NUTRITION PROBLEMS ON PASTURES ON THE AHURIRI RECLAMATION AREA

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INTRODUCTION

Probably everyone present here today is familiar with the story of the 1931 Napier earthquake, but I wonder if it is equally well known that the Ahuriri Lagoon Reclamation owes its origin to this same disaster.

A little over 24 years ago this area of over -8,000 acres was used. as a haven for yachts, fishing and swimming. The colony of terns, which has since established itself near the gannet rookery at Cape Kidnappers, made their home on the few small, shingle islands which dotted the lagoon. The earthquake thrust the entire area up some 5 to 8 feet, completely exposing much of the sea-bed, while the remainder carried only shallow draughts of water. This then was the beginning of a project which has since become an example of what human, ingenuity and hard work can accomplish.

DEVELOPMENT

As a financial depression had caused unemployment throughout the country the Government originally became interested in the development of the Lagoon with the idea of firstly providing work and eventually the subdivision and settling of families on small holdings. Economic conditions have modified this idea, but in the final settling up this may yet come about.

The title to the land is vested in the Napier Harbour Board and has been since 1874. Prior to the commencement of development it was leased to the Lands Department for a period of 21 years.

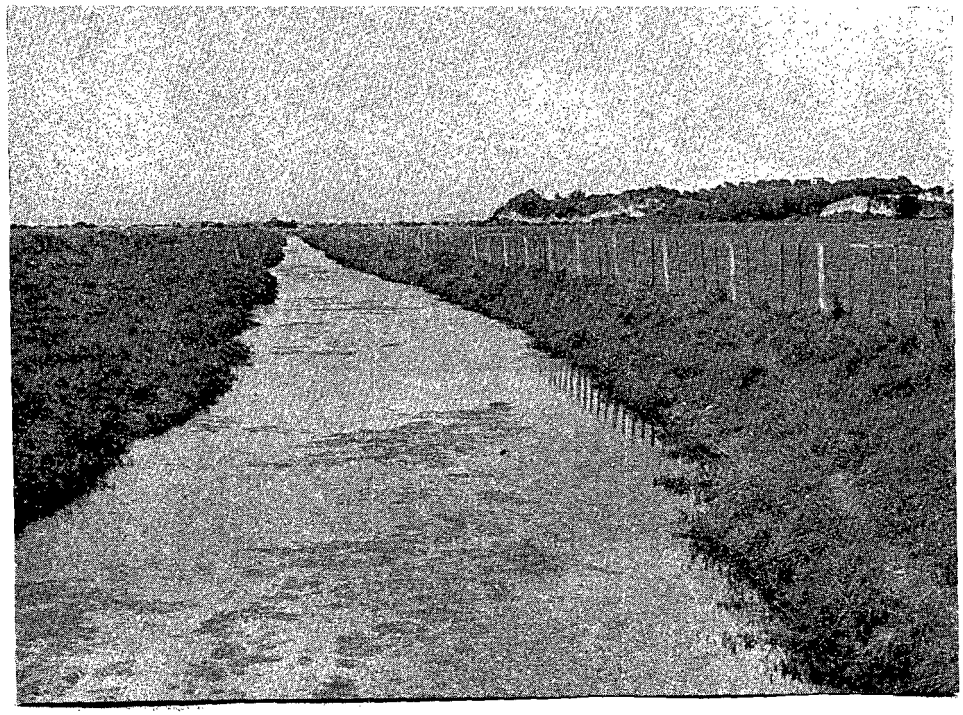
One of the first to realise the possibilities of developing the Lagoon was the late Mr Guy Rochfort, who suggested to the Board that the land could be re-

claimed from the sea by stopbanks. In 1932 Mr E. C. Aston, Chief. Chemist to the Department of Agriculture, visited the area and soil samples were drawn both below and above the water level.

After the determination of surface levels, the Lagoon was divided into two sections, the northern section of approximately 5,000 acres and the southern section of about 2,500 acres. As well as this about 700 acres were reserved as ponding areas. As the northern and southern sections had a common main outflow to the sea this naturally became known as the Spillway, and it was into this that the whole system of drainage emptied.

In 1934 a comprehensive drainage scheme was commenced by the Public Works Department. Approximately eleven miles of stop-bank was erected as a protection from flood waters from the hills and to exclude the tidal waters. Two pumping stations, 'the one in the northern section capable of removing 30,000 gallons of water per minute, were installed to remove the drainage water from the enclosed area, As de-watering proceeded 26 miles of internal roads, were constructed, 34 miles of main drains excavated, and 354 miles of parallel lateral drains, 2 chains apart, were dug to hasten

One of the main drains in the Ahuriri reclamation area.

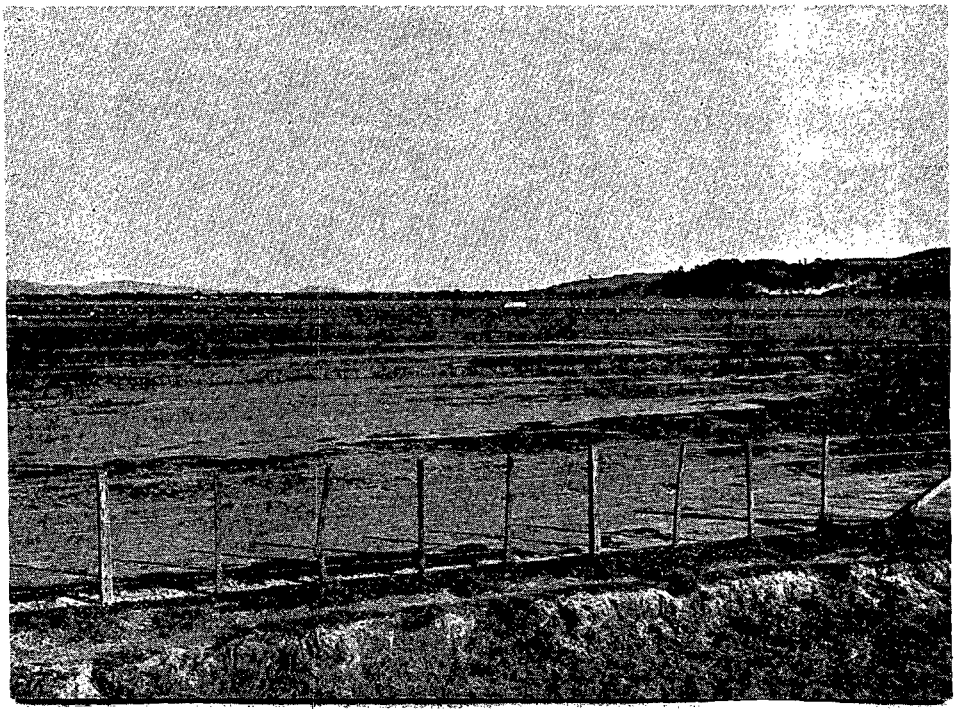


the removal of surface salt. The salt- was recognised as being the main obstacle to the establishment of pasture.

The first sowing to pasture took place in 1937, and by 1939, on the 6,000 acres of effective farming land, 90 miles of fencing had been erected and an artesian water supply (20 miles of piping) installed to reticulate the whole area. The stock carried was 3,400 breeding ewes, 4,300. dry sheep, which were mainly wethers, and a few head of cattle.

As the grassing down and cropping was dependent on the degree of salt in the soil systematic sampling and analysing of soil samples each- year was carried out. Natural vegetation also helped to serve as a guide as to the salt content. The first species to show up after the removal of surface water was *Salicornia* or salt weed. The period of survival of this weed was according to the changing salt content in the soil. A salt content of 0.5% would see it going out. The next to appear was buckshorn plantain *(Plantago coronopus),* sea aster *(Aster subulatus)* and *Puccinellia,* followed by *Melilotus,* volunteer white clover and tall fescue. The appearance of tall fescue was taken as the first sign that the soil was ready for ploughing with a view to sowing barley as a green feed crop, prior to

Salt patches on the Ahuriri reclamation area.



sowing down the pasture. Discing and deep ploughing was found most effective in hastening the natural desalting which was the main requirement in making it possible to utilise this area as a farming unit. From 1939 to the present day development has been contingent on this factor.

In 1951, when the original lease expired, an agreement was reached whereby the northern block was transferred to the Lands Department and the southern block was retained by the Napier Harbour Board. It was estimated that, of the original 8,000-odd acres, nearly 2,000 were taken up with roads, drainage, waste areas and a commercial aerodrome. The majority of the remaining area had been developed and subdivided. The carrying capacity had increased and quite a large cropping programme-incorporated in the general farming management.

PASTURES AND SOILS

Since the development and removal of salt no difficulty has been experienced in the establishment of first class pastures. Pasture swards containing perennial ryegrass, cocksfoot and white and red clovers are capable of carrying 7 to 8 sheep per acre. Unfortunately, these same pastures have been responsible for poor stock thrift, especially amongst young animals. Herbage analysis has shown that the molybdenum contained in the herbage, particularly clovers, is excessive, and is responsible for the condition called "conditional copper deficiency.'!

The soils which are described as silt and clay loams are mineral and mainly derived from limestone country. They are low in organic matter, very alkaline, high in free lime and potash, and extremely high in phosphate, no doubt due to the long and large accumulation of decomposed marine life. These soils are also poor structurally, and shell fragments are quite obvious throughout. The "puggy" nature of the clay loams impedes drainage and, during a hot summer, these dry out badly leaving the ground surface a series of large open cracks. The analyses show the pH ranging from 7.8 to 8.2 ; calcium at 20+ ; potash 30 ; and phosphate from 30 to 40.

The soils are slightly high in molybdenum con-tent, about .48 p.p.m., but show a relatively high potential availability of the total amount present. The alkaline reaction, together with the high phosphate levels tend to favour the molybdenum uptake. The analyses have shown from the herbage that the

molybdenum uptake ranges from 3.9 p.p.m. in the autumn up to 10 to 14 p.p.m. in the spring, while that of normal non-affected pastures is from 1 to 3 p.p.m. The uptake of copper on the lagoon pastures is about normal, that is of the order of about 8 to 10 p.p.m. on a dry matter basis. Work overseas on similar soils derived from calcareous materials have shdwn that, where the phosphate status of the soil is high, applications of phosphate have a considerable effect in increasing molybdenum availability. The molybdenum uptake in plants is also worth noting. Clovers, for instance, take up more molybdenum than either grass or weeds, in fact clovers are rather lopked upon as molybdenum accumulators, and from this point of view, clover-dominant swards, as sometimes experienced on the lagoon, are undesirable.

Dr. Davies, of Rukuhia Soil Research Station, in his investigations on some of the salt tolerant plants, pointed out that plantain was much higher in copper content and lower in molybdenum than the ryegrass and white clover species. This, I feel, is the reason why, before establishment of the better species of grasses and clovers, lambs were fattened off their moth&s without any applications of copper. Pastures, if one could call them such, were dominant plantain, *Pucci-nellia* and weeds, but with the de-salting, and the replacement of salt tolerant plants with a normal pasture sward, the molybdenum trouble has increased.

With the introduction of these highly 'productive pastures the condition of the livestock today is of considerable economic importance. Although the molybdenum uptake is excessive the copper content of the herbage is normal.

Copper applications, therefore, are specific as a control.

STOCK THRIFT

On searching through files dealing with deficiencies of trace elements the first reference to the Ahuriri Lagoon was in the spring of 1944. The liver of a hogget .had then been tested for copper. and the result showed a copper content of 32 p.p.m.-a very low figure. It appears that drenches containing copper and cobalt were then administered at intervals but the re-. sults obtained were not satisfactory and in 1945 a report states that "stiffness and resultant wasting in the young lambs, and in some cases paralysis" were present. During that same year, i.e.,- 1945, a heifer's liver showed a copper content of only 10.1 p.p.m. and it was

suggested that copper superphosphate be used as a topdressing.

There is no indication of what progress was made during the following years but apparently stock were not as good as desired and cattle were difficult to rear as well as sheep, and most animals from the property were sold as stores.

In recent years all our investigations have been confined to the block of approximately 2,000 acres farmed by the Napier Harbour Board as from 1951, when the area was divided. On this property cattle showed signs of copper deficiency, that is unthriftiness and loss. of colour from black to brownish grey. Trouble was also experienced with sheep, many of which. were unthrifty, and only a small percentage of lambs were sent to the Works. It was found impossible to keep cattle on the property all the year round if excessive wastage from deaths was to be avoided, and cattle were sent to graze out elsewhere for a few months each year. Apparently, during this period of grazing out, they built up a high copper level in their livers which carried them on for the remainder of the year when returned to the Lagoon for stores. Early in 1953 a liver from a cattle beast showed that only 8.4 p.p.m. of copper was present. This is a very low figure indeed considering 200 p.p.m. is regarded as normal. This beast had been grazing on part of the farm which had not been topdressed with copper. Breeding cows were uneconomical as young stock could not be reared.

During the spring of 1953 pasture samples were taken and sent to Wallaceville Animal Research Station for copper and molybdenum estimation, at which time there was a fair percentage of unthrifty sheep on the farm and cattle were only there temporarily. Two pasture samples were taken. The first sample, taken from .a paddock which had not been topdressed with either superphosphate or copper, showed a moderately low copper content of 6 p.p.m. and a molybdenum content of 6.5 p.p.m., which is more than twice the normal amount. The second sample, taken from a paddock topdressed with copperised super, as one would expect, showed that the copper content had risen, but unfortunately the molybdenum content was raised also, both elements being just in excess of 11 p.p.m.

Early in October 1953 an interesting thing happened, which later led to the production of fat lambs of average quality and with practically no tail end. Two paddocks of similar types on which ewes and

lambs of 5 to 6 weeks of age were, grazed began to show a marked contrast in the condition of the lambs. In one paddock the lambs' were scouring. -profusely and consequently were not doing well. In the other paddock the lambs were thriving and showed no signs of scouring.

On inquiry it was found that in the paddock where no scouring was present copper had been applied in January and again in April, while in the paddock where the lambs were scouring and unthrifty,. copper had been applied in January only. It then appeared as if copper must be applied nearer lambing if healthy lambs were to be reared and losses prevented. Blood samples were taken from a small number of both lots of lambs, and the lambs which were scouring showed a low copper content of 0.03 while the healthy lambs showed a normal content of 0.1.

Copper was then applied as a spray at the rate of 5 lb. per acre and the scouring eased off in about a week or 10 days. In 1954 copper was again sprayed on about lambing time and no trouble was encountered and practically all lambs were disposed of to the freezing works. The lambing percentage of 106% was very satisfactory. The average wool clip was 10½ lb., but it is expected that this figure will be exceeded this year. It is interesting to note that on some other properties in the Wairoa district, where the uptake of molybdenum is higher, the sheep and Iambs thrive normally but here a disease condition is set up which is directly and quicklv controlled by the application of copper sulphate. Whether some other factor is involved is not vet known, and further tests may throw more light on the subject. At present copper sulphate is applied during both autumn and spring, but during the coming year it may be a good idea to discard the application of copper sulphate during the autumn and see if the one application applied during the spring will suffice. This is the critical period when molybdenum is highest and when the lambs become unthrifty. During early September of this year lambs began to scour as in previous years and a copper spray is being applied again and it is hoped will have the same beneficial effect as in previous years.

A small number of breeding cows and heifers have now been brought on to the property as an experiment to see if the trouble of rearing young stock can be overcome. So far no trouble has been encountered, but it will take a couple of years before the final result is known. Last summer. an outbreak of facial,. eczema

caused some losses in the ewe flocks even though reasonable precautions were taken, and it would appear that this may be a problem in future years. The block now carries approximately 200 cattle and 2,500 ewes more than' it did in 1951. This is a rapid 'increase in the last 4 years and with closer subdivision and further investigation into. the copper and molybdenum complex in the animal's body there should be no reason why even higher production should not be obtained.

EXPERIMENTAL WORK

Although applications of copper have materially assisted stock health preliminary trials have been laid down with various sulphates, etc., with a view to reducing the molybdenum content of the pasture.

The trial was laid in June 1954 and the materials used -were sulphur, copper sulphate, double superphosphate, sulphate of ammonia, and gypsum. It's very confusing to try and read a compiled table, so the results I am giving you are by way of a summary:—

See table on next page.

SOIL ANALYSES

pH Figures

	6.4.54	13.12.54	7.3.55	26.4.55	24.5.55
1.	8.0	7.87	7.7	7.6	7.8
2.	7.97	7.83	7.3	7.8	7.3
3.	7.93	7.73	7.5	7.6	7.6
4.	7.87	7.97	7.8	7.6	7.8
5.	7.80	7.83	7.8	7.6	7.5
6.	7.93	7.7	7.5	7.5	7.6
7.	7.97	7.57	7.2	7.4	7.3
8.	7.83	7.67	7.6	7.7	7.8

As a point of interest, the pH figures are also given although the trial was not designed to lower the pH of the soil.

Three months following the laying down of the trial pasture samples were taken. Results showed that there was a pronounced lowering of the molybdenum levels with gypsum at 1 ton per acre-from 10 p.p.m. on the control to 2.2 p.p.m. on the gypsum plot. Five cwt. of sulphur also reduced the uptake from 10 p.p.m to 3.7 p.p.m.

The following month these treatments, and also sulphate of ammonia at 3 cwt. per acre applied every

HERBAGE ANALYSES FROM PASTURE SAMPLES

Figures p.p.m.

Plt. No.	Treatment	Amts. per acre	6.9.54 Cu.	6.9.54 Mo.	6.10.54 Cu.	6.10.54 Mo.	8.1.2.54 Cu.	8.1.2.54 Mo.	12.1.55 Cu.	12.1.55 Mo.	25.5.55 Cu.	25.5.55 Mo.
1.	Control	—	16.5	10.0	9.0	5.8	8.4	3.0	8.0	5.7	12.6	3.9
2.	Sulphur	1cwt. (annually)	14.1	8.7	7.4	4.8	7.6	2.6	7.0	5.3	12.4	3.9
3.	Sulphur	5cwt. (every 6 months)	11.2	3.7	9.1	1.9	9.0	2.0	7.0	5.1	12.1	3.5
4.	Copper Sulphate	20lb. (annually)	14.2	8.5	9.7	5.5	6.9	2.3	6.5	5.2	12.7	4.3
5.	Double Super	3cwt. (annually)	23.4	10.6	17.3	3.2	7.6	2.8	5.8	5.2	12.3	4.1
6.	Sulphate of Ammonia	lcwt. (every 2 months)	11.5	8.8	8.3	3.6	7.8	2.2	7.7	4.4	12.6	2.9
7.	Sulphate of Ammonia	3cwt (every 2 months)	12.9	7.3	9.0	2.7	8.1	1.9	7.3	3.6	14.3	1.8
8.	Gypsum	1 ton (annually)	23.5	2.2	9.9	1.7	8.1	2.2	8.1	4.9	11.6	4.0

two months, had all reduced the molybdenum significantly. There was little change in the pH levels.

Herbage analysis taken 12 months after application showed that the sulphate of ammonia at 3 cwt. per acre applied every two months had made a decided reduction in molybdenum uptake. This treatment also reduced the pH level slightly from 7.97 to 7.3, not a particularly noticeable drop. Both the gypsum and sulphur which had showed a marked significance after the first few months were at this stage on a par with control.

As with any trial work; time is the testing factor, and it is hoped that over the next few years conclusive results will be obtained.

The Ahuriri Lagoon reclamation is by way of being a pioneer undertaking for this type of work in New Zealand but we understand now that there are other areas in the country which may be developed along similar lines. It is pleasing to think that the work that has gone into this project will be of the greatest value to these new undertakings.

DISCUSSION

E. D. Andrews: The unthriftiness of lambs described by the speaker is more reminiscent of cobalt deficiency than copper deficiency.

Byrne: No trials with cobalt were conducted. The copper seemed to cure the lambs.

Dr. Cunningham: Although copper has apparently cured these lambs the symptoms are not those normally met with in copper deficiency. There axe quite a few areas where herbage copper is lower than on Ahuriri Lagoon, yet there are no symptoms. In experiments I have tried to induce copper deficiency by feeding too much molybdenum, that is, molybdenum at a rate as high or higher than that ingested by stock on this area. Both ewes and lambs stayed fit. By topdressing with molybdenum I have produced similar Mo and Cu figures as reported on Ahuriri Lagoon soils. Result: They grew better and killed more heavily. The explanation does not lie in the molybdenum-copper ratio alone. It would be unwise, therefore, to extend observations on the Ahuriri Lagoon soils to other areas where lambs are unthrifty.

There has been a vogue recently in the South Island in using copper for unthrifty hoggets. In some cases it was overdone and toxic quantities of oopper were applied. As far as cattle are concerned there is no doubt at all the Ahuriri symptoms indicate copper deficiency; as far as sheep are concerned they do not.

Q. (N. A. Cullen): Dick in Australia has shown that sulphur affects the toxicity of molybdenum. Is it dangerous to use sulphur on occasion.

A. (Dr. Cunningham): Sulphur allows molybdenum to be excreted more rapidly and to take copper with it by a mechanism which we do not understand. We have done many sulphur'analyses. These indicate that in most of our

pastures there is enough sulphur to allow molybdenum to get rid of copper.

Q. (P. B. Lynch): Is barley grass infestation severe on the Lagoon area? Is it associated with high fertility?

A. (Collin): There is very high soil fertility all round. This is probably the reason for barley grass coming in.

Q. (E. C. Ayson): Are you getting responses to superphosphate?

A. (Collin): I have not seen a marked response to superphosphate, especially on the heavier soils.

E. C. Ayson: A small area similar to Ahuriri Lagoon is found above Tutira. The soil reaction is about pH 7.0. *There is* a high pasture content of Mo ard we have trouble with sheep.