. 3,7%, mean int. 0,1/.

C. exile mostly was found in pullus /ext. 14,1%, mean int. 4,2/ and juvenis ; in adult the ext. was only 2,5% and mean int. 0,3.

C. ovopunctata in most cases was localized in the final part of alimentary canal - ileum /39,9%/, while C. exile in duodenum /46,6%/. Only in 21 bird individuals mixed invasions of these species has been detected. In that case the localization of parasites was the same like above.

C. ovopunctata has been found during the whole year, but in May, September and February the extensiveness and intensity of invasion was higher. C. exile has been only from April to October in the host organism with low extensiveness and intensity observed.

MORPHOLOGY AND BIOMETRY OF BITING LICE FROM *PHASIANUS COLCHICUS* L.

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958 males, 1399 females and 2117 nymphs collected from pheasants in the lower Silesia region were examined. Metrical data indicated a low individual variability. For example, the ratio of variability in the body length of the imago and nymph was 3-6% and 4-11%, respectively.

The developmental stages of nymphs were differentiated on the basis of metrical and morphological features. In the Amblycera some groups of short hairs, located on the latero-ventral region of the 4-6th segment of the abdomen, were chosen as diagnostic features. In the Ischnocera, the chaetotaxy of the postero-dorsal margin of the pterothorax was included also as a diagnostic feature. Sexual dimorphism in the morphology of the antennae was detected in third instar nymphs of *Lipeurus maculosus maculosus* and *Reticulipeurus mesopelios colchicus*.

PARASITE BEHAVIOURAL FACTORS IN ARTHROPODS
CONTROL IN POULTRY

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The toxicity of membromvinphos /code name IPO-63/ against arthropods have been studied. The tested chemical was synthesized in Poland. This work was carried out with Eomenacanthus stramineus, Menopon gallinae, Goniocotes gallinae, Dermanyssus gallinae and Ceratophyllus gallinae. In the preliminary tests the survival of several species on hen's feathers was examined. The IPO-63 was tested on arthropods collected from birds. Mean lethal concentration /LC₅₀/ of the compound was determined, which gets at 0,02-2,00%. The most sensitive to IPO-63 appeared to be M. gallinae and E. stramineus, which in vitro can survive 2-5 days. A little less sensitive occurs to be D. gallinae. These parasites were lightly sclerotized as species mentioned above, but their viability was at least two times longer. The most resistant to the IPO-63 were G. gallinae and C. gallinae, which characterized long viability in vitro and high degree of sclerotisation. The results of studies on the IPO-63 efficiency both in vivo and in vitro corresponded.

MODERN ASPECTS OF TOXICOLOGY OF ANTHELMINTICS.

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Classification of the techniques used to evaluate the danger of chemical components, including anthelmintics, is extremely important in modern toxicology. This classification is based primarily on the rate of LD₅₀. In the USSR a strict classification, approved by the special department of the United Committee of WHO on the problems of professional hygiene, has been adopted. In other countries, although the toxicological characteristics of chemical compounds are based on the LD₅₀, the classification is not as strict (Hodge and Sterner, 1943). In the USSR, the cumulative properties of chemical compounds are evaluated according to the coefficient of cumulation (C cum) (L.I. Medved., 1974). In recent years teratogenicity and residues of anthelmintics in milk, meat, byproducts, eggs and fat for human consumption have become extremely important. Biochemical, chemical, physico-chemical and radiological methods (the latter two methods being particularly sensitive and highly specific) are used for the detection of residues of compounds.

THE PREVALENCE OF COENURIASIS (GID) IN SHEEP IN
BRITAIN, AND THE AGE GROUP AT RISK

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Details are given of the prevalence of *Taenia multiceps* in foxes, dogs and sheep from surveys done in North (Edwards et al., 1979 a and b); South (Williams, 1976 a, b and c) and Mid Wales (Hackett and Walters, 1980, 1981) and from the results of post-mortems on sheep performed in Veterinary Investigation Centres throughout the United Kingdom.

The post-mortem data confirm the observations of Edwards and Herbert (in press) that young lambs are most susceptible to infection and that age resistance develops very rapidly, this coinciding with the period during which lambs start to ruminate. The period between ingestion of oncospheres and development of chronic coenuriasis (gid) is very variable but the majority of cases occur in animals of 0.5 - 1 year > 1-2 years of age. Thus, store lambs, ewe and ram lambs are most likely to die of this infection and the data demonstrate the risks involved to animals of this age group where gid is endemic.

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