VACCINATION AS A METHOD OF CONTROL OF STOCK DISEASES IN NEW ZEALAND.

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There are a number of diseases in stock controlled by means of biotherapy and this fact makes stock-owners hopeful that this relatively easy method of control might be used in all complaints, particularly those of dairy cows. In almost all bacterial preparations for disease control, it is necessary that the organisms producing the disease should cause a definite response in the body of the animal, that is, that antibodies or antitoxins should be normally produced. Also, in practice, the causative organism itself or some necessary fraction of that organism must be used to create immunity, for in some diseases it is the secondary infection which may cause the severe symptoms following a primary infection which could be controlled.

In giving consideration to vaccine therapy considerable knowledge of the growth habits of the organism, and end products formed in the body, is required to decide what type of preparation is likely to be of use to bring about active or passive immunity.

It is unnecessary to go through the history of vaccine production except to say that some, such as small-pox vaccine, were arrived at empirically before the days of the science of bacteriology, simply by observation of occupational diseases, or by trial and error. Others followed deliberate trials based on an incomplete knowledge of the organism, and such vaccines have usually required modification, while others still, have been scientifically conceived with as full a knowledge of the unit cell as is possible in bacteriology. Bacteriology, however, is not a pure science, but a mixture of many sciences including chemistry, physiology, nutrition, and animal health generally, with a technique built up to enable the worker to handle dangerous organisms with impunity.

There are a number of different types of vaccine made use of in disease control. The main classification might be given as:-

1. Live virus with or without antisera which prevents serious effects.
2. Antitoxins.
3. Antibacterial, either live or dead organisms or parts of organisms.

Although New Zealand is free from serious epidemic diseases, yet there are many minor diseases which respond to control by biotherapy, and they can be discussed in detail.

GROUP 1:

Dog Distemper is now being prevented by injection of a virus and anti-serum. The method of control is not an unusual one, that of preventing the disease becoming generalised or serious by giving a passive immunity along with the live organism which creates a strong active immunity. Distemper virus is one which acts on the central nervous system so that the proper method of inoculation is an intradermal one and not a subcutaneous as for many toxaemias. This is not generally recognised but operators using the intradermal route would be assured of a higher immunity. In distemper passive immunity by the use of anti-sera produced from dogs by injection of virus

plays an important part where animals have been sent to Shows and are liable to come in contact with the disease in a virulent form. Frequently mild infection occurs by contact at the Show and active longstanding immunity results. Anti-serum can also be used curatively in dogs provided the injection is made in the early stages of the illness before many secondary conditions have been established. Its use will ward off the distressing paralysis which is so frequently a late symptom of distemper.

Contagious ecthyma in sheep (lip and led ulceration) is a virus disease causing skin lesions of the nose, tongue, mouth and coronets. The disease passes through the stages of papule, pustule, and scab, just ad does Cow-pox. As many animals are affected together in a flock, it is customary now for the scabs to be scraped off the face of the sheep and forwarded to the Wallaceville Laboratory. The scabs are dried in desiccators and stored for some months, then soaked in gylcerine to get rid of final contaminants. The scabs ground in glycerine are used as the vaccine. Although crude, the method is very efficaccous and by scarifying the skin of sheep and rubbing small amounts on to the scarified surface, lesions are confined to one area, usually the skin of the thigh - and a mild attack of the disease thus produced conveys a high degree of immunity, sufficient to protect for the life time of the animal. 23,750 doses were used in New Zealand last season, all made from scabs sent in by stock-owners, and prepared and standardised at Wallaceville. Unfortunately, a further demand of 40,000 could not be supplied for lack of material.

Fowl-pox vaccine can be made from scabs produced by scarification of the combs of cockerels. Often a pigeon strain is used to vaccinate poultry for its is milder in action and the results in the bird are not so severe. Occasionally considerable trouble arises in a flock where too strong a vaccine has been used, with death, or moulting and loss in egg-production eventuating. Although Fowl-pox vaccine may be made crudely and usually is, yet there is a scientific method also where the virus is grown in the incubator on the chorio-allantoic membranes of a living chick embryo. Plaques can be distinguished after a few days of growth and the membrane is then ground up in glycerine, and standardised for use. To inoculate the vaccine a stab method is employed or after plucking a portion of the leg the vaccine is rubbed in to feather follicles.

Although this vaccine could be made in New Zealand it is usually bought in Australia. Most of the vaccine is used in the Auckland province.

Cow-pox is a disease which should lend itself to control by vaccination of the live virus, and tentative trials have been made using the ordinary human small-pox vaccine, but as neither controls nor inoculated animals have contracted the disease, results have not been conclusive.

GROUP 2:

The second type of vaccine used is that based on the production of exo-toxins either in the body proper or in the intestinal canal. Organisms which produce toxins in vivo will usually produce them in vitro, and acting on that knowledge vaccines are produced in large amounts by growing anaerobically on chosen media.

The oldest of this type of vaccine in use in New Zealand is Blackleg vaccine. The disease Blackleg, due to B. chauvoei, attacks calves and more recently a sheep strain has been recognised. The organism came into New Zealand along with Anthrax in

unsteamed bone-flour and made several districts in New Zealand dangerous for well-conditioned calves. First vaccines used were so-called attenuated vaccines made from dried calf muscle heated for some hours to kill vegetative organisms and leaving a rich spore vaccine. The use of this vaccine no doubt spread the disease and killed many valuable calves. Manufacture was tedious and attempts to standardise the vaccine were never satisfactory using guinea-pigs or calves. So afraid of the vaccine were stock inspectors that they usually filtered most the powder out before the day's work began.

With newer knowledge and the recognition of the value of the fluid accumulating in and about the lesion, a fluid which was used to produce antibody and known as aggressin, it was realised that it was not the organism itself which was responsible for immunity after vaccination but the response to the toxic body generated by the organism. As a rule, however, such toxin was too dangerous but further work showed that it could be made non-toxic by the addition of formalin, giving a body known as a "toxoid". This method, the injection of toxoid, has been adopted for control of most of this class of disease.

Blackleg, whether in sheep or cattle, is so controlled, and last year 22,440 doses of vaccine for sheep and 72,650 doses for cattle were produced at Wallaceville.

A disease known as Black Disease and due to B. oedematiens growing in sheep liver damaged by the larval liver fluke is most efficiently controlled by a toxoid produced from B. oedematiens.

Tetanus, too, can be controlled in Army Mounted Camps by the use of a similar toxoid, and both this and Black Disease vaccine are obtained from Australia.

There is a much weaker vaccine coming under this heading and used widely in New Zealand to control Pulpy Kidney in lambs. Pulpy Kidney is due apparently to the toxin of B. ovitoxicus which, under certain nutritional conditions not properly understood, grows in the stomach and intestine of the animal and there produces a toxin which is absorbed and may cause sudden death.

Because under natural circumstances only weak antibody is produced, the vaccine does not produce strong immunity. However, vaccination gives an example of passing immunity from ewe to lamb by vaccination of the ewe while pregnant. The antibody is present in colostrum and protects the lamb for about 6-8 weeks moderately well. There are, however, many breakdowns and this vaccine is in no way as useful as is Blackleg or Black Disease vaccine. Considerable quantities are sold and imported from Australia. Two types of vaccine are produced, the one a normal toxoid and the other concentrated by precipitation, but blemishes to the carcase can occur when this alum precipitated material is used in lambs designed for export.

GROUP 3:

A third type of vaccine is made from organisms which do not produce exotoxins but which sensitise the animal tissues to the foreign proteins of which they are composed, or to fractions of the organism such as the capsule or the flagellum. The third group of vaccines may be used alive or killed, but it is only rarely that a killed vaccine is useful either prophylactically or curatively. Frequently in this type of vaccine organisms are chosen from the animal to be treated and are thus autogenous but in preventive work mixed strains of the organism are generally used.

Of the dead vaccines, those used for Streptococcal infections such as Strangles of horses or Mastitis in dairy cows, and Staphylococcal infections have never become properly established. Their action is too weak. Regarding Strangles, the immunising fraction is thought to be the capsule which is seen well at six-hour growth, but a well made capsule vaccine which was put up for horses at the beginning of the war was not effective in preventing a Strangles outbreak.

The Salmonella roup, the typhoid-dysentery group of man, is well represented in animals and many efforts have been made to produce vaccines to protect animals and birds but they have been unsuccessful. It will require considerable work amongst the antigenic factors which are found in these organisms and this work is about to commence at Wallaceville on Salmonella suipestifer which is so common in pigs in this country. Success in this disease would have an effect on the control of B.W.D. of poultry which is due to another member of the group.

One of the best of the live organism types of vaccine is that to prevent Anthrax. There is much secrecy in the manufacture of Anthrax vaccine which is usually an attenuated spore type, attenuation being carried out by a variety of processes. It is a vaccine which is best inoculated intradermally and can be used only on certain animals. Horses, for instance, would probably die of the disease, whereas sheep and cattle are protected. We have had occasion to deal with Anthrax from time to time in New Zealand, the disease having gained entrance many years ago in unsteamed bone flour used as ballast. The spores live many years in the soil but may be brought to the surface by rooting, burrowing or ploughing, and so gaining entrance to an animal, where the vegetative form is produced and the animal dies. To control the disease, animals, particularly newcomers, on a farm known to be infected are inoculated annually for some years. Such vaccination is very effective.

Of the live vaccines there is one which may shortly come into use in New Zealand but which has not yet been tried here, and that is one for the disease Swine Erysipelas. Although this disease is not common and is present in chronic form, yet it will require control.

The most interesting work of recent years in vaccine therapy has been carried out on Contagious Abortion of dairy cows. The disease itself is well established in this country and causes serious loss. There is a strong antibody response to invasion of the body by Brucella abortus so that there has been every reason to expect that a vaccine would be of use. American workers found an attenuated strain of Brucella abortus which did not cause the usual abortion of the foetus and a study of this strain in America (Strain 19) has made a vaccine a real form of control. Two types of the organism exist, a smooth and a rough, as in many bacterial groups, and the attenuated strain was of smooth type. In Great Britain, a rough attenuated strain 45/20 has been tried but was found to give less immunity and has been almost abandoned.

Availing himself of the experience gained by American workers, Buddle set to work to produce the vaccine in New Zealand and the results may be given in detail. Departmental and Dairy Board officers have been responsible for field inoculations and accumulation of statistics and this has made a first-class experiment. From Mr. A. Ward, Dairy Board Statistician, we have the estimated loss of production from two and three years' old heifers as approximately £250,000 but this is a direct loss in butterfat and does not take into consideration the further loss from sterility and cow abortions.

The vaccine itself is prepared at Wallaceville by Mr. Buddle and his team of workers. Great pains are taken to keep cultures smooth and pure and attention to these details has ensured very little contamination in growth on bulk media.

In the first year, while technique of growing the organism was being perfected, some 3,000 calves and heifers were vaccinated, but in 1943 Wallaceville issued 23,000 doses, 1944 - 43,000, and 1945 up to the present 95,000 doses, so the farmer is taking advantage of this useful method of control.

A table prepared by the Animal Research Division summarising results of inoculation in 1943 in calves and yearlings shows us that in two year olds there was an abortion rate of 21.5 per cent. and in cows 7.6 per cent, while in 1944 those calves vaccinated in 1943 on the same farms gave an abortion rate of 3.1 per cent. These results were obtained in 771 herds from 11,804 vaccinated calves. In 20 herds where yearlings were vaccinated before service and where the abortion rate in controls in 1943 was 39 per cent, the abortion rate in 1944 was 2.1 per cent.

Therefore, in calves and yearlings vaccinated in 1943 abortions dropped to 3.05 per cent. as against 22.1 per cent.

A further interesting table built up from 17 herds only but which later can be added to, shows that non-vaccinated heifers in 1942 were averaging 38.2 per cent, abortion rate, but after vaccination of calves the rate dropped to 6.3 per cent. in 1943, and 1.36 per cent. in 1944.

In non-vaccinated cows in these same herds the abortion rate was 10.1 per cent., 8.0 per cent., and 4.7 per cent., the reduction probably being due to the lowered active abortion rate in younger animals running in the herds.

Vaccination has been carried out by Live-stock Division officers and also in many districts by Club Veterinarians, and results are so good that vaccination of calves against contagious abortion is recognised as a valuable means of control.

In conclusion, one might mention the action of bacteriophages some of which are apparently biological entities. Results following their use have not been satisfactory for, apparently, proteins present in the area where the organism responsible for the disease lodges, are apt to cause an adherence of the phage so that there is too little activity on the primary disease organism. By lowering numbers of organisms, phages may permit phagocytes to function normally, and so cure the disease, but phages themselves do not seem to be directly responsible.

Vaccines can, therefore, be claimed to prevent a great deal of loss in New Zealand. That being the case there seems to be a very good reason why a small, well equipped Biological Institute should be built by the Government to produce all the vaccines and biological preparations we require, an Institute similar to the Commonwealth Serum Laboratories of Australia.

DISCUSSION ON DR. HOPKIRK'S PAPER:

MR. LESLIE asked what chance there was of the introduction of a serum to combat blood-poisoning in ewes.

DR. HOPKIRK: I think that first of all we have to know what organism is responsible, and two come into this: Vibriou septique and Bacillus chauvoei. A great many of these blood-poisoning outbreaks are due to the blackleg bacillus (B. chauvoei)

and in a number of cases they have been prevented in the following years by vaccination. Death is so sudden that there is not likely to be time to use a serum following shearing or crutching or whatever it is. Death usually occurs within three days, and one could not get an anti-serum to the place in time. I think the solution of the problem lies in this: farmers who anticipate having sheep affected should have been vaccinated either with V. septique vaccine or blackleg vaccine. It is the second one that should be mostly used, because the majority of sheep die from blackleg. This was not recognised until a few years ago.

In connection with a question from a member concerning the value of a serum against scours in fowls, suggested as being due to B. coli, MR. ROACH said Messrs. Burroughs Welcome tried to produce B. coli serum for the treatment of calf scours. For that reason they asked the veterinary investigation officers back Home to supply them with specimens from calves dying from white scours in order for them to get fresh cultures. They found that the semological types, and the antigenic properties varied considerably, but they produced a commercial serum. They made the point in their pamphlet that the semological types varied so much from farm to farm that they did not place very much reliance on the therapeutic result and would prefer to prepare sera against local varieties. The findings expressed in these pamphlets were borne out during the years 1942-43 and part of 1944 back Home when the commercially-produced serum, produced in bulk, was shown to be not very efficacious in controlling calf scours. Other methods were better. On the other hand, when the serum was produced from an organism which had been isolated from the farm in question the results were better; on the whole this type of therapy does not give any great encouragement at the moment.

MR. BONNER asked if it would be possible to put up a mixed vaccine for calves.

DR. HOPKIRK: It would be possible to prepare a mixed vaccine for calves but we are not very satisfied of the need for it. Many specimens coming into the Laboratory at Wallaceville are from calves which have been dead for some time and one of the commonest putrefactive organisms is Vibriou septique, the cause of malignant oedema. Hence it is difficult to be sure of the significance of finding this organism in P.M. material. If it were definitely established that V. septique was responsible for calf mortalities a specific vaccine against this strain could be employed with some confidence.

MR. WARD: In his paper the doctor has not mentioned at any length the question of vaccinating against mastitis.

DR. HOPKIRK: I suppose that question was bound to come up. Vaccines are made for streptococcal and staphylococcal diseases. They do not seem to be of very much use in the human sphere, and I do not see why we should expect them to be of use in animals. As far as we can measure it, there is not a great anti-body response to these organisms in the body. Unless they stimulate a fair response, bacterial species will not produce a good vaccine, and hence we should not anticipate from them much assistance in controlling mastitis. The experience is that you do not get very much from them, otherwise we would have had vaccine used all over the world and not by a few companies in New Zealand. A lot of farmers still like them, but from my point of view they have never shown any promise whatever.

MR. DODSON: I do not know of one farmer using vaccine against mastitis in my district. I know dozens who have tried it, but not one is using it now.

DR. FILMER: The question has been raised of vaccinating against the blood poisoning that occurs at lambing. Perhaps an experience we had with some of our facial-eczema experimental ewes in the Waikato may be of interest. We had trouble with them at lambing and in addition the infection got so bad that it followed the bleeding from the jugular. The mortality from bleeding became an embarrassment to the experiment, so a vaccine was prepared for us, and it appeared to be very effective. Our trouble disappeared, and I think that supports what Dr. Hopkirk has said in regard to the likelihood that it could be controlled fairly effectively by a vaccine.

Mr. Buddle's tables follow on next page.