IMPROVING LIVESTOCK PRODUCTION THROUGH BETTER DISEASE AND PARASITE CONTROL

The Turrialba meeting not only considered the broad problems of improving veterinary services, but also gave particular attention to the control of external parasites, internal parasites, foot-and-mouth disease, brucellosis, tuberculosis and rabies, and to the inspection of meats and other foods of animal origin. In addition to further consideration of the diseases just mentioned, the Baurú meeting also gave attention to hog cholera, and paratuberculosis or Johne's Disease, and to quarantine problems (Phillips, 1950 and 1953). In the light of the interest shown in various subjects in the discussions at Turrialba and Baurú, talks at the Buenos Aires meeting were limited to consideration of the control of foot-and-mouth disease and brucellosis, and to the control of parasitic infestation and of the diseases which parasites are known to transmit. Important information arising from the discussions in Buenos Aires is therefore summarized below under three headings.

Control of Foot-and-Mouth Disease

A number of recent events and technical developments having a bearing on the control of foot-and-mouth disease are summarized briefly in the following paragraphs.

Vaccines produced from " culture " virus are coming into more extensive use in some parts of the world. Some evidence has been produced to indicate that the degree of immunity set up by vaccines prepared from " culture " virus in use today may be slightly lower than that prepared from " natural " virus, but it is generally admitted that, for practical field purposes, " culture " virus-vaccine gives rise to a sufficient degree of resistance to natural infection. The duration of immunity produced by each type of vaccine has not yet been established under controlled conditions although field evidence in some countries indicates that animals injected with " natural " virus-vaccine, have withstood infection for at least 12 months following vaccination. The establishment, by controlled experiments, of the duration of immunity of a satisfactory level to withstand infection with foot-and-mouth disease virus is of much importance from the point of view of advising on the intervals between vaccinations in countries in which extensive use of

vaccine is a policy for control for the disease. In some countries in Europe extensive vaccination programs are being carried out; they vary from vaccination of all cattle in the country to vaccination in areas or zones surrounding outbreaks. In other countries, a " stamping-out " or slaughter policy is strictly adhered to or is practised together with vaccination. The occurrence of " variants " or " mutants " within the three different types of foot-and-mouth disease viruses has given rise to some difficulties in carrying out successful vaccination schemes; the results of research work are overcoming this limiting factor. Evidence from field observation is accumulating that a mixture of vaccines injected subcutaneously in one dose will successfully immunize cattle against all the types of virus from which the vaccines are prepared, but further work on the subject is necessary. Such research work is considered important in order definitely to ascertain whether this convenient method of administration of vaccine can be accepted as a satisfactory and efficient field procedure.

Although it is realized and appreciated that the eradication of foot-and-mouth disease must eventually consist of a " stamping-out " or slaughter policy, the use of vaccine will continue to have an important place in some countries for practical and economic reasons and, therefore, detailed attention should still be given to its satisfactory production and use.

The immunization of pigs still presents some difficulty, but there are hopeful signs from the result of work carried out in Denmark that virus recovered from infected cattle may be adapted to the pig and that from such an adapted strain a satisfactory immunizing product for pigs may be produced.

A major attempt at regional co-operation in the control of foot-and-mouth disease has been initiated in Europe through the formation of the European Commission for the Control of Foot-and-Mouth Disease within the framework of FAO. Eleven countries are now co-operating in this new venture, which should be watched with interest by other regions where co-operation among countries may be essential to the effective control of the disease. The objects of the Commission are to assist European countries by international effort to control the spread of the disease in Europe and to arrange and adopt measures for the prevention of its entry into Europe. Such regional measures are essential before world-wide control of the disease can be hoped for.

There is general recognition of the urgent need for international action for the control of foot-and-mouth disease in the Americas and the operation of an agreed policy on preventive measures to ensure continued freedom in the countries in which the disease is absent. The efficacy of methods of control now being applied in several countries to suppress outbreaks and to prevent spread of

the infection, the occurrence of vesicular disease which may simulate foot-and-mouth disease and the need to ensure accurate diagnosis, and the part played by native wild animals as reservoirs and vectors of the virus, are all problems of major interest.

New developments reported in a number of countries and observation on the current situation are summarized in the following paragraphs.

In *Argentina*, progress has been made in the control of foot-and-mouth disease and difficulties which arose from considerations such as the large number of livestock in the country and the extensive livestock movements throughout the country have been partially overcome. Until 1945, when a special decree was enacted, much of the control of the disease was vested in local authorities. The decree provides for over-all national powers of the Ministry of Agriculture, and since 1945, the general position has improved. Special precautions are taken to prevent the entrance of the infection into Patagonia which, because of its geographical position, lends itself to the exclusion of the disease. Cattle destined for Patagonia, for example, should be vaccinated and the supplying area should be free from foot-and-mouth disease for at least 15 days prior to the movement of the animals. The area of origin of cattle for export to foreign countries should be free for at least 30 days. Notification of outbreaks is compulsory and control consists in the application of restrictions on movement, sanitary police measures and extensive vaccination in the area surrounding an outbreak.

Vaccination against foot-and-mouth disease in Argentina is not compulsory but is usually practised. Many farmers adopt vaccination as a preventive plan. Compulsory vaccination is envisaged and pilot experiments are being carried out in different parts of the country. Experience has shown that when infection appears among vaccinated cattle, the symptoms of the disease are mild and the lesions slight. Vaccination carried out immediately in an area surrounding an outbreak is reported to be usually followed by a clearing-up of the epizootic in about 15 days. In calves, good results are reported following a combination of protein therapy and vaccination and this method of treatment is now receiving detailed study.

In Argentina, it is believed that vaccination should be carried out every four months in order to maintain a satisfactory level of immunity, since experiments had shown that after four months, the immunity drops sharply to a level below that accepted as efficient for protective purposes. By the adoption of a 4-monthly vaccination policy and the practice of sanitary control and movement restrictions, Argentine authorities report that foot-and-mouth disease is being effectively controlled.

In 1939, a National Foot-and-Mouth Disease Institute was

established. Its activities comprise research work on the many aspects of the disease and the control of the large quantities of vaccine produced by the 15 private or semi-private laboratories in Argentina. Different processes for the production of vaccine are being studied, e.g., the methods of Frenkel, Thomas, Belin, etc., and it was hoped that by the end of 1955 information regarding a new method for the production of vaccine might be available. Concentrated vaccine in doses of 2 c.c. injected intradermally was said to produce satisfactory results.

Canada has been free from foot-and-mouth disease since May 1952. The Animal Contagious Diseases Act provides the authority for all necessary measures to ensure freedom from the disease. Control of the disease is handled entirely by the federal government. Arrangements exist for diagnosis work, and courses of instruction for department veterinarians are regularly held. No vaccine is is produced or used in Canada, complete eradication being the method of dealing with outbreaks.

In *Chile*, foot-and-mouth disease is enzootic and all three types of virus exist, although type C is seldom found to be the cause of outbreaks. Control plans have final eradication of the disease as the objective. The plans are on the following lines: in each of the provinces a trivalent vaccine will be used in the first instance, and then mono- or bi-valent vaccine, every six months for two or three years, depending upon the incidence of the disease. The scheme includes the movement of the operators from one zone to another at stated intervals, and provides for the vaccination of calves. In addition, there will be in operation, sanitary policy measures, market control, quarantines and livestock traffic control. The aim is that by the end of a few years foot-and-mouth disease will be under good control in the country.

In *El Salvador*, there is no foot-and-mouth disease. No facilities are available to deal with a possible outbreak. However, officials are working, with the help of FAO technicians, to draft a law which will provide a basis for meeting the problem of keeping the country free from the disease.

In *Panama*, educational campaigns are in operation whereby livestock owners are acquainted with the symptomology of foot-and-mouth disease and vesicular diseases in general, and the urgent need to report any suspiciously affected animals. At present, Panama is free from the disease, but there is in existence a decree in which regulations are laid down for the control of the entrance of the infection into the country. The Pan-American Sanitary Bureau (PASB) co-operates in diagnosis work; up to the present all outbreaks of vesicular disease have been diagnosed as vesicular stomatitis, type " New Jersey. "

In *Peru*, foot-and-mouth disease is usually confined to a re-

stricted area in the valley of Lima and rarely extends from this locality. Imported cattle are usually the sources of outbreaks. Cattle from abroad must now be vaccinated and the disease is no longer a serious problem. Because of geographical conditions in the country, e.g., rivers forming natural barriers, the spread of the infection is not difficult to control. Outbreaks are controlled by the use of vaccine, injected subcutaneously. Vesicular stomatitis in dairy cows, in which the lesions occur on the udder and which gives rise to mastitis, do occur. The disease may be confused with cow pox.

Jamaica is free from foot-and-mouth disease, and there is recent legislation on methods of control of the disease, should it appear in the country. Provision has been made for the operation of a "slaughter" policy, without the use of vaccines.

In the *United States of America*, the last outbreak of foot-and-mouth disease was in 1929. Measures for the control and immediate eradication of outbreaks of the disease exist and include provisions that the federal authority may take action independently or in co-operation with the affected states; the imposition of restricted livestock movement; the immediate slaughter of all infected and exposed animals and the payment of compensation; the inspection of premises within and outside the affected area; restriction of movement of people; and the application of disinfecting procedures. Also in the United States, a corps of veterinary diagnosticians, specially trained in differential diagnoses of vesicular diseases is strategically located throughout the country. Facilities are available for typing strains of virus; the use of vaccine is not contemplated. Total eradication by slaughtering all infected and exposed animals is considered the surest and most practical means of eradicating the disease should it appear in the United States. Research work is being carried out in recently opened laboratories located on an island.

In *Venezuela*, since 1950, different agencies have been used in dealing with foot-and-mouth disease. There is now a Foot-and-Mouth Disease Department in the Ministry of Agriculture. A special laboratory has been set up for purposes of diagnosis and vaccine production. Throughout the recent outbreaks, type O virus was prevalent, type A being much less commonly found and was confined to limited, small areas. The actual number of outbreaks recorded and types of infecting virus are as follows: 1950 - 44 (O); 1951 - 58 (O), 6(A); 1952 - 21 (O); 1953 - 5(O), 1(A); 1954 - 4(O). 3(A); making a total of 142 outbreaks in 132 of which the virus was O and in 10, A.

The general control methods in Venezuela are extensive vaccination, some slaughtering, the enforcement of sanitary police measures and the restriction of movement of livestock. In the

early stages of the recent outbreaks, slaughter was not practised; later, the slaughter of infected animals was introduced together with extensive vaccination. No indemnity is paid for slaughtered animals. The successful results obtained by this procedure made it possible to divide the country into zones that were clean; those freed from the disease; those under observation, and those in which vaccination was carried out. It has been reported that no outbreaks have been confirmed since July, 1954.

Vaccines in use are always mono-valent and if it is found necessary to protect against two types of virus, two mono-valent vaccines are used. In the north of the country, vaccination is carried out every four months, but in the south, because of difficult geographical and other conditions, the interval is six months. There have been no confirmed outbreaks in the south since 1953. Vaccine, in doses of 2 ml., is injected intradermally. The Frenkel type of vaccine has not yet been used. Only a limited study has yet been made on strains of virus; vaccines are prepared from strains recovered from infected animals. The laboratory has produced 24,145,334 doses of Type O vaccine and 217,750 of Type A, and keeps a large reserve stock of epithelium for preparing both types of vaccine.

Regulations in Venezuela provide for the notification of the occurrence of any vesicular type of lesion in an animal to the appropriate authority and samples of tissue are sent to the laboratory. Quarantine measures are applied at once; if foot-and-mouth disease is not diagnosed, the restrictions are removed, but if the disease is confirmed, the above-mentioned procedure is put into operation.

The Pan-American Sanitary Bureau maintains a Foot-and-Mouth Disease Center in Rio de Janeiro for the benefit of members of the Organization of American States. Its usefulness to the various countries is generally recognized. In addition to direct assistance to countries, information concerning foot-and-mouth disease and other vesicular types of disease in Central and South America is compiled.

Control of Brucellosis

A second meeting of the Joint FAO/WHO Expert Committee on Brucellosis, the report of which was published in 1953, reached conclusions which are of importance to countries in the Americas and elsewhere. Some of the conclusions are summarized in this paragraph. The most important basis of control of brucella infection concerns detection and elimination, or effective isolation, of the infected animals. Sero-agglutination tests should remain of

primary diagnostic importance for individual animals. Screening tests to locate infected herds are, however, of considerable value, examples of the tests being the milk ring or ABR test, the milk plate test and the milk-capillary-tube test. Results of the milk whey agglutination test indicate its value in differentiating between cattle showing sero-agglutination reactions caused by *Br. abortus*, strain 19, and those showing similar reactions caused by natural infection. It has been shown that a high percentage of whey samples from uninfected, strain 19-vaccinated animals show no agglutinations below the minimum diagnostic level while a high percentage from infected animals show agglutinin titres above the diagnostic level. It has to be pointed out, however, that the test loses accuracy when it is applied during the early and late stages of lactation. No reports have been published of a more satisfactory vaccine than that produced from *Br. abortus* strain 19. It is still recommended that pregnant cattle should not be vaccinated, for although permanent infection in them does not result from vaccination, the injected strain may be excreted from the uterus or udder for a period up to one week following parturition. It is now considered that, in herds in which the results of agglutination tests are not taken into account in controlling brucellosis but in which vaccination is being practised, young bulls of 6 to 8 months of age may be vaccinated as well as heifers. The available evidence indicates that animals vaccinated once as calves are still resistant to infection up to five pregnancies. Some observers believe that the continuing resistance may be related to age and that, therefore, revaccination after the first or subsequent calving is not likely to be necessary.

Recent Developments in Various Countries

In *Argentina*, considerable importance is attached to the milk ring test. Studies have been made in dairies and milk pasteurizing plants on the incidence of brucellosis in animals, as shown by this test. It has been suggested that some scheme might be operated whereby premiums might be paid for milk from non-infected herds and so farmers might be induced to clear their herds of infection. Similarly, agglutination tests, using whole blood from cattle at abattoirs, packing stations, etc., had been carried out and have given rapid results of a satisfactory nature. Many thousands of animals had been tested by this method, and infected herds had been located.

Following the satisfactory results of the use of vaccine prepared from *Br. abortus*, strain 19, as an immunizing agent of high value and its safety in 1949, the Government of Argentina adopted this

as the only vaccine to be used in the country. This dispensed with the use, among other vaccines, of live cultures which had actually spread the disease. A policy of slaughter of infected animals and vaccination of healthy animals as an ideal procedure presents difficulties in a country like Argentina with a cattle population of some 43 million and a scarcity of trained teams of workers to carry out diagnosis work, hence such a policy could not be carried out. Calfhood vaccination was, therefore, adopted in 1947 as a government-sponsored, though voluntary, control measure. Following the formulation and adoption of a plan to control the vaccine, the official vaccination scheme was begun. Some farmers objected to the scheme, largely because of the agglutination reactions following vaccination. The Government then limited vaccination to calves and advised against repeat vaccinations so that reactions in adult animals, vaccinated as calves, would be reduced to a minimum. It was also felt that, if the immunity set up by calfhood vaccination persisted at a satisfactory level for say 5 or 6 lactations, the economic life of the dairy cattle would be covered. Bulls were not included in the vaccination scheme because of the persistence of sero-agglutination reactions, following the use of the vaccine. It is now considered that the time will soon arrive when, in small areas, a " stamping out " plan with slaughter of infected cattle and the payment of compensation may be considered.

The program of prophylaxis in Argentina includes educational work, given both orally and by the use of written material. Field demonstrations of the carrying out of control practices are proving of value not only from an educational point of view but also because, from them, information is obtained on the spread of brucellosis and appropriate measures for its control can be taken. The practical value of the sero-agglutination test for individual animals and the screening tests for herds in the dairy zones has been demonstrated.

In *Canada*, brucellosis is controlled through either the brucellosis-free listed herd plan, based on the results of the sero-agglutination tests, or the federal-provincial brucellosis calf herd vaccination program. Brucellosis is not a notifiable disease in Canada. Sero-agglutination tests are compulsory only for imported animals, animals for export, herds under the brucellosis-free listed herd plan and for cattle attending certain national livestock shows. Research work is confined to specific problems arising from the control measures. Quarantines are not imposed on outbreaks of the disease. The educational campaign in Canada is limited to the distribution of pamphlets by provincial governments.

In *Chile*, the control program includes sero-agglutination tests of cattle, progressive elimination of reactors throughout the country, vaccination of calves between 4 and 6 months of age, and ex-

tension work. The production and use of vaccine is controlled by the Government. There is also a strict control of imported animals. Official declarations of freedom from brucellosis are required for imported breeding cattle, for cattle sent to shows, for the purchase and sale of high quality breeding animals and and for all cattle in some parts of the country. A control campaign carried out jointly by the National Health Service and the Ministry of Agriculture, similar to that for cattle, is in operation for goats in the Province of Santiago; animals in which infection is diagnosed by sero-agglutination test are eliminated. Educational campaigns in Chile include the dissemination of information on the disease through the press, radio and publications.

In *El Salvador*, the highest incidence of brucellosis in cattle is in the central and coastal zones of the country. Of 3,104 sero-agglutination tests carried out in these regions, 12.6 percent were positive and the reaction in a further 18.6 percent was considered as indefinite. The tests are carried out with antigen, standardized according to the recommended international method. The ring test has been used for samples of milk taken from the market. In 1954, of 6,816 samples examined, 32.4 percent were positive; in 1955, of 2,287 samples, 10.5 percent were positive. Most of the milk examined came from the area around the capital and from the western zone. Similar tests carried out on 391 samples from the eastern zone proved negative, while in 109 samples from the Santa Ana area, 11 percent were positive. There is no legislation for the control of brucellosis, but some livestock owners are, voluntarily, following the advice given by government veterinarians. The introduction into the country of a vaccine against brucellosis is prohibited. It is only for purebred cattle that tests are carried out to ensure freedom from brucellosis on importation.

In *Jamaica*, although brucellosis is a notifiable disease no regulations are in force concerning its control, nor is the disease considered of sufficient economic importance to justify the application of permanent control measures. Vaccine prepared from *Br. abortus*, strain 19, is used to a limited extent, and the features of the disease and methods of control are publicized throughout the country. In diagnosis work, the international standard *Br. abortus* anti-serum is the basis of sero-agglutination tests, although there is no regulation for the compulsory carrying out of such tests. No quarantine regulations are in operation; government veterinary officers give advice as required.

In *Panama*, the control of brucellosis is still in a preliminary stage and regulations have not yet been passed on the subject.

In *Peru*, the control scheme for brucellosis is practically identical with that carried out in Argentina. The central campaign is being carried out on a voluntary basis under official control,

and it is expected that it will be possible to reduce the incidence of the disease to such a low level that more drastic measures can be taken. Although no statistics exist to show the effects of vaccination in the incidence of the disease, it is significant that there are many fewer abortions and cases of retention of the placenta in the vaccinated herds; and further, that it is now possible to re-populate dairy cattle areas with animals produced in Peru, whereas, formerly, replacements had to be imported.

In the *United States of America*, there has been a constant increase in the funds made available for work on brucellosis, by county and state governments' control and eradication procedures being developed jointly by the federal government and the states. An extensive educational program is in operation; many agencies are co-operating in this work. The eradication program now in operation aims at the eventual elimination of the disease. Primary attention is given to systematic sero-agglutination tests, the elimination of reactors, the disinfection of premises and replacements with healthy cattle. Calfhood vaccination with *Br. abortus*, strain 19, is an important part in the program. Research work is still progressing, especially on the titre interpretation of the results of sero-agglutination tests in cattle vaccinated in calfhood, non-specific reactions to the sero-agglutination and milk ring tests, brucella types infecting cattle, swine and goats, and improvement of immunizing agents.

In *Venezuela*, a campaign for control of brucellosis is being undertaken. For sero-agglutination tests the *Br. abortus* antiserum used for standardization of antigens throughout the country is controlled by the State Veterinary Laboratory.

Import Regulations Concerning Reactions to the Agglutination Test in Vaccinated Animals

There is general agreement on the need for further research to establish the possible variations in the results of the sero-agglutination test in naturally infected and in vaccinated livestock in relation to gestation and *post partum* periods.

In *Argentina*, with regard to the importation of cattle, vaccinated with *Br. abortus*, strain 19, vaccine, there are in existence special regulations with which the countries of origin have to comply. Modifications of the regulations are now being studied because of the finding that sero-agglutination reactions in vaccinated animals may persist for longer periods than was at one time thought.

The subject of the duration of sero-agglutination reactions at different titres is a highly technical matter, however, which requires

further study and careful consideration by a group of experts such as the Joint FAO/WHO Expert Committee on Brucellosis. Among the points requiring further attention is the question of variation in the titres of sero-agglutination reactions during and immediately following pregnancy for which some experiments show that there is a considerable depression during this period and that, therefore, results might be misleading. Also, in Argentina, an increase has been noted in the titre of the sero-agglutination reaction of strain 19 vaccinated animals for a period subsequent to vaccination with foot-and-mouth disease vaccine.

International Standards

This subject was discussed at the Baurú meeting, where attention was drawn to the adoption by the Committee on the Standardization of Biological Products of the World Health Organization of the anti-serum evolved under the auspices of the International Office of Epizootics (OIE), as the international standard by which *Br. abortus* antigens, used in sero-agglutination tests could be standardized. Such standardization is essential if the results of agglution tests carried out in various countries are to be readily comparable.

In *Argentina*, the antigens produced are reported to correspond with the international standards. The Ministry of Agriculture has decided that all antigens used in the country should be so standardized and standard anti-serum is being distributed for this purpose.

In *Chile*, the Institute of Veterinary Research is responsible for diagnostic and antigen production techniques, and international standardization methods are used.

In *Canada*, the international standard *Br. abortus* anti-serum has not been adopted. However, there is much exchange of information on sero-agglutination tests with the United Kingdom and the United States of America.

The Pan-American Sanitary Bureau, (PASB), which is also a regional office of the World Health Organization, takes an active part in standardization. A study carried out in 1951/52 showed marked differences in antigens from both medical and veterinary laboratories throughout Latin American countries. Seminars were held in 1951 and 1952, one for countries in South America and the other for those in Central and North America. Each country was represented, often by personnel concerned with both public health and livestock interests. Emphasis had been laid on the need and advisability to designate one or two laboratories in each country to be responsible for standardization of antigens. Few

countries have as yet seen fit, however, to implement this recommendation.

Although some differences of opinion exist, there appears to be rather good agreement that governments should take the necessary action to affect the standardization of procedures for the diagnosis of brucellosis and especially of antigens for use in the sero-agglutination test, through the designation of a central national authority to accomplish this purpose by following the standards agreed and recommended by the OIE, FAO, WHO and PASB.

Control of Parasitic Infestation and of the Diseases Parasites are Known to Transmit

The economic effect of parasitic infestations is not confined to losses by deaths of infested animals, but is largely concerned with lowering of normal production of animal products, including milk and meat, low yields of wool, damage to skins and hides and impaired labor activity of draft cattle. It is impossible, even in general terms, to evaluate the total loss from the various conditions arising from parasitic infestations, but it is agreed that they are extremely high in all countries.

Although some of the more recently introduced medicaments used for anthelmintic purposes are of marked value, there are still some parasites for which adequate control treatment does not exist; further research is needed. Again, it has to be pointed out that the use of anthelmintics alone, although playing an important part in its control of parasitic infestations, cannot produce entirely satisfactory results. The practice of improved methods of husbandry, together with the provision of suitable nutrition, with special attention to minor or trace elements, must also occupy an important place. Research is still needed on the influence of nutrition on parasitic infestations.

While total eradication of certain parasites may be possible, with others, especially those infesting the gastro-intestinal tract, the aim should be to reduce the numbers that the level of infestation does not markedly influence the economic position of the livestock in question.

Improvements in pastures mean that an increased number of livestock may be maintained in a given area. The effect on parasitic infestation may be great, unless attention is given to husbandry and the use of suitable anthelmintics.

Attention should also be directed towards the danger of introducing types of parasites into a country which is free from them, through importation of livestock.

In planning control measures to be used in a country for the

control of parasites, due regard should be given to climatic conditions which may influence the life cycle of the parasites; climatic conditions may, for example, determine the interval between the applications of insecticides for the control of some ecto-parasites.

In the field of zoonoses, some parasites assume an important role in both human health and livestock economy, and campaigns for control are, therefore, of special importance.

Recent activities in various countries, aimed at the control of parasites, are summarized in the following paragraphs.

In *Argentina*, some 6 million ha. have been cleaned of ticks during the past ten years. The method consists of the regular treatment of cattle with satisfactory insecticides over a period, taking into consideration the duration of the stages of the life cycle of the tick under different climatic conditions when arranging the intervals between treatments. Stress has been laid on the need for rotation of insecticides used in treatment because of the tendency of ticks to become resistant to some of the products in use; and to the value, in land clearing schemes, of harrowing the land in the area. In woodland districts, such treatment of the land cannot be carried out and eradication may, therefore, be a more difficult problem in such areas. It is essential that all the cattle in the area be subjected to treatment with insecticides in any eradication scheme. There are now in progress some further pilot experiments in different parts of the country, representative of the various climatic and general husbandry conditions found in Argentina. In some, it has been found that ticks can be eradicated in about two years.

There is also a parasite, *Thysanosoma actinoides*, found in Patagonia and in the vicinity of Buenos Aires, which causes death of infested cattle. The life cycle of this parasite is unknown; however, there is evidence that a vector is necessary for its completion.

Distomatosis is commonly found in cattle, sheep and pigs; good control results follow the usual methods of preventive treatment, and, when attention is given to the calcium content of the food of the animals, the commonly used drugs, such as carbon tetrachloride, can be safely administered.

The treatment of cattle imported into tick-infested areas from tick-free countries or areas to pre-immunize them is also practised; for this purpose the blood of infected animals is used. Treatment of those which become infected with anaplasmosis or piroplasmosis is also carried out. Such drugs as trypan blue, acaprin and acriflavin are used.

In *Canada*, diseases transmitted by ticks are not a problem. There are no regulatory provisions under the Animal Contagious Diseases Act with respect to tick or tick-transmitted diseases. Blood-sucking flies, Tabanidae, exist but have not been known to

transmit disease to livestock. The only outbreak of trypanosomiasis in Canada occurred in 1952; the infected cattle herd was destroyed and buried. Mange (scabies) in cattle, sheep and horses is a notifiable disease. Affected herds or flocks are quarantined and treated under official supervision. The control of endo-parasites is carried out by private veterinary practitioners, and educational pamphlets from official cources are distributed. Anthelmintic drugs and pasture control are used. Human tapeworm infestations, livestock cysticercosis, fascioliasis and hydatidosis exist, but are not under official control, except that there is compulsory cooking of all garbage fed to pigs and poultry.

In *Chile*, the tick family Ixodidae is prevalent and although the *Boophilus* type is found on cattle imported for slaughter purposes, it appears that this tick may not be adaptable to the conditions of the country. Trypanosomiasis does not exist in cattle in the country, nor are Dermatobia or Hypoderma found. In connection with Hypoderma, it has been noted that, although imported cattle sometimes carry the larvae, the adult fly does not develop.

Thysanosoma actinoides is commonly found in sheep, and hydatidosis, trichinosis and cysticercosis are also present. Compaigns are in operation for the control of hydatidosis. Distomatosis in its acute phase is responsible for deaths in sheep; the disease is now being controlled in both cattle and sheep. Parasitological investigations are carried out at the Institute of Veterinary Research.

In *Ecuador*, anaplosmosis has been found in zebu cattle, especially bulls imported from countries which for a long time have been tick-free. Thus, there is need for pre-immunization either before the animals leave the country or inmediately on their arrival in Ecuador.

There are two different types of country: the mountainous region, and the low tropical region. Parasites infesting the gastro-intestinal and respiratory tracts are commonly found in both types of country. On the other hand, distomatosis is found only in the high altitudes, for although eggs of the liver fluke find their way into streams, and are conveyed to the lower parts of the country, the mature flukes do not develop there. Research is in progress to determine the reason. The parasite, *Oestrus ovis*, gives rise to a considerable amount of loss in sheep, and is being only partly controlled by the methods in practice. Trichinosis does not exist in the country, and the incidences of hydatidosis and cysticercosis are insignificant.

In *El Salvador*, external parasites are among the principal causes of livestock losses. In the case of ticks, *Boophilus* spp. and *Amblyomma* spp. appear to be the most common but there

has been no study of their distribution. They transmit piroplasmosis and anaplosmosis. No rickettsiasis nor trypanosomiasis has been reported. Excepting the distribution of propaganda, there is no provision, such as a law or national program, for the control or eradication of ticks and other parasites. However, more and more individual farms and ranches are using pesticides to combat them.

Torsalo (*Dermatobia hominis*) is not severe. The majority of the infested cattle come from the frontiers bordering Honduras and Nicaragua. The central zone is practically free. In addition, there are a few isolated cases of infestation with *Sarcoptes* and *Psoroptes*.

Internal parasites are a very serious source of loss to the livestock industry as they infest about 99 percent of the animals. The principal ones are: in cattle — *Haemonchus contortus;* in horses: *Strongylus* spp; in swine: *Ascaris lumbricoides*, *Cysticercus celluloae* (affecting approximately 15 percent of the hogs), but no *Trichinella spiralis*; in poultry: *Coccidia* and *Haeterakis gallina.* Individual farmers are using anthelmintics such as phenothiazine, kamala and carbon tetrachloride.

Information obtained concerning the occurrence of plathelminths in humans and of cysticercosis and *Fasciola hepatica* in domestic animals is being used as propaganda in the drive to obtain adequate laws to serve as a foundation for fighting these pests on a nation-wide basis. FAO technicians are advising on the framing of a law to meet these problems in El Salvador.

In *Jamaica*, the ticks commonly found are *Boophilus annulatus* (var. *microplus*) and *Amblyomma cayennense* in cattle, *Dermacenter niteus* in horses, and *Rhipicephalus sanguineus* in dogs. Anaplasmosis and piroplasmosis are enzootic in native livestock, and imported animals suffer severely. There are no rickettsial diseases.

Ticks are controlled by dipping and spraying, using appropriate insecticides. There is no law for compulsory treatment. Biting flies and horn flies are present, but are not serious pests; trypanosomiasis is not present. Screw worms are found but torsalo is absent. Advice is given on the control of internal parasites by visits of veterinary officers to an area, following observations made in the abattoirs.

In *Peru*, no marked official effort has been made to control parasites and parasitic infestations. However, some work is under way. For example, one private corporation is now employing eight veterinarians on parasite control in the sheep. Mortality has been reduced from 26 to 2.5 percent; average wool yield had been raised from 3.5 to 6.5 lb., and average carcass weight had risen 24 to 42 lb. The number of sheep now owned by this corporation has increased from 160,000 to 200,000.

The faculty of Veterinary Medicine has undertaken a survey from which there will be available a complete picture of the types and locations of livestock parasites in the country.

As in some other countries, much care is taken with diseases of virus and bacterial origin; but little or no attention is given to parasites, with the result that parasites, not present in a country, may be introduced by imported livestock. An example is the introduction of the parasite *Thysanosoma actinoides*. which is responsible for some cattle losses and impaired production.

The prevalence of hydatidosis has been noted and there is urgent need for its prevention from both the public health and livestock economy points of view. In collaboration with the Inter-American Health Service, the Faculty of Veterinary Medicine is to carry out a survey of the condition, for which veterinary students will be used.

The *United States of America* enjoys a virtual freedom from piroplasmosis, theileriasis and trypanosomiasis, but heavy losses occur from cattle grubs, screw worms, horn flies, lice, ticks and mites. There are already some indications that the oral administration of phenothiazine, the medicament commonly used in the control of some gastro-intestinal parasites, may also have some value in reducing the intensity and incidence of grub (warble) infestation. Observations are being made on the value of other medicaments. In controlling mange (scabies) in the different species of livestock, and screw worms, lice and certain flies, a major problem with newer insecticidal dips is the disproportionate removal of the suspended particles of active ingredients by the passage of animals through the fluid; and a practical difficulty is the lack of a suitable biological or chemical test of dip strength.

In connection with the endo-parasites, considerable progress has been made in the United States of America in the control of of coccidiosis, trichomoniasis and anaplasmosis in cattle. Improved husbandry, newer chemo-therapeutical agents, artificial insemination and better methods of diagnosis have all contributed to better control results. In cattle, there have been recognized some 40 species of helminths of more or less economic importance. Although available medicaments are of value in controlling some of these worms, there is, as yet, no appropriate treatment for more than half of them.

In pigs, helminths are the most important parasites causing economic losses. Some 18 species are recognized. Problems of control are complicated by the presence of certain other parasites, of which the commonest are kidney worms, lung worms, larval tapeworms, thorn-headed worms, trichinae, threadworms and whipworms. The annual loss in swine is estimated at more than U.S.$ 200 million.

Parasites of sheep and goats are of special importance throughout the country, the proportionate loss from helminth infestations being higher in these than in any other classes of livestock. The use of available anthelmintics is causing an encouraging reduction. It is recognized, however, that the use of antiparasitic drugs cannot alone solve practical problems of parasite control.

In *Uruguay*, so far as ectoparasites are concerned, mange (scabies) and lice infestation are no longer problems, but tick control is still of considerable importance. A new law is about to be enacted in this connection. With the improvement of pastures it will be possible to concentrate more sheep in a given area. This means there will be more opportunity for the development of gastro-intestinal and lung worm infestations, and attention will have to be given to rotation of the sheep stock and the necessary anthelmintic treatment, both arranged according to the duration of the stages of the life history and the parasites under the different climatic conditions.

In *Venezuela*, the livestock, as in the majority of the American countries, suffer the pernicious effects of ectoparasites, the most important among which are *Amblyomma cayennense*, *Boophilus microplus*, *Dermatobia hominis*, *Lyperosia irritans* and *Stomoxys calcitrans*. The Venezuelan Ministry of Agriculture, through its Ectoparasite Department, has been conducting intensive control of these parasites since 1936. As the first step in the campaign, arsenical dips were employed and it was possible to clear ticks from one part of the country (Aragua State) which specialzies in milk production. After ten years of control, a problem cropped up in that the new tick generations had become resistant to arsenic. Fortunately, by that time there had been discovered chlorinated hydrocarbon insecticides which are harmless for warm-blooded animals, but lethal to ectoparasites, and are very persistent in their action.

After these insecticides had been the subjects of experimentation by the Department, plans were made for control with these products which are applied by means of spray pumps. In the case of toxaphene, it was found that the toxic dose for animals is 40 mg. per 2.2 lb. of live-weight. With the sprayers used, no animal received more than 10 g. of the active principle, in fine suspension, which is equivalent, for an animal weighing say 880 lb. to half the toxic dose per 2.2 lb. Up-to-date some 22. million sprayings have been carried out without any cases of poisoning, nor have skin lesions been caused by the treatment. The chief advantage of toxaphene, compared with other ectoparasiticides, is its greater persistency. The campaign is welcomed by the stock farmers because of the benefits it has brought to them in the control of ticks, bot flies and other external parasites of livestock.

Literature Cited Regarding Disease and Parasite Control

PHILLIPS, RALPH W. (Editor). *Report of the Inter-American Meeting on Livestock Production.* FAO Agricultural Development Paper No. 8, Food and Agriculture Organization of the United Nations, Washington, D.C., U.S.A., and Rome, Italy. 1950.

_____. *Report of the Second Inter-American Meeting on Livestock Production.* FAO Agricultural Development Paper No. 33, Food and Agriculture Organization of the United Nations, Rome, Italy. 1953.

JOINT FAO/WHO EXPERT COMMITTEE ON BRUCELLOSIS. *Joint FAO/WHO Expert Committee on Brucellosis — Second Report.* FAO Agricultural Study No. 24, Food and Agriculture Organization of the United Nations, Rome, Italy. 1953.