POISON HAZARDS TO STOCK

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In this paper I am going to deal briefly with the main types of poison hazards to stock which we have dealt with during the past few years in the Department of Agriculture, and then describe the salient points of three investigations presenting features which have not been reported from other parts of the world or which are unique.

For a mixed gathering of this nature the method of treatment of the data will be to give a general narrative account of our findings in routine and research work during the past ten years, pointing out the principal agents causing losses, usually unnecessarily, in stock.

It is almost impossible to assess the annual loss to New Zealand production through the death of stock through poisoning since it is problematical how much of the total is suspected as such, let alone confirmed in the laboratory.

Compared with the results of the major stock ills, losses are very small in the aggregate but they are sometimes disastrous to the individual farmer.

However, there is a constant dribble of specimens to Wallaceville for conformatory analysis and losses generally are of the order of ten or less in the case of cattle and fifty or less in the case of sheep.

Naturally, we fail at times to confirm the tentative field diagnosis of poisoning even where there has been extremely strong field evidence but this also happens in human toxicology and is generally due to the fact that the toxic material has been present in just lethal amounts and has been excreted or neutralised before death occurs.

We are very fortunate in New Zealand in that malicious poisoning seems to be unknown in farm animals.

Considering sheep, quite serious losses occur at times following drenching with nicotine sulphate - copper sulphate mixtures or with bluestone alone. Usually there is evidence of over-dosing due to faulty weighing out of materials or through giving a bit more than the normal dose, 15 grains, just for luck.

We have on record loss of sheep through the use of arsenical baths for foot-rot. In one case a stud ram was stood in such a bath for ten minutes and although allegedly watched during that time to guard against its drinking the solution, undoubtedly died of acute arsenic poisoning. Veterinary opinion is that the use of such baths is quite unnecessary for the treatment of foot-rot.

With regard to the poisoning of sheep following dipping in arsenical or phenolic dips, although the dipping fluids are often blamed or suspected, we have no conclusive evidence from the chemical data that poisoning does occur. Extraordinary carelessness is displayed at times in the handling and storage of arsenical materials and recently ten of a batch of seventy rams were lost through weed killer stored on a shelf in a shed dropping on to rock salt and thence on to the soil below, where it was licked strenuously by the rams.

Somewhat similar is the case of two cows which died after being fed bran on to which arsenic compound, probably weed killer, had leaked.

Weedkilling operations with arsenicals are responsible for the greatest cattle losses due to poisoning and we find that care-

lessness in spraying blackberry, thistles, etc., near a neighbour's boundary and often, over the boundary, causes deaths in cattle. Similarly, losses are occasioned by animals being put back to graze on sprayed areas in too short a time. Operations by local bodies along roadsides also lead to losses through cows being grazed there, the owners being ignorant of the fact that spraying has been carried out.

In experiments to determine the rate of disappearance of arsenic from pasture sprayed with lead arsenate, sodium arsenite, calcium arsenate, and paris green at the rate of 6 lbs. in 100 gallons of water per acre, we found that about fourteen days were essential and twenty-one days advisable to bring down the levels to a safe margin for grazing sheep. Heavy rain had fallen four days after spraying. It is not possible to give a general safe time limit owing to variations in rainfall, growth and rate of application and hence the use of arsenical weedkillers will be attended always with some danger to grazing stock.

Lead poisoning of the acute variety is encountered in both cattle and sheep and is generally due to old paint pots being dumped or left lying about accessible to stock, or to freshly painted surfaces being licked for the sake of the linseed oil. We have had one case of lead poisoning due to old battery plates being eaten by calves. Of course, stock often get into trouble through wandering into sheds or to dumps where dangerous materials are stored. Then, again, is the constant danger of poisoned baits being found and eaten by stock and deaths due to strychnine and phosphorus are encountered.

The question of suspected alkali or salt poisoning in pigs from skim-milk comes up occasionally and we have been able to demonstrate the presence of alkali in the feed but we have not so far been able to detect excessive amounts of salt in the viscera of the animals. It generally happens that by the time animals are affected by salt poisoning the original food has been completely consumed. In a case reported at the end of last year thirty pigs varying from weaners to heavy porkers died, presumably from salt poisoning, and the stomach contents contained only normal amounts. However, the factory manager later admitted that salt was inadvertantly run into the whey tank.

With regard to poultry very little poisoning occurs or, alternatively, is not suspected and recorded.

To turn to the homely mangold, we have been advised of two cases in cattle in the first of which thirteen out of twenty-four in-calf cows died after being fed what was estimated at about 30 lbs. each of yellow mangolds which had been pulled for about six weeks and left lying on the ground not in heaps (0.72 per cent. KNO_3). In the second case following a change from yellow to red mangolds 30-40 cattle were found lying prostrate on the ground in about six hours. Fortunately, all but eight steers and two heifers recovered. The carcases were sent for boiling down and no post-mortem was made. We had samples of the roots sent to the laboratory and though we could not observe any ill-effects in a heifer which eat about 73 kilos. in three days (about a pound of KNO_3) we did find about 35 per cent. of methaemoglobinaemia, but no other ill-effects, in a sheep which was drenched with 2,625 c.c. of juice of the red variety. The same sheep had shown no effects when drenched with juice equivalent in terms of nitrate from the yellow roots. Though these cases are not clear cut and confirmed there are good grounds for suspecting this useful article of stock food. I shall refer later to mortality in pigs following the use of cooked mangolds.

In 1936 heavy mortalities in young pigs and unthriftiness in older pigs were suspected to be due to the installation of new pipe lines to convey and distribute skim-milk.

Briefly, the circumstances were as follows:-

On one farm two piggeries were run from two dairies without any trouble. Early the year before one of the piggeries was shifted to new ground and a new 16 chain pipe-line installed. Numerous deaths occurred among the young pigs shortly afterwards. The pigs comprised about twentyfour suckers on mothers and thirty stores. During the winter, so very little skim-milk was available that molasses and water was pumped through the pipes and fed to the pigs which did quite well. When milk again became plentiful in the spring and was pumped in quantity through the pipes about 40 to 50 pigs died. The symptoms noted were: pigs went off their feed, got up on their toes with stilted gait, showed swelling of joints, and lameness, became unthrifty, half grown pigs failed to grow, young pigs died, while sows were mainly unaffected. Pigs at the other piggery were unaffected. Examination of the organs of affected animals and milk after passing through the pipe-line led to the institution of experiments on the toxicity of zinc which had always been maintained to be non-toxic. We have been able to reproduce the lesions in growing pigs by feeding zinc lactate in a skim-milk diet and have found that 0.005 per cent. of zinc in the diet will cause lesions as severe as those obtained by twenty times as much (that is 0.1 per cent., a figure that we encountered in some skim-milk). Fortunately, the zinc is all removed from a pipe line in one or at the most two seasons.

In the past few years we have had no reports of further mortalities from this cause. We did hear recently of a farmer who treated his new pipe line system with waste sulphuric acid to remove the zinc inner lining.

The disease has not been reported from any other country, probably as this system of skim-milk distribution is peculiar to New Zealand. The removal of the danger seems to be to use black (i.e. unvalvanised) piping for this purpose.

In quite a different category was the investigation, a few years ago, into the alleged poisoning of cattle by arsenic occurring naturally in the soils and waters of the Reporoa district which lies adjacent to and south of the Waiotapu thermal area. Though very large amounts of arsenic, up to 2 per cent. of As. were present in the soils and muds examined, and up to 2.6 grains of As_2O_3 per gallon in the waters of the district, we were unable to demonstrate the large scale arsenical poisoning in stock which had been alleged following the discovery, in gross amounts, of this element. A few deaths were undoubtedly due to arsenic poisoning, mainly on one farm lying nearest to the thermal area and where the water supplies were heavily contaminated. Considering the amount of arsenic present it was surprising that animals managed to survive at all in the affected area which covered about 3,000 acres. It is interesting to note that there was not a large uptake of arsenic by the pasture grasses and to this fact the ability of cows to graze on the area with safety was probably due.

More recently, we had occasion to study the formation of nitrite in cooked mangolds. Following the cooking of about three tons of chopped up mangolds with live steam a farmer lost about 200 out of 500 pigs which were fed on the morning following cooking. The roots had been freshly pulled but it was found that this fact bore no relation to the formation of nitrite, the temperature of cooking being the important factor.

The table gives a summary of the results obtained in a number of experimental cookings made on roots which had been pulled and clamped for seven weeks:-

Vat.	Temperature of Cooking	Held at stated temperature for:	Grains of Sodium Nitrite p. gal. next morning.
1.	170°F.	-	45
2.	190°F.	50 mins.	35
3.	208°F.	30 mins.	20
4.	210°F.	120 mins.	1.0

There was no nitrite detectable in the original roots nor was there any present at the completion of cooking, except in the case of Vat 1. The whole conversion from nitrate, which is always present in varying amounts in mangolds, took place during the cooling process. The conversion was shown by Mr. Nielson of Wallaceville to be independent of bacteria present and was probably due to enzyme action.

Feeding experiments on pigs with pure sodium nitrite showed that the higher concentrations of nitrite obtained in these experiments would be fatal.

The salient points of this investigation were that:-

(a) During the cooling, following the cooking of mangolds, dangerously high amounts of nitrite were formed from the relatively non-toxic nitrate present in the roots, unless,

(b) Cooking was carried out very close to boiling point and was prolonged for at least two hours.

(c) The clamping of mangolds for seven weeks did not prevent the formation of dangerously high amounts of nitrite following low temperature cooking.

DISCUSSION ON MR. McINTOSH'S PAPER:

MR. GRIMMETT: Sometimes the work is interesting and one gets on to a line that leads to research work that can be exciting and, on occasions, humorous. I remember a case in which a number of fowls died in the vicinity of the Petone Railway workshops, and when we opened them up the gizzards were more than half-full of all kinds of metal, particularly sharp pieces of iron, and one fowl had about a three-inch nail right through the gizzard, bent and protruding. Altogether, there was an interesting and amusing collection of exhibits. Mr. Grimmett went on to congratulate Mr. McIntosh on his paper.

Mr. McINTOSH: There is a normal content of most inorganic toxic materials in the animals organism, and even if not required for normal metabolism it will nearly always be there. Arsenic sulphide may be in the gut contents, and give a good reaction, but it will not necessarily have toxic effects. The point is to show the presence of absorbed poison, and not just poison in the gut itself.

MR. TAYLOR: Some years ago I came across a rather serious case of poisoning of pigs through skim milk being pumped through a new and long galvanised pipe line. Is there any method of making the pipe line danger-proof other than by putting in black pipe, because the average farmer who already has galvanised pipes on the job is not usually willing to pull it up and put down the black?

MR. McINTOSH: If he has galvanised piping and is going to have trouble he will get it in his first season. We followed one new installation, taking regular samples, and we found that five

months was long enough for all the inner galvanising to be removed. There is no danger after the first year. One factor is the volume going through, in relation to the length of the piping. If you can dilute the material inside, no pig will get enough to injure it. In feeding experiments at Wallaceville we found that two months was generally the time necessary to produce lesions.

MR. TAYLOR: In this particular case - it was some years ago - they decided very quickly that it was the pipe line that was causing the trouble and put in a trolley line to bring the milk down in vats. Is there any method of treating that pipe by pumping diluted sulphuric acid through in order to remove the galvanising, followed by washing out with water? Would that make the line safe?

MR. McINTOSH: One farmer in Hamilton has done that. I had hoped to meet him a month or two ago to hear his experience in the use of sulphuric acid in a pipe line, but I was unable to. Zinc and H_2SO_4 react together and I wondered what sort of fountains he would have at the end. I know that he treated the pipes first, in conjunction with the chemist of the Dairy Company's laboratory at Hamilton, who would be able to tell him when the pipe was free. It is possible to remove the galvanising. To do it after the milk had gone through it would be necessary to ascertain that the pipe was clean so that the acid could come in contact with the lining.

On the question raised by MR. DODSON of whether swedes caused red water,

MR. McINTOSH said: If there is reasonable ground to suspect that swedes do cause red water, the problem boils down to whether there is some material in the roots causing it, and I think it would be quite simple to deal with it. I am afraid I cannot give any promise forthwith.

MR. DODSON: Diagnosing it is no trouble. We want some way to stop it.

MR. WEBSTER: Has Mr. McIntosh any information about chronic copper poisoning? I ask this because, in the light of some entirely accidental experimental work at Massey College, it seems quite possible that such cases may occur. What we were trying to do was to raise a number of lambs entirely free from parasites. At birth, the lambs were put into a shed. The ewes, which were outside, were brought in several times a day and the lambs were allowed to drink, but otherwise they were left entirely indoors, on a concrete floor, with clean straw bedding which was changed two or three times a week. After weaning, the lambs were put on to concentrates, but we found in the faeces that a few eggs of internal worm parasites began to creep in. To make a proper job we decided that every time the pens were cleaned out we would give them a slight rinsing with bluestone solution. Shortly afterwards, some of these lambs started to die. It was a mystery. They went off suddenly with characteristic symptoms - blood in the urine and very characteristic tarry-looking kidneys, gun-metal colour. I discovered that the symptoms coincided with what is known in the United States and the south of France as "gun-metal kidneys" and the symptoms coincided with chronic copper poisoning. We found that when the lambs went back into the pens after the straw was put down they always nibbled at the fresh straw. The amounts taken were insignificant, but they managed to pick up sufficient copper to bring about these symptoms. We cut out all copper, but the interesting point is that we ultimately lost upwards of 60 per cent. of the lambs, and the deaths continued for some ten months although the copper was withdrawn. Analysis showed that a very large accumulation of copper sulphate from the bluestone wash that had been used had been taken up by the lambs.

MR. McINTOSH said in reply that he was unable to comment on copper poisoning in its chronic aspects.

DR. CUNNINGHAM: 1½ grams of bluestone for 30 or 40 days would kill most sheep, even large ones. Half a gram a day given to a large sheep for 100 days would kill it. What appears to happen in the sheep is that the liver cannot absorb the copper and immobilises it to stop its toxic effect. It is rather surprising that 10 months after the last dose was given deaths should still be occurring. However, to continue with the chronic copper poisoning story, it is of interest that the bovine animal generally is very much more resistant to copper poisoning, and the sheep is peculiarly susceptible to additional amounts of copper above the normal.

MRS. ROBERTS asked whether Mr. McIntosh and his associates included in their work an enquiry into the ultimate effect of toxic materials, other than saying that they were present and caused death.

MR. McINTOSH pointed out that that did not enter into their scheme of things. If it was known that toxic materials were present in quantities consistent with poisoning it was left at that. "That particular aspect is dealt with by a one-man team," he added. "I operate with the Fields Staff and directly with the Wallaceville laboratory, and the ultimate effect of poisons generally cannot enter into our scheme for reasons of time and on account of insufficiency of staff. There are many theories as to the ultimate causes of death. It is a fundamental problem, I know, and it would be nice to know what did happen."

DR. McMEEKAN: There are two general observations relative to the case of mangold poisoning of pigs which Mr. McIntosh has described. Mr. McIntosh mentioned that he does not know why this farmer fed these roots warm. The farmer concerned was engaged in a very worthy attempt to produce about 1,000 bacnners a year without the aid of the dairy cow, and his basic ration accordingly had to be something comparatively cheap, and roots were the logical choice. His greatest difficulty was to get the animals to eat enough of such a bulky diet to grow sufficiently fast, and by warming the food he found that the intake was considerably increased and a reasonable growth rate was obtained. It is unfortunate that the attempt failed completely and the business has now disappeared, but at least he has left us an interesting scientific legacy in respect to the danger of heating mangolds.

Referring to the use of galvanised pipes for pig feed, DR. McMEEKAN said it was a reasonably safe bet that there had been about a thousand new installations of galvanised piping in piggeries since war broke out, distances of anything up to 20 chains, and relatively little trouble had been experienced. The Pig Recording Supervisors are aware of Mr. McIntosh's work, and they advise farmers how to handle the piping to avoid trouble. The usual advice is not to leave milk in the pipes, but to leave them full of water. If this is done for the first year no trouble occurs.

MR. McINTOSH: We advocated that from the start, but we found that with the large installations the pipes were always full. It was all right for short pipe lines to be flushed, but with big installations that were always full it could not be done.

MR. ROACH said that in 1940-41 he had had experience with "blitzed" wheat from silos that had been bombed. It contained splinters of metal and more particularly of glass. There was another similar product which was definitely wheat and glass alone. The problem was: "Could it be fed to poultry?"

MR. McINTOSH: The question of the toxicity of powdered glass on dogs has been very thoroughly studied in South Africa.