AMERICAN ASSOCIATION OF VETERINARY Parasitologists

JULY 17, 1978
DALLAS CONVENTION CENTER
DALLAS, TEXAS

PROGRAM AND ABSTRACTS

SHORT REPORTS:

8:15–10:00 FOOD ANIMAL PARASITES

10:15–12:00 COMPANION ANIMAL PARASITES

SPECIAL TOPICS:

1:30–2:15 PATHOPHYSIOLOGY OF CANINE HEARTWORM DISEASE
R.E. LEWIS, C.A. RAWLINGS, J.W. McCALL, UNIVERSITY OF GEORGIA, ATHENS, GA.

2:15–3:00 ARRESTED DEVELOPMENT OF OSTERTAGIA OSTERTAGI IN CATTLE: CURRENT CONCEPTS
J.C. WILLIAMS, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LA.

3:15–4:00 NEW AND IMPROVED METHODS FOR ECTOPARASITE CONTROL IN CATTLE.
E.C. LOOMIS, UNIVERSITY OF CALIFORNIA, DAVIS, CA.

HIT THE TRAIL FOR TEXAS!

The American Association of Veterinary Parasitologists meets this year in conjunction with the American Veterinary Medical Association in the Dallas Convention Center, Room E-405, on Monday, July 17, 1978, Dallas, Texas. The program includes three invited papers in addition to a regular morning paper session.

For early arrivals, coffee and pastries will be available at 7:45 a.m. in the meeting room. AAVP membership dues for 1978-1979 ($3.00) are payable at that time. Participants who are not members of the AVMA will not be required to register for the AVMA Convention. Following last year's successful precedent, a happy hour will again be held after the 4:00 p.m. Business Meeting in the room of our Vice-President, Dr. E. L. Roberson.

SHORT REPORTS

8:10 am OPENING REMARKS
N. F. Baker, AAVP President

8:15 EFFICACY OF OXFENDAZOLE AS A SWINE ANTHELMINTIC
R. M. Corwin, Columbia, MO

8:30 INFLUENCE OF PLASMA ESTERASE ON ANTHELMINTIC ACTION OF HALOXON IN SHEEP
N. F. Baker and R. A. Fisk, Davis, CA

8:45 A COMPARISON OF THE PREVALENCE OF DICTYOCAULUS VIVIPARUS IN CATTLE AND ELK IN WYOMING
R. C. Bergstrom, Laramie, WY

9:00 STUDIES ON THE MODE OF ACTION OF A FASCIOLICIDE DIAMFENETIDE
R. S. Rew and P. A. Madden, Beltsville, MD

9:15 AN OUTBREAK OF TAENIA SAGINATA CYSTICERCI IN GRAZING STEERS IN VIRGINIA
B. Hammerberg, G. MacInnis and T. Hyler, Blacksburg, VA

9:30 UNUSUAL TAPEWORM LESIONS IN PORCINE LIVERS FOUND AT POST-MORTUM
D. Zinter, Beltsville, MD

9:45 EVIDENCE FOR A CELL-MEDIATED IMMUNE RESPONSE IN AVIAN COCCIDIOSIS
J. J. Giambrone, P. H. Klesius and S. A. Edgar, Auburn, AL

10:00 COFFEE BREAK

10:15 ONCHOCERCIASIS IN MICHIGAN: SEASONAL PERIODICITY AND CHARACTERISTICS OF MICROFILARIAE
A. Shearer, R. W. Leid and J. F. Williams, E. Lansing, MI

10:30 CHRONOLOGY OF CHANGES IN CATS INFECTED WITH AELUROSTRONGYLUS ABSTRUSSUS
J. J. Hubbell, A. K. Prestwood, J. M. Losonsky, M. B. Mahaffey and J. A. Barsanti, Athens, GA

10:45 HEPATOZOON CANIS IN TEXAS DOGS
T. M. Craig, J. E. Smallwood, K. W. Knauer and J. P. McGrath, College Station, TX

11:00 HYPOBIOSIS OF CANINE HOOKWORMS
G. A. Schad, Philadelphia, PA

11:15 EFFICACY OF REDUCED DOSAGES OF BUNAMIDINE HCl AGAINST DIPYLIDIUM CANINUM IN LARGE DOGS
E. L. Roberson and T. M. Burke, Athens, GA

11:30 EFFICACY OF GRANULAR FENBENDAZOLE AGAINST NATURALLY OCCURRING HELMINTH INFECTIONS IN DOGS
T. M. Burke and E. L. Roberson, Athens, GA

11:45 CHANGES IN SERUM PROTEIN LEVELS DURING THE COURSE OF TREATMENT FOR CLINICAL DEMODICOSIS
G. Kubat, H. Jordon and J. Homer, Stillwater, OK

12:00 LUNCH

1978 PROGRAM COMMITTEE

J. B. Malone, Chairman
G. W. Benz
D. K. Hass

1. Efficacy of Oxfendazole* as a Swine Anthelmintic

R.M. CORWIN

Oxfendazole (Synantic^{R}) reportedly has broad spectrum anthelmintic activity in horses, sheep, cattle and swine. During 2 trial periods, oxfendazole was administered as a feed additive to feeder pigs. The results of the first trial were reported in AJVR (April 1977) and concluded that a dose of 3.0 mg/kg body weight given once was as effective in the removal of adult Ascaris, Oesophagostomum and Metastrongylus as were larger doses of 9.0 and 18 mg. Results were variable at all 3 dose levels against Trichuris.

The purpose of the second trial period was to pinpoint a specific dose level which was most efficacious. One hundred fourteen (114) pigs were allotted to 7 experimental groups which represented dose levels of 0, 1.5, 3.0, 3.75, 4.5, 6.75, and 9.0 mg/kg. Oxfendazole was efficacious at 1.5 mg/kg against Ascaris (99.9%) and Oesophagostomum (100%) and at 6.75 mg/kg against Metastrongylus (98.4%). Efficacy against Trichuris was again variable.

*Oxfendazole, Syntex Research, Division of Syntex (USA) Inc., Palo Alto, CA.

2. Influence of Plasma Esterase on Anthelmintic Action of Haloxon in Sheep

N. F. BAKER, R. A. FISK

It has been demonstrated (Baker et. al., Am. J. Vet. Res. 31, 1970, 865-871) that the presence of an A-esterase (EsA+) in the plasma of sheep protected them against the neurotoxic signs produced in sheep without the plasma A-esterase (EsA-). Since the protection may be related to the hydrolysis of haloxon, it is important to determine if the presence of the esterase might result in a lower anthelmintic efficiency in EsA+ sheep than in EsA- sheep. One hundred and sixteen lambs were utilized in three controlled anthelmintic trials. Two groups of control lambs, EsA+ and EsA-, and 2 groups of treated lambs, EsA+ and EsA-, were utilized in each trial. The 3 dosage levels of haloxon tested, one level was tested in each trial, were 20, 25, and 35 mg/kg body weight. The nematodes against which haloxon was tested were Ostertagia circumcincta and Trichostrongylus axei in the abomasum, and T. vitrinus, T. colubriformis, Nematodirus spathiger, and N. filicollis in the small intestine. No difference in anthelmintic efficiency of haloxon attributable to the presence of plasma A-esterase was detected.

3. A Comparison of the Prevalence of Dictyocaulus viviparus in Cattle and Elk in Wyoming.

R. C. BERGSTROM

Lungworms, Dictyocaulus viviparus (Bloch, 1782), of cattle are found rarely in Wyoming. Conversely, the same nematode species (a different subspecies ?) is found in elk in the state at all times of the year. During the past 20 years only 2 cases of bovid dictyocaulosis have been detected by routine analysis of about 9,000 fecal samples at the Wyoming State Veterinary Lab. How-

ever, a herd of yearling Hereford bulls northeast of Jackson, Wyoming, in heavily used elk range, was found positive for D. viviparus during the spring of 1969. After treatment no additional cases of dictyocaulosis have been found in that or adjacent bovine herds. Elk near Jackson and in other herds of the state are "loaded" with lungworms during the spring. Eighty per cent of the elk in some herds are positive during the month of May. However, by October and November of each year fewer (15-22%) elk carry the infection. Prior to 1971 about 50-200 elk, mostly yearlings and cows, remained on the National Elk Refuge at Jackson during the summer. Numbers of lungworm-positive elk was very high (over 90%) in that group throughout the spring, summer and fall. Since 1972, the elk have been driven off the refuge during the summer and about 10% decrease in prevalence of lungworm infections has been noted. When large numbers of elk winter on the refuge it appears that more animals are infected (~ 75% as compared to ~ 57%) than when fewer elk are present. Pathological changes associated with D. viviparus infections were similar in cattle and elk.

Published with the approval of the Director, University of Wyoming Experiment Station as S. A. 893 .

4. Studies on the Mode of Action of a Fasciolicide Diamfenetide

R.S. REW and P.A. MADDEN

Diamfenetide, a diphenoxy alkane, is effective against Fasciola hepatica in ruminants especially against the immature, liver-stage worms (Rew et al., 1978). Though the diphenoxy alkane is active 'in vivo', only the deacylated dibenzylic amine is active 'in vitro'. Incubation of F. hepatica removed from rabbits, sheep, or cattle with diamfenetide (amine) 'in vitro' caused a contracted paralysis. This was a slowly developing paralysis which was dependent upon concentration of drug and age of worms. Immature worms (less than 6 weeks p.i.) were paralyzed by $1X10^{-5}M$ diamfenetide (amine) in one hour 'in vitro'. Adult worms (more than 14 weeks p.i.) required $1X10^{-4}M$ drug for paralysis in one and one-half hours. Carnitine or betaine (.012M) delayed the paralysis. Ultrastructurally, a "blebbing" response was visualized on the integument of the treated worms. Glucose transport was inhibited 'in vitro'. Inhibition of transport was more complete at equivalent drug concentrations in younger worms. The physiological mode of action of diamfenetide may be a result of one or a combination of several of these observed effects.

5. An Outbreak of Taenia saginata Cysticerci in Grazing Steers in Virginia

B. HAMMERBERG, G. MACINNIS, T. HYLER

Eighteen of forty pasture-reared steers on a city prison farm in south central Virginia were found to have cysticerci at the time of slaughter. These steers were born, weaned, and raised on pasture and ranged in age from 8 months to 3 years at slaughter. All of the animals came off pastures which received applications of city sewage sludge on a regular basis. Examination of sludge revealed intact parasite ova including cestode eggs. Numbers of cysts per animal were from one to 15 and were found in heart, diaphragm, tongue, pillar of the diaphragm, biceps, masseter, round, mylohyoideus, and esophagus in decreasing order of frequency. Differential

leukocyte counts at slaughter did not show consistant eosinophilia in infected steers. Based on these observations the potential for similar conditions, favorable for cysticercosis in cattle, existing elsewhere in the United States are evaluated.

6. Unusual tapeworm lesions in porcine livers found at post-mortum.
D. Zinter

Three cases containing tapeworm lesions in the liver of swine are presented. In one case the cysts were viable and the other two were dead and degenerated. Based on the size and shape of the hooklets found in two of the cases, Echinococcus sp. is suspected of being the etiologic agent.

7. Evidence for a Cell-mediated Immune Response in Avian Coccidiosis.
J. J. Giambrone, P. H. Klesius, S. A. Edgar

A cell-mediated immune (CMI) response to oocyst antigen extracts of Eimeria necatrix was shown in Single Comb White Leghorn chickens vaccinated with a commercially available coccidiosis vaccine (CocciVac) by delayed hypersensitivity (DH) and lymphocyte blastogenesis. A particulate oocyst antigen from E. necatrix gave positive DH wattle reactions in 10 of 20, 9-week-old chickens vaccinated at 4 weeks of age and 10 of 20, 31-week-old chickens which received 3 additional vaccinations at monthly intervals starting at 18 weeks of age. In contrast, only 4 of 20, 31-week-old chickens which received the 3 additional vaccinations gave positive lymphocyte blastogenesis reactions with blood derived leukocytes against alakali soluble oocyst antigen extracts from the particulate oocyst antigens. The 40 control chickens which did not receive CocciVac did not produce significant DH reactions, although 1 of 20, 31-week-old control chickens did produce a positive lymphocyte blastogenesis response. The ability of the chickens to mount a measurable CMI response to oocyst antigens did correlate with disease resistance. All chickens which produced a significant CMI response were totally refractory to challenge with virulent E. necatrix, while all unvaccinated chickens which failed to produce a CMI reaction were susceptible to challenge. In addition, 3 of 10 and 2 of 10 vaccinated chickens which did not produce a significant CMI response at 9 and 31 weeks of age, respectively, were susceptible to challenge.

8. Onchocerciasis in Michigan: Seasonal Periodicity and Characteristics of Microfilariae
A. SHEARER, R. W. LEID, J. F. WILLIAMS

A survey was undertaken to determine both the prevalence and geographical distribution of Onchocerca cervicalis in horses and ponies within the state of Michigan. From August 1977 to May 1978, skin samples weighing 5-10 gm were obtained from the umbilical region of 132 animals (range 5-28 animals/month, $\bar{x}$ 13.2) at necropsy. Samples were cut into 5 mm^3 pieces and incubated overnight at 37°C in sterile saline. The fragments were filtered out and the fluid spun down. The sediment was resuspended in 10 ml of 2% formalin and gently forced through an 8 μ filter and examined for the presence of microfilariae. If present, the number of microfilariae were counted and expressed in terms of microfilariae per gram of tissue (wet weight). The prevalence progressed from a high of 80% in August 1977 to a low of 8% in December 1977 and gradually increased to 42% in May 1978. Horses between the ages of 11 to 20 years presented with the highest infection rates (66%). Mares of all ages appeared to have a higher incidence of infection when compared to stallions (32%-24%). Interestingly, a foal at 6 months of age was observed as positive

although at a low level of infection. Microfilariae levels ranged from less than 1 organism/gm of tissue to greater than 44,000/gm of tissue. Intensity of infection appeared not to be related to time of year at which skin sections were obtained. Duplicate aliquots of positive samples were stained and examined for acid phosphatase activity. Microfilariae were found to contain 4 distinct and spatially separated regions that showed substrate cleavage. Three of these were densely staining compact areas with the remaining one a rather diffuse band. Microfilariae were subjected to density gradient centrifugation on 10-30% linear gradients of metrizamide. The living microfilariae banded between 17-20% (w/v) and were uncontaminated with host cellular components. Supported in part by Rockefeller Fdn. Grant # GA-HS-7735

9. Chronology of Changes in Cats Infected With Aelurostrongylus abstrusus

J.J. HUBBELL, A.K. PRESTWOOD, J.M. LOSONSKY, M.B. MAHAFFEY, J.A.BARSANTI

Twenty domestic short-haired cats, 6 to 12 months old, free of detectable lung disease via chest radiographs, and parasite free via Baermann procedure and floatation, and FeLeuk negative, were infected per os with 100 L1 larvae of Aelurostrongylus abstrusus.

These cats with 3 controls were followed for 6 months as to physiological changes monitored by EKG, radiographic changes, peripheral blood smears, fecal examination and serum electrophoresis.

All cats were necropsied at different times throughout the 6 month period.

10. Hepatozoon canis in Texas dogs

T.M. CRAIG, J.E. SMALLWOOD, K.W. KNAUER
J.P. McGRATH

Gametocytes of Hepatozoon canis were identified in circulating neutrophils of three dogs admitted to the Small Animal Clinic at Texas A&M University. The dogs, from different parts of the state, were depressed, reluctant to move, anorexic and had intermittent fever. All of the dogs had marked neutrophilic leucocytosis and two of the three exhibited periosteal new bone reaction on the vertebrae, ilia, ribs and limb bones proximal to the carpus and tarsus. The only known vector of H. canis, Rhipicephalus sanguineus is widespread in North America. Hepatozoon canis has never before been described in dogs in the western hemisphere, however, species of Hepatozoon parasitizing reptiles, rodents, mustelids and procyonids have been described. Some of these species of Hepatozoon may be synonoymous with H. canis. Treatment was pallative and may have served to increase circulating parasitemia. After a period of time all of the dogs improved in condition and are no longer exhibiting clinical signs of disease. The importance of H. canis as a pathogen is still speculative, but the striking similarity of clinical signs, radiographic and hematologic findings certainly warrants further investigation.

11. Experimentally induced hypobiosis in Ancylostoma caninum infections of pups

G.A. SCHAD

Larvae of a strain of Ancylostoma caninum isolated in Baltimore, Maryland were cultured in Harada-Mori tubes at 28°C with 11 h light and 13 h darkness daily. Upon reaching infectivity they were stored under temperature regimes simulating autumnal conditions. Similar conditioning had been shown to induce an increased potential for hypobiosis among the parasitic stages of some other species of nematodes. Male, 2-month-old, hookworm-naive beagle pups were infected by gavage with the conditioned larvae ($50L_3$/lb). This route of in-

fection was chosen to prevent larval migration so that the entire parasite population could be recovered from the gastrointestinal tract. Baseline levels of arrested development were determined by infecting pups with fresh larvae harvested from cultures as soon as the larvae reached infectivity. Infective larvae maintained at 5°C or at 15°C for 23 days showed a propensity for hypobiosis exceeding baseline levels. More consistent elevated levels of dormancy were induced by simulating a sudden frost, i.e. by decreasing temperature from 15°C to 5 °C seventeen days after storage had begun. Simulation of daily diurnal temperature fluctuation between 15°C and 5°C did not cause a further increase in inhibited development, nor did prolongation of any of these treatments to 57 days.

Low intestinal worm loads were associated with high levels of hypobiosis, suggesting that the conditioned larvae might migrate to extraintestinal sites. In subsequent studies, about 80% of the worm load was constituted of hypobiotic larvae and 17-31% of these larvae were recovered from the somatic musculature.

Under conditions precluding reinfection, and with the chemotherapeutic elimination of adult worms, it was shown that dormant larvae could resume development and re-establish patent infections.

12. **Efficacy of Reduced Dosages of Bunamidine HCl Against Dipylidium caninum in Large Dogs**

E. L. ROBERSON and T. M. BURKE

Fifteen reported cases of idiosyncratic reaction (sudden death) among dogs treated for cestode infection with bunamidine HCl (Scolaban) have occurred in the U.S., i.e., 1 in approx. 600,000 dogs. These cases were all large dogs which received in excess of 1200 mg total oral dose. The reaction, which appears to be dose related, has prompted investigation of the anticestodal efficacy of low maximum doses (800 and 400 mg) in heavy dogs. Each of these doses plus a placebo control was tested in 40- to 60-lb dogs harboring naturally occurring infections of Dipylidium caninum. The investigation was conducted as a double-blind study.

Ninty percent of 20 dogs were cleared of Dipylidium by total doses of either 800 or 400 mg (9 of 10 dogs/test dose). Dosages ranged from 7.5 to 20 mg/lb of body weight. Nine of 10 placebo controls were positive for Dipylidium at necropsy.

Similar investigations are underway to determine if a maximum dose of 800 or 400 mg bunamidine HCl is also efficacious in 60- to 80-lb dogs.

13. Efficacy of Granular Fenbendazole Against Naturally Occurring Helminth Infections in Dogs

T. MICHAEL BURKE and EDWARD L. ROBERSON

The success of Fenbendazole suspension against induced and naturally occurring helminth infections in dogs prompted investigation of the activity of the granular formulation of this compound against the common helminth infections in dogs. The efficacies of various dosages (5, 20, 25, 50, 100, 150 mg/kg of body weight) given for 1, 3, or 5 daily treatments were studied in 101 dogs with naturally occurring parasite burdens. Dosage levels of 50 mg/kg/day x 3 days and 20 mg/kg/day x 5 days were highly effective (98-100%) in eliminating Toxocara canis, Ancylostoma caninum, and Trichuris vulpis. All tapeworm infections of Taenia spp were completely eliminated from dogs receiving the former dosage while 8 of 10 dogs were cleared of this

cestode after receiving the latter dosage. Dipylidium caninum tapeworms were not satisfactorily expelled following either treatment regimen.

Untreated control dogs expelled 20.5% of ascarids harbored, 4% of whipworm burdens, less than 1% of hookworms, and no tapeworms during an 8-day period of fecal collection prior to necropsy.

14. Changes in Serum Protein Levels During the Course of Treatment for Clinical Canine Demodicosis

G.J. KUBAT, H.E. JORDAN, J.T. HOMER

Serum protein levels, determined by cellulose acetate electrophoresis, have been collected from dogs with the generalized form of demodectic mange, the localized form, and from normal dogs. Serum protein levels from affected dogs were measured at the time treatment was begun, and at three week intervals throughout the course of treatment until termination. Examination of the data reveals that dogs with the generalized form exhibit a trend toward a consistent elevation in the Beta fraction, specifically the Beta-2, and variable changes in the level of the Alpha-2 fraction, from the normal values. These trends appear to hold throughout the course of treatment. In general, dogs with the localized form exhibit no trend toward an elevation in the levels of protein fractions, either at pretreatment or throughout the course of treatment.

15. Pathophysiology of Canine Heartworm Disease

R.E. LEWIS, C.A. RAWLINGS, J.W. MCCALL

Heartworm infection is a multiple-organ disease in dogs. The Dirofilaria immitis results in clinical signs primarily due to cardiopulmonary alterations. The pathophysiology of these cardiopulmonary alterations will be related to the stages of the disease and the severity of the infection. These observations are based upon retrospective studies of naturally occurring heartworm disease cases, as well as experimental heartworm disease in dogs inoculated with the infective Dirofilaria larvae. Radiographs will be used to demonstrate the development as well as used to relate the frequency of the disease.

16. Inhibited Development of Ostertagia ostertagi in Cattle in the U.S.: Current Concepts

J.C. Williams

Ostertagia ostertagi is considered to be one of, if not, the most economically important nematode parasites of cattle in temperate areas of the world. The incidence, complex epidemiology, and pathogenesis of this parasite has given rise to a large literature. Although workers in the U.K. have provided most of the intense research effort that has led to our present understanding of inhibited development of early fourth stage larvae (EL_4) and Type II ostertagiasis, investigators in the U.S. made important contributions regarding initial discription of the phenomenon of inhibition in O. ostertagi. However, little or no association was made between the inhibition phenomenon and possible disease sequelae. The major objective of this discussion is to briefly review the complex epidemiology of O. ostertagi and the investigative efforts that have led to our current understanding. Additionally, results and tentative conclusions on epidemiologic and experimental studies carried on in Louisiana will be presented. A central question to be addressed is: does the complex epidemiology, inhibition of larval development, and Type II ostertagiasis occur within the U.S. or N. America, as described and intensely studied by workers in the U.K. and elsewhere? A study by Martin, Thomas, and Urquhart (1957) who investigated several outbreaks of parasitic gastroenteritis in Scotland appears, according to most reviews, to be the beginning of intense effort put forth in the U.K. on O. ostertagi. Since that time investigators in the U.K. have produced a mass of information to support their ideas on the epidemiology of this parasite. A gist of this information as applies to conditions in the U.K. are: infective larvae ingested on pasture in autumn and early winter become inhibited at the EL_4 and the phenomenon is environmentally dependent; different strains of the parasite probably exist, one being inhibition prone, the other not prone to inhibition; inhibition does not appear to be closely related to population dynamics of the worm or various factors associated with the host. Factors relating to the duration of the inhibited state are not clearly understood, but are believed to be synchronous to some extent with the duration of environmental conditions adverse to development and survival of the free-living stages. Comprehensive studies on the epidemiology of O. ostertagi, the prevalence of larval inhibition and Type II ostertagiasis have not been reported in the U.S. or N. America. Prior to 1960, numerous reports were made on the detection of larval inhibition, but little or no association was drawn to its role in epidemiology or disease sequelae. Since 1960, there have been a few investigations from California, Texas, Georgia, Louisiana, and Canada in which the occurrence of larval inhibition and possible association with Type II infections were noted. Under conditions in Louisiana, most reported cases of parasitic gastroenter-

itis in cattle occur from autumn to winter. In many cases, the association with poor nutrition is evident and also, many cases are diagnosed as severe ostertagiasis. These are most likely Type I infections. Studies on larval inhibition in O. ostertagi have been carried on in Louisiana since 1971. In several production trials with yearling cattle and by use of tracer calves, preliminary evidence suggests that inhibited development of O. ostertagi occurs primarily between December and April, the climatic period which is most adverse to development of the free-living stages. Use of a plasma pepsinogen determination has yielded excellent results in both field and experimental infections. The relative significance of Type II infections in Louisiana during and after the period of accumulation of inhibited larvae is not known. A great deal of comprehensive study, including detailed clinical, parasitological, and pathologic analysis is urgently needed in various parts of the U.S. to determine if, when, and under what circumstances the complex epidemiology of O. ostertagi does exist.

17. New and Improved Methods for Ectoparasite Control on Cattle
EDMOND C. LOOMIS

Research and development on new chemicals for the control of external parasites of livestock have provided cattlemen with an arsenal of many different compounds coupled with a wide choice of application methods. Aside from the requirements of minimum or no toxicity and maximum safety to man, animals, and the environment, the development of livestock pesticides has been targeted to provide compounds which offer greater residual effectiveness, permit minimum handling of animals, and allow for the use of less material.

Current and future aspects of livestock parasite control will be reviewed including the use of animal systemics and oral larvicides, the appearance of new chemically-structured compounds such as insect growth regulators and synthetic pyrethroids, the status of chemically-charged ear tags, boluses and implants, and finally the use of biological control agents.