Soil Minerals – the key to Farming Wealth and Your own Health

By Brown Trotter

The interesting life story of this great NZ farmer, Brown Trotter, who pioneered the use of trace minerals in NZ farming. As a result he greatly increased his farm's profitability, improved the health and breeding of his livestock, and won numerous prizes at stock shows. At age 65 he began taking the same trace minerals himself and dramatically healed his serious heart disease.

An important farming book for every New Zealander

Learn how to protect yourself from heart disease and other serious health disorders, by supplementing your diet with important trace minerals lacking in our New Zealand soils and foods.

You can farm more profitably, plus add years of vigorous health to your life, by supplying the trace minerals lacking in NZ soils

At age 59, Fairlie sheep farmer Brown Trotter's farm animals were among the healthiest in New Zealand. Yet Brown Trotter himself was, in his own words, *"decrepit, very lame, and with a bad heart."*

His animals won prizes year after year at shows. He got them to that stage by pioneering the use of trace minerals in NZ, such as Copper, Zinc, Iodine and Selenium. Either by top-dressing to the soil, or as a drench.

Brown would buy under-nourished lambs from other farms at a low price, and then, next season send them out as fine specimens of fat lambs and obtain top prices.

However, despite his success with his animals, Brown's own health began to deteriorate from age 45. He soon began to black out continually.

At age 64, an X-ray and cardiograph revealed a severely diseased heart. He was immediately flown to Greenlane hospital to be operated on. This was just to hold the situation, and perhaps to gain another year or two of life.

When Brown came home from the hospital, he continued to deteriorate. He writes, *"I couldn't read. About two lines and I fell asleep. This was an existence I came to dread. I realised I was turning into a cabbage."*

NZ sheep farmer Brown Trotter.

Finally, in desperation he decided to take the same minerals that had worked wonders with the health of his sheep. He weaned himself off the drug digoxin and began taking his sheep minerals, Magnesium, Zinc, Selenium and Iodine.

A dramatic improvement occurred. Brown's energy, alertness, and strength began to speedily return, even though he was still smoking heavily.

Six months later, at age 65, after 20 years of ill-health he describes himself as *"healthy."*

At age 67, to the amazement of doctors at Princess Margaret Hospital he recorded a perfect cardiograph. His doctor, Dr Hull stated, *"It has never been known in medical history."*

Brown Trotter died 13 years later in 1984, in his 80th year, of cancer in his liver and pancreas which started from a cigarette burn on his lip. (He remained a heavy smoker all his life.) His heart however, remained healthy and strong until the end.

The first half of this interesting book relates Brown Trotter's mineral experiments with his animals, and reproduces some of the amusing and thrilling newspaper debates with skeptical vets and government soil scientists.

Then he tells the important story of how he restored his heart health, using the same trace minerals that brought exceptional health to his farm animals.

ISBN 0-908850-20-4

9 780908 850204

ZEALAND PUBLISHING HOUSE $23.95
Private Bag 12029, Tauranga. New Zealand.

Soil Minerals – the key to Farming Wealth and Your own Health

BY

Brown Trotter

The interesting life story of this great NZ farmer, Brown Trotter who pioneered the use of trace minerals in New Zealand farming. As a result he greatly increased his farm's profitability, improved the health and breeding of his livestock, and won numerous prizes at stock shows.

At age 65 he began taking the same trace minerals himself and dramatically healed his serious heart disease.

A farming book for <u>every</u> New Zealander

Learn how to protect yourself from heart disease and other serious health disorders, by supplementing your diet with important trace minerals lacking in our New Zealand soils and foods.

First published 1978 by The Timaru Herald as "Rape of Our Heritage."

This Edition 2005 re-edited and reformatted by health researcher David Coory, with permission and assistance from Brown Trotter's three sons, also sheep farmer-chemist David Walpole of Tauranga, and beef farmer and fertiliser specialist Ewan Campbell of Waihi.

Further copies of this book can be obtained by writing to:
Zealand Publishing House
Private Bag 12029,
Tauranga. New Zealand.

Or by Phone, Fax, Email or Internet (credit card or direct credit payment).
Phone: 0800 140-141 (NZ only) or (07) 576-5575
Fax: 0800 140-142 (NZ only) or (07) 576-7392
International: Phone 0064-7-576-5575
Fax 0064-7-576-7392
Email: orders@zealandpublishing.co.nz
Internet: www.zealandpublishing.co.nz

ISBN 0-908850-09-3

Cover picture: Brown Trotter's Fairlie farm 'Coulmore.'

The publisher welcomes comments or corrections that may improve and enhance future editions. Please write to David Coory, Zealand Publishing House, Private Bag 12029, Tauranga. New Zealand, or email david@zealandpublishing.co.nz or phone (07) 576-5322.

Foreword by Jim Marshall

When I first heard about Brown Trotter and his ways of farming with trace elements, I went to visit him on his farm.

I learned that his stocking rates per acre, fat lambs, and wool production were all above average. His beef cattle were a picture, and all achieved with very little worm drench.

He sowed trace elements on his pastures and 50 kg of superphosphate per acre every second year. He also made his own salt lick, and fed all year round.

He brought in many poor lambs and cattle and used a mineral drench that he made to his own recipe. He got great delight in showing what his methods did for these animals, and then sold them for a great profit.

Brown often said, *"If we could only get livestock farmers, market gardeners and grain growers to sow trace elements, how it could help the soil and plants."* He was pretty sure that human health would improve also, and that medical costs in New Zealand would drop. After all, we are only what we eat.

His farm always stood out among others, especially the colour of his pastures. He often stated that his animals were content eating 3 blades of grass, not 30, for they got what they needed.

I was privileged to know Brown with his trials and methods. He had an eye for stock. I felt he was years ahead of his time.

I also have a good eye for stock, so I took in what he said. I visited his farm six times a year during different seasons.

My background was dairy farming for some 20 years, then I changed to sheep. I too sowed trace elements on my farm, but not to the extent of Brown Trotter. I also fed a salt lick.

With my own practical experience and Brown's knowledge, my wife Marie and I started a trace element business in Gore over 20 years ago, as I could see a deterioration of stock health.

Just before he died, Brown told me he would love to rewrite his book, because Zinc was going to be a vital trace mineral for fattening, wool growth, and fertility, and he hadn't written much about Zinc.

I feel that today, a lot of farmers are still going down the wrong track. I hope they enjoy reading this reprinting of Brown's book and trying some of his methods to improve stock health.

Jim Marshall. Alexandra.

Contents

Chapter one

Where we Trotters came from

The Trotters were originally border reeves in southern Scotland, that's what their friends called them. To others they were just plain border thieves.

They had two hobbies, other people's cattle and pretty girls. One they drove, the others they usually flung across their saddle.

Their coat of arms, the fastest horse on the border, their motto "Festina Lente." "Hasten slowly" or more usual "Hasten with caution."

My grandfather went broke in Scotland. He was a cattle dealer. An outbreak of foot and mouth disease occurred in an adjacent area. At that time the control was to slaughter all stock within a 15 mile radius of the outbreak. He had to stand by and see 600 fat cattle killed. No compensation, even though there was no foot and mouth disease in his herd.

He came to New Zealand in 1866 with his family – four boys and one girl. He became head shepherd on Goodwood Station at Palmerston, about 30 miles north of Dunedin.

His wife, who was my grandmother taught school at Goodwood.

My father John Trotter

In 1880 my father, his third eldest son, John Trotter, went to work for my uncle James Wilson at Alandale Station.

My father became a top shearer, 242 with the blades was his top tally. Very good in cross-bred sheep.

He also put himself through night school to qualify for an engineering ticket, which he needed to operate the Alandale threshing mill.

He and his mate Jimmy Creighton, in one season hand-sowed 3000 acres of wheat on Alandale. The two men also had to mix and cart their own seed. They averaged 40 acres a day. Sown straight in the furrow, with no fertiliser and then harrowed in.

When matured, this wheat was all cut with the old back-delivery method,* hand-tied and stacked.

My farm 'Coulmore'

In 1900 the Seddon government divided the large Three Springs station up. My father was successful in the ballot and drew Coulmore. So we were one of the original settlers on the Punoroa settlement.

---

* A type of horse drawn mower, with two seats for the driver and operator and a cutter bar on the left.

In 1932, when I first started topdressing, I used two horses pulling a 10 foot wide, light-framed topdresser.

In 1938 I purchased a tractor and graduated to a 24 foot wide Reid and Gray set-up, using three double box machines in a triangle configuration.

Coulmore is very steep, dangerously steep in places. Steep enough to side-slip a crawler tractor. I used to think it great fun when the tractor sideslipped a few feet. Now I can no longer see the joke.

Top dressing escapades

John Brazier of Christchurch was the first to topdress here with a plane, in the early 1950's. Alan Potter followed with a tiger moth.

Alan was a very playful chap. On one occasion two well dressed chaps appeared (Departmental officers) and said to me, "Well, Brown, you are at least getting the stuff fired on."

I ageed to let them to walk over a paddock which had been topdressed, to see how much of the ground had been missed. They went to do this and were making a thorough inspection.

On the next load Alan Potter said to me, "What are those B's up to?"

I told him they were a bit sceptical of his coverage and were having a look.

He turned to the men loading his plane and said, "Give me a load of lime. I'll teach those boys a lesson."

Up he went and dive bombed those two. He had them down on their knees. Finally they crawled under our staging for shelter.

Another time, when we were top-dressing on a Saturday, Alan flew four miles with a load of lime and two rolls of lavatory paper and dive-bombed some golfers. He told me it was unfair that I should have to give up my golf and yet all my mates be allowed to play. On that occasion Alan had a close call on being reported for dangerous flying.

Why I wrote this book

My friends have told me that if my work is to be of value, then it must be recorded. I was born on this farm in 1907, and have had my three score and ten years, so perhaps my friends are right. So where do I begin?

I am a farmer by choice. My father offered to set me up in any business I wanted. But I have always loved the land, my horse, my dogs and working with stock.

As a small boy, I spent a lot of time playing at being a shepherd. Our petrol came in wooden cases in those days and I would split up the petrol cases and built sheep yards. Acorns were my sheep.

When Dad asked me to decide what I would do for a living, I said, "Even if there is more money to be made in other fields, I prefer to

spend my life doing what I enjoy most." I eventually took over 'Coulmore.'

This 496 acre 'Coulmore' is steep farm land and lends itself to grassland farming. A lot of hard work was done wheat cropping in the old horse days. Sometimes three men on the sheaf binder, then all the crop had to be carted to the hill-tops to be available to the old Clayton portable mills. Then grain had to be carted to Eversley, a mile north of Fairlie.

With the advent of tractors (we bought our first in 1938) the Clayton portable mills were replaced by header harvesters. This put an end to grain cropping on Coulmore.

The farmer appears to me to have three responsibilities.

1. To earn a living for his wife and family.
2. To produce food for the nation.
3. To farm the land in such a way that the next generation can also farm.

Surely the third is by far the most important. If farming is to survive, great care must be taken to preserve the soil nutrients, which are essential if the soil is to be maintained in a healthy state.

History shows that because of ignorance, the old buried walled cities created their own dust bowl. The city surrounds were cropped until the land was robbed of all humus. The nutrients disintegrated and the soil broke down and buried the cities.

Similar ignorance has been displayed by our Dept of Agriculture who have sacrificed our future by their recommendations to farmers. These recommendations in the last 45 years have been based on achieving bulk growth, with little regard to whether the growth was worth eating and contained the nutrients necessary for healthy animals.

Even today, 45 years after scientists set out to grow two blades of grass where one grew before, their idea of soil-testing is to only test for four minerals, Phosphorous, Calcium, Potash and Nitrogen, known as the big four.

Sensible testing requires at least the inclusion of 16 more minerals, known as trace minerals. 'Coulmore' has been topdressed without a break for 45 years, beginning in 1932.

The story will unfold as we go.

In 1945, in desperation to find out what was going wrong on my farm, I first started to investigate on my own.

32 years of research

The findings I present in this book are my own. After 32 years of research I believe I am entitled to them, and to make

recommendations to the farming industry.

The claim by the Dept of Agriculture that pasture development as recommended by them is scientific farming, is a load of rubbish.

Whenever I ask any of them, "What is the mineral content of pasture that sheep will thrive on?" The invariable answer is "We don't know."

Now how can anyone claim to be scientific when they do not even know what they are trying to achieve?

They are accurately named 'bulk experts.' They are certainly not livestock farmers.

Please remember as you read this book that the articles included were written a long time ago. And my comments are made a long time afterward.

I am still learning

I do not pretend to know all the answers. I now realise just how little we all know. I am still learning, and still puzzling to find answers as to why certain things occur.

I have had a lot of help from many people. In the beginning, our local chemist Mr Collins, and our local doctor Terry O'Brien were of great help.

I also had correspondence with Mr Fergus Hickey, a medical trainee who gave up medical work because he believed he could accomplish more for the health of New Zealanders through the soils than he could ever accomplish through surgery.

Fergus Hickey

Fergus Hickey, in my opinion is far and away the leading soil scientist in New Zealand. We met in late 1949 and became firm friends. Did we ever argue? Of course we did. Life is dull without argument among friends.

Fergus Hickey had a quality which I admire greatly. A readiness to listen to and examine the views of others.

Very early in our acquaintance he told me that the only answer he could make to my questions and concerns about pasture management was a shotgun mixture of all trace minerals. This was because of actions and interactions between the minerals.

At that time I was dubious. But I now believe that comprehensive fertilising must come to farming.

I have not seen much of Fergus Hickey since the mid 1960s, but I have been constantly in touch through his South Island representative, Jim Chisnall of Timaru.

Here again I found a kindred spirit. Many thanks to Jim Chisnall for his help and discussions. And yes, plenty of argument. He has been the conveyor of many messages from Fergus Hickey.

Because of the helpful discussions which have taken place over the years, I have included some of the letters which we exchanged in the late 1940's.

A hornets nest stirred up

I spoke publicly on the subject of stock health all over Canterbury in 1949 and 1950. The talks took the same pattern in all places, so I have only included the relevant ones to show what a hornets nest I stirred up.

However even though I made a few mistakes in those days, even after this long time, I do not wish or need to retract anything I said. I will comment further after readers have read the newspaper articles which are reprinted in this book.

All of this happened a long time ago. We have a new generation of farmers. Even the young men who returned from overseas at the end of the war and took up farming are approaching retiring age. Most of the middle-aged farmers of that period are either retired or have passed on.

My first mineral experiments

I first topdressed in the 1946 season with copper, cobalt and iron. I did not repeat it the following season because I did not know whether one dressing was sufficient or not. But I had to use the mineral lick again.

I topdressed again with these minerals in February 1948 and decided to test out the results of this dressing on fat lamb production. So I purchased 1500 cast ewes* from Shag Valley station at Palmerston.

These sheep were Romney Corriedale cross, just average for size and were bred to Southdown and Border Southdown rams.

The first draft of lambs was taken to the works the following year in January 1949.

1387 lambs were killed at an average weight of 38.99 lbs. The balance of 286 were killed a month later at 36.86 lbs.

So from 1500 cast ewes put to the ram, 1679 lambs were weaned and killed out at an average weight of 38.65 lbs. An excellent weight.

The ewes were frozen and averaged 64lbs.

When the first draft of lambs were killed, all the Departmental chiefs were there to observe. Dr Filmer and all his veterinary team.

The Works management told Dr Filmer that the livers were the best seen that season, they packed eight to the standard works pail as against the average of 16-17.

---

* Cast ewes are female sheep regarded as past their peak breeding years.

Chapter two

My copper and iron experiments

This is my first public talk, as reported by the Timaru Herald.

Worm control with bluestone claimed by Fairlie farmer

Timaru Herald, Jan 15, 1949.

By giving his sheep an iron and bluestone (copper sulphate) lick, Mr W. B. Trotter, of Fairlie, claimed to have controlled worms in his flock, when giving a lecture at Fairlie last night.

During the 1944 season he spent £700 on drenches, after which he decided there must be something the matter with his sheep besides worm trouble.

"I was in the position of having to find the solution to the problem or else give up sheep farming," he said.

Mr Trotter's property consists of 496 acres of limestone country, four miles from Fairlie and runs from 1000 ft to 1400 ft above sea level.

Topdressing with superphosphate over the whole farm was first carried out in 1932 and resulted in a rapid increase in carrying capacity.

In 1932, 650 ewes and 150 hoggets* were carried, being increased to 1400 ewes in 1938. For three years outstanding results were obtained.

Signs of trouble

The first signs of trouble ahead came with disappointing lamb weights. They fattened slowly, were shelly* and weighed up to 4 lb lighter than they appeared to be.

In September 1938 the storm finally broke. "The 1400 ewes were very well wintered and were carrying that bloom which one expects to see north of the Rangitata River", he continued.

"The pastures were a dark green colour, about 2 inches long, the weather was good and the job of lambing looked like being a picnic."

So it was, but a picnic of a different sort. "The ewes 'cracked up' * as soon as they were put on the pasture, and by tailing time 80 ewes had died, and the others were casting their lambs."

"We wore thigh leggings during tailing, the scouring* was so terrific."

'Super sickness'

"Actually the results of the season were surprisingly good. The ewes were drenched with bluestone and Black Leaf 40* in the tailing yards and also had two more drenches before weaning. 50% of the lambs were killed off the

*A hogget is a young sheep up to the age of one year.

* Shelly means to be lighter in weight than appearance would indicate.
* 'Cracked up' means failed to thrive.
* Scouring is a farming term for dysentery.
* Black Leaf 40 is a worm pesticide of 40% nicotine sulphate tobacco extract.

mothers"* Mr Trotter said.

Being limestone country, the Dept of Agriculture thought in 1932 that it was good farming to topdress with super-phosphate alone. When a retest was made in 1938, it was found that 'super' had brought about what could be described as 'super sickness' or acidity.

Lime was then used in conjunction with the super. Five dressings of 1400 lb of lime and, 1¼ cwt* super were given. The results were good, though from 1938 onward, systematic drenching had to be done.

With the advent of war and shortage of labour Mr Trotter gradually turned to hogget farming. With these sheep the majority of the work is done in the winter and he found it a distinct advantage to be more or less free in the spring to do agricultural work, as against lambing a big mob of ewes.

By 1943 he was carrying 4000 mixed sexed hoggets and a few cattle. These hoggets were mostly second cuts.* He also undertook lamb-fattening.

By buying most of the feed, an average of 10,000 fat lambs was maintained for six seasons.

When Phenovine worm drench replaced bluestone and Black Leaf 40, a 100% guarantee kill on worms was given.

Sheep would not thrive

Mr Trotter said he expected wonderful results and was most disappointed. Though the death rate was controlled, the sheep would not thrive.

"During the 1944 season I spent £700 on various drenches and had convinced myself that there was something else besides mere worms affecting the health of the hoggets."

"I had to find the answer to the problem or else get out of hogget farming, perhaps even sheep farming altogether. What follows is the result of desperation."

"I considered that the worms left the sheep in an anaemic condition and this was probably why they would not thrive, even with drenching."

"An iron tonic would be prescribed by a doctor for an anaemic child, so why not for sheep?" he continued.

On making inquiries from a chemist he was told that sulphate of iron would have a very constipating effect on stock. However to stop the scour had been his ambition for years.

Iron experiment begun

So as an experiment he decided to take the culls of his hoggets and use them as a control mob. He would try to stop them scouring by feeding them sulphate of iron in a lick, or kill them.

No drenches were to be used.

Forty hoggets were culled out immediately after shearing and put in the holding paddock. If worms were about they would be there in abundance.

Small quantities of lick were carefully weighed, 1%, 2% and 3% of iron was fed.

Copper also tested

He also had a few old Merino ewes with Border-Leicester lambs at foot, and they started to scour.

---

* 'killed off the mothers' means while the lambs are still feeding from their mothers.

* A cwt or hundred weight is 112 lbs (approx 50 kg).

* Second cuts are inferior animals culled from the flock, after the best animals have been taken out.

So as a further experiment he drenched them with a bluestone (copper sulphate) drench, while their lick contained 1% of iron.

"Those Merino ewes flew* for about three weeks, then started to scour again. On repeating the copper drench they again responded well."

"This led me to ask Mr Collins our local chemist if there was any relationship between copper and iron. His reply was, "The full brother. If by chance you are short of copper, nothing will thrive on the place. Lack of copper leaves stock without the power of assimilation."*

On hearing this, he also added copper sulphate or bluestone to the lick for his hoggets.

Outstanding results

"When I reached 5% of iron and 3% of bluestone in the lick, the cull hoggets stopped scouring and in a fortnight were fat. There were no deaths."

Eventually the main mob of sheep were also fed 5% iron and 3% of bluestone, with outstanding results.

"To give some idea of how good these results were, I killed off grass, 2249 wethers.* Average weight 46.8 lb. An excellent weight when one makes due allowance for the fact that 900 of these were half-bred two-tooths,"* Mr Trotter said.

All the fine-woolled sheep were carrying so much condition in the wool that at 100 yards they looked like tar-tipped merinos. *

Topdressing iron and copper

Such excellent results came from this lick that he determined to topdress the farm with various mixtures along the same lines.

In January 1947 he tried to interest the Stock Dept in this topdressing trial but without success.

However he was so convinced by his own results that he decided to carry on.

These were the mixtures he used:

150 acres were dressed with:
- 1400 lb of lime.
- 1 cwt super.
- 12 lb sulphate of iron.
- 6 lb of bluestone.

180 acres were dressed with:
- 1400 lb lime.
- 1¼ cwt super.
- 12 lb limonite.*
- 6 lb bluestone.

120 acres were dressed with:
- 1400 lb lime.
- 1¼ cwt super.
- 10 lb bluestone.

"The results on all blocks were excellent," claimed Mr Trotter.

"I carried 4000 hoggets through that 1947 season. They were only drenched once. The death rate was 2%, quite a difference from the results of the 1944 season."

Neighbour's success

"The hoggets in 1947 did so well that a neighbour asked me what I had done to them."

"He too became interested and used both the lick and the sowing method. Today he is as firmly

* 'flew' means 'progressed rapidly.'
* Assimilation is the process of absorbing nutrients into the body.
* A wether is a castrated male sheep.
* A half-bred two-tooth is a cross-bred sheep between 1 and 2 years old which has its first two adult teeth.

* Merino sheep which have a dark brown grease tip on their wool.
* Limonite is an iron oxide fertiliser.

convinced as I am that the solution to the worm problem lies in the application of copper sulphate to the soil, and not with the drenching gun."

"Much delay has been caused by the failure of the Stock Dept to co-operate. I have been forced to work entirely by trial and error."

"My reason for waiting so long in reporting this has been that I did not know whether one dressing of bluestone had finished the job or started it."

Scouring stopped

"In the past most of my sheep have been wintered at Baling. But this year I brought the hoggets home in September. They were shorn in February as lambs, starved all winter, and most stockmen would describe them as rabbits. I turned them out without the lick, to see what would happen. They scoured as usual, though none died. By returning to the lick mix they cleared up quickly, and today are thriving."

"In 1945 the lick was licked freely all season. This year the hoggets appeared to fill up in two months. From this it would appear that the bluestone topdressing in 1947 had given a carry-over, though not sufficient to make further applications unnecessary," he said.

"At this stage I had better make it quite clear that I am a grazier, not a technical expert. At the same time I make no apology for my practical opinions."

"What do we know of copper in our soils? Copper is a trace mineral, vital to stock health. Is it the medium through which assimilation of other minerals is made possible?"

Super and lime

"Today our technical experts talk of development of land. Heavy applications of super and lime are the main theme. This results in at least doubling the carrying capacity of our pastures. To do this two blades of grass must be grown where one grew before."

"What happens then to the other minerals in the soil? From the outstanding results obtained for the first few years, it is obvious that the feed grown is of good quality, and well up to standard so far as mineral content is concerned."

"But a call has been made on the soil to double the supply of minerals, without any investigation as to whether the supply is capable of this demand."

"From my results obtained by applying copper sulphate, I feel certain that this vital trace mineral could not stand the strain, and resulted in mineral-deficient feed being grown. The pastures lacked the necessary amount of sustenance, though they looked well."

The worm problem

"We now obtain an entirely new view of our worm problem."

"Actually my findings differ only slightly from what technical experts have told farmers."

"We agree that the sheep is the natural host of the worm, and that the complete eradication of this pest is impossible. Also that sheep fed on a high level of nutrition seem to be quite safe from serious infestation."

"What I wish to add to this is that sheep do not become the perfect worm host until they reach a state of low nutrition, a state brought about more by mineral starvation than feed starvation."

"If it is possible to avoid the

anaemic state brought about by mineral starvation, the worm cannot attack the flock seriously enough to make drenching necessary."

One particular difference which Mr Trotter has noticed in his sheep is that even the culls appear to be 'packed with lead.'*

Dangers of fertiliser

It was time to wonder if most of the crops produced for food were worth eating, either by humans or stock.

The implications were that all ground which has been fertilised and forced in any way other than cultivation to produce more than it would normally do, is in grave danger of growing crops which lack essential minerals. Home kitchen gardens were also in this class.

Soil analysis as practised at present was not comprehensive enough. An accurate analysis of vital trace minerals would appear to be necessary.

"There did not seem to be any technical reason why all soils could not be brought to a high state of production," he said.

Cause not cure

"The Veterinary Dept is prone to look for cure rather than cause."

"If causes can be located then the cure is automatic. Remove the cause and the cure naturally follows."

"I do not say that no cure should be sought, but that the most important thing is to find the cause."

"If sufficient copper is taken away from stock, they are left without the power of assimilation."

Hospitals overflowing

A doctor had told him that human beings were affected in the same way. Lack of copper was responsible for most anaemic troubles. The approved treatment was a combination of copper and iron. Copper deficiency will result in an anaemic state.

It follows that if human beings are the same as sheep, an extreme shortage of copper would result in a form of paralysis, which shows a marked preference for the young.

"Is infantile paralysis then just an acute form of copper shortage?" he asked.

"I admit to being on very insecure grounds there, but I am forced to ask the question."

"The farmers' main job is to feed the people, and so far, we have nothing to be proud of. If we had hospitals for sheep in this country they would be full to overflowing."

"It is little credit to us, or the Department set up to assist us, that our human hospitals are full to overflowing, while the cry still goes out, 'Produce more and more!"

"Also, it does not make sense to me to expect a healthy nation of people, while we have millions of unhealthy stock," he concluded.

* ie, heavier than they looked. Culls are sheep that are not thriving.

Chapter three

Fergus Hickey animal nutritionist writes to me

26th March. 1949

From: F. Hickey
Great South Road, (Waikato),
TAUPIRI, NZ

To: Mr W. B. Trotter,
Farmer.
FAIRLIE

Dear Sir

Within the last few days I have been shown a newspaper cutting in which was reported the substance of an address which you gave to your local branch of Federated Farmers sometime in January last.

I am extremely interested in your remarks, as your experiences coincide very closely with some extensive research I have conducted on behalf of my principals over the past seven or eight years.

I am the Research Officer in Animal Nutrition for Wonder Distributors Ltd, manufacturers of fertilisers and stock foods. At quite an early stage in this work I was led to the conclusion that a high proportion of animal ailments was due to:

(a) a disturbance of the proper protein/carbohydrate balance in their food.

(b) an improper balance, or actual deficiency of the mineral elements required for their nutrition.

The former would appear to be largely the consequence of indiscriminate use of phosphate topdressing where it is not required at all, or used far too heavily where it is required.

On the mineral side, past fertilising practices make no attempt at all to replenish soil and pasture with the many minerals, 15 or 16 in number, which are essential to the healthy life of plant and animal, and which are being continuously removed in animal products.

The latter problem can be met, in part, by the use of a suitable lick mixture, but I have found that the best long-term policy is to topdress pastures and crops with a scientifically compounded mineral fertiliser, containing all the minerals in appropriate proportions.

After very extensive trials over a wide range of soil and pasture types, such a mixture is now being made commercially and has produced excellent results.

I have just returned from a visit to the South Island, and in the course of my trip passed through Fairlie and was given the newspaper cutting referred to. Unfortunately I had not heard of your work at the time or I would certainly have called to see you with a view to asking permission to examine your stock, pasture and soil.

You will not be at all surprised to learn that throughout my experience I have not found the Departmental officers to be particularly co-operative. They are not at all up-to-date in current research throughout the world in mineral metabolism. And during a recent visit to the Head Office of the Department I discovered some very significant gaps in their reference library. I pointed these out to them and they are making an effort to remedy the situation.

I mention this matter as you remarked in the course of your address that you had failed to obtain the co-operation of the Livestock Division, and presumably of the Field Division.

On the other hand, Lincoln College is very interested in the work and appears to recognise its importance and need. During my trip I spent a day with the research officers of the College and gave them some details of the lines on which I am working and of the results achieved.

It is quite obvious that this is the beginning of a more rational system of fertilising which will ultimately assume large proportions.

In England at present, the LCI is developing a scheme for getting the various minerals into solution and spraying them on to pastures and crops, but this appears to me to be an unnecessarily expensive way of doing it, as it costs something like 32/6 * per acre, whereas topdressing with the compounded minerals in a dry form is entirely satisfactory where there is an average rainfall, and costs only about 12/6 * per acre.

Many farmers have achieved good results by mixing approx 50 lbs of our mineral supplement with about 1¼ cwt of super while others have used about 100 lbs. The former would appear to be sufficient where there is no evidence of an acute mineral deficiency and it is desired merely to replenish the soil in respect of the minerals removed in animal production.

On the other hand, where there is reason to suspect an actual deficiency (either by symptoms in the animals or actual tests of soil

* $3.25 in decimal currency. * $1.25 in decimal currency.

or pasture) a somewhat heavier dressing of up to 100 lbs per acre gives good results.

You may be interested to learn that when applied at the latter rate, the amounts of soluble iron and copper coincide almost exactly with the amounts you have applied, but of course this compounded blend contains not only iron and copper, but also magnesium, cobalt, boron, sodium, calcium, manganese, zinc, chlorine, phosphorus, sulphur, nickel, etc.

I am sending you herewith a copy of a small booklet, "The Nutrition of Farm Animals in New Zealand" which I recently wrote on behalf of my principals. You may be interested in browsing through this. Perhaps the remarks on pages 56 and 57 will appeal to you.

I should like to congratulate you upon the bold and ambitious lines of your experiment, and to add that I am certain you are working upon the right lines.

Yours faithfully,
F. HICKEY.

Second letter from Fergus Hickey

8th October 1949

Dear Mr Trotter

My head office has sent me a copy of your letter to them of the 29th September and asked that I should reply to the same.

I have from time to time been sent some, possibly all, of the newspaper articles in which your views have been published, and needless to say I am extremely interested in them.

Your views are certainly opposed to the official attitude of the Dept of Agriculture but do not make the mistake of assuming that the Departmental point of view is shared by scientific men generally. So many of these men have told me that they do not agree with the Departmental view but they are powerless to express contrary opinions.

My main bone of contention is that the Department tends to lag too far behind current research work being done in other centres overseas.

So far as I am aware, we initiated the idea of using comprehensive compound mineral mixtures for pasture and crop top-dressing, and we spent several years in trials on different soil types before making the mixture a commercial product.

However, during the last few years, the idea has been taken up in a very big way both in the United Kingdom and the USA,

particularly the latter. Certain States in the U.S.A. have already added the so-called 'secondary' minerals to their Fertilizer Acts, but I honestly believe that our own Dept of Agriculture is unaware of these developments.

It seems quite senseless to go on year after year replenishing the soil with merely lime and phosphate, and occasionally potash, when other minerals are equally necessary, and just as vital to animal health and production.

I saw recently where Dr. A. F. Camp, a leading United States soil scientist said that, "it is safer to omit phosphate and potash from fertilisers for long periods without bad results than it is safe to omit certain of the 'secondary' minerals."

I am sure that in time the authorities here will come round to this way of thinking, but I expect they hate the thought that they did not initiate it.

The Dept of Scientific Research (DSIR), which has some 'top, line' men on its staff, has a much more open mind, but the men do not care to express themselves too publicly for fear of putting the Dept of Agriculture men 'off, side'. Privately, I have had some very interesting views put to me.

For instance, at Grasslands, Palmerston North the experimental pasture station of the DSIR, they have everything that money can buy in the way of improved strains of grasses and clovers, also fertilisers, yet they have told me that they would not think of running their dairy herd without supplementary minerals.

On one occasion I asked one of their leading men why it was, if they knew that supplementary mineral treatment was necessary, they did not make a statement to that effect in contradiction of Dr Cunningham, and thus help to lead 'the poor bewildered farmers out of the wilderness.' They told me that it was more than their lives were worth to come out in opposition to the Dept of Agriculture.

It is a pity that this sort of thing is allowed to continue. If one dares to oppose the Department, one is confronted with the heavy artillery of scorn, even reaching libellous proportions. It is impudent on their part because they are not really well informed. It is quite clear that extension work among the farmers of New Zealand is no task for the faint-hearted, unless one's views coincide with those of bureaucracy!

I should very much like to visit your property and have a good look at things, but I don't see that this will be possible for some little time yet as my hands are very full at the moment with some current projects. I have not quite your implicit faith in soil and pasture analysis. They are of course useful guides, but I find that the most useful and reliable diagnostic procedure is a survey of

such symptoms as appear in the animals grazing the pastures, together with trial and error in connection with application of different substances.

I should nevertheless be very interested to study the report on the soil analyses made for you on the 17th July. That should be a good starting point. I should say that there would be nothing to be gained by repeating these tests, they do not vary very much. Pasture, on the other hand is in a different category as the mineral content varies remarkably throughout the year, so that analyses made in say January, would doubtless be very different from others made in say July. Actually, as you will have noted from an article in the July issue of our Company's Bulletin, I have most faith in a proper correlation of all three factors, soil, pasture, and animal tissue.

I assume that the Departmental analysis of your soils included pH determinations; I should very much like to see these, as they provide a valuable indication concerning the status of certain secondary and trace minerals.

I am inclined to think that you will find that our Compounded Mineral Fertiliser is not such a 'hit and miss' affair as you possibly assume. The main purpose of such mixtures is to replenish soil and pasture with the various minerals which are lost to the farm per medium of animal products and they are balanced up with this in view. It is obviously not practicable to compound a special mixture for each farm. (This might indeed mean a special mixture for each individual paddock as the latter often vary a great deal.) Such a method of attack on the problem pre-supposes a degree of exact knowledge which Science does not yet possess. Of course, where there is a profound deficiency of one particular mineral, or minerals, such for example as copper or cobalt, it is sometimes necessary to apply additional amounts of these minerals, but for ordinary purposes the Mineral Fertiliser contains sufficient of these nutrients to make separate applications unnecessary.

If it is convenient for you to let me inspect the soil analyses you already have, I can then advise you as to the need of pasture analyses. In the meantime I would say that you are already proceeding on sound lines, that is, in applying different minerals such as copper and iron and observing the results. One must, of course, agree with Dr's Filmer and Cunningham that too much copper can be dangerous, but there is a fairly wide safe, margin, and from what I have read of your past treatments I should say it is unlikely that you have approached the danger point. All the same, copper is only one of the necessary minerals and I cannot see that it is likely to prove a panacea for all your troubles.

It would help me if you would give me some particulars as to the

stock you are carrying and of any notable symptoms. For instance, do you have any difficulty in rearing young stock, either sheep or cattle? What weights do you get in your lambs? What is your lambing percentage? Are you troubled with pulpy kidney or sleepy sickness etc. etc? Information such as this is of value in getting a true picture of the matter.

I shall not be satisfied until I have an opportunity of visiting your farm and having a look around, also a detailed talk with you. It is stimulating to find a practical farmer so interested in the problems, and what is more, prepared to tackle them in such an individualistic way. Science can help a great deal but trials and actual results are probably the surest in the long run.

Yours truly,
F. HlCKEY
Wonder Distributors Ltd.*

Third letter from Fergus Hickey

26th October, 1949

Dear Mr Trotter,

I have received your letter of the 12th instant but I am not quite clear as to whether it is in reply to mine of the 8th or whether our letters crossed in the post.

I have also received the samples of pasture, but it took many days to get here and was not really in a suitable condition for chemical analysis. I have always found that analyses are utterly unreliable unless the samples are quite fresh.

The information you have sent me concerning your soil tests is most interesting. Like you, I do not have unlimited confidence in soil tests. They are of course useful in their place, but they must be interpreted together with other data.

Now, in your own case, soil analysis has shown that the phosphate, potash and lime status are more than satisfactory, and yet, as a practical farmer you are sure that a moderate topdressing with phosphate and lime will be beneficial. I have seen this sort of thing so often, and seen it proved correct, that I never feel happy in being dogmatic on the strength of soil tests alone.

Nevertheless, I should think it quite improbable that a lime, phosphate or potash deficiency could be responsible for any troubles you are experiencing.

Since you have had such a marked response from copper

* Wonder Distributors are now Mainland Minerals.

supplementation, it would certainly appear to be possible that there are deficiencies of other secondary and trace minerals.

Your soil pH is at a level where one can expect deficiencies in trace minerals, particularly copper, zinc, manganese and cobalt. We can get the best evidence on this score by observation of results after the mixed minerals have been applied.

I am looking forward to my next visit to the South Island as I am most anxious to meet you and have a good look at your place. It is possible that I shall be down there on a short visit before Christmas, in which case I shall let you know in ample time.

With kind regards,

F. HICKEY.

Chapter four

My 1950 address to Federated Farmers on the results of my copper experiments

Big gathering at Ohoka

Striking evidence of the interest farmers are taking in mineral topdressing of pastures was provided on Tuesday evening when at an open meeting called by the Ohoka and Districts branch of Federated Farmers, more than 140 farmers turned out to listen to an address by Mr W. B. Trotter of Fairlie, whose work with copper sulphate has attracted such wide interest.

Mr Trotter was given a most attentive hearing, and was warmly thanked at the end of the evening. It was substantially the largest meeting the Ohoka branch has ever held, and the branch is noted for the excellent attendances at its open meetings.

Mr Trotter opened by saying that not much was known about the effects of minerals on the soil, and the subject was important enough to warrant immediate and thorough investigation. He suggested that part of the board's funds that have been set aside for research should be spent in investigating minerals and their effects upon pasture.

After describing the results he and some of his neighbours had obtained with the use of copper sulphate as a top-dressing, Mr Trotter said that copper was a typical example of the minerals important to pasture growth. Something was known about copper, for instance, that it was necessary for the formation of bone and blood in all animals.

Unbelievable 70% increase in production

"Some people may think that an increase of 70% in production from pasture treated with a mere 5 lb of bluestone (copper sulphate) is unbelievable," he said, "but Lincoln College got similar results on land near Christchurch. After treatment with copper, this land produced an extra 14 tons of carrots to the acre."

"I think it unfortunate that the Lincoln College did not analyse the carrots to see what extra elements there were in the treated carrots. It appears that the copper must have acted as a catalyst, and either built up the strength of the plants so that they could absorb the extra minerals, or acted on the soil and made minerals available that were previously locked up."

"No half-way house"

"My argument with the Dept of Agriculture is that they will not recognise any half-way house," said Mr Trotter. "It must be either black or white. Either there is a deficiency or there is not a deficiency. To my mind it is a lot more dangerous to have a deficiency which is just on the borderline than it is to have a bad deficiency. If there is a serious deficiency, stock will show it by dying, or becoming very sick, and the deficiency is easy enough to recognise and deal with. But if the deficiency is small, all you know is that the stock are not just right, but you can't pick why."

Pregnancy trouble at Fairlie

Deaths last year among his 1500 ewes numbered 35, said Mr Trotter. Of these, five died from misadventure, and the other 30 from pregnancy trouble, or what was diagnosed as milk fever. He believed the milk fever was more probably grass staggers, because the ewes responded well to molasses, which suggested that the deficiency was magnesium.

The pregnancy trouble he had was also probably a deficiency trouble. From his line of ewes, a mob was run off and sent down to a farm on the plains near Ealing. Two of these ewes developed pregnancy trouble before they left Fairlie and could not be sent.

The farmer to whom they were sent had never seen pregnancy trouble, and was still waiting to find out what it was, as none of the ewes sent to the plains developed pregnancy trouble, though it continued to crop up in the rest of the flock at Fairlie.

"It seems to me that the trouble is due to some mineral which is not present at Fairlie being present in the plains pasture," Mr Trotter said.

Composition of good pasture not known

He also said that he had asked Dr. Cunningham of Wallaceville what the mineral composition of good pasture was. Dr Cunningham replied, that while something was known about four minerals, and a little about four more, the total mineral composition of good pasture was not known.

"Sheep and worm infestations have always gone together," said Mr Trotter, "but I think you would find that before a worm problem becomes serious, you have got to have stock in a certain low condition of health. Healthy stock are never affected."

"I tried to interest Dr Cunningham in taking an analyses of pastures from which healthy stock were coming, on different classes of land, with the idea of having a standard analysis of pasture worked out so a farmer compare his own pasture and see where he stood."

"But Dr Cunningham said that his department was up to its eyes in work and did not have the staff. So work on pasture analysis would have to wait. He suggested it might have to wait 10 years. I believe that is too long."

Benefits of optimum mineral balance

A chart showing the relative importance in soils of 17 different minerals was displayed by Mr Trotter. He then developed the theme that these minerals were in balance in good soils.

The balance he claimed, could be upset if extra quantities of one or other of these minerals were added, such as when calcium, phosphorus and nitrogen were added as part of normal farming practice. This addition of extra quantities would obviously destroy the balance, and could result in other minerals and trace elements being exhausted by the additional plant growth that followed, or being locked up in a form not available to plants.

This was where a standard pasture analysis would be invaluable. A farmer could have his pasture analysed to see if the minerals were in balance, and if not, add what was needed to restore the balance.

"If we could provide all the minerals, and keep the proper balance," he said, "it is very hard to see what limit there would be to production. We have the rain and sunshine needed to make growth."

Mr Trotter predicted that mineral deficiencies similar to those found at Fairlie would surely be found elsewhere in Canterbury. It might be that the minerals were in better balance in the plains, but under modern pasture methods, there would certainly sooner or later be trouble.

His own land was valued at £15 10s an acre, yet its production amounted to £22 an acre last year. It was second-class land, but much of the second-class land of this country started with the great advantage of an assured rainfall.

Irrigated light land would come into its own when minerals were better understood. On light land under irrigation, the effects on stock health would become quickly apparent.

No danger at 5 lb of copper per acre

Mr Trotter concluded by discussing the possibility of danger from applying too much copper to pasture. Dr Cunningham had told him that there would be no danger at all if 5 lb were spread on every acre in New Zealand.

Not all land was copper deficient, so any farmer trying copper would be quite safe to put on 5 lb. If he got no response, more could be applied.

Chapter five

Christchurch Press reporter writes about my farm and copper experiments

Mr W. B. Trotter claims marked stimulation of clovers from copper sulphate

Christchurch Press, February 18, 1950.

No farm in Canterbury to-day has better clover in its pastures than the farm of Mr W. B. Trotter.

His property is on rather steep downland, three miles beyond Fairlie along the Mount Cook road.

All over the farm, clover is growing with astonishing vigour and is supporting a concentration of stock not usually encountered outside some of the more favoured districts of the North Island and Southland.

Mr Trotter's experiences with copper sulphate topdressing of pastures to control worms in sheep are now widely known throughout the South Island. It would be no exaggeration to say that his claims have roused as much interest among farmers as any major development in farming in recent years. His disagreement with the Dept of Agriculture has also been followed closely by farmers.

Land description

Mr Trotter's farm is 496 acres of moderately easy spurs and steep gullies. It lies on a belt of 4000 to 5000 acres of limestone country roughly along the southern side of the Fairlie basin, and faces well into the sun. The altitude is from 1200 to 2000 feet.

Soils

150 acres is 6 to 18 inches of tarry soil* on limestone rock. On a further 200 acres, the limestone rock outcrops here and there, but between the outcrops the rock is overlaid by varying depths of puggy brown clay, with a good depth of excellent loam on top.

The remaining 150 acres of the farm are away from the limestone, and consist of up to six feet of clay over shingle.

Except for 50 acres of steep gully face in native grass, most of the property is ploughable, but the tractor-driver would need good nerves on some of the steeper sections.

Climate

Rainfall averages 31 inches. Natural drainage is good. Summers are very hot in the shelter of the hills, but nor'west showers usually keep growth moving throughout the summer.

Frosts are severe in the winter and there is little growth in pasture between May and well on into September. The unimproved value of £7 10s an acre looks modest.

* Tacky black clay-like soil common over limestone rock.

History

The farm was taken up on subdivision in 1900 by Mr Trotter's father. It was farmed well according to the standards of the day.

Until 1931 when Mr Trotter took over, it usually carried 650 ewes and had the normal mixed farm programme of grain and fattening crops, which meant that most paddocks stayed down only three years in grass. A small dairy herd was maintained for some time.

Topdressing results

When Mr Trotter took over, liming and topdressing were beginning to come into prominence, and a topdressing programme was undertaken in 1932.

In three years the ewe flock was raised from 650 to 1400.

Up untill 1936 the record of the farm was excellent for fattening lambs, although the district has always been noted as a difficult one for the production of fat lambs.

Worm troubles

After 1936, worm troubles which had become increasingly apparent, became acute. And until 1943, the major concern of the farm was the drenching and nursing of lambs (and ewes) to get even a modest number into the works.

It was exasperating work, and in 1943 all the ewes were sold off the place and a policy of fattening wethers for the winter market and overwintering ewe hoggets for sale as two-tooths was adopted.

As may readily be imagined, the health of stock during these years was very much in Mr Trotter's mind.

Remarkable results with copper

He finally concluded that the stimulation given to the soil by topdressing might have caused an imbalance in the pasture minerals. And this in turn might have reduced the capacity of his stock to resist worm infestation.

He experimented on this theory and more or less by accident found that copper sulphate gave him quite remarkable results when applied mixed with his normal sowing of 1¼ cwt of super.

He began to add 5 lb of bluestone to his super in 1947, and in the following year turned the farm back again to ewes, but with a lot of cattle among them.

Cultivation is now down to a minimum, and usually consists of about 30 acres of winter feed, generally soft turnips and chou moellier (the chou to give feed in times of snow) sown on pasture, followed by grass sown with oats which are fed off and not harvested.

The long period of grazing and topdressing has brought the farm to the stage where he is now faced with ploughing in first-class pasture for his winter feed crops.

The policy is to set stock with about four ewes to the acre plus a beast to two acres. If feed begins to get away, cattle are added to give control.

At present much of the pasture on the farm is out of control, largely the result of the exceptional season. The winter was unusually dry and mild, and the spring very dry, but since December the district has had 13 inches of rain. The place could easily have supported another 100 head of cattle.

Drenching unnecessary

Since these new policies have been adopted, there has been no trouble with worms. Drenching has

been unnecessary, and at the beginning of this week all his stock looked in perfect order.

Probably the best proof of this is the draft of lambs, numbering 1338 which went to the works on January 12.

They were the produce of 1500 Romney-Corriedale ewes, bought in Otago, and were by Southdown and Southdown-Border-cross rams.

Excellent returns

Of the draft, 441 went 2's at an average weight of 33.8 lb, 567 went 8's and averaged 39.6 lb, 315 went 4's at an average of 44.8 lb, and there were six 2 year olds at an average of 52.5 lb.

The draft included four seconds, and five were rejected because of injury when they were caught in a smother while being trucked.

The draft averaged 38.99 lb and gave an average return of 42s 4d a head.

The ewes began to lamb slowly about September 3. Only 150 lambed during the first week, and 600 the second week.

Beside fat lambs bred on the place, lambs are bought both for fattening and for sale at the autumn fairs, and a big number of cattle are turned off fat.

Present stock

Stock carried on the 496 acres at the beginning of this week totalled 180 cattle, either two or three-year-olds, 1500 main flock ewes, 330 Romney ewes bought for flushing and resale at the autumn fairs, 500 Merino wethers, of which about half will be fattened and the rest sent to another property, and 1700 lambs.

The lambs include about 200 of the late fatteners from this year's lambing. The rest are mixed sex bought in, the wethers for fattening, and the ewes for sale at the autumn fairs.

Stock are now beginning to move off the place fairly rapidly. For instance, two trucks of fat cattle went away this week. By the end of the season, about the end of June, the place will have turned off about 240 head of fat cattle for this year. The number last year was slightly larger.

It is proposed to winter this year about 1800 head of ewes and 200 dry sheep, but no cattle. All the cattle will be sold off because they are inclined to cut the paddocks about during wet spells in the winter. Cattle will be bought in the spring for fattening.

Impressive stock levels

That is an impressive concentration of stock, but even more impressive is the tremendous bulk of feed that every part of the farm is producing.

The policy is to get as near to an all-grass farm as possible, but a limiting factor is snow. It does not come every year, but when it does it is necessary to have accessible feed available for the ewes. Mr Trotter has tried saving small areas of grass for the tail end of the winter, and has found the sheep do better on it than they do on feed, but he dare not take the risk of relying entirely on grass.

No better clover anywhere

Most prominent in the predominantly rye-white pastures at present is the clover. It would not be possible to find better clover anywhere.

This exceptionally strong growth appears to be the result of the dressings of bluestone.

A neighbour's experience

Certainly this is the view of a neighbour whose whole farm is used to carry one of the leading Romney flocks of the province.

A difficulty in the district is that ryegrass is subject to severe attacks of rust, which in some years has serious effects on lambs. For the stud breeder this summer visitation is a real problem.

Three years ago he tried copper on one paddock, but with some anxiety in view of his commitments as a stud breeder.

Results were far beyond his expectations in the thrift of the sheep fed on the coppered pasture, but more important was the exceedingly robust growth of clover, just at the time he needed it most.

Normally ryegrass would be beginning to move and his worries over rust to begin.

Stock improved out of sight

He now uses copper extensively and says his stock have improved out of sight.

His ram lambs do better from the start and go through their usual difficult stage without trouble. They are heavier, and his hoggets are cutting more and better wool.

His use of copper is convincing, because as a stud breeder he could not afford to make mistakes.

Incidentally, the clover stimulation is giving rise to some fears for the future.

In the ordinary way the great growth of clover should soon give a pronounced lift to the grass, whereas at present the clover is suppressing the grass. Therefore the rye may come away strongly enough in future to bring back the rust threat.

Pasture experiment

One farmer who is using copper has started to get away from dependence on perennial ryegrass.

Last autumn he sowed a paddock with two bushels of Italian, 11 lb of certified perennial, 2 lb of mother white clover, 3 lb of Mont clover, 2 lb of crested dogstail, 2lb of Timothy, and 2lb of cocksfoot. Heavy seedings are fairly usual in the district.

Other causes?

Whatever the merits of Mr Trotter's medicinal topdressing may be, the majority of his neighbours are now following his lead and believe that they are getting great results.

Production figures from Mr Trotter's own farm demonstrate that the well-being of both stock and pasture is at an extremely high level.

Unfortunately, several factors obscure the cause of the excellent results he and a number of his neighbours are obtaining. The topdressing programme might, for instance, be the cause of a general rise in the level of thrift of the pasture and stock, with the stock consequently able to shake off worm infestation.

The use of large numbers of cattle with sheep is a recognised method of controlling worms.

The season has been especially favourable for clover all along the hills, but these men say that does not account for the whole of the exceptional growth.

Also, Canterbury has recently been passing through a cycle of dry years, and worm trouble has been of minor importance.

If for no other reason, a scientist

would reject Mr Trotter's claims on the ground that management policy has been changed several times in recent years. Therefore there is no standardised set of conditions against which changes in the health of stock and pastures can be measured.

That of course does not absolve the scientists from the duty of making properly controlled tests of Mr Trotter's theories. It may well be that the changed circumstances of the farm are a result of one or more of the changed management practices. If that were so, something valuable would have been added to farming knowledge.

The results may be valid for a particular soil type in a particular climate only. In any case, many farmers round Fairlie, and some as far afield as North Canterbury and Southland, believe there is a particular virtue in bluestone.

To save them from expenditure which is possibly wasted, a proper investigation should be made.

But Mr Trotter claims that he has had no encouragement from the Dept of Agriculture, and in this statement he is supported by neighbours.

Chapter six

Dept of Agriculture misses the point on trace element deficiency

Trace elements

THE WEEK, 8th July, 1950.

The Director-General of Agriculture, Mr E. J. Fawcett seems to have missed the point of the request made by Federated Farmers, North Canterbury for an investigation into trace element deficiencies.

"Highly qualified scientists engaged on the work"

Mr Fawcett's reply to Federated Farmers stated that "a large and highly qualified body of scientists was engaged on the work, and that the wide use of copper, boron and cobalt compounds was proof of the value of the work."

The value of these compounds on soils known to be deficient in them was not in question. What is in question is the possibility that soils in districts not recognised as deficient, may in fact be deficient to the extent that returns from New Zealand's most important crop – grass, may be less than could be obtained with the addition of certain minerals.

Farmers throughout the country have followed with close interest the results Mr W. B. Trotter of Fairlie has obtained from copper topdressing. And also his theory that topdressing with lime and normal fertilisers may have upset the balance of other minerals in the soil, so that they are not available in full quantity in the pasture eaten by stock.

Farmers are of course fully aware of the excellent results in bush sick districts when cobalt is used. They are also aware of the work done over many years to define the areas where cobalt and other deficiencies exist.

It's imbalance that needs examination

It is not these straightforward deficiencies that are so deeply interesting farmers at present. Mr Trotter's results have been solid enough to lend weight to his claim that there may exist, even on pastures regarded as high producing, some shortage or imbalance of certain elements essential to the full production of that pasture.

It is this aspect that needs examination. Investigation would mean chemical analysis of pasture itself, not the soil on which it grew, or the stock fed on it.

What is needed urgently is some authoritative pronouncement on

whether those farmers who are using such substances as copper, cobalt and molybdenum in districts where soil surveys show no deficiency of them, are wasting their money, or endangering the health of their stock. At least one commercial organisation is already doing good business with fertilisers which contain a dozen or so elements which are said to be already present in pasture.

Copper now unprocurable in Christchurch

Some farmers have gone to great lengths to buy such substances as molybdenum, and the use of copper sulphate has increased to such an extent in recent months that whereas a big order formerly was a 50 lb bag, farmers are now ordering it by the ton for topdressing. At present it is unprocurable in Christchurch.

A lot of farmers have satisfied themselves that there is something in Mr Trotter's claim. If there is nothing in it, and the department has satisfied itself that there is nothing in it, the department should say so at once, if for nothing more than to prevent farmers from wasting their money.

Minister of Agriculture Mr K. J. Holyoake's views on trace element deficiencies in Canterbury

From our Parliamentary reporter, 25th September, 1950.

The effect of trace element deficiencies on the health of stock in Canterbury has been investigated by the Dept of Agriculture for a considerable time according to the Minister of Agriculture Mr K. J. Holyoake.

In a reply to a request by Federated Farmers that the Government should have the imbalance of trace elements in the province investigated by its best scientists, Mr Holyoake said that "areas affected by deficiency of copper, cobalt and iodine are known and have been mapped."

"With the progress of the work, new deficient areas are found from time to time. The information is used by field officers in their ordinary work with farmers, and methods for the correction of deficiencies are made known."

"investigation progressing favourably"

Mr Holyoake has also told Federated Farmers that "the scientific investigation of trace element problems in Canterbury and throughout New Zealand is progressing favourably."

"The major deficiencies and causes of loss are at present controlled, and the extension of the investigation into less obvious aspects is proceeding."

Imbalance of trace elements

Federated Farmers had suggested that there was an imbalance of trace elements in Canterbury, and referred to Mr W. B. Trotter of South Canterbury who, by the application of copper to land had surmounted very considerable difficulties in the maintenance of

the health of stock.

Their letter to Mr Holyoake had also said that it was considered that with the growth of irrigation in Canterbury, damage was being done to the balance of elements of the soil through leaching.

Federated Farmers dissatisfied with reply from Minister of Agriculture

28th September, 1950.

Dissatisfaction with the reply received from the Minister of Agriculture, Mr K. J. Holyoake, to representations made to the Dept of Agriculture by Federated Farmers about trace element deficiencies in Canterbury land was expressed at a meeting of the North Canterbury Federated Farmers yesterday.

Will take a firm stand

"We have been asking Wellington for an investigation into this problem for some time now, and I feel we will have to take a firm stand," said Mr A. A. Macfarlane.

He knew of a farmer in Nelson who had applied a bluestone lick to his land and found a definite improvement in both his stock and land.

Mr P. Croft moved that the Dept of Agriculture be asked to make available to each branch in the district, copies of the maps of the deficient areas as outlined by the Minister. The motion was carried.

Mr G. G. Gardner then moved that a letter should be sent to the Department asking that a qualified chemist be appointed for the South Island to investigate trace element deficiencies.

This motion was also carried.

Chapter seven

Soil liming reports at a 1950 chemists' conference

Effects of liming soils

by Mr W. B. Healey of the Soil Bureau, Wellington

"Besides the generally expected benefits from liming soils such as reducing acidity, improving structure, supplying calcium, and encouraging biological activity, liming was also followed by changes in trace element status," said Mr W. B. Healey at the conference of the NZ Institute of Chemistry this week.

Mr Healey said that where the original soil was markedly acid, was well supplied with organic matter, and contained good reserves of micronutrients, lack of productivity might be due in part to toxic concentrations of elements such as manganese.

The adjustment of toxic to more normal levels and the improved plant growth resulting, was a less generally appreciated benefit of liming such soils.

Additional demand all other plant nutrients

Acid soils low in organic matter, and especially the heavily leached ones, respond readily to liming, but the increased plant growth makes additional demands for a corresponding increased supply of all other plant nutrients," said Mr Healey.

"The elimination of one deficiency, chiefly responsible for the holding back of plant growth in such soils, must inevitably result in a deficiency of a second limited nutrient."

"Frequently it is more than one micronutrient that becomes deficient, for the addition of lime not only reduces their availability, but also increases the demand for them when plant growth is improved."

An experiment on lime particle size

by Mr B. L. Elphick, senior lecturer in soils and fertilisers at Lincoln College

An experiment he had conducted to study variability in South Island agricultural limestone, and the influence of the properties of fineness of grinding on solubility in the soil, was described by Mr B. L. Elphick.

He said that it was generally believed that because of the great differences in hardness and porosity of limestones, harder

limestones required appreciably finer grinding for solubility. The results of his experiment however did not support this view.

All limestone finer than 40 mesh equally soluble

He said results confirmed the very wide range in physical and chemical properties of lime, but showed that (under the conditions of his experiment) the differences in rate of solution due to fineness of grinding were surprisingly small and occurred mainly in the initial, more rapid stages of absorbtion.

For most practical purposes, all limestones, when finer than 40 mesh (350 microns*) could be regarded as equally soluble. Differences in solution of commercial hard and soft limestones must therefore be small, he said.

* 350 microns is about the size of average beach sand. Fine beach sand averages about 200 microns and silt and clay particles are normally below 62 microns. A human hair averages 100 microns in diameter.

Chapter eight

Vets come into the picture

Mr A. H. Turnbull's belief that copper deficiency can be determined from liver analyses

23rd September 1950.

In his report to the annual meeting of the North Canterbury Farmers' Veterinary Club, Mr A. H. Turnbull, chief veterinarian said, "Investigations have been started to determine the extent of trace element deficiencies in the club area. So far three properties have been found to be deficient in copper."

"Members are advised that it is in their own interests to obtain veterinary advice before carrying out an expensive programme of topdressing with an element that may already be present in adequate amounts."

"The extent of the deficient areas can only be determined by carrying out chemical analyses, and in order to assist this survey we would appreciate the co-operation of any farmers who consider that their properties may be deficient in any of the more common trace elements."

Liver analyses

Mr Turnbull, said that the estimations were made on liver analyses.

This gave sufficient data to enable advice to be given on whether trace elements were needed or not.

The object was to save farmers from spending money uselessly on land that was not deficient.

My letter challenging chief veterinarian Mr A. H. Tumbull's view on liver analyses

30th September, 1950.

In your Farm Page on Saturday, September 23, appears a report by Mr A. H. Tumbull, chief veterinarian to the North Canterbury Veterinary Club, in which Mr Turnbull states that sufficient data had been obtained from liver analyses to enable advice to be given on whether trace elements were needed or not.

There is no one in New Zealand today who knows sufficient about liver analysis to give an accurate diagnosis as to whether any good can result from an application of either cobalt or copper to the soil.

Scientists so far have only been able to make a sure diagnosis in the case of acute deficiency and have made no attempt to cope with borderline deficiency.

A lamb should be born with a copper count of about 200 parts per million.

This supply must last the lamb until it starts to graze, as there is no copper in milk. There is therefore a rapid natural decrease in the copper count of milk lambs.

Upon commencing grazing, more copper is available to the lamb, and then the normal range of copper

runs up as high as 700 parts per million.

200 ppm copper or less would benefit

Scientists will only diagnose as deficient, lambs with a copper count of 50 parts per million (ppm) or under, yet it is certain, that all lambs with a count of 200 parts per million or less would benefit from additional copper.

With such a wide range of 'normal' copper count, no one has placed with certainity the point where the use of copper becomes dangerous and ceases to be beneficial.

Pasture analysis only

There is only one type of analysis which may be taken as conclusive in the use of copper and cobalt.

May I advise farmers in the North Canterbury district to accept pasture analysis only.

Dr Cunningham has placed the correct level of copper which should be in pasture at from 11 to 18 ppm, and of cobalt .68 to 1.10 ppm.

Two out of three properties need copper and cobalt

At least two out of three properties in that district will receive great benefit from the use of copper and cobalt. And though they may have been advised by Mr Turnbull that they do not need either of these elements, most properties can prove him wrong by testing the use of copper under part of a rape crop, or part of any other crop.

Canterbury has very little acute deficiency of either copper or cobalt, yet pasture analysis will show that two out of three properties have a pasture analysis of from 7.5 ppm to 8.5 ppm in copper, and from .25 ppm to .35 ppm in cobalt.

In other words, only three-quarters of the correct amount in copper and half the correct amount in cobalt.

Although scientists do not recognise either of these levels as deficient, they must surely be sub-standard and great benefit will result from the application of 5 lb of bluestone and 5 oz of cobalt to the acre.

Veterinarian Mr J. W. McLean of Lincoln College casts doubt on my experiences with copper

Widespread interest has been aroused throughout Canterbury by the success claimed by Mr W. B. Trotter of Fairlie, in controlling worm infestation and other troubles in his stock.

Mr Trotter's experiments and results were discussed at the recent conference of the NZ Veterinary Society and have attracted the attention of various other scientific organisations.

The letter printed below is from Mr J. W. McLean, veterinarian at Lincoln College, who has taken a close interest in the case.

Mr McLean writes:,

Farmers may be misled

I have read with interest in your Farm and Station page the lengthy report of how Mr Trotter of Fairlie

has achieved control of worm parasites in sheep in a space of four years by methods other than normal drenching. Or as inferred, by the provision of copper in the form of a lick or applied to pasture.

The results appear to be so exceptional and spectacular as to deserve thorough investigation to establish the validity of these claims, lest other farmers in the same or other districts should be misled into believing they can as easily do the same.

Such a belief, though possible, is highly improbable in view of what is already known about copper deficient soils in New Zealand and other countries.

Copper research in NZ

Veterinarians and chemists of the Animal Research Division of the Dept have carried out extensive investigations on the copper status of New Zealand soils over the last 10 years.

As yet, a complete survey of all areas of the country has not been made, but sufficient is known to give a general indication of the soils likely to be affected, and of the nature of the troubles met with in stock where a copper deficiency does exist.

In general, most reclaimed swamps and peaty soils are likely to be deficient, and some pumice soils in the North Island. Occasionally other soil types are affected.

Symptoms of deficiency

Symptoms of copper deficiency in animals vary according to species and the degree of deficiency. No effects are seen in horses, and pigs are rarely if ever affected.

The symptoms in sheep and cattle are strangely enough, quite different. Adult sheep show little effect, even when kept on copper deficient pastures for long periods. However the deficiency shows itself in the health of the lambs.

In these, the bones are fragile, and the nervous system is damaged, giving rise in bad cases to deaths of young lambs, and in less severe cases, to a swaying gait due to inco-ordination of the muscles, principally of the hind quarters.

In fine-wooled sheep there is a stringiness of the wool due to loss of crimp. But as a rule there is no scouring or evidence of worm infestation, as with cattle.

Cattle are more susceptible to copper deficiency and show different symptoms. In bad cases the most characteristic sign is severe, persistent scouring which may lead to rapid loss of condition and death.

This feature has given use to the popular name of 'Peat Scours.'

Less affected animals may not scour but they are usually poor in condition, and milk production is markedly reduced.

Calves are more seriously affected than adult cattle. They develop a scour most commonly during their first winter and spring, which may be so bad as to make the rearing of replacements impossible.

During this period they appear to be more than usually susceptible to heavy infestation with worm parasites.

Excessive copper harmful

It is well recognised that the treatment and prevention of these conditions is by making up the deficiency of copper. Either by supplying it in the form of a lick, or for preference, by applying copper sulphate (bluestone) to the soil as a topdressing.

In this respect it is important to

remember that the quantities applied must be carefully measured since excessive quantities may be definitely harmful, particularly for sheep.

Such then, is a very brief summary of some of the more important facts concerning copper deficiency as it occurs in New Zealand.

Uninformed theorising

Mr Trotter's observations are exceptional in that they do not appear to fit in with these known facts.

It is only reasonable therefore, to suggest that Mr Trotter's observations should be carefully examined before they are accepted as stated by farmers.

Mr Trotter talks somewhat glibly of worms, anaemias and copper deficiencies, and yet in discussing this matter with him I was informed that no worm examinations have been made, no blood counts carried out to determine the degree of anaemia if any, nor any estimations of copper in soil samples, animal tissue or plant material. These must, I know well, be carried out.

In saying this, I do not wish to criticise Mr Trotter's trials and observations, which I know were boldly prosecuted and earnestly made in a spirit of helpfulness.

It is natural that he should attempt to give an explanation of his observations and 'practical opinions' on the possible effects of his findings on human and animal nutrition. Even to criticise 'the Department set up to help him' is understandable.

Mr Trotter is a sound, progressive farmer, apparently an acute observer and an influential member of his district. His trials and observations may prove to be exceedingly valuable.

His somewhat uninformed theorising is not so valuable, and to some may even be misleading.

I reply to veterinarian Mr J. W. McLean criticisms

Mr W. B. Trotter has written in reply to the comments of Mr J. W. McLean, veterinarian at Lincoln College on his experiences with worm control. Mr Trotter writes:

Destructive criticism

The position is this. I made my findings on the worm problem public, entirely for the good of the sheep industry in New Zealand and though I must expect criticism, I do object to destructive criticism, which I am afraid Mr McLean's comments are.

This mineral approach to the worm problem is entirely new. Mr McLean then, as a technical expert, has little or no knowledge of this angle of the problem. Yet he has written to your paper on the subject.

I went into the experimental business with one object in view, to enrich the blood of my sheep so that they would respond to drenching. Much to my pleasure, I found that when the blood was enriched, the drenching became unnecessary.

Other farmers have also had excellent results

Having obtained this result, I invited five other sheep farmers who were in trouble with unthrifty sheep to try this system.

All had the same excellent results and are prepared to make known the facts as they know them.

The findings which I made public then were the results of six properties, not from my own farm only, as Mr McLean inferred, and are consequently all the more valuable.

Mr McLean has warned farmers, *'lest they be misled into believing that they can easily get the same results.'*

I think he should have rather, encouraged them to run trials under supervision. That is the way to prove this system, not to cry hands off.

Mr McLean has made much of what he terms the *'copper status.'* His writings tally exactly with Bulletin No. 238 written by Dr I. J. Cunningham of Wallaceville.

This is an excellent work and I do not wish to pass derogatory comments, only to use this booklet to prove that, though the copper experimental work has been going on for 10 years, progress has not been very rapid.

For instance, Dr Cunningham writes, *'No direct evidence has been obtained in New Zealand of the efficacy of licks for sheep.'*

Half-way house important

Also, according to the booklet, there is no half-way house in copper supply. Either there is a deficiency of copper, or not.

I think the half-way house in copper supply will prove most important as regards the worm problem.

A normal copper count is placed at 500 ppm (parts per million) in sheep livers.

A deficiency count is placed at 23 ppm.

Table of copper counts

What I wish to bring about is a table of copper counts reflecting the incidence of worm in flocks.

Take the following as an approximate table of copper counts:

600 ppm. Buoyant supply. No serious worm infestation.

500 ppm. Normal supply, very slight infestation.

400 ppm. Good supply, slight infestation.

300 ppm. Moderate supply, moderate infestation.

200 ppm. Weakening supply, serious infestation.

100 ppm. Short supply, very serious infestation.

50 ppm or under. Deficiency supply, ataxia* likely, impossible to keep stock on property without provision of copper in one form or another.

Questions for Mr McLean

Let's waive the technical objections and get down to the job of finding out if the copper count really does indicate the incidence of worm, and if not, why have six sheep farmers obtained such excellent results using my system?

If copper status does indicate the incidence of worms, and controls them, then the farmers of New Zealand can wave good-bye to worm infestation by raising the copper count in their flocks to the buoyant level which I have tentatively placed at 600 ppm.

---

* A muscle and nerve disorder leading to unco-ordinated movements.

If Mr McLean cares to reply to this, would he start off by answering the following questions:

1. Considering that he has stated that no worm counts were done on my sheep, whose job would he consider that to have been, mine or the Veterinary Dept?

2. Mr McLean talks of uninformed theorising. Have I then in my theorising made any statement which he can definitely state to be wrong?

3. Is it true to say that a few years ago Mr McLean came to his father's farm in Cricklewood to deal with lambs which were dying freely? Having taken worm counts, he drenched them adequately, but did not stop them dying. Four were killed for examination. Would Mr McLean please publish the copper counts in the livers of those sheep?

Mr McLean was on my Fairlie property on January 8, 1949. We had a long discussion on the results of my trials. His technical mind would not accept the facts without more proof than I could supply, such as worm counts, blood counts, etc. Had he lived here during the last 10 years he would not have needed worm counts to prove worm troubles.

4. Finally I showed Mr McLean 400 wether hoggets. These had been drafted out of 2700 in September as culls. Would Mr McLean report on these sheep? Were they healthy, and had they made good growth?

Drop the red tape

Mr McLean will, I think, also admit that the results he has seen here would justify an optimistic view of further trials which must be carried out.

Actually the technical experts have in their hands most of the proof necessary from the results obtained by the application of copper to the copper deficient peat lands. Let them examine these closely.

5. Has the copper count reached buoyant level? If so, what is the result on stock health?

6. Do the farmers on these lands still have to drench the sheep regularly for worm control?

These questions and answers mean much to flockmasters in New Zealand, and again I would say, drop the red tape and get down to work.

Mr J. W. McLean replies to my letter

Mr J. W. McLean, of Lincoln College, commenting on the letter of Mr W. B. Trotter which was published last Saturday, writes:

I regret that Mr Trotter should have regarded my criticism as wholly destructive. This was certainly not my intention, nor is it now. As he so aptly remarks, the question '*means much to flockmasters in New Zealand*.' It was for this reason, and this reason alone that I have taken an interest in the problem.

As I have stated before, his trials and observations may prove to be exceedingly valuable, but I am still convinced that more evidence is required, substantial evidence, that the results obtained were due to

copper, and copper only, so that other farmers with similar trouble may go ahead with confidence.

Radical changes made

During the period under review, Mr Trotter has made radical changes in his farming practice, which might very easily have some bearing on the problem.

He states that his troubles started in 1938. He was certainly not alone in this, for about this time there were widespread and serious losses amongst all classes of sheep throughout the whole of Canterbury and North Otago.

Since then, except for one or two seasons, principally when the summer rainfall has been high, little of a serious nature has occurred.

Careful survey needed

No one has suggested or inferred that the last word has been written concerning the nutritional effects of copper, or of the extent and degree of copper deficiency in New Zealand soils. But from what is already known, I believe that the logical approach to the problem is not the indiscriminate application of copper as a topdressing, as might be inferred from Mr Trotter's remarks, but a careful survey of suspected areas by means of chemical analysis of organs and tissues from animals in such areas. Where such examinations indicate a deficiency, a response to the application of copper can be expected.

Data to be collected

At present the college is assisting the Dept of Agriculture in the collection of data for such a survey.

Both organisations are not only interested, but eager to assist any farmer who suspects a mineral deficiency on his property.

These same facilities, together with facilities for making blood and worm counts have been offered personally to Mr Trotter, and the offer still stands.

It is a little surprising, therefore, that he should say *'drop the red tape and get down to work.'*

Finally, Mr Trotter asks whether in his theorising he has made any statements which I can definitely state to be wrong.

Obviously, no useful purpose would be served by pursuing that topic. What I am concerned about are the statements that are definitely right, for which there is indisputable or even reasonable evidence, so that a reliable body of information may be built up for the benefit of the farming community.

Chapter nine

Soil scientist Dr Cunningham addresses farmers on mineral deficiencies

The only known deficiencies in NZ soils are copper, cobalt and iodine

30th June, 1951.

Trace minerals in relation to stock health were fully discussed by Dr I. J. Cunningham, director of Wallaceville, with about fifty farmers during a winter farm school at Darfield this week.

Minerals possibly dangerous

Dr Cunningham said that only three deficiencies that affected stock were known in New Zealand, and he warned farmers of the possible dangers of supplying extra minerals unless it was known there was a deficiency.

He spoke for about an hour, and spent another hour answering questions.

"The New Zealand system of farming was particularly favourable to the development of deficiencies," Dr Cunningham said, "because in general, all the feed the stock received on the average farm was grown on the farm. Whereas it was normal practice in many overseas countries to import large quantities of foodstuffs for stock, with the result that deficiencies would be made good."

Copper, cobalt and iodine

"Deficiencies of copper, cobalt and iodine were known to occur in specified areas in New Zealand, but so far no other deficiency had been shown to affect stock."

Cobalt deficiency

"Severe cobalt deficiency was easy to recognise," he said. "Stock became increasingly unthrifty and eventually died. Their appearance was that of animals which had been starved."

"Less severe deficiency was harder to recognise. It might reduce the rate of production of livestock, but not kill them. When cobalt deficiency was suspected, veterinary advice should be sought."

Copper deficiency

"Copper did not stand by itself in animal metabolism as cobalt did, but was bound up with molybdenum, with which it had to be in balance."

"The effects of copper deficiency in livestock varied for different classes of stock. In adult sheep signs of deficiency were confined to a wool condition in Merino sheep. Other breeds were not apparently affected, and no other signs appeared."

"There was however a marked effect on lambs, which if their mothers were severely deficient in copper, would not be able to walk properly after birth. Later, at 3 to 6 weeks old they developed fragile bones and inability to control their limbs."

"Cattle of all ages were affected by inability to walk, by extreme

unthriftiness, and by severe scouring in the flush of spring and autumn. The scouring in cattle was associated with a surplus of molybdenum, in addition to a shortage of copper."

"Control was achieved by simply supplying copper to the affected stock, and could be supplied in many ways."

"Topdressing was the best method. Licks should not be used unless it was absolutely impossible to topdress. Licks were dangerous because stock might get too much copper and be poisoned."

"I particularly want to stress the danger of too much copper," said Dr Cunningham. "It takes very little copper to induce poisoning. If you took 2 ounces of bluestone, divided it into 40 equal parts, and fed one part to a sheep each day, you would kill it inside 30 days. You can see that that would not be very much copper."

Molybdenum caution

"Most of the peat soils of New Zealand contain molybdenum in very large quantities," Dr Cunningham continued. "Some of the Ashburton peats were the only ones that did not have more than sufficient of this element."

"Molybdenum is being used fairly widely to promote clover growth," he said. "It is necessary for the nodule-forming organisms, without which clover does not thrive."

"However, if a deficiency of molybdenum is established, the way to get over it is by topdressing with very small amounts of molybdenum. You only need one or two ounces to the acre. If you use one or two pounds, you will have trouble. If you want to use molybdenum, get advice from the Department first."

"Anything to do with molybdenum should be approached with extreme care or you may get molybdenum poisoning. If you do put on too much, we may perhaps be able to help you, but I would much rather not see you in that dilemma."

"In an experimental area on the Hauraki plains we found that 5 ounces to the acre was far too much for stock."

Iodine deficiency

"Iodine deficiency is more important in the South Island than the North," he said, "but is not yet very well understood."

"It might occur for the first time on a farm which had been in the same family for 50 years and managed in the same way, and then not occur again. It was not known why the trouble suddenly cropped up."

"The characteristic symptom was the swelling of the thyroid gland in the throat."

"Treatment was by supplying iodine, which must be provided as a lick with potassium iodide at 10 ounces to the ton of lick."

Dr Cunningham concluded by saying that those three deficiencies were the only ones known in New Zealand."

"Deficiencies which might limit the growth of pasture were outside his province."

Farming has negligible effect on supply of soil minerals

A Mr Faulkner suggested, that as stock had been grown and taken off hill country for 50 or 60 years, hill country might be becoming deficient in some minerals. Every hill farmer noticed that stock seemed to be doing better in certain

years. “Are deficiencies creeping up on us gradually?” he asked.

“The soil was the origin of all minerals,” said Dr Cunningham, “whether they were used by growing crops or by animals.”

“In very simple terms, it could be said that as the parent rock broke down to form soil, some of its minerals were released.”

“Different rocks and different conditions made the rate of release vary. The quantity of minerals removed by stock in 50 or 60 years would be quite negligible.”

Mineral deficiences not apparent from pasture

To a questioner who asked whether there were noticeable differences between pastures on deficient and normal soils, Dr Cunningham said that with cobalt there were none.

“Cobalt is required by plants in such minute quantities that laboratory experiments to study the effects of cobalt deficiency have failed to produce a deficiency. Even under the most exacting laboratory conditions it has not been possible to remove all traces of cobalt from the other nutrients needed to grow the plants.”

“Copper was different. In acutely deficient areas in Australia, it is not possible to grow certain plants at all, and other plants including fruit trees also show certain effects.”

“The most seriously deficient area in New Zealand is in Hauraki. Grasses are not affected, but there is just sufficient difference in clover growth to be discernible. There is no known plant effect from iodine deficiency.”

Mineral imbalances

Mr Faulkner then asked, “Is there a danger of inducing an oversupply of copper, if land not deficient was topdressed with copper?”.

Dr Cunningham replied, “Top-dressing at a rate of 5 lb to the acre is not likely to be harmful, but what we don’t know is the relationship among all the other elements. We know that copper and molybdenum are antagonistic. Too much copper may interfere with the molybdenum, and too much molybdenum may suppress copper.”

“If copper is put on to an area where it is not needed, there are two possible effects. First, that we may harm our own pockets, and second, that we may harm the balance between copper and molybdenum.”

“If copper is put on when it is not necessary there might be a distortion of the balance of other minerals.”

“5 lbs to the acre might not be too much copper as copper, but it might cause too little of something else.”

“In normal conditions, sheep take into their livers perhaps one part in every 20 that they receive from their feed. The rest they void. If the whole 20 parts were taken into the liver, every sheep in the country would die of copper poisoning.”

“There is something in a sheep that dictates how much copper is taken into the liver. What that something is, nobody knows yet, but if that something was upset, it might result in copper poisoning.”

“That is the greatest harm that may come from copper top-dressing,” he said. “We don’t know what the something is, but we are looking for it.”

“I would advise against copper unless you definitely know there is not enough in your soil and plants.”

19 elements needed for plant and animal growth

Mr B. H. Pridie asked, "You have spoken of four minerals, but we are told that 19 are needed for plant and animal growth. Are you sure that there are no other deficiencies?"

"We can't be certain that there are not some other element deficiencies in New Zealand," said Dr Cunningham. "We just don't know. But there is no evidence from any other part of the world as yet that any mineral deficiency affecting stock health has occurred."

"Small animals have been tested with diets from which all elements such as tin, nickel, and magnesium have been removed."

"Effects on these small animals have been detected after very exhaustive processes have been gone through to take these elements out, but those conditions are unlikely to occur naturally."

"The indications are that plants need these elements more than animals do, and that if plants grow, animals get enough."

Lack of NZ researchers

"You may ask, if we don't know these answers, why don't we get to work and find out."

"We are working on the three minerals of importance to the economy of New Zealand."

"We have only a small staff. This is not a matter of money, but of getting people who are interested to do the work. We have got to concentrate the resources we have on the ones we know are of economic importance."

"It might take two or three workers 10 years before they began to get anywhere with, for instance, manganese, and each individual element would require the same amount of work."

"A lot of people are working on these things all over the world, and their results are being published as soon as they are available. We are keeping a close watch on the literature and if anything comes from the work overseas, we will get on to it here immediately. We haven't the people to put on to the work here."

Chapter ten

Dept of Agriculture advises against copper, unless they recommend it

Reported in 'The Man on the Land'

There may be some farmers who are wondering if the experiences at Fairlie with copper supplements for sheep during the last four years have adequately proved the value of copper sulphate topdressings as an infallible prevention of worm troubles, and also as a sure booster for the better thrift of lambs and sheep, writes an officer of the Dept of Agriculture.

As there are many contributory factors to be considered in the fertility build-up and the successful grazing results on any farm, it is premature for us to make positive statements about the part played by copper supplements in the results obtained at Fairlie.

At the present time the Dept of Agriculture is examining the possibility of copper deficiency in South Canterbury.

Disappointing results

"During the last two years, one farmer in the Fairlie district has attempted the use of copper sulphate on pastures, as well as in licks, and has obtained disappointing results. Since June 1949 this farmer has lost several ewes and hoggets from jaundice caused by copper poisoning. These losses are liable to continue for several more months."

"The pastures on this farm were abundantly topdressed with copper sulphate, but no apparent worm control resulted. The lambs suffered a setback with worms during the early summer of this season. Those of the mob drenched with phenothiazine showed the best response."

"The farm owner even threatened to sue for recovery of losses caused from the use of copper." **(* See my comments on this over the page. Brown Trotter.)**

Australian experiences

Outbreaks of chronic copper poisoning have also been reported in Australia on frequent occasions.

Deaths of sheep have occurred near copper mines where the pastures had become contaminated with copper-bearing dusts from dumps.

Other mortalities from jaundice occur where outcrops of copper-bearing rocks raise the copper content of the soil, and also where sheep graze in orchards that have been sprayed with copper spray mixtures.

It is more than 10 years ago since the Dept of Agriculture first investigated 'swayback' in lambs and established the existence of copper deficiency in New Zealand.

Use copper only if Dept of Agriculture recommend

Since then a considerable amount of research has been done which indicates that more investigation requires to be done on related minerals.

Until further research is completed, and in view of the risk of copper poisoning, farmers are

advised not to use copper sulphate topdressings or licks unless recommended to do so by the Dept of Agriculture.

* Copper over-supplied

I visited the property mentioned in this article and saw a beautiful example of yellow jaundice. I also found a mis-application of the recommended use of copper.

The recommendations made by me were either:

(a) A lick containing 3% of copper.

(b) A drench of 2 lbs iron, 1 lb bluestone, and 1 oz cobalt to 5 gallons water.

(c) Sow with a crop, 6 lb of bluestone per acre.

However, not only was bluestone sown with a rape crop, but a double strength lick was supplied. 6% of copper was being put in the lick intead of 3%, and molasses was added. The lick was so palatable that the sheep were fighting for it.

I was told that he had doubled the amount of bluestone because he considered that if 3% was good, 6% would be twice as good, and the molasses was added to 'make sure they ate it.

All I could say was, you're B... lucky you have only lost a few. You had better get that lick away or you'll lose the lot.

No further action was taken against the Department.

Dr Cunningham – Mr Trotter's views on copper "just wasting money" and "not supported"

When he spoke to a meeting organised by Federated Farmers in Christchurch last week, Dr Cunningham, superintendent of the Animal Research Station at Wallaceville said, that to apply copper to soil which was not known to be copper-deficient was just wasting money.

Mr A. C. Wright, senior biologist of the Soil Bureau of the DSIR went further. He said that such applications might be dangerous.

The attendance of farmers was about 15 and in addition a number of men from the Agriculture, Lands, and other Departments were present.

Mr Wright said an examination of soils in North Auckland had shown that copper topdressing on some soils caused partial sterility of the soil.

Soil organisms killed

"In pot trials, the addition of copper sulphate had killed more than half the soil micro-organisms," said Mr Wright.

"This probably resulted in a release of soil copper held in the bodies of the microbes, and certainly caused a release of nitrogen."

"For a time this stimulated plant growth, but the plant took up only a small proportion of these resources."

"The remainder might be lost in drainage water. However, valuable micro-organisms which appeared to take a long time to recover, were killed."

"There might be better ways of administering copper," said Mr Wright, "but before a recommendation could be made about the

application of copper, further investigation would have to be made."

"From several studies it had also been found that some soils were deficient in copper because they lacked copper minerals in their parent rock. These soils needed copper both for proper plant growth and for rearing healthy stock."

"Other soils had a small reserve of copper which was either not becoming available fast enough to supply fast-growing plants, or was being washed out by high rainfall before plants could use it."

Trace element experiments

Mr Wright said that all these problems and others relating to trace elements besides copper were under experiment.

At the moment there was only one cause of delay and that was staff accommodation, but steps were being taken to meet this problem.

If farmers were anxious to have a trace element survey made in Canterbury he urged that they should make representations to the appropriate quarter.

Peat land copper deficient

Dr. Cunningham said that copper deficiency had been found near Hamilton on the Hauraki Plains, and it was now known that practically all peat land had the deficiency.

In Canterbury there were small areas of peat near Lake Ellesmere and Ashburton. However the Ashburton peat did not show the deficiency.

All over New Zealand the deficient area totalled something under 500,000 acres.

Sheep, cattle and pigs affected

"Simple copper deficiency affected sheep, cattle and pigs."

"On sheep, other than lambs under three months, the deficiency had no effect, but when there was acute deficiency, lambs under three months developed paralysis."

"Losses could range from practically nothing, up to 100%. Usually they amounted to about 10%, though they were sometimes 30% to 40%."

"This type of loss had occurred in parts of North Canterbury," said Dr Cunningham.

"Cattle did not do so well on copper deficient land, they become anaemic and do not produce normal calves. Sometimes the calves were like the lambs, they did not grow normally and might have fragile bones."

Surplus molybdenum has same effect as low copper

"In the North Island there were areas where there was a deficiency of copper and a surplus of molybdenum."

"In one or two flocks the responses to these conditions had been identical to those under copper deficiency. Adult sheep had been unaffected but lambs had suffered from paralysis."

"Cattle also scoured badly in the spring and sometimes in the autumn, and there was a falling off in production. Calves did not do well and were susceptible to broken bones."

"A small area in this category had been found near Ladbrooks," said Dr Cunningham.

"This type of deficiency was important," he added, "in that there was a tendency to use molybdenum to promote clover growth. This was all right provided the quantity used was not excessive."

"Control of both conditions could be achieved by the application of 5 lb of bluestone to the acre," said Dr Cunningham.

"Under the second condition, the effects of molybdenum were neutralised."

Canterbury problems

"In Canterbury it had been suggested that there were special problems, and that such troubles as scouring, unusually heavy parasite burden and declining weight of lambs could be solved by the use of copper sulphate."

Dr Cunningham said that unfortunately he had never been invited to see stock when they were actually suffering from these troubles. He had always heard of them some time after they had happened.

"The veterinarian in the Dept of Agriculture at Timaru, Mr M. C. Armstrong had sent a questionnaire to 229 farmers in the Fairlie district asking for details of their fat lamb production over the last 10 years."

"Of the 38 who had replied, only 27 gave information covering more than one year. The returns for 14 showed that their production was standing still, while the balance showed an improvement. The problem therefore did not appear to be as stated by the farmers."

Mr Trotter's copper claims not supported elsewhere

"Information from reports of the Meat Board also showed that the problem was not as severe as indicated. It appeared that Canterbury and Otago lamb weights were not declining in comparison with New Zealand weights. In fact they were tending upwards. For the two freezing works in South Canterbury, weights were not less than the average."

"Mr W. B. Trotter of Fairlie had strongly advocated the use of copper sulphate," said Dr Cunningham. "He has claimed that it reduced parasites."

"From his experience in the North Island, this was definitely not so," said Dr Cunningham.

"Mr Trotter also claims that extra copper made possible an increase in the growth rate of lambs."

"So far that had not been found to be the case in the North Island. Of three groups on a copper deficient area, those grazing normally had killed out at 60 lb, those where copper sulphate had been applied as a topdressing killed at 61 lb, and where the mothers had been drenched with copper, the lambs killed at 62 lb."

Mr Trotter's heaviest sheep had the lowest copper

"Six livers taken from the heaviest of Mr Trotter's sheep had shown a lower copper content than from the lightest," continued Dr Cunningham.

"While the claim was not supported by evidence at present. it had to be still further investigated in the future."

Both Dr Cunningham and Dr J. F. Filmer, director of the live stock division of the Dept of Agriculture, emphasised that farmers should make known their stock problems to officers of the live-stock division, or veterinarians of the department.

Dr Filmer said, "These men, who had the whole organisation of the department behind them, knew where to take these problems if they could not give the answers themselves.

He favoured this procedure above the proposal of Federated Farmers

that a highly qualified chemist should be stationed in Canterbury to study trace minerals."

Soil maps displayed

Dr Cunningham showed to the meeting maps indicating areas of trace element deficiencies. The maps were prepared on the basis of known deficient areas and soil types by the Dept of Agriculture, in conjunction with the Soil Survey Division.

"Where an area is known to be deficient, soil of the same type elsewhere is also considered likely to be deficient. Therefore, as the officers of the Dept of Agriculture move around, they check with farmers on the same type of soil to see whether they too have a deficiency and advise them accordingly."

Chapter eleven

My replies to the Department soil scientists and vets

My reply to Mr A. C. Wright and Dr I. J. Cunningham

The opinions on topdressing pastures with copper given at a meeting in Christchurch recently by Dr I. J. Cunningham, Dr J. F. Filmer and Mr A. C. Wright broke little new ground.

Mr W. B. Trotter, who has been a leading advocate for the use of copper sulphate in certain conditions, comments on these opinions in a letter printed further below.

It was most unfortunate that so few farmers turned up to the meeting, possibly because few of them knew about it, but it is doubly unfortunate that Mr Trotter was not there to take part in the discussion. Farmers all over the country have taken a deep interest in the experiences of Mr Trotter, and a large number have spent, and are spending money on many other trace elements for topdressing pasture as well as on bluestone.

Most farmers can at present spare some money for experimental work, but there has been a strong demand from individual farmers and from farmers' organisations for carefully controlled scientific research into the results Mr Trotter has reported from time to time.

It is most sincerely to be hoped that Dr Cunningham and Dr Filmer, Mr Wright and other Government scientists will be at the Lincoln Sheepfarmers' meeting to be held at Lincoln College on May 30 to June 1, when Mr Trotter will present a paper on his experiences. The event would give an ideal opportunity for full discussion of a subject which is very much in the minds of farmers.

Mr Trotter's letter

Farmers in Canterbury have been warned on many occasions by Departmental Officers of the dangers arising from the use of bluestone as a topdressing.

And now, after over two years, we have the official opinion stated by Mr Wright and Dr Cunningham.

Mr Wright says 'Application may be dangerous.'

The use of the word 'may' proves that Mr Wright does not know whether it is dangerous or not.

This is however a modification of the stricter warnings which have been issued to farmers from time to time in the past.

Mr Wright should take a trip to the copper hills in Australia. He can easily prove or disprove his theory there. He will find bluestone lying on the surface of the ground, and also that the best wool and sheep in Australia are grown there.

70% increased production

Dr Cunningham told me in conversation that as a scientist he is required to be exact, yet I do not think he has said anything which cannot be completely refuted.

He states first that anyone who used copper on soil which was not known to be deficient was wasting

money. Well, on my property no copper deficiency is known. I sowed one ton of bluestone, costing £60 and had an increase in production of 70%, representing a return of approximately £4000. I do not think that was a waste of money.

Questionnaire results

As regards the questionnaire issued to 229 farmers in the Fairlie district, my thanks are due to the farmers who did not answer.

I told local farmers at the time that the statistics asked for by Mr Armstrong would be used as an argument to attempt to discredit my experiments.

We all know that through the big increase in the use of lime and super in the Fairlie district, stock has increased, wool has increased, and lambs have increased.

My reason for advising farmers not to answer the questionnaire was that it was not likely the answers would reveal that this increase has been obtained at the expense of stock health.

This is proved by the huge increase in the use of stock remedies, something like 2000%. This information is vital to obtain a true picture of the position.

His stock immune from worm

Dr Cunningham has said that I claimed the use of copper has reduced parasites. This is not correct.

What I have said, and I repeat it, is that the use of copper has made my stock immune from worm attack.

The action which I took was not initially against worm, but rather to strengthen the red blood cells of the animals. Having accomplished this, I find that the worm is powerless to attack.

I removed the cause, so I did not need to bother with cures.

60 lb lambs

I have also claimed that extra copper has made possible an increased rate of growth in lambs.

Dr Cunningham has gone to some of the best country in New Zealand (there are not many lambs which kill at 60 lb or better in New Zealand) to see if this is so.

My lambs are so good that most farmers in this country would be very interested to know just what they were fed on, what pasture analysis revealed, what pasture species were present, and so on.

Why his light lambs had higher liver copper

He seems to think that because the light lambs in my draft of January 1950 had a higher liver copper count than the heavier lambs, it disproves my claim.

The answer is quite simple. The smaller lambs were twin lambs. Dr Cunningham selected six large lambs and six twin lambs of the same age.

The copper count in a liver represents the amount of copper which is in storage. There is no copper in milk, so nature provides each lamb with a quantity of copper in the liver which must suffice until the lamb starts grazing.

Copper is an integral part of bone, and also required by the lamb to utilise iron in the liver to form red blood cells.

These lambs all started grazing about the same time and so the intake of copper should be equal. However, the single lambs made much more rapid growth than the twins, and in building a bigger frame, naturally used more copper.

The limiting factor in the growth of the smaller twin lambs was the milk supply of the mothers, which would only be about half that obtained by the single lambs.

Therefore the single lambs which had made such rapid growth could hardly be expected to have as high a copper count as the smaller twins.

To speak at Conference

I have been asked to give a paper on this subject at the Farmers' Conference to be held at Lincoln College at the end of May, so I will reserve further comments until then.

May I conclude by thanking North Canterbury Federated Farmers for their support and for their persistence in at long last obtaining this official statement.

A further reply to Dr I. J. Cunningham

Widespread interest was attracted earlier in the year by a lecture given by Mr W. B. Trotter of Fairlie giving details of results he had achieved in controlling worm infestation in stock on his property at Fairlie.

His conclusions were not entirely accepted by the scientists, and in this article Mr Trotter gives some details of what has passed between him and Dr I. J. Cunningham of Wallaceville in recent months.

Mr Trotter writes as follows:

Mr Trotter's letter

Since my original lecture to farmers in early January, a good deal has happened. I have before me a letter from Dr Cunningham dated January 31, 1950, in which he states among other things, *"Any effect from topdressing with copper would be achieved only if there is a deficiency of copper prior to the topdressing."*

This is common sense, as it is most unlikely that any benefit would be obtained from topdressing with any mineral of which supplies were adequate.

However, having obtained outstanding results from topdressing my property with 6 lb of bluestone to the acre, the deficiency is proved beyond any reasonable doubt.

The letter states further: "*To make the story of copper deficiency in New Zealand clear to you, I have enclosed Bulletin 238.*'

Copper halfway house

I answered Dr Cunningham's letter February 26 and told him that I did not think there was any copper deficiency in this district such as his department recognised, (ie, a copper count of 25 ppm or less) but I thought that the halfway house (copper count of 300 ppm) would prove most important.

Further, that there was a distinct link with copper count and worms in stock.

Dr Cunningham's reply to me of March 2 rejected the worm link but stated, *"I do agree that in general terms, mineral deficiency would make an animal more susceptible to infestation by parasites than an animal not deficient, if other circumstances of exposure to parasites are the same."*

To clear up this matter of copper count, I then offered to obtain sample livers from this district for testing.

At the farm school held in Fairlie on May 23 and 24, we were again lectured on copper deficiency and found that Dr Cunningham had

'discovered' *'complicated deficiency of copper.'* This is when the copper count falls and the copper is still further depressed by an over-supply of molybdenum, giving symptoms similar to simple copper deficiency.

The fact that this complicated deficiency occurs at a copper count between 250 and 350 ppm points out that the halfway house I spoke about in my reply to Mr McLean and Dr Cunningham is proving most important.

I could perhaps accuse Dr Cunningham of annexing my halfway house and calling it *'complicated copper deficiency'* but I am much more interested in waiting to see whether he will also recommend to flockmasters that they raise the copper count to the buoyant level of 600 ppm.

Liver test results

In carrying out my undertaking to supply livers for testing, I sent three livers to Wallaceville through our local stock inspector.

The report sent to me from Wallaceville, dated April 4 gives the copper counts as: 260 ppm, 418 ppm and 710 ppm.

(The same report sent to the local stock inspector reads: 710 ppm, 418 ppm and 260 ppm – upside down, hardly the standard of work expected from Wallaceville.)

15 soil minerals

At question time during another lecture on fertilising practice, also at the farm school, I asked Mr J. D. Wraight of the Department, why it was that the Dept of Agriculture appeared to concentrate all its energies on applying lime and super to the soil?

The answer was, *"because they are the most important."*

The true answer would have been *"because they are used in the largest quantities."*

There are at least 15 minerals which are required in measurable quantities for healthy stock, and just as long as the Dept of Agriculture concentrate on applying just two of these 15 minerals to the soil, just so long will they encourage farmers to mine their soils of the other 13.

No two minerals can be the most important, as all have their separate functions to perform. All are inter-dependent and interrelated.

With examples such as, what 5 oz to the acre of cobalt has meant to the bush-sick areas, and 5 lb to the acre of bluestone have meant to the peat lands, the importance of some of the minerals which are used in lesser quantities cannot be doubted.

Also the fact that outstanding results have been obtained by applying 6 lb of bluestone to the acre to various properties in the Fairlie district points to the need for something more rational in the way of fertilising practice.

The usable quantities of the various soil minerals must be found and special fertilisers made to supply the needs of various crops.

As a sheepfarmer I am mainly interested in how well my ewes milk. So I will make an attempt to topdress my property with a fertiliser closely related to the mineral content of milk and await results with confidence.

Sheep lick experiment

In the June issue of the 'Journal of Agriculture' there appears an article by Dr Cunningham which appears to prove that sheep only eat licks because they like them.

A great deal of my work has been done with licks. May I therefore

venture to contradict this article and point out where the work is faulty and the results erroneous.

In doing this I want to make it clear that I carry no banner for the manufacturers of proprietary licks. I have an unfinished argument of long standing with them.

The purpose of any lick should be to supply minerals in short supply and/or correct the balance of minerals in the diet.

To ascertain what is required and in what quantity, a pasture analysis should be taken. This analysis should be compared with a milk analysis, which is a near perfect food. But allowance would need to be made for any deficient mineral.

Better still, slaughter an animal and test for all minerals.

Dr Cunningham failed in this and chose a lick for palatability rather than suitability.

Then again without testing, he chose two similar paddocks, but only similar so far as he could see. Then by force feeding an overdose of lick to one section of sheep (10 grammes a day is equal to 1 lb a year), he found that the sheep so fed ate more lick than the control mob.

In other words he created a depraved appetite in the sheep and all that is proved is that this particular lick was unsuitable.

Scientists

On the same page of the journal appears a booklet review by Dr Filmer. This booklet was sent to me at the end of March and I read it with much interest.

I have no hesitation in recommending farmers to read it, as it is definitely constructive, which is more than can be said for the review which concludes, *"View with suspicion any of its findings and recommendations, which are at variance with the findings of reputable, disinterested scientists."*

How I wish that we had some system of bonus payments to the said scientists for excellent work, then perhaps they would not be so disinterested.

Copper and infantile paralysis

Finally, may I repeat a question which doctors should be able to answer without much trouble?

Is infantile paralysis, as it affects humans, just a copper deficiency?

I ask this because the first sign of copper deficiency in sheep is bone weakness. New Zealanders are world-famed for the chalkiness of their teeth.

So it would appear that if we have the first symptom, perhaps the second may apply also.

My reply to veterinarian Mr M. C. Armstrong

(The original newspaper article is not included in this book.)

Mr W. B. Trotter of Farlie writes commenting on an article which appeared in this column last Saturday. Mr Trotter has expressed the desire to answer some implications made in the article by veterinarian Mr M. C. Armstrong of the Dept of Agriculture, Timaru.

Mr Trotter writes:

Copper benefits

I do not think that Mr Armstrong can truthfully infer that *'copper deficiency occurs only on peat country.'*

Further, Mr Armstrong has never been on my property, so any examination which he has made has been purely wishful thinking.

Now I have claimed that I have obtained certain benefits from the application of copper sulphate to my property, namely, bloom in the wool of sheep, the return of lustre to the eye, and a much improved lactation from the ewes.

Mr Armstrong says that the only known effect of copper deficiency on mature sheep is a '*stringiness of the wool.*'

Among stockmen, stringiness of wool has always been accepted as a sure sign of unthrifty sheep, while bloom in the wool and a bright, bold eye have always signified, and always will signify, thrifty sheep.

Copper and lactation

With regard to the lactation of the ewe, this is probably the greatest single factor in fat lamb production. Unfortunately, 90% of the ewes in this district go dry at Christmas time, resulting in weaning in early February rather than good, sappy, fat lambs if the ewes could be induced to milk throughout January.

In the October issue of the 'New Zealand Journal of Agriculture' is an article by Dr Cunningham on the copper requirements of peat lands. Here is an example of the value of copper, as given in that article: *"One dairy farmer, by spending £13 on bluestone to top-dress his farm, received approximately £300 in increased cream cheques."*

For some strange reason this improvement has not been applied to sheep.

Copper and weak bones

Mr Armstrong says further that, *"Anaemia is not a recorded symptom of copper deficiency."*

Farmers have been told that good supplies of phosphate and lime will result in improved bone in their sheep. Yet regardless of the supply of these two minerals, the first symptoms of copper deficiency are weak bones.

This would show that the bone-building process also depends on the supply of copper.

Furthermore, when copper is deficient, the iron which should be used to form red blood cell haemoglobin, is stored in the liver of the sheep instead.

Now I have said that if the bone-forming and blood-building functions of the sheep cease, the sheep will have anaemia.

Mr Armstrong says I am wrong. Perhaps he can then tell us what would happen?

Careless fertilising practice

Mr Armstrong finally says that the value of the matters raised by me has been to *'focus considerable attention on sheep nutrition.*'

What I have brought up goes further than stock, it calls attention to the carelessness of the fertilising practices recommended by the Dept of Agriculture;

Surely the fact that bluestone has been applied to certain properties in the Fairlie district with outstanding results, proves the need of this mineral, and the need of a more rational system of fertilising.

No one or two minerals can be the most important. Each and every mineral has its own particular function to perform. All are equally important and interdependent. The supply of every one must be adequate if optimum production is ever to be reached.

Cobalt and bush sickness

One glance at the bush sick areas where cobalt was the remedy, and another glance at the peat lands should convince anyone of the importance of trace minerals, which are not used in such bulk as some others.

I think it is time that some attempt was made to play 'put and take' with the soil, with special fertilisers for every crop.

In the case of milking animals for instance, a fertiliser containing the mineral analysis of milk, plus a maintenance ration for the milking animals themselves, with the minerals in their correct balance should give excellent results.

How much easier for the animals, and how sane, compared with leaving so much to chance, Mr Trotter's letter concludes.

Correction

It should be recorded that neither in last week's article, nor in talks at the Fairlie or Waimate winter farm short courses did Mr Armstrong use the term "*stringiness of the wool*" as being the only known effect of copper deficiency. The expression he used was "*the wool shows no characteristic abnormality*.

Chapter twelve

The real cause of worms in our flocks

My letter to the Christchurch Press

Christchurch Press, September 9th, 1950.

[This letter from Mr W. B. Trotter was referred to Dr J. F. Filmer, director of the Animal Research Division of the Dept of Agriculture for comment. No reply has yet been received.]

Mr W. B. Trotter of Fairlie writes:

Cards on the table

I have been extremely lucky in my experiments with the use of bluestone and sulphate of iron in worm control.

There is a third mineral, cobalt, which plays a vital part in the control of anaemia.

Fortunately my property has plenty of cobalt, otherwise the results of my experiments would have been disappointing.

I would advise users of the lick method to include 1 oz of cobalt to every pound of bluestone, until such time as they have opportunity to have pasture tests taken and the supplies of cobalt tested.

Real reason for the worm

The time has arrived in this controversy to put the cards on the table. Departmental officers have told me that my work cannot be accepted by the Department.

As scientists, departmental officers start an experiment. They get a certain result. This result is checked and double checked for ten years. Then the results are made known and may be treated as fact.

This is very sound procedure. I quite agree that scientists cannot afford to somersault every second year.

However the Department has told farmers for years that the reason why the worm has become a menace to our flocks is because topdressing and better grasslands have enabled a greater concentration of stock. Thereby building up the worm population until it reaches such proportions as to make it a menace.

As a result of my experiments over the last five years, I have contradicted this statement made by the Department.

Lime and superphosphate

My findings are that the reason the worm is becoming a menace to our flocks is because of the action of lime and superphosphate, which changes the mineral balance of pasture.

This change results in an anaemic state in the animal, which allows the worm to attack.

Treatment for the anaemia will enable the animal to throw off the worm infestation. For if the anaemic state is avoided in the animal, the worm cannot attack seriously enough to make drenching necessary.

The Department have stood up to a grilling from farmers for eighteen months, and refuse to be drawn.

They have not contradicted my findings.

Was the research ever done?

This leads me to ask whether the

ten years of research which should preceed any statement issued by the Department on the worm question was ever done.

If the research was not done, then the silence of the Department is understandable.

Dr Filmer, head of animal research has made, or allowed to be made, a loose statement which has been acted upon as fact.

Many thousands of pounds of taxpayers' money has been spent in looking for a cure for worms. An accounting to justify this expenditure must be made.

The reluctance and definite hostility of the Department to investigate my findings now takes on a rather new significance.

Evidence from 100 properties

When I wrote the first article on this worm question, I had evidence from two properties. Today I can call supporting evidence from approximately 100 properties.

Next year there will be several hundred properties with interesting reports to make.

Questions for the Dept

To clear this business up, may I ask through your paper that the Department answer the following questions:

1. Was the ten years of research which should have preceded the Departmental statement as to the cause of the worm becoming a menace to our flocks ever done?

2. Where was the research work done, and by whom?

3. Is the Department prepared to table its evidence for examination?

If the answer to these three questions is, yes, then may I ask:

4. How would the Department explain why such excellent results are being obtained in worm control on various kinds of land by using bluestone as a topdressing and bluestone and iron in a lick?

Failure by the department to answer these questions will enable farmers to decide whether the department is guilty or not, and to frame a suitable course of action so that we can get satisfaction.

Chapter thirteen

My talk on stock worm at the 1951 Lincoln College Conference

Mr chairman and gentlemen, in reading this paper to the Conference, I wish to present evidence which has been gathered from personal experience. And in closing, to present what I consider to be the solution to the problem. Work which must be done if our industry of fat lamb raising is to survive.

How I overcame worm in my sheep

Fat lamb raising became a major problem on my property in 1938. From 1938 until 1945, to be successful I had to use the drenching gun at regular intervals.

During 1945 I determined to try and strengthen the blood of my sheep in order to avoid so much drenching.

I gave them a combination of copper and iron in lick form and had complete success.

I have not needed to drench a lamb bred on my property since 1945.

There is also a third mineral which plays a major part in the formation of the red cells in blood. It is cobalt. Fortunately for me, my property has a sufficiency of cobalt, otherwise my results would have been disappointing.

In 1947 I began my first topdressing trials, testing three combinations:

1. 6 lb bluestone to 12 lb limonite.*
2. 6 lb bluestone to 12 lb sulphate of iron.
3. 6 lb bluestone.

All trials were with lime and superphosphate.

Not only did I retain stock health, but I obtained a growth response of 70%, as measured by carrying capacity.

The results contradict what our scientists tell us

These results, obtained by myself, and now others, contradict what our scientists have been telling us about worms in our sheep.

The scientists say that worm attack is the natural result of better farming, the growing of two blades of grass where one grew before, and the carrying of two sheep where one was carried before.

I have said, that worm attack is caused by a weakness in the blood of the sheep. And before the worm can affect sheep, this

* Limonite is an iron oxide fertiliser.

weakness or anaemic condition must be present.

Consequently it is better farming practice to attend to nutrition of the blood than to drench for worm.

Scientists have long recognised that nutrition plays a major part in the prevention of worm attack, all I have done is pin down the particular kind of nutrition.

How to administer the minerals

There are three ways of administering necessary minerals to stock. Drenching, a lick, or top-dressing. All have their advantages and weaknesses.

The drench mix:

2 lbs sulphate of iron.
1 lb bluestone.
1 oz cobalt.

Mix in solution and build to 5 gallons of drench. Give at this time of year, 1 oz to 1½ oz.

The lick mix (per 100 lb of lick):

3 lb bluestone.
5 lb sulphate of iron.
3 oz of cobalt.

Topdressing:

5 –10 lb bluestone per acre.
5 oz cobalt (according to carrying capacity).

Probably the drenching method is the surest of all, but it entails a considerable amount of work. To be completely successful it is necessary to repeat at regular intervals.

The lick method has proved very successful on my property and on others in my district, but the quantity of bluestone should be adjusted each week, depending on the amount consumed by stock per week, otherwise copper poisoning is possible.

The topdressing method is only reliable if there are no major deficiencies among other soil minerals, such as potash, but it will give a terrific growth response, as well as results with stock health.

The Department trying to discredit these results

The Dept of Animal Research are trying to discredit these results. Here we see a curious clash between science and practice. Science says I am wrong, but my pastures and stock are responding.

Argue as it may, science cannot get past results. Science should be examining this critically to find out why my stock and pastures are responding.

I have asked for the privilege of examining the scientific work, ten

years of which should have been done, which enabled scientists to tell farmers why the worm had became a major stock problem. I have been ignored.

Was the work ever done, or did some senior scientist of the Department make a guess and guess wrong?

No work has been done on my findings by the Animal Research Department, though they were invited to oversee my first topdressing trials in 1947.

Furthermore Dr Filmer visited me in July 1949. But why such a negative attitude? Why not admit that I am right if they cannot prove me wrong?

It is remarkable how many misleading statements have been made to farmers by responsible Departmental officers. It is time the correct story was told.

Excess copper and molybdenum both dangerous to stock

Copper and molybdenum are deadly enemies to each other. Both are very dangerous to stock when taken in excess.

Each affects the other. Copper in excess causes yellow jaundice. Molybdenum in excess produces what we called 'teart pasture'.* Just 20 ppm of dry matter of molybdenum in pasture will cause stock to scour to death.

What is necessary is that the correct balance between these two minerals be obtained and maintained. One controls the other and dictates how much the plants can supply to the animals.

However, if copper is too high in the soil, it is still necessary to have plants of a type that will take up the excess copper before copper poisoning of stock is possible. So farmers have this extra protection given by plants.

As far as I am aware there are only two plants in New Zealand which take up too much copper, they are Cats Ear and St John's Wort. So on ordinary pasture it is virtually impossible to get copper poisoning, even if a too liberal hand is used in applying bluestone.

More than 5 lb of bluestone per acre needed

The Dept of Agriculture recommend a dressing of 5 lb of bluestone per acre. However this is insufficient to raise pastures up to the optimum level of copper necessary to make full use of the lime and super which we apply.

Dr Cunningham has established that the optimum level of copper in pasture is from 11 to 18 ppm. Why then recommend a dressing which, though it provides a sufficiency of copper under moderate

* Pasture high in molybdenum, which makes copper unavailable.

production, supplies only deficiency amounts when some of the other minerals such as calcium and phosphorus have been raised to optimum levels?

It appears likely that molybdenum is stimulated in the soil by the constant application of lime and super. This in turn would result in the soil copper being depressed. This fits the results obtained by my applications of copper too well to be lightly dismissed.

Worms have a role in healthy sheep

Nobody knows how many worms are necessary to cause death to stock. However it could be a major disaster if our scientists ever produce a worm remedy which was 100% effective.

Intestinal worms were provided by nature to assist the digestion and metabolism of the animal. My results prove that they do not become a menace until the animal becomes unhealthy. As an example of this, take an animal which loses appetite and therefore in which normal blood formation ceases. The worms then have insufficient legitimate work to do, but must continue to work to survive, even to the extent of attacking the organs of the animal and doing such serious harm as to cause death.

Such a theory would account for the results which I have obtained by restoring appetite and blood formation to my sheep. It also accounts for the fact that the worm count in healthy sheep shows such little variation. This fact makes it possible for scientists to notify farmers, from the worm count in unhealthy sheep, when danger is imminent.

Our present fertiliser policy costly, careless, wasteful and dangerous

I have not found the perfect fertiliser. If I had, then results would be the same everywhere. This has not happened. I know of three properties which have shown no response to topdressing with bluestone. I feel that I have only brushed the outside of the solution to an ever increasing problem which confronts our sheep industry today.

Of the 92 known elements, science tells us that a certain number are necessary in plant production. Science is not too certain of the number and new minerals are being added to the list from time to time.

For the basis of this paper I will use the following list of 19 minerals.

Calcium	Sodium
Phosphorus	Chlorine
Potassium	Magnesium
Nitrogen	Iron

Boron
Sulphur
Manganese
Copper
Iodine
Cobalt
Molybdenum
Zinc
Nickel
Arsenic
Fluorine.

If those 19 minerals are entitled to be on that list, the reason is that they have a particular function to perform. I have no doubt that it would be possible to find out the ideal amounts of these minerals for optimum health in our stock.

Professor Comber of Leeds University wrote a book called *"The Scientific Study of the Soil."* In this book he states that it is impossible to alter a soil condition and still keep existing minerals constant. When minerals are added to the soil there are all sorts of interactions and reactions. Some minerals are depressed, others stimulated.

In view of this statement by Professor Comber, I am forced to the conclusion that the fertilising policy recommended by our Dept of Agriculture is costly, careless, wasteful and dangerous.

There is no need for me to enlarge upon cost at a farmers conference like this.

The policy is careless, because of their failure to study the effects of adding minerals to soil, mainly lime and super, while failing to counteract the depressing effects of these applications on some of the other soil minerals vital to our stock health. This study would appear to be fundamental in any fertilising policy.

The policy is wasteful, in that the quality and quantity of our production will be dictated by the lowest balance of necessary minerals, not by the highest. Consequently the stock cannot use all the calcium and phosphorus which we make available because of lack of supporting minerals. Farmers are paying for fertiliser which cannot be utilised.

The policy is dangerous on three counts. Stock are being fed on minerally unbalanced food, which means they have to cope with excess minerals which cannot be used, and deficiencies of others which deprive them of carrying out normal functions of the body.

The least they will have is constant indigestion and they will also have poor health due to their lower resistance to disease.

If this fertiliser policy is continued, it will ruin the balance of minerals in the soil and destroy our agriculture. Our plants and animals will become so unhealthy as to make it impossible to carry on.

The using up, or locking up in the soil, of just one necessary mineral, can create a desert out of the richest farm in New Zealand.

Healthy balanced soil prevents disease

In his book *"Microbial Antagonisms and Antibiotic Substances"* Professor Selman Waksman tells how healthy, balanced soil creates conditions where health-giving bacteria thrive, and where there is no room for bacteria-causing disease. These are attacked and killed by the health-giving variety and vice-versa.

If this balance is destroyed, the disease bacteria replace the health-giving variety.

Does this account for the fact that, while some farms are forever in trouble with bacterial disease such as blackleg, pulpy kidney and arthritis, other properties have immunity?

In 1950, 1600 of my ewes were exposed to blackleg by being dipped in an infected dip. Of the sheep dipped before mine, 25% were lost with blackleg, but not one of mine was lost. During the next two days, 2000 other sheep were dipped and 60 deaths were recorded. I followed on with 2400 merino wethers, and again none of mine were lost.

Why did my sheep have more resistance? Somewhere there is to be found perfection in mineral balance. The answer to our problems is also to be found there.

What we need to do

This is what we need to do:

1. Soil testing, to prove what minerals are present in the soil.

2. Pasture testing, to prove that stock are receiving the necessary minerals from the pasture.

3. Plant selection, to ensure that our pastures are capable of giving the animals their mineral requirements. Plants are very selective in their mineral uptake. Some of those which are today regarded as weeds may be very important in conveying necessary minerals to our animals. Such plants as Cats Ear, Yarrow and Chickweed.

4. A new approach to pasture, judging by usefulness rather than beauty.

Summary

This conference will perhaps have observed several things in particular. In drenching, it is necessary to combine copper, iron and cobalt. This is the correct treatment for anaemia, but does not affect the worm. The same applies to the lick method.

When topdressing with copper, we also receive the benefit of the stimulating effect of copper on its particular friends. Iron is in this category too as far as I can tell.

I have tried to show, that if our stock is to be healthy we must

start from the soil. Start with healthy soil, follow with healthy plants, and the result is healthy animals.

These are within our grasp, if our scientists will do their job.

I suggested two ways this could be done:

1. Try to grow pasture which corresponds as nearly as possible in mineral content to milk, making special allowances for copper and manganese which are absent in milk.

2. When any farm shows outstanding results, such as 250 to 300 lb of lamb meat per acre, take pasture tests to find out just what mineral balance produced these results. And note also the pasture species present, to find what type of pasture gave the results. (Avoid properties which needed the drenching gun or the injection needle.)

Our scientists caused this trouble, so let the scientists correct their mistakes.

The solution to our stock problem does not lie with the drenching gun and injection needle, which seems to be the only approach the Animal Research Dept have made. It lies in finding the cause of disease and removing that cause.

NZ should lead the world

NZ is the envy of the world, a producer's paradise, the richest soil and the best climate. Therefore we should lead the world in stock husbandry. This stock problem is world wide. If our scientists are too lazy, the solution may have to be found elsewhere.

It is in the hands of this conference whether the search for perfection is worthwhile. Will we do it now, or will we pass over our farms to the next generation of farmers in an unhealthy state?

I would like to point out that, though our scientists state that it is possible to analyse pasture samples for every known mineral, the mineral content of a good pasture is unknown.

This knowledge is necessary to farmers and scientists alike. Why do we not work on it?

Personally I hope to live to see animals which are fed on balanced minerals. They will be a sight worth seeing and a pleasure to all concerned.

Lincoln College to supervise a copper experiment

I am pleased to be able to announce to the conference that Lincoln College has agreed to supervise some experimental work with copper in the Fairlie district. Two areas have been selected and subdivided.

It is proposed to apply bluestone to half of each block, together with lime and super, and check results compared to lime and super

alone. The College has agreed to be responsible for all the technical work entailed.

Nothing but good to our industry can result. May I express my sincere thanks to the College.

Dr Filmer's comment on my paper and my challenge

After I had read my paper at the Conference, Dr Filmer, director of Animal Research at the Dept of Agriculture who had the next paper on Farm Hygiene stated, "*What a colossal cheek any farmer had to hold himself up as an expert on animal health.*"

In reply I pointed out that I had offered Dr Filmer all the co-operation one man could offer another. Half my farm, Dr Filmer to farm one half, and in return his Department would make the returns to me as good as the returns which I obtained from the other half.

If I was wrong, it would cost him nothing, but if the figures I had produced were correct and sustained, then it would cost the Department a great deal of money.

This offer had been refused on the grounds of disinterest in any land owned by me. A further offer to rent a bit of ground for the Department to develop under usual techniques. Me to pay for all fertilisers used and then to cure the trouble which undoubtedly would occur with one application of mineral, was also refused.

A challenge to prove me wrong

Then I said, "Now I will challenge you to prove me wrong. I am not interested in a cat and mouse game. You are wrong, I am right.

As a top veterinarian, you know all about injections and drenches, but the point I want to make is that you and your Department will have to change to a study of nutrition of our animals for a period of about ten years, and win, lose, or draw, you Dr Filmer will be much better equipped, and learn an awful lot, and so be better fitted to carry out the duties you owe to our industry as chief of animal research."

Dr Filmer took no further part in the discussion.

From the fact that this all took place in 1951, 26 years ago, it is obvious that the Dept of Animal Research did not accept the challenge and have not put out any findings on the subject.

Chapter fourteen

Lincoln College's report on their two year copper experiment

During the last few years there has been much discussion in Canterbury on the possibility of there being important mineral deficiencies affecting the health of stock in the province.

These discussions reached their peak about two years ago when Mr W. B. Trotter of Fairlie was putting forward his views on the importance of copper, based on the experience which he had on his own farm.

If Mr Trotter's claims could be substantiated, it would be a matter of some importance. The Dept of Agriculture refuted Mr Trotter's claims but did not undertake to put them to the test.

Lincoln College took a detached academic interest in the matter until it became apparent that many farmers were applying copper to their land, and that the Dept of Agriculture was not going to investigate Mr Trotter's claims.

After discussion with Mr Trotter we agreed to put his theory to the test. The following is a brief report of what has been done and with what result.

Two farms in the Fairlie district selected

Two farms in the Fairlie district were selected: That of Mr J. McConnell on the stony alluvial flats of Allandale, and that of Mr R. J. Murphy and Son on the clay downs above Fairlie.

Copper had not previously been applied to these farms.

A suitable paddock on each property was selected, fenced in half, and one half of each received an annual topdressing of l¼ cwt of super alone, and the other half, 1¼ cwt of super plus 5 lb of bluestone.

Ewes bred on the properties were taken and split evenly into two mobs, one for control and one for the copper.

Records of lambing were kept and the lambs were weighed or judged at weaning. Fleece weights were not taken, but wool samples were taken at the start in 1951.

We now have the results of two seasons.

In 1951 the topdressing was not done until winter, and the ewes did not go on to their treatments until just before lambing.

In 1952 the ewes were on their treatments all the year except for a period during winter.

Results on Mr J. McConnell's Farm

The ewes were Corriedales, mated to Corriedale rams, 200 per group.

The lambing percentage was: control 103%, copper 104%.

Neither group of lambs did well this year 1953, and at weaning there was no visible difference between the two groups.

Drench experiment

After weaning, a small experiment was conducted in which drenching with an iron, copper and cobalt drench was done, versus no drench.

Again there was no difference, but owing to climatic conditions the feed conditions were very poor and it could scarcely be considered a fair test.

In 1952 the same ewes were run, but owing to grass grub the numbers had to be reduced to 110 on the control side and 96 on the copper side. The lambing percentages were 102% on each side.

At weaning the control lambs were to the eye decidedly better than the copper lambs.

This was confirmed by the drafting percentages from the control group and from the copper treatment group.

In neither year were any differences noted in the mortality of the lambs.

Conclusion

It is clear that on this property copper had no beneficial effect and in the second year it had a deleterious effect.

Mr R. J. Murphy & Son's Farm

The ewes employed were Romneys, mated each year to Romney rams. It was intended to carry 50 ewes on each side, but some of the ewes proved to be dry, so that the actual number of sheep carried was 49 ewes and 72 lambs on the control side and 43 and 63 lambs on the copper.

Attempts to control the pasture with cattle were frustrated by Tutu poisoning.

At all times the sheep had ample feed.

By weaning time it was our opinion that better control was exercised by the higher numbers of stock on the control side and that therefore on these grounds the control sheep should have given the better result.

At weaning we were able to weigh the lambs. The average weight (corrected for differences in the proportion of twins) was: control 59.6 lb, copper 66.1 lb. The copper lambs were visibly much better than the control lambs.

In 1952, the sheep carried were 45 ewes and 62 lambs on the control side and 45 ewes and 61 lambs on the copper. The lambing percentage was the same in each group.

At weaning the copper lambs had a better bloom and the average weight of the lambs was 63.2 control, and 66.2 copper.

The top eight of the wether lambs in each group were killed and averaged 32 lb control and 38 lb copper.

Samples of wool from the copper lambs were slightly superior to those from the control.

Drench experiment

In March 1952 a group of 20 store lambs, averaging 55.4 lb live weight (not off any copper treatment) were given an iron, copper and cobalt drench.

An undrenched group, averaging 53.1 lb live weight acted as a control. These lambs were weighed 4-5 weeks later and the weight gains were found to be:

Control group	16.9 lb.
Copper group	18.0 lb.

They were all drafted fat into the works at the beginning of June. The control lambs averaged a 35.0 lb weight gain with 66% seconds and a 2.31 lb wool pull, while the drenched lambs averaged 37.2 lb gain with 15% seconds and a 2.65 lb wool pull.

(The fact that the control lambs were 2.3 lb lighter in live weight at the beginning must be taken into account in this comparison.)

Wool quality

In 1951 the ewes were subjected to their treatments from September onwards. It was not considered that statistically significant differences in fleece weight could appear in this time and consequently fleeces were not weighed, but samples were taken for grading, of the wool grown since September.

The differences in grade and quality were very small but were in favour of the copper treatment on both farms.

Owing to bad weather at shearing and a misunderstanding, neither weights nor samples were taken in 1952. Samples of wool taken from the lambs at weaning on the Murphy property showed a slightly higher grade for the copper treatment.

Conclusion

It is not possible to give all the details which have been observed, but the summary given should at least let farmers know the bare results of what has been found. The interpretation of these results is open to question and we would prefer at the moment to leave farmers to draw their own conclusions.

Further, the trials are not very extensive and to a certain extent not conclusive. However, as some opinion would naturally be expected of us we would make the following statement, knowing full

well that others may not entirely agree with it.

Firstly, there is no place for copper on Mr McConnell's property and presumably on soils of a similar type.

Secondly, we consider that copper has definitely proved beneficial on the clay downs farm of Mr Murphy & Son. It is of interest that this property is similar to Mr Trotter's in soil type and situation.

If this second conclusion is correct, the implication is that copper may be of value on some farms, even when chemical analyses of pasture and sheep's livers do not indicate any deficiency.

Again assuming the results to be correct, what interpretation is to be placed on the reduced response to copper on Mr Murphy and Son's farm the second year, and the strongly negative response on Mr McConnells farm?

Has too much copper been applied? What should one do next, apply more copper, or attempt to counteract copper by applying molybdenum?

At the present time the trials are being discontinued for a number of reasons. The situation is much too complex to be solved by anything but a carefully designed and accurately controlled series of experiments, conducted at considerable labour and expense. The work involved in the trials so far has been done by the farmers concerned in their own time.

We feel that we have done what we set out to do. If it is considered that further work is worthwhile, much more finance and labour will have to be provided. This is a matter for those whose responsibility it is to provide finance for agricultural research, bearing in mind the importance of this problem in relation to other spheres of research competing for finance and labour.

Lastly we would like to thank Messrs McConnell, R. J. Murphy and J. Murphy for their co-operation and hard work, and Mr W. B. Trotter who provided some financial assistance.

We would also record that at no time were we, or as far as we know the farmers concerned, in any way influenced by Mr Trotter.

My comments on the Lincoln College report

The Lincoln College team came down under the direction of Professor Coop.

The first point I would like to make is the disinterest of the Dept of Agjriculture in accepting the challenge issued at the Lincoln College conference, to investigate my claim of an imbalance of trace minerals.

After all, how could they agree? If I was proved right, and the evidence presented was quite conclusive, there would be very red

faces among Departmental chiefs when the results came to hand. Quite a few resignations could well have followed.

The Lincoln College team and myself worked on two properties, Mr J. McConnell's property at Ashwick Flat, light alluvial soil and flat. And Mr R. J. Murphy and Son's property 'Ngapunawai' about two miles away and similar to 'Coulmore.'

The only mineral used was bluestone.

The drench experiment

A very definite response on Mr Murphy's property. The store lambs mentioned had one drench of copper, cobalt and iron drench costing only 2 shillings and 1 penny to drench 1600 lambs. Yet the result was excellent.

A weight gain increase of 1.1 lb, but better still, a grading when killed of 37.2 lbs as against 35 lb control, with 15% seconds for drenched and 66% seconds control. Illuminating results.

The grazing trial

So far as the grazing trial was concerned, when weaning time arrived there was no doubt whatever that bluestone was away out in front.

When sexed it was apparent that only 25% of the wether lambs on the control side were safe to be killed, whereas 80% of the bluestone could be drafted. We were faced with the decision as to whether it was better for comparison to kill equal numbers from each block.

This was done. We killed 8 lambs from the control, averaging 32 lb with 75% seconds, and 8 lambs from the bluestone group averaging 38 lbs, all primes.

Results from Mr McConnell's farm

The report includes Mr McConnell's farm. It is quite correct as far as it goes, but strays when the report starts to theorise.

This property is a rehabilitation block and was heavily limed by the previous owner. Only bluestone was used, with nil results.

This now proved to be the first real lesson I have had in using minerals out of context. The liming would necessitate the use of iron in combination with the copper.

Won 1st and 2nd prizes

However this experiment has a sequel, Mr McConnell gave me 16 lambs when the experiment was over saying, *"Here, Brown, take these home and see if you can do anything with them, they will die if they stay here."*

I took them home, drenched them with copper, cobalt and iron and turned them out on a paddock which had been topdressed with copper, cobalt and iron, with fortified super.

These lambs were very sick. It took three hours to drive them one mile to the paddock.

One died the first night, two others cast their wool, and the top 6 won 1st and 2nd prizes at the Mackenzie Show the following Easter as fine wool freezers.

My thanks to Lincoln College team for their interest, and also to Messrs Murphy and McConnell for allowing the experiments and making their properties available.

Chapter fifteen

High selenium sulphur cures fading disease in lambs

Christchurch Press, December 10, 1955.

The possibility of a relationship between sulphur deficiency, and Johne's disease or general unthriftiness in lambs in parts of Canterbury, is raised by Mr W. B. Trotter of 'Coulmore' Fairlie.

In his many interesting statements, Mr Trotter says that since the autumn of 1951 he has been interested in experiments designed to combat a serious disease in lambs. Mr Trotter writes:

I have noticed in The Press, several interesting articles on the Farm and Station page concerning sulphur deficiency and Johne's disease.

If space will permit, I request the privilege of writing my experiences in regard to the use of sulphur and perhaps to add something worthwhile to the interest which has been created.

Disappointing results with copper, cobalt and iron

The affected lambs are apparently quite normal until they are weaned, and then they fade, in spite of any drenches which may be given.

To all appearances this fading disease is exactly what could be expected from cobalt deficiency.

In 1951 and 1952 Professor Coop of Lincoln College carried out both field and drenching trials with copper, cobalt and iron.

While some response was obtained, the results could only be described as disappointing.

Excellent results using sulphur

In 1953 I had occasion to do a sulphur trial on my own property, to see what effect on stock extra sulphur would have.

The topdressing I used was 1¼ cwt superphosphate, 5 lb bluestone, 10 lb sulphate of iron, 5 oz cobalt, and 7½ lb flowers of sulphur.

Allowing 12½ lb of sulphur* to be contained in the 1¼ cwt of superphosphate gave a dressing of 20 lb of sulphur an acre.

The results were excellent. I had 16 'faded' lambs in my possession and I turned them out to live or die on this sulphur trial.

One died the day they were put in the paddock, but the other 15 survived, and though two cast their wool, they recovered and did well enough to win a first prize in April as freezing wethers.

Selenium not sulphur

However with regard to the success I had with the 16 lambs which were brought home from Mr McConnell's property, this proved to be the biggest error I have made in all my experiments.

It took me three years to find out how wrong I was in giving credit to sulphur. But a natural mistake under the circumstances.

The following year I again used sulphur, as part of fortified super, with a nil result.

---

* The combined Sulphur content of the bluestone, sulphate of iron, and flowers of sulphur.

About this time the Fertiliser Companies were complaining that the high selenium content of Japanese sulphur was causing trouble to machinery and were successful in having Japanese sulphur banned.

I have since tried for years to import Japanese sulphur without success.

I realised that the results I achieved did not belong to sulphur, but to the selenium content of the Japanese sulphur.

Mr Trotter's 'Coulmore' farm visited by Christchurch Press farming reporter

Christchurch Press, June 9th, 1956.

Holding that the proof of the pudding lies in the eating, Mr W. B. Trotter of Coulmore, Fairlie is satisfied that he is working on the right lines in his adherence to the use of certain trace elements, notably copper.

Mr Trotter also holds that nutrition in stock is more important than the use of drenches and the injection needle. For years he was a voice in the wilderness, but undismayed, Mr Trotter has held to his convictions. Today he is convinced that ultimately his ideas will have a large following.

Thus the writer's recent visit to Mr Trotter's pastures had more than ordinary interest.

Mr Trotter's property

At the outset, without entering into the pros and cons of his experiments, it is no exaggeration to describe Mr Trotter's property as one of the outstanding ones in the lower Mackenzie in production, quality, and health of livestock. His pastures presented a truly pleasing picture.

Few farmers can hope to reach the top of their calling these days without at least an elementary knowledge of soil chemistry. Therefore this writer has no apologies to offer for the somewhat technical level of the first part of this article.

No place for molybdenum in grassland farming

Of particular interest are Mr Trotter's views on molybdenum, which he expressed to the writer in the following terms, "I am forced to the conclusion that molybdenum has no place in grassland farming."

"The growth responses are undoubted. Undoubted also are the results of its use without any apparent harmful effects on undeveloped country."

"All these have had full publicity. But not nearly so much publicity has been given to the very dangerous ability of molybdenum to release copper from the animal body, thus preventing new red cells (haemoglobin) being formed in the blood. And so we have the cause of anaemia."

"Where molybdenum finds conditions to its liking, such as with adequate liming and a satisfactory level of trace minerals such as cobalt, it can cause, and is causing a severe death rate in hoggets."

"This is because it is robbing these young sheep of copper, which is a necessary catalyst in the formation of new blood. Therefore these young animals are laid wide

open to worm attack."

In the autumn of 1952, Mr Trotter laid down his first trials with molybdenum and copper. He was endeavouring to find out whether it would be possible to combine these two minerals to advantage in topdressing pastures.

This move became necessary as he found that that with the continued use of bluestone, the first three years of clover growth were good, but after that, clover growth was retarded.

"Considering that clover is by far the best conveyer of copper among our normal pasture plants," continued Mr Trotter, "it seemed essential to keep the clovers going, otherwise the use of bluestone tended to defeat its own object."

"In 1952 I used ½ oz of molybdenum and 5 lb of bluestone an acre. The results until mid-October were excellent.

At this period the season became very wet and no worthwhile conclusions could be reached."

Interesting trials

"In 1953 I used 1 oz of molybdenum and 5 lb of bluestone an acre. The results in that year were the same as in 1952."

"In 1954 I again used 1 oz of molybdenum and 5 lb of bluestone. In that year the season proved different in that we had a dry period until December 10, when 4½ inches of rain fell."

"The weather then became dry again until February 10, when 3 inches of rain fell. These two dry periods, interrupted with two falls of rain on warm ground, provided sufficient moisture to cause a flush of feed."

"For about three weeks after the rain, during the early period of the flush of feed, the stock lost condition rapidly. There was some scouring, but there were no deaths, and then the stock started to thrive again."

"In January 1955, I had the best pasture I have ever seen, something near to the ideal."

"I bought in Romney wether lambs, turned them out to pasture, and they were fit to draft in 10 days, but because of crutching, they had to be held for three weeks."

"On January 10, 3 inches of rain fell and I was confronted with the dismal spectacle of the lambs going to pieces.

At the same time I was unable to draft them because I was precluded from sending freshly crutched lambs to the works."

"When the period of three weeks from crutchings had elapsed, I was able to draft 80% of the lambs and they killed out at 33.6 lb, but so bare on the ribs that it appeared risky to send them to the works."

"I did not use any molybdenum in topdressing last autumn, but when the drought broke, I again noticed this falling away in condition on the flush feed after rain on warm ground. Thus I am forced to the conclusion that molybdenum has no place in grassland farming."

Vanadium and tungsten

Mr Trotter went on to say that of the three heavy minerals used in steel hardening and adaptable to agriculture, molybdenum, vanadium and tungsten, he intended to lay down trials with both vanadium and tungsten. He was hopeful that vanadium, which had no reaction with copper, might replace molybdenum in his top-dressing.

This would allow the free use of

copper (so essential to the health of stock) in his pastures.

Talking generally, Mr Trotter expressed his opinion that, "The level and quality of New Zealand's production will be dictated by the lowest level of available minerals, not by the highest level. Thus the very great need today to study mineral antagonisms."

Antagonistic minerals

At present he was topdressing with borax and iron to overcome the antagonism which existed between these minerals and calcium.

He was also topdressing with bluestone to counteract the antagonism existing between copper and phosphorus, due to phosphorus being constantly added to the soil over the years through the use of superphosphate.

He had used serpentine* superphosphate which he said contains 10% of magnesium rock, in an effort to overcome the antagonism between nitrogen and magnesium.

This trial had not been entirely successful. A better way he now considered might be to reduce the nitrogen content by taking a crop of wheat.

Another mineral being used in trials at Coulmore was sulphur, for the farm was in a sulphur-deficient region.

He was also topdressing with 5 oz of cobalt to the acre on some pastures. As far as he was aware, there was no antagonism affecting that element.

Mr Trotter's farm policy is to provide the balance of minerals necessary to promote the general health of his stock through the natural intake of pasture rather than by the employment of the drenching gun or injections.

This, he emphasised was the reason for his originating his trials with trace elements some 11 years ago.

Drenching

"I am not afraid to drench," he said, "but I do not normally do so. If I have occasion to drench in the future, it will be with copper, cobalt and iron in the ratio of 16-1-32. This being the balance of minerals required to encourage the stock to form new red cells in the blood."

"Generally however, I am not an advocate of drenching."

"I admit I may have been sticking my neck out for years in my emphasis on the importance of importing into the soil, and maintaining there, a proper balance of trace elements, notably copper. But my work in this direction has paid me handsomely."

"The results achieved are excellent, particularly when compared with the 1938–1945 period when the drenching gun was the main implement on my property."

Stock levels

The area of Coulmore is 496 acres. In 1938 it carried 1400 ewes and nothing else. The wool clip was about 10,000 lb and stock losses were appreciable.

Last year the farm wintered and sheared 2080 sheep, with a wool clip of 21,500 lb, or the high average of 43 lb of wool an acre.

The sheep wintered included 560 nine year old ewes, and 150 small cull wether hoggets.

The death rate among the hoggets from all causes was 1%. In addition

* Serpentine is a high magnesium content rock used to add magnesium to superphosphate, and also to help it flow more freely from aircraft hoppers.

20 of the very old ewes died of ante-partum paralysis.*

Lamb meat production

Calculated on an acreage basis, lamb meat production this season was impressive.

300 of the breeding flock at Coulmore were stud ewes. Apart from these sheep the lambs weaned from the commercial flock of 1050 ewes was 1240.

Of these 270 were retained for flock replacements. The balance were killed off the grass at an average weight of 31 lb, and it has been a very dry season.

In the season just ended, in addition to the fat lambs bred on the farm, Mr Trotter sold off the place an additional 200 killable lambs.

All the 9 year-old ewes, with the exception of 40 which were potted, *were fattened and sold off the grass to the freezing works.

When the drought was at its worst, the sheep population including lambs was 3600, together with 300 cattle.

Subsequently most of the cattle had to be turned out on another property because of shortage of feed.

Cups won

Another endorsement of Mr Trotter's successful farm management is seen in his outstanding success in the livestock and wool classes at the Mackenzie Country show at Fairlie this year. He won no fewer than eight cups in the following categories:

Most points in the show,
Livestock.
Flock sheep.
Crossbred wool.
Fat lambs.
Fat sheep.
Ewe lambs and three-quarterbred sheep.

In addition, he carried off the Burnett Cup for sheep most suitable for stocking hill country below Burkes Pass.

Also the Grant Memorial Cup for most points in wool-flock sheep, and fat lambs.

Incidentally the competition in the wool classes drew no fewer than 206 entries, and many fleeces which were unplaced compared favourably with prize-winning entries at outside shows where competition was restricted.

Sheep breeds

Because of Mr Trotter's show successes, it is worth pointing out that he finds three-quarterbreds admirably suited to his class of country, none of which by the way, is flat. Indeed much of it is on the steep side and requires to be top-dressed from the air.

His practice is to mate Lincoln halfbred ewes with Romney rams, giving him a three-quarterbred flock. He finds these three-quarter bred give him a good fleece. His hoggets have clipped 13 lb and 11 lb respectively for the last two years.

From 650 three-quarter bred ewes last year, he obtained 920 lb of crutchings.

He also finds these ewes great milkers. He says, "They will milk right through to February if required. In this respect the Romney ewe fails miserably."

---

* A pregnancy disorder.
* Sheep which are not doing well often develop a pot belly.

Chapter sixteen

Soil tests on my farm

I include here a soil test taken in 1968, 13 years after the last molybdenum was applied.

A dressing of sulphur was applied in 1955 to try to reduce the pH. The pH dropped from 6.4 to 5.8.

Note that the sulphur level is still double the desirable amount and the molybdenum has remained at over five times the desirable level.

At the time of my writing this, 1978, it is now 23 years since the molybdenum was applied, and I still have to watch that paddock when we get heavy rainfall and soil temperatures are high, from December to February.

The molybdenum kick is still in evidence and I have to be prepared to shift all stock.

Naturally I am pleased that it only applies to one paddock on the farm. It also explains why I would outlaw molybdenum from farming, especially with the suitable alternatives of vanadium and tungsten.

NZ SOIL TESTING SERVICE LTD

Managing Director: H. E. Menrath, M.Sc., M.Agr.Sc. (Wageningen, Holland), 17 Sparks Road, Christchurch. Phone 35-295.

Results of Soil Test. No. Ag84, 28-5-1968
Mr W. B. Trotter, FAIRLIE.
Paddock No. 9

Element	Figure obtained	Desired Figure
pH	5.8	6.3
Calcium	850	1000
Magnesium	8	6
Potassium	35	40
Ammonium	3	0.5 - 3
Nitrate	45	35
Phosphorus A	2.5	2.0
Phosphorus B	7	5
Iron	3.5	6.0
Manganese	3	2.5
Zinc	1.2	0.5
Sulphur	63	30 min
Copper	20	Very high

Results of Grass and Clover Test

Element	Figure obtained	Desired Figure
Cobalt	.15	.15
Molybdenum	.8	.15
Copper	20	12-15
Boron	22	20-30

Explanation of Figures

pH: measured in water, soil to water ratio 1:2.

Potassium, Phosphorus A, Nitrate and Boron: ppm, measured in water extract, soil to water ratio 1:10.

Phosphorus B: ppm soluble in diluted Sulphuric Acid (Beater method).

Calcium, Magnesium, Potassium, Ammonium, Nitrate, Iron, Manganese and Zinc: ppm in soil extract, determined according to improved method of Morgan-Venema.

Plant material: ppm in dry material.

NZ Soil Testing Service Limited is a completely independent laboratory, not connected with the manufacturing or sale of fertilisers or mineral mixtures.

Remarks and Recommended Applications

The pH and calcium content of this paddock are below average for pasture.

The magnesium and nitrate figures are normal, but the potash figure is slightly below level.

The direct available phosphate content and the phosphate reserve are good.

Iron, manganese and zinc are adequate.

The sulphur figure is good.

The soil copper figure is very high.

We analysed the grass and clover and found sufficient cobalt, molybdenum, boron, and a copper figure above level.

We advise you to apply ½ ton of finely ground lime per acre as soon as it is convenient for you.

Apply in spring or autumn, 1½ cwt of superphosphate, and ½ cwt of muriate of potash per acre.

Do not apply any copper on this paddock for several seasons.

Recommendations are made in good faith. However, the Laboratory can accept no responsibility for the result of these recommendations.

Chapter seventeen

The controversy heats up

No evidence that trace elements will prevent or cure ill thrift say veterinarians

Christchurch Press, July 25, 1957.

"Farmers could save themselves needless expense, if they were top-dressing their properties to prevent ill-thrift in lambs and hoggets," according to the annual report of the Ashburton Veterinary Club veterinarians.

"There is no evidence at present that any type of trace element, topdressing, or drench will prevent or cure ill-thrift."

The report stated that in some areas of Ashburton county, notably Mayfield, Anama, Carew, Methven, and Lyndhurst, ill-thrift was responsible for serious mortalities and reduced rate of gain.

"The present state of knowledge, far from complete though it is, indicates that the condition is associated with reduction in food intake."

"The reasons for reduction in food intake are not understood clearly, but again evidence indicates that changes take place in the plant which make it unattractive to sheep, particularly young growing sheep. The animals are starving in the midst of apparent plenty," says the report.

Cobalt trials

About 20 trials to determine the contribution cobalt deficiency played in ill-thrift outbreaks were conducted last autumn by the club.

"It has been known for many years that some soils in the county are marginally deficient in copper and cobalt. It is also known that in marginally deficient areas, a season of prolific growth can precipitate a mild cobalt deficiency, which is not apparent in years of normal growth."

"Up until this year, despite the examination of several hundred ewes for cobalt since the inauguration of the club, we have not been able to demonstrate low liver cobalt figures. Just a few livers this year were shown to be low in cobalt."

"Of the 20 cobalt trials done, only three showed a mild response, indicating that cobalt plays little or no part in the production of ill-thrift."

Mr Trotter's drench tested

"As a result of statements made by Mr W. B. Trotter regarding a drench for unthrifty lambs, three trials using this drench were carried out."

"The value of the drench as measured by weight gain showed that there was no significant response to treatment."

"In one extensive trial using this drench, lambs drenched with phenothiazine* gave a significant weight gain response, whereas lambs drenched with Mr Trotter's drench grew at slightly lower rates than the control lambs which had no treatment."

"Therefore, as measured by these controlled trials carried out in this

* A veterinary medicine to rid farm animals of internal parasites.

area, there is no evidence to support Mr Trotter's claims," the veterinarians decided.

Ram mating trial

A preliminary trial in an attempt to establish the mating efficiency of rams, ie, how many ewes should be run with the ram, was carried out on 18 properties during the last breeding season.

"The results obtained are encouraging and warrant the continuation and perhaps even the extension of this work. If performances can be repeated, the findings are likely to be of considerable economic importance to the sheep industry. The findings are of a radical nature and it is thus very necessary that they be substantiated by sound evidence before they are published."

Ovine brucellosis vaccine

"The ovine brucellosis vaccine to control epididymitis (inflamation of the testicles) of rams would be available next season. Results of trials indicated that it was highly efficient and a useful method of lessening a cause of reduced breeding efficiency and wastage, in rams."

10-15% lambs dying at birth

"As an extension of the work carried out by the Gisborne Veterinary Club to classify the time and nature of death of newly born lambs, some 300 odd lambs brought in daily by farmers were systematically examined.

This type of work was a long term project, its objects being to see if there is any factor or series of factors that could be controlled to reduce the high percentage of lambs dead or dying within a few days of birth. Surveys had shown that these losses ranged from 10% to 15% of all lambs born."

66% goitre found

"One finding is probably of immediate importance, two properties showed an incidence of 66% goitre of all lambs submitted."

"It is probable that goitre contributed to the high level of perinatal lambs deaths on these properties.

Steps will be taken this coming season to see whether correction of the iodine deficiency (which causes goitre) will reduce the number of lambs born dead or dying soon after birth."

My reply to the veterinarans

Ashburton Guardian, August 1st, 1957.

Mr W. B. Trotter of Fairlie, in a letter to the editor of the 'Guardian' replies to comments made by the Ashburton Veterinary Club on his suggestions for the treatment of ill-thrift in lambs, reference to which was made in the club's annual report.

Molybdenum the cause of poor results of drench

In his letter, Mr Trotter states that owing to the peculiar medicinal quality which molybdenum has of releasing copper from the body, very poor results would be obtained from drenching with any copper drench where molybdenum had been used.

Mr Trotter's letter continues, "Considering that the land con-

cerned is in a sulphur-deficient area, and that molybdenum has been used to some extent, it should be obvious that any person in opposition to him could select properties which would give little or no response to the drench."

"I submit therefore, that any trials should be accompanied by a properly certified statement as to the fertilisers which have been used during, say, the last seven seasons."

His recommendations based on fact

"My recommendations are based on the approved and accepted scientific fact that minerals in various combinations carry out every function of the body."

"Therefore, perfect health should be attained when we supply to our animals correct minerals in the correct ratio."

"It can be readily understood just how desperate the club veterinarians are, their veterinary science having proved inadequate to cope with ill-thrift, as judged by the colossal death rate in lambs. But surely there is no need to make themselves ridiculous."

Experiment suggested

"I recommended that farmers, who have cause for concern with stock health, topdress part of their properties on which sheep could be kept separately, with copper, cobalt, and iron. The result of this experiment would show at weaning time, and could only result in good to our industry."

"Where no response is obtained, trials should be run with sulphur or gypsum."

"These recommendations are soundly based on ecological vitality and backed by 12 years of full experiment."

"Considering the large number of messages of thanks I have received from various parts of Canterbury, I feel that I can await results with confidence."

Public request

"Now comes news of a more serious nature. At the annual meeting of the Ashburton Veterinary Club held on July 29, 1957, Mr R. C. Bean, on whose property one of three drenching trials was carried out, reported that the lambs drenched with my drench showed a weight gain of 7 lbs, while undrenched lambs lost 2½ lbs."

"He requested that the statement, *'There is no evidence to support Mr Trotter's claims,'* be deleted or amended."

"May I make a public request to the executive of the Ashburton Veterinary Club that they withdraw the report, and make public just what did happen in each of the trials which the veterinarians conducted."

Ill-thrift in lambs caused mainly by parasites says veterinarian Mr M. C. Armstrong

Timaru Herald, January 25, 1958.

"It was likely that massive infestations by internal parasites were the main cause of ill-thrift in lambs, in affected South Canterbury areas," said the Government veterinarian Mr M. C. Armstrong yesterday.

Wet weather to blame

"The long continued period of dull, wet weather, with rank uncontrolled pasture, has favoured mass hatchings of worm eggs and great activity of infective larvae on the grass and clover leaves."

Mr Armstrong said that the losses on worst affected farms had been severe, and in some cases deaths had exceeded 200 lambs. About 50% of the lamb flocks on these farms had shown severe ill-thrift.

Investigations into an outbreak of ill-thrift in lambs on 15 farms in the Morven-Glenavy, Orton and Fairlie districts were made recently by Mr Armstrong. The affected farms were on light land, which has been well developed by fertilisers and sown in English grasses and clovers.

"During last season, lambs fattened well and the areas concerned were healthy for sheep," said Mr Armstrong. "The exceptional season this year, with long periods of changeable, dull, wet weather during November, December and up to mid-January promoted a prolific growth of pasture on all the affected farms. Pastures have been continuously wet and rank."

"None of the farms carry any cattle to control pasture growth. Hay making has not been great because of the weather."

"Furthermore, the shutting up of paddocks for silage has not been attempted."

"On most of the farms, the older lambs born in August or early September have thrived well and some good drafts of fat lambs have been taken.

The later-born younger lambs have not done well since November."

Post mortem results – worms

Mr Armstrong said that post mortems on unthrifty lambs have been completed on the farms affected.

In every case a heavy burden of small hair, stomach worm, identified as the species of ostertagia, had been the only significant finding.

Scouring was not a feature of the trouble and in most cases the faeces were formed and firm.

"The ostertagia parasite is one which causes great loss of blood, damage and ulceration of the stomach wall, and loss of appetite due to poisoning," said Mr Armstrong. "This would explain the inconsistency of the feed story on the several farms studied."

"Lambs have remained unthrifty and died on a variety of feed stuffs, including lucerne, clover, mature rape, pasture topped by the mower, and hay aftermath paddocks."

Penothiazine required

"Penothiazine was the best drench available against ostertagia and other small worms of this type," said Mr Armstrong.

"But dose rates 1½ times the normal recommended dose, of a phenothiazine containing a high percentage of very fine particle size is essential for a high degree of efficiency against this parasite."

Mr Armstrong said he had carried out a drench trial on a farm using 1½ fluid ozs of phenothiazine, which contained not less than 70% particles under five microns in size. The results as tested on post mortem were satisfactory.

Ill-thrift caused by mishandling our soil says Mr W. B. Trotter

Timaru Herald, March 5th, 1958.

Mr W. B. Trotter of Fairlie, a member of the Electoral College of the New Zealand Meat and Wool Board made a statement yesterday on the vital question of ill-thrift in lambs, which has been causing alarm in South Canterbury for some time.

Mr Trotter has made a special study of the problem. He writes as follows:

I am convinced that ill-thrift will cause the death of millions of lambs in New Zealand in the next few years. Ill-thrift is the result of mishandling our soil. What has happened on the light land is only the promise of what is to come in years ahead on our heavy land.

Excess fertiliser the cause

The treatment by way of fertilisers given to the light and heavy land is similar, considering that the quantity of soil per acre would only be approximately half on the light land, as compared to the heavy land.

Fundamental errors in applying fertilisers far in excess of the quantity required will naturally bring ill-thrift to the light country first, but just as surely this will be followed by a severe outbreak of the disease on our heavy land.

Already the warning signs are here, being shown in the 'shelliness'* of the lambs on heavy country by surprisingly light killing weights off various properties.

Ill-thrift first appeared on my property at Fairlie in 1935. I have lived with it for 23 years. I claim to know how it happens, why it happens, and what we must do to combat it.

By ignoring fundamental principles in fertilising, the future of the grassland industry has been sacrificed for spectacular short-term results in land development.

Necessary minerals

Science tells us that minerals in various combinations carry out every function of the body. Therefore it is logical to suppose that when we are successful in delivering to our animals the necessary minerals in their correct proportions, we should obtain perfect health.

Various lists of minerals have been submitted as being the necessary ones, but the list I propose to submit is as follows:

Calcium	Phosphorus
Potash	Nitrogen
Sulphur	Copper
Cobalt	Iron
Magnesium	Manganese
Sodium	Chlorine
Iodine	Boron
Carbon	Hydrogen
Oxygen	Arsenic
Fluorine	Zinc

(Molybdenum, Tungsten or Vanadium).

Calcium, well known for its part in bone promotion.

Phosphorus, required in bone construction.

Potash, required for the soft tissues of the body.

Nitrogen, one of the five elements in wool fibre. Also plays an

* Shelly means to be lighter in weight than appearance would indicate.

important part in grass growth.

Sulphur, a blood purifier. Also maintains the body's cooling system, and is an element in wool fibre.

Copper, a catalyst in the formation of haemoglobin (the red cells in the blood), and an integral part of bone and teeth.

Cobalt, for appetite and also a catalyst in the formation of red cell iron, from which the red blood cell is manufactured.

Magnesium, well known perhaps as a deficiency which causes staggers, and in breeding functions.

Manganese, also required in the breeding function of the animal.

Sodium, the largest ingredient in blood, and with chlorine as common salt, responsible for the stimulation of the various soil assets.

Iodine, well known for its work on the thyroid gland, and very important in breeding.

Carbon, **Hydrogen and Oxygen**, the three remaining elements in wool fibre, which also include sulphur and nitrogen.

Molybdenum, Tungsten and Vanadium, the three heavy minerals, used in steel hardening. Either one of them appears to be necessary in the soil for the fixation of **Nitrogen** and **Boron**, which are commonly found as a deficiency following liming, and causing brownheart in swedes.

Not nearly so well known is its responsibility for the development of chlorophyll in pasture, which enables the plants to breathe and accept vitamins from the sun's rays.

Also **Arsenic**, small traces of which can be found in the animal body. This appears to have a medicinal effect.

Fluorine, for the hardening of bone and teeth.

Zinc, required for plant growth, and again in medicine to counteract deformation of the bowels.

If all those minerals have the right to be on that list, then they are responsible in part for some necessary function of the body.

If they are taken away entirely, they mean death.

If they become available in only deficiency amounts, they will limit production in any area.

Health-giving bacteria thrive in balanced soil

The diseases which affect our stock are of two kinds, bacterial and nutritional.

Professor Waksman in his book *Microbial Antagonisms and Antibiotic Substances* makes it clear that the available mineral content of the soil controls the bacterial population.

Also that a healthy balanced soil creates conditions in which health-giving bacteria live and thrive. But once the balance of the soil is destroyed, these health-giving bacteria can no longer exist and are replaced by undesirable bacteria.

Professor Comber of Leeds University in his booklet *A Scientific Study of the Soil* points out that it is impossible to alter one soil condition and keep existing minerals constant.

Whatever we add will stimulate some minerals and depress incompatible or unfriendly minerals.

The essential principle therefore in soil development appears to be the balance of all minerals which are applied.

Surpluses of any kind can wreck our agriculture. For out of these surpluses come deficiencies.

Surplus minerals can attack other incompatible minerals in the soil and deny them to the plants and animals.

If we went to our chemist and searched with him through chemistry books, we would find that the incompatible mineral with phosphorus is copper.

With calcium it is iron.

With sulphur it is cobalt.

With nitrogen it is also cobalt.

If it can be shown that excesses of these minerals are in the soil, it would not be surprising to find that we have a disease in our animals of which the main feature is a lack of blood.

Real reasons for ill-thrift

Features of ill-thrift which I would point out are:

1. A shortage of earthworm.
2. A short lactation period of the ewe (in extreme circumstances ewes will cast their lambs at birth, being unable to feed them).
3. A lack of blood in the lambs.

In the first, it would appear that we have lost the mineral balance in our soils, and made it impossible for the earthworm to survive and work. An application of copper, cobalt and iron to the soil restores the position and the earthworm returns.

In regard to the second and third, we have been told that worm infestation is the main cause of ill-thrift. I disagree with this. We have a lamb born at approximately 6 lb to 7 lb live weight, and we expect it to grow to 70 lb live weight and fatten at the age of 14 weeks.

If the lamb is to do this, the manufacture of red cells in the blood must be practically continuous.

Under these circumstances, the worms could preserve the life of a healthy lamb, which may possibly run the risk of dying of excess blood pressure. The worm, by drawing off blood through the bowel may save the lamb's life.

However, if there is any interference with any, or all of the minerals (copper, cobalt and iron) which are required for the manufacture of red cells, then we obtain an entirely different picture.

Manufacture of red cells can no longer continue, the worms now draws off blood which the animal can no longer spare and death results.

99 lb of soil minerals used each year per acre

It is not very difficult to show that we have applied minerals in excess of usable quantity.

Take a 500 acre property which has been very highly developed and is carrying 2000 ewes and breeding replacements. I have deliberately placed this figure high so that readers will know the figures following are well above the average for our district.

The method of arriving at a mineral annual requirement would be to take the total stock produced per acre, burn at red-heat until reduced to ash. The ashes remaining would represent the mineral content taken from the soil.

Now allow for weaning 2500 lambs, the retention of 500 as replacement stock, and the selling of 2000 fat lambs.

This would allow for the killing of four fat lambs per acre, one cast ewe and the sale of five fleeces per acre.

Allowing the lambs 70 lb live weight, the ewe 120 lb, and the fleeces at 10 lb each, we have a total gross production per acre of 450 lb.

Effects of excess lime and phosphorus

Science tells us that the proportion of liquid weight to dry matter is 78%, leaving 22% as the mineral content, which equals 99 lb per acre.

Yet this 99 lb, if we are to restore to our soil the minerals which we send away, must be spread among the 21 minerals named above.

Where then does the scientific case come from which recommends an application of two tons of lime per acre and 2 cwt to 3 cwt* of superphosphate?

We farmers in New Zealand have got cause to ponder the origin of that old saying, *'Lime without fertiliser makes both farm and farmer poorer."*

We apply phosphorus in amounts beyond which plants are capable of using. The result is an attack on the soil copper. We apply lime with the object of changing the soil from acid to alkaline. In the process we neutralise vital soil acids and also the iron supply.

This is the reason why your pH rises from 6.3 to 6.6. This is the point which has been placed as the ideal at which the most growth takes place, but unfortunately entirely ignores the fact that some of the necessary minerals require some acidity before they become available as plant food.

Pasture testing

Perhaps the strangest thing of all is that with all the talk of scientific farming, nobody has been interested enough to try and find out what makes good land good.

It has been stated that with modern expertise it is possible to do complete pasture tests.

An analysis of the mineral content of exceptional pasture should explain why we obtain lambs that kill at 40 lb off some properties.

It would seem vital to the well-being of our industry that such analysis be taken. Also, by making a comparison with poor pasture, we can find out what has gone wrong on properties where the lambs are dying.

Overcoming ill-thrift

So far I have talked about conditions within the soil, yet the problem of ill-thrift can be divided under three distinct headings, which are:

1. Correct mineralisation of the soil. To ensure that the necessary minerals are available to the animals.

2. Correct pasture mixture. To act as a conveyor from the soil to the animal.

3. Correct metabolism of the animal. To ensure there is no interference in the animal preventing usage of minerals.

The first I have already dealt with.

As regards the second, were we to select plants having regard to their properties of uptaking various minerals from soil, I feel sure that before long we would be planting a lot of the herbs which we have been taught to regard as weeds.. Plants such as dandelion, chickweed and

* Under the old imperial system there are 20 cwt (112 lbs) to a ton (2240 lbs). A metric tonne and imperial ton are almost identical.

yarrow. There would also be very little ryegrass sown.

Outlaw molybdenum

With the third, I know of three cases where copper, cobalt and iron will not work, or only give a partial result.

Of the heavy minerals, molybdenum is the favourite, yet I would outlaw it from New Zealand farming. It is incompatible with copper and in addition has a peculiar medicinal quality which allows it to drain all copper from the animal body.

The dangers of its use cannot be over emphasised. Just why the Dept of Agriculture would recommend its use when there are alternatives of tungsten or vanadium, I cannot follow.

I have found also that copper, cobalt and iron, either as a drench or as a topdressing, give very little result on sulphur-deficient country.

Yet a dressing of 100 cwt of fortified superphosphate, together with 6 lb of bluestone, 12 lb of sulphate of iron, and 5 oz of cobalt per acre will give good results.

Sulphur and cobalt are incompatibles, yet appear to be complementary to each other in animal metabolism.

Excess nitrogen harmful

The third case concerns nitrogen.

We take land which is running 1 to 1½ ewes per acre, apply lime and superphosphate and in so doing build the carrying capacity from 4 to 5 ewes per acre.

In the initial stages nitrogen is not a problem, because we have insufficient of it, but when the carrying capacity rises, the nitrogen return to the soil from the animals is greater than the take-out. This causes a nitrogen build-up beyond the desirable level in the soil.

This is probably the nastiest situation possible for stock. For raising the nitrogen locks up the magnesium and cobalt.

Lack of magnesium will cause grass staggers, and lack of cobalt, as already pointed out, ill-thrift.

Under these circumstances we can topdress with magnesium sulphate and increasing amounts of cobalt, but I have noted that even with a cobalt application of up to 1 lb per acre (in place of the recommended amount of 5 oz) it only lasts a comparatively short time.

Also there is a bacterial attack on the sheep which appears to make it impossible to get any result from the direct use of cobalt.

Winter stock on grain

The cheapest and best way to deal with this problem is by taking a grain crop, thereby reducing the nitrogen within the soil to a level at which it works for us, rather than against us.

Consideration should therefore be given to the inclusion in the rotation, of a wheat crop. Or perhaps the time has arrived when New Zealand farmers might choose to alter their system to winter our stock on grain, rather than legumes.

One bushel of oats is a maintenance ration for a sheep for 86 days.

Such a system has the very great advantage that surpluses can be stored against droughts, as compared to legumes which cannot be stored.

Testing on my property has shown that one crop of wheat, grown without fertiliser, reduced the nitrogen content of the soil 50%.

Tests of the following new pasture

showed that the cobalt supply improved 2½ times.

Copper, cobalt and iron

In conclusion, may I recommend to farmers who have cause to be dissatisfied with stock health, that they experiment with these three trace elements, copper, cobalt and iron.

They can be given in a drench, a lick, or by topdressing.

The drench mixture is:

2 lb of sulphate of iron.
1 lb of bluestone.
1 oz of cobalt.

Mix to 5 gallons of water in a copper or earthenware container.

Give 1 oz every 10 days, or if the lambs are weak, reduce the amount of drench to half and drench at 5 day intervals.

The lick is:

100 lb of salt.
5 lb of sulphate of iron.
3 lb of bluestone.
3 oz of cobalt.
Bind in with molasses.

This lick is six times the strength allowed for sale in New Zealand. Government regulations are based on a consumption of 2 oz per week, or 6½ lb per year.

However under field trials I have found the actual consumption to be l½ lb per year, so there is not much disagreement about the amount of copper which sheep require.

Under this method, there is no certainty that all the animals are eating the required amount, consequently it is the method I would favour least.

Topdressing minerals best

The best method of all is to topdress these minerals on to your pasture.

I would recommend that you select one or two paddocks, particularly paddocks that have been disappointing recently, and topdress these as a test.

The topdressing mix is:

1 cwt fortified superphosphate.
12 lb of sulphate of iron.
6 lb of bluestone.
5 oz of cobalt.

When ill-thrift first appears, it is likely to be in the simple deficiencies category and can be dealt with by these means.

Veterinary surgeon Mr D. A. Walker replies to Mr Trotter on ill-thrift

Timaru Herald, March 13th, 1958

"Mr W. B. Trotter of Fairlie on Wednesday, March 5 had published in 'The Timaru Herald' a lengthy statement concerning ill-thrift in lambs," writes Mr D. A. Walker, B.V.Sc. of Timaru.

"I offer this reply in case some farmers might accept such a statement from a member of the electoral college of the Meat and Wool Board as being without question in its accuracy."

"Mr Trotter asks in his article that anyone having the temerity to argue with his theories, be specific. In my own sphere I shall do that."

"Firstly, the main known principles involved in the aetiology* of ill-thrift are grouped under these main causes:"

* Cause (of a disease).

1. Pasture unpalatability.

This is self-explanatory. The reasons why pastures should be unpalatable are fairly numerous. I shall mention three:

(a) Little variation in pasture species. Ryegrass and its derivatives have done inestimable good for pasture improvement, but in certain seasons on good soils, once past its optimum length, lambs and hoggets do not like it. Similarly with white clover.

I would suggest as a basic pasture mixture:

H1 ryegrass.
Timothy.
Cocksfoot.
Dogstail
Red and white clovers.

Such pasture mixtures would be especially useful for weaning lambs.

(b) Too high soil improvement, giving lush growth which pushes grass past the optimum for grazing.

This lowers the actual food value, increases the cellulose food content and at the same time lowers palatability.

I would suggest that on very high improved soils, a judicious lowering of the food value by the growth of a cereal crop would immeasurably improve the palatability in succeeding seasons.

(c) Seasonal variations. A wet summer such as this, produces a rapid rank growth. In a dry summer ill-thrift is less apparent.

2. Marginal mineral deficiencies.

Some areas of New Zealand are definitely deficient in copper and cobalt and some startling results are being shown by their uses in weight gains.

To prove this weight gain, dosed sheep should be kept in similar environment as untreated sheep to gain a proper comparison. This is called a controlled experiment.

3. Parasites:

The pathogenic* effects of parasitism have been proved so often that to argue the point is ridiculous. Perfectly healthy sheep on adequate food, if given a challenge of parasite larvae, immediately start to retrogress.

In practically all cases of mortalities of lambs and hoggets which I have investigated in South Canterbury, there has been a complicating factor of parasitism.

At least two species of parasite are involved:

Ostertagia Trichostrongylus (Black Scourworm).

Haemonchus (Barber pole or stomach worm).

The use of fine particle Phenothiazine is required to control these conditions. And in severe cases, half as much again as the manufacturers recommend is necessary to rid the sheep of same.

Sheep once dosed should be placed on a pasture which has been spelled for three weeks in this type of damp weather.

The use of nicotine sulphate and copper sulphate drenches is also satisfactory, although only partly as successful as Phenothiazine.

These three factors appear to be the main causes of ill-thrift and if guarded against, I think Mr Trotter's prediction of millions of lamb mortalities will be unfounded.

At this stage I would suggest to farmers that they have post-

* Disease causing.

mortems performed on any serious losses to determine the cause of these deaths.

Minor inaccuracies

To those who read Mr Trotter's hypothesis last week, I must point out a few minor inaccuracies.

1. Mr Trotter estimates the ash content or the rough mineral content of a lamb to be 22%. In actual practice it is about 2%.

2. Mr Trotter lists 23 substances as essential minerals, whereas in reality only 14 of them are. The others are elements, four of which are gaseous.

Let me comment on these:

(a) **Nitrogen** is fixed by plants from the air and excreted by animals, and is only applied as fertiliser to give an early growth.

(b) **Magnesium** deficiency is only found in grass staggers in cattle. This is a metabolic disorder not a pasture deficiency. Ryegrass staggers in sheep is not such a deficiency, but due to a toxin in grass.

(c) **Sodium and chlorine** are abundant in any improved pasture.

(d) **Carbon, hydrogen and oxygen** are supplied in plenty as the normal basic constituents of carbohydrates. A very large percentage of all grasses is carbohydrate.

(e) **Iron** is plentiful in New Zealand soils and the only known deficiency of this metal has been found in glasshouses growing tomatoes and in some orchards.

(f) **Molybdenum** (the outlaw) is essential for nitrogen metabolism in plants. Deficiencies particularly affect the growth of legumes, rape and other brassica crops. In recent years, adding molybdenum has turned large areas of third-class land to top-class pasture areas in North Auckland, Coromandel, Manawatu, Hawke's Bay, and the Wairarapa.

Also in the South Island in Marlborough and Southland, and especially good results in North Otago.

At present the Dept of Agriculture is running over 800 field trials throughout New Zealand.

I would point out to farmers that the use of molybdenum is essential where it is indicated for use by the department, but its misuse is to be guarded against.

(g) **Boron.** According to 'Underwood,' a world ranking expert in an article in the Australian Veterinary Journal: "*Boron is required by plants only and is not essential for animal nutrition.*"

(h) **Copper.** Even normal plants seldom carry levels of copper much above the animal's mineral requirements, therefore in copper deficient soils, pasture and stock usually, but not invariably, show signs of deficiency.

(i) **Zinc and Manganese** are similar in that they are normal trace elements in plants and animals. But the relative requirements are so different, that in contrast to copper, incontrovertible evidence of zinc and manganese deficiency in grazing animals is unknown.

(j) **Arsenic** is entirely undesirable, and any arsenic found in tissues is an accumulative poison.

Blood pressure

4. Mr Trotter suggests that lambs will die of high blood pressure if

parasites are not available to take off all the extra blood cells they develop if they have adequate copper and cobalt.

The life of blood cells is no longer than 8 weeks, at which time they are destroyed by the cells in the liver, spleen and bone marrow and replaced by new ones. Elementary physiology tells us that most body tissues are being replenished quite regularly during normal life.

Let me assure every farmer that parasites are undesirable in every way. They can promote anaemia, cause severe gastroenteritis, and by so doing lessen the time in transit of the intestinal contents, hence reducing the time available for digestion. So much so that a sheep with a pathological burden of worms can be starving in the midst of plenty.

List of diseases

(4) Mr Trotter lists diseases as being of two kinds, nutritional and bacterial. How simple a veterinary surgeon's life would be if this were correct.

Here is a more comprehensive list: bacterial, fungal, protozoan, viral, parasitic (both internal and external), neoplasms, leucaemias, nutritional, metabolic, hereditary, constitutional, congenital, poisoning, reproductive disorders.

Earthworms

(5) Earthworms do well on improved pasture as they live on humus and organic matter, which is more plentiful on improved pasture. The seagulls that follow the ploughman know this full well.

(6) The bacteria in the rumen aid in the absorption of cobalt in the synthesis of vitamin B12, hence the apparent success of cobalt bullets which are reputed to last in the rumen for two years.

Letter to the editor from a farmer

Sir, A man I met in a bus about a week ago praised Mr Trotter's advice on land development. He thought it the finest piece he had read.

Last Friday I read Mr Walker's reply and his criticism, and although I know him as a veterinary surgeon, I should discount his views as a farmer.

Salt for grass palatibilty

I must say that if grass is not palatable to stock, use a little discretion in topdressing. I once had a paddock of rank grass the cows would not eat, so I had some bags of salt laid across the paddock. I sowed it at the rate of 3 cwt an acre. The cows left nothing but the roots and the paddock has been green ever since.

Kerosene to kill maggots

I read a piece in your paper some time ago against using kerosene to kill maggots on sheep.

That is nonsense. I helped to deliver 2000 ewe lambs for my boss at Methven. They got the scours drinking stagnant water. I was told by the boss to carry a bottle of kerosene about with me. I never lost one lamb. Although the maggots had got under the skin.

I saved hundreds until the drain on the kerosene was too great and he changed me over to a diluted, non-poisonous dip. Then I lost every one.

Salt licks and super

Salt licks now are a thing of the past, so you can look out for a big death rate, and just smile, until we can get our Government to import enough salt from Australia and use less super.

Devon-born.

Mr Trotter replies to veterinary surgeon Mr D. A. Walker

Timaru Herald, 20th March, 1958.

Mr W. B. Trotter of Fairlie has replied to veterinarian Mr D. A. Walker, B.V.Sc. of Timaru who challenged assertions in an earlier treatise by Mr Trotter on the question of ill-thrift in lambs.

Mr Trotter writes:

In your issue of March 13 appears a reply by Mr Walker, B.V.Sc. to my statements on ill-thrift. Mr Walker disagrees with almost everything I have said.

Dying lambs

As to my estimate that millions of lambs will die in New Zealand in the next few years, statistics show that 29 million lambs were born in New Zealand this season. The normal death rate, at present, is in excess of one million.

Last August I presented a remit to the Electoral College requesting the establishment of a nutrition authority to study ill-thrift, along the lines which I spoke about in my article. I received unanimous support. So ill-thrift is widespread in New Zealand.

I would estimate that half all lambs born are pastured on so called 'developed country.'

The death percentage on properties where the outbreak is severe, reaches the crippling rate of 50% or worse. Therefore if all the developed land incurs ill-thrift at once, and the death rate reaches 50%, 7 million of lambs would die in a season.

The sequence of ill-thrift will strike the various districts in this order.

First, light stony country.

Then high rainfall medium land.

Then the heavier land.

The only developed country in South Canterbury which has a chance of avoiding this outbreak would be the salt spray coastal country.

This season about half the properties in this Fairlie district have ill-thrift in varying degrees. So I will stick to my estimate.

Trace minerals

Fortunately, Mr Walker's opinions are not shared by all veterinarians in South Canterbury.

Some veterinarians are men of vision and realise only too well that the mixing of veterinary remedies with the judicious use of trace minerals is paying dividends in the control of ill-thrift.

For a man who, in the course of his occupation, travels round the countryside, Mr Walker is surprisingly ill informed.

I would recommend to Mr Walker to remember that when veterinary science argues with ecological* vitality, it is the science dealing with symptoms, versus the more perfect science of dealing with root causes.

---

* The mutual dependence of living things on each other.

Veterinary science must always be at a disadvantage as the application of ecological vitality science removes the need to practise veterinary science.

Mr Walker replies in his sphere (which I wish was a good deal larger) and lists under numbers various points in my previous article.

1. Palatability. Entirely a matter of mineral content. When a pasture contains the mineral balance which an animal requires, it will always be palatable regardless of length, or conditions under which it is grown.

(a) No pasture is useful to feed animals on, unless it complies with correct mineral content.

(b) What Mr Walker tried to say is, When the major minerals are built too high in the soil, better results will be obtained when a cereal crop is taken to restore the balance, and raise the fertility (not lower it).

The optimum production which can be obtained from any land is dictated by the mineral balance, having regard to the requirements of the crop, in this case raising lambs.

(c): The greatest strain on mineral balance is always in periods of lush growth. In drought seasons all mineral action ceases and there is consequently no growth.

1. Mineral deficiencies. Mr Walker states that there have been some startling responses to the use of copper and cobalt.

Even more startling ones will be obtained by the inclusion of iron on soils which have been heavily limed.

3. Parasites. I stated quite clearly that worm attack finished things off, but that this attack was made possible from the lack of copper, cobalt or iron.

The record of phenothiazine in control of ill-thrift is not good. Always it has managed to slow up the death rate, but has never been successful in obtaining recovery of the affected lambs. It can be quite good, but only if followed by copper, cobalt or iron to restart the formation of haemoglobin.

So called inaccuracies

1. Percentage of ash. If Mr Walker is correct at only 2%, then I have underestimated the amount of over-supply of lime. Instead of 5 tons of lime being sufficient for 200 years, it is enough for 2000 years. Even worse.

2. Now to the list of 23 minerals, and it is here that Mr Walker really becomes childish.

Nitrogen, carbon, hydrogen, and oxygen are four of the five elements in wool fibre.

In my list I did not state that these or any minerals had to be supplied through the soil, only that they are necessary. If the supply is secure and adequate no action is necessary.

Magnesium deficiency. I have seen sheep and cattle, both down in the same paddock with staggers.

Just 12 lb of magnesium sulphate (Epsom salts) oversown by aeroplane works magic, and 24 hours after sowing it was impossible to put either sheep or cattle down.

48 hours after sowing it was noted that the sheep came in season.

Sodium and chlorine (salt). On the coastal sea spray country, sheep have never been known to touch salt.

In the Upper Mackenzie, sheep have fought so hard to get salt that

smothers are not unknown.

Where rock salt is kept up, runholders claim that no cases of swamp-fever appear. The need for salt in the Upper Mackenzie is urgent and its requirement can be graduated downward from there to the coastal salt spray areas.

Iron. This mineral is certainly plentiful in New Zealand soils, but after heavy liming it becomes progressively unavailable as a plant food and therefore to animals.

White muscle disease (the extreme deficiency case) can be controlled efficiently by an application of up to 20 lb of iron per acre. Also a bloom will be obtained on sheep such as bloom dipping would give.

Molybdenum. Entirely wrong. Science has not proved that molybdenum is essential.

Science has proved that a heavy mineral is essential for the fixation of nitrogen by plants. As stated earlier there are three available heavy minerals, **molybdenum, tungsten** and **vanadium**.

Molybdenum is the chosen one. It is quite true to say that the Dept of Agriculture has laid down 800 trial plots. This announcement was immediately followed by a stern warning to farmers against the use of molybdenum by Dr Filmer (chief of animal research).

Boron. So boron is not essential to animals. Most farmers have noted that sheep will eat the boron rich skins off badly infected brown heart swedes, but would starve on the dirty brown hearts.

I also pointed out that boron in grass is responsible for the development of chlorophyll and the acceptance of vitamins from the sun's rays. Mr Walker says that these functions can be dispensed with.

Copper. There are only three plants known in New Zealand which are capable of accepting copper at toxic levels. They are, Cat's-ear, St John's wort and Ragwort.

Therefore on ordinary pasture any quantity of bluestone may be applied safely. It is unnecessary to apply more than 5 to 6 lb per acre.

Zinc and Manganese. Evidently Mr Walker has not heard that the AMP Society is bringing into production 750,000 acres of South Australian desert with copper and zinc, and has not heard of successful fat lamb trials with manganese in Southland.

Arsenic: This was contained in Person's drench. Many farmers regret its loss as a tonic drench.

Arsenic is still used in medicine as a tonic and for nervous complaints.

Worms

Mr Walker conveniently twists my observations concerning worm infestation. There is quite a difference between the words 'could' and 'will.'

I pointed out that the worm is powerless to cause real harm to animals with a strong blood stream, and could even save the life of a lamb which was manufacturing haemoglobin at a very fast rate and which reached maturity before drafting date.

Higher authorities than Mr Walker state that it is undesirable to remove all worms, that some are necessary for the metabolism of the animal.

Diseases

I stated that the diseases which affect our stock are of two kinds, bacterial and nutritional.

Mr Walker in reply has quite an imposing list, but for all the value his list is in the present discussion he may as well have added collywobbles.

I would list the following common diseases which represent in my opinion 99.9% of the death rate in NZ.

Bacterial. Tetanus, blackleg, odema, scabbymouth, ballinitis (pizzle rot), arthritis, pulpy kidney, bloat, epidermatitis, foot-rot, and abortion.

Nutritional. Milk fever, ejected vagina (bearing trouble), ante-partum paralysis, white muscle, ill-thrift, facial eczema, staggers, and failure to breed.

I did lose a cow once with poisoning. I think the year was 1927.

But when I recall that I lost 4000 sheep with ill-thrift from 1938 to 1945 inclusive, this doesn't seem very important.

Earthworms

Earthworms do well provided no major deficiencies are present.

In 1940 I ploughed 40 acres and did not see a worm. I ploughed up slaters instead.

The earthworm returned following the application of copper, cobalt, and iron. When stock health was restored the earthworm returned.

Bacteria

The relation of bacteria in the rumen or first stomach of the grazing animal, and the utilisation of cobalt is well known.

The cobalt bullet, although unduly expensive at 1 shilling each, can do a grand job on simple deficiency country.

Considering that the cobalt bullet is only recently imported, it is too early yet to give a decision.

I would, however point out that under sulphur deficient conditions and excess nitrogen, results from its use are likely to be disappointing.

Copper, cobalt and iron trial

If I am successful in obtaining the permission of the principals, I hope to be able to report on some outstanding results from the use of copper, cobalt and iron on trial areas where ill-thrift has been prevalent the last two seasons.

Veterinary surgeon Mr D. A. Walker replies

Timaru Herald, March 25th, 1958.

Mr D. A. Walker, B.V.Sc. of Timaru has replied to Mr W. B. Trotter's second article on ill-thrift in lambs in the following terms:

In reply to an article written by me in answer to a treatise written on ill-thrift, Mr W. B. Trotter contributed a further article on March 20.

This unfortunately makes it necessary to respond again, and to be brief I have no further information than that which I mentioned earlier, but I must again correct the inaccuracies brought up by Mr Trotter. I shall list them as follows:

1. Death rate in lambs:

Mr Trotter gives no percentages of deaths caused by the following

diseases, placed roughly in chronological order of appearance:

Neonatal mortalities (of the new born), navel infection, goitre, arthritis, marking diseases, tetanus, haemorrhage, blackleg, arthritis, and one of the big killers, pulpy kidney.

2. Palatability. This is not necessarily concerned with mineral content alone, old gorse contains all the minerals ideal pastures have, but sheep do not eat it.

3. Parasitism. All parasites, be they internal or external are entirely undesirable, and only fictional authors would say they had any desirable place in the normal animal.

Some bacteria are essential for ruminal fermentation. This is known as symbiosis.

Concerning the use of phenothiazine, I stated that parasites were one of three major causes of ill-thrift. Obviously these are the ones which will respond with dosing.

Fine particle phenothiazine is very successful against Trichostrongylus and ostertagia, the two culprits found in most cases of ill-thrift in the Waimate area.

4. Lime. Five tons would last an acre 2000 years according to Mr Trotter, this needs no comment.

5. Magnesium deficiency.

Veterinary experts say that grass staggers in sheep have no relation to magnesium deficiency. It is due to a toxin in rye and phalaris grasses.

This is not to be confused with grass tetany in cattle which is a magnesium deficiency, and is only successfully treated by injection as orally Epsom salts is only a laxative.

If Mr Trotter's sheep came in season 48 hours after topdressing, I would suggest that he must have confused his minerals with sex hormones.

6. Sodium chloride (common salt): Mr Trotter states that the only developed land which might miss out on ill-thrift are the coastal salt spray areas.

Wrong again, Glenavy, Morven and Kingsdown are all in such areas, and these places have both cobalt deficiency and parasitism, two of the three factors I mentioned before.

Mr Trotter suggests that sheep in high country have a craving for salt. However a craving for a substance does not, of necessity, indicate that it is metabolically essential. How many smokers need tobacco to maintain life?

5. Iron: Iron is readily available in all New Zealand pastures. No shortage has been shown in any other animal than piglets. The control is to run piglets on pasture or change soil in the sty.

8. White muscle disease: This is a vitamin E deficiency and is in no way connected with iron.

9. Copper. I quote from the *"New Zealand Veterinary Association Handbook"* under 'Aetiology of Copper Poisoning:

(a) Excessive intake of copper, e.g. pasture contamination with copper sulphate footbaths or oral dosing of copper.

(b) High normal copper and low molybdenum in pasture (ratio more than 150:1), particularly clover, resulting in slow excretion and accumulation of abnormally high amounts of copper.

(c) Liver damage by alkaloids in

ragwort and possibly other species. Occurrence is uncommon but New Zealand wide.

10. Molybdenum: Where advised by the Dept of Agriculture is essential, but where no deficiency exists can be dangerous.

11. Arsenic: This was mixed in NCA drench as an anthelmintic, which means 'to kill parasitic worms.'

Clear the parasites out and livestock will improve.

12. List of diseases: Mr Trotter obviously does not understand this aspect of his subject. He states that 99% of deaths in sheep are caused by a list of disorders which he gives. I shall correct:

(a) Tetanus, blackleg, malignant oedema and pulpy kidney can all be prevented by vaccination or the use of anti-toxins.

(b) Scabby mouth is caused by a virus, not a bacterium and can be vaccinated against. There is a very low rate of death and most cases respond spontaneously in three weeks.

(c) Pizzle rot, very low death rate unless flagrantly neglected.

(d) Arthritis: Can be prevented to a large extent. Most cases in South Canterbury respond to penicillin. Fairly low death rate. The biggest problems are carcass condemnation and loss of weight in lambs.

(e) Epidermatitis is new to me, unless he means epididymitis*. The death rate in this disease has been caused by judicious throat cutting, but even this disease can be vaccinated against.

(f) Milk fever and ante-partum paralysis are the same, a mineral deficiency responding immediately to calcium borogluconate.

If as Mr Trotter suggests, some of these diseases cause such a high percentage of deaths, it is time the farming community heard which diseases can be eliminated by preventive vaccination.

13. Mr Trotter states that I am childish, short-sighted and ill-informed, presumably because I have tried to draw the attention of the farming community to the fact that mineral deficiencies and top-dressing aspects are only part of a more complex disease process which we all call ill-thrift.

He further states that other veterinary surgeons do not share my views. I challenge Mr Trotter to name a qualified veterinary surgeon in South Canterbury who disagrees on any of the major premises I have made.

* Inflammation of the testicles.

Mr Trotter replies further to veterinarian Mr D. A. Walker

Timaru Herald, April 1,1958

Mr W. B. Trotter, of Fairlie, has replied again to Mr D. A. Walker, B.V.Sc. in their discussion on the causes of ill-thrift in lambs.

Mr Trotter writes as follows:

'Thinking' asked a question in your issue of March 21 as to the relationship of seasonal conditions and ill-thrift.

I think it is safe to say that the greatest strain is always placed on mineral resources during lush, growth periods.

But once ill-thrift appears, it will remain until dealt with, and with quite a wide variation of intensity.

Ill-thrift is still rampant on the plains country, but thanks to copper, cobalt and iron, the death rate has been reduced substantially. However not all properties are using it yet.

To 'Facts' who writes in your issue of March 28, I say that Mr Walker is fighting hard to preserve ill-thrift as a clinical thing, but will lose the battle, because in the field the comparison lies between fat lambs off the mothers (the record of copper, cobalt and iron) versus lambs which need veterinary attention. Even my opponents will be forced to concede a difference in value of £1 per head.

Now to Mr Walker, B.V.Sc. who replied on March 25:

1. Death rate in lambs. This is hardly relevant to the present discussion, but for Mr Walker's enlightenment, these figures may be obtained from the Gisborne Veterinary Club which has made an extensive survey in this matter.

2. Pasture palatability. Nothing further to add.

3. Parasites. Mr Walker is evidently unaware that extensive work at Ruakura Research Station has shown quite conclusively that the worm count has no significance until nutrition fails.

It would not be very difficult for him to obtain these results.

4. Lime. I stand by my original estimate of the usable quantity of lime was ½ cwt per acre per year, one ton in 40 years, five tons in 200 years.

5. Magnesium deficiency. Surely Mr Walker does not expect grown up people to believe him when he states that magnesium deficiency can only be treated by injection.

Obviously the topdressing of magnesium sulphate will do better.

Here again, a science which deals only with symptoms, comes in conflict with ecological vitality which deals with causes.

6. Salt spray. Glenavy, Morven, and Kingsdown are coastal, but not salt-spray areas. The area I had in mind was a small area of Seadown.

Most storms run parallel to the coast. It is all a matter of how much salt spray is deposited per acre.

Real salt-spray country would be found in Taranaki where the foliage is stripped off hawthorn hedges on the seaward side for up to 20 miles inland.

Concerning salt, Mr Walker still has not explained why sheep on the Seadown do not eat salt, yet would smother to get it in the upper Mackenzie.

I think the farmers in both areas smoke equal amounts of tobacco.

7. & 8. Iron. Field work with iron will show how wrong Mr Walker is.

9. Copper. Yes, and my informant is Dr I. J. Cunningham, New Zealand's number one man on copper, and recognised as being in world class.

10. and 11. Nothing to add.

12. Diseases. Evidently we have been successful in shortening our list of diseases to something near reasonable.

(f) Under this heading Mr Walker states that milk fever and ante-partum paralysis are the same, a mineral deficiency responding immediately to calcium boro-gluconate.

The injection is 100% effective for milk fever, but valueless for ante-partum paralysis.

Surely no one with a veterinary degree should be guilty of such an elementary mistake.

The only known remedy for ante-partum paralysis is to take ewes which start to lag in the mob and give them a complete change of diet, such as green feed.

Once these ewes go down there is no known remedy.

Challenge

Mr Walker challenges me to name one qualified veterinarian who disagrees with anything he has said. I refuse to involve my friends (note the plural) in my arguments. They can please themselves whether they enter this contest or not.

In turn I challenge Mr Walker to supply any names of veterinarians who agree with everything he has said. I think that there are six veterinarians in South Canterbury.

Letters to the editor from two more farmers

Ill-thrift

Sir, After hearing Mr Trotter at Mayfield last year, I sowed a paddock of young grass with the minerals he recommended.

The lambs this year off the above paddock are a flock-master's delight. They have never been drenched, vaccinated, or had any stock lick. Quite a contrast to the rest of the lambs on my property.

These others have needed to be drenched three times, at weekly intervals, with a drench using ½ lb of sulphate of iron added to each bottle.

Results were very encouraging.

Mr Walker says the last two wet seasons are responsible and that the trouble is seasonal.

May I remind him that ill-thrift has been in this district for six years and getting progressively worse each year.

His ideal pastures do not produce ideal sheep, and as for his mineral experts, they are only a mythical illusion.

I am satisfied Mr Trotter is right.

Tried It. Ashburton.

Marvellous results

Sir, I have read with interest the recent articles by Messrs W. B. Trotter and D. A. Walker on ill-thrift. My own experience has been similar to Mr Trotter's in that the use of too much lime and super has resulted in years of ill-thrift and heavy lamb losses.

Drenching with phenothiazine has been disappointing.

Against veterinary advice I changed to Mr Trotter's drench with marvellous results.

I then decided to get my farm soil tested, and this showed very low copper, cobalt, and iron in the herbage.

For the last three seasons I have topdressed where required with 5 lb bluestone, 6 oz cobalt sulphate, and up to 20 lb sulphate of iron per acre.

The result is that my lambs are as good as could be expected and losses are small without phenothiazine drenching.

If iron is not necessary, as Mr Walker suggests, why is it that my lambs used to go to an ironstone patch on a river bank and lick the dirt?

Several of my neighbours have rung me up on the phone to see what drench I am using.

It is one bottle of nicotine copper sulphate, 1 oz cobalt, and 1 lb sulphate of iron in 2 gallons of water.

Dosage is 1 oz per lamb per week.

Fat lamb drafters say the results are outstanding.

Would Mr Walker be prepared to hold an open trial on affected lambs with phenothiazine, and Mr Trotter's drench by a fat lamb drafter or stock agent under the following rules:

(1) Phenothiazine mob (branded red dot).

(2) Controls (unbranded).

(3) Trotter's drench (branded black dot).

(4) Lambs to run in one mob.

(5) Deaths to be tallied for each mob.

(6) Costs of the two drenches listed.

(7) Lambs to be killed separately and results published in 'The Timaru Herald.'

R. J. Moore, Lynford, Ashburton.

Chapter eighteen

Others drawn into the debate

Mr H. E. Menrath M.Sc. M.Agr.Sc. on ill-thrift

Timaru Herald, April 5th, 1958.

The much discussed problem of ill-thrift in lambs has drawn into the list Mr H. E Menrath M.Sc. M.Agr.Sc. of Christchurch who states:

With great interest I read Mr Trotter's article in The Timaru Herald of March 5 about ill-thrift in lambs. Before discussing some of his views, I would like to publish some findings which may be of interest to farmers.

Four causes of ill-thrift

Statistical evidence obtained during several years, and from experiments carried out on 16 farms in the 1957-58 season, showed that the following factors cause ill-thrift in young stock.

1. Trace element deficiencies.
2. Unbalanced grass-clover mix of the pasture.
3. Too much nitrate in the soil during certain periods of the year.
4. Too little variation in plants (grasses and weeds).

Trace element deficiencies

In many areas of New Zealand and mainly, but not exclusively on the light soils, deficiencies of trace minerals (copper, cobalt, magnesium and iron) are found which have a detrimental effect on stock health.

Mostly these deficiencies are borderline cases, the minerals being available in just or nearly sufficient amounts during late autumn, winter and early spring. In that period, pasture growth is slow and the roots apparently are able to absorb from the soil the necessary element in reasonable amounts.

However, as soon as the grass and clover start to grow rapidly (spring and early autumn) the trace element content of the plants drops accordingly. This is the time when ill-thrift suddenly occurs.

The trace element deficiency can be single or multiple.

Best producing farms often struck worst

It is found mainly on land which, in order to increase the carrying capacity has been heavily treated with lime and phosphate for many years.

The best producing farms are often struck worst with ill-thrift.

By testing the foliage it can be found if copper or cobalt is lacking, or if molybdenum is too abundant.

Molybdenum can be a slow poison

I agree completely with Mr Trotter about his fear of molybdenum. It can be a slow but sure-acting poison, and responsible for stock trouble in many parts of New Zealand, especially on soil with a pH of 6.0 and higher.

Applications of molybdenum should be restricted to areas either not connected with stock at all, or hill country where the pH of the soil is sufficiently low to keep the availability of the molybdenum checked, and where lime applications are not likely to take place.

Even then the copper level of the pasture should be tested and if low,

or only just sufficient, a copper application should be provided to prevent stock trouble.

I would like to take this opportunity to mention that in cattle, and sometimes also in sheep, trace element deficiencies (cobalt and copper) can cause infertility.

Southland farm experiments on ill-thrift

With respect to ill-thrift in lambs, experiments have been carried out on ten farms in Southland during the 1957-58 season.

After initial analyses of the foliage, recommendations for trace elements were submitted to the farmers who divided their paddocks each in two halves, one half treated with trace minerals, the other untreated.

From then on the health of the stock was watched carefully. And every 3-4 weeks a foliage analysis for trace elements was carried out for the paddocks.

This was done more often in the fast growing period.

Although the investigations have not yet been completed, a few general conclusions can be mentioned here.

(a) In several cases, the 6 oz of cobalt per acre which had been applied, either by spraying or mixing with fertiliser, appeared to have disappeared in the foliage within two months.

This means that cobalt has to be applied as late as possible before weaning the lambs, and may have to be repeated during the summer.

(b) The copper application of 5 lb of bluestone per acre lasted much longer, although in some cases, not until the end of the season.

On a few farms the copper level in the foliage decreased rapidly when growth became flush in December and January.

Therefore, if copper is applied late in spring, the chance of it lasting right through the season is good.

Copper and cobalt

In addition to the above experiments, many farmers in Canterbury had their soil and foliage analysed, and applied the minerals recommended with success.

In my opinion copper plays at least as important a role in ill-thrift as cobalt.

Iron

In some cases an application of sulphate of iron gave extra improvement on land which had been heavily limed in the past and where a copper deficiency was found.

As an outright iron deficiency is unlikely, it looks as if the healthy effect of the copper application was increased by the iron.

Nitrite poisoning

Although the effect of trace minerals was quite distinct, it was soon found that other factors were also playing a role in the ill-thrift of lambs.

In some cases, lambs improved after the application of trace minerals, but when the flush growth of pasture started, they deteriorated rapidly. Yet the mineral content of the pasture foliage tested good.

In most of these cases the pasture contained a high percentage of clover, more than 60%, (although the ill-thrift effect in a few cases was found on pasture with a low to medium percentage of clover 20-40%).

However, in all ill-thrift cases, without any exception, the nitrate content of the soil appeared to be

high at the stage when the flush growth started.

The nitrate content of the clover was above normal, 500 ppm and higher, in some paddocks where ill-thrift occurred. This could have caused a poisoning of lambs if the nitrate was reduced to a nitrite* in the intestines.

However other samples' of pasture foliage showed a normal nitrate content, therefore nitrite poisoning could not be the sole reason for the ill-thrift and death of lambs on these paddocks.

Lack of fibre

The ill-thrift causing pastures produced foliage with a low percentage of dry matter (16-20%) and a high percentage of protein in the dry matter (26-32%) during the period of flush growth.

The foliage appeared to be soft, and could be pulled to pieces easily without the crunching sound usually heard with this treatment.

Although no fibre tests have been carried out, it seems as if the fibre content of the unthrifty pastures is lower than is desired to counteract the large amounts of moisture and protein.

Too narrow mix of pasture

Information obtained from a number of farms showed that pastures consisting of H1 and clover, perennial ryegrass and clover, pure H1, and pure ryegrass all produced more ill-thrift than pastures with a more broader mixture, including cocksfoot, timothy and dogstail.

Foliage tests showed a much lower cobalt and copper content in H1 and perennial ryegrass, than cocksfoot and crested dogstail.

White clover varied greatly. Sometimes the cobalt or copper content was lower than grass, sometimes it was equal or higher.

Weeds useful

Weeds such as dandelion, capeweed and plantain always showed a higher percentage of cobalt and copper, and usually a lower percentage of molybdenum, than the grass and clovers of the same paddock.

Mineral licks

In general, my views with regard to the steps needed to be taken by farmers in order to prevent or cure ill-thrift agree with those of Mr Trotter, although there are some points on which I would like to make some comment.

Although Mr Trotter is apparently well aware of the possibilities of pasture tests (both soil and foliage) he advises in his article to use a standard mineral mixture as a lick, or as a mineral topdressing, which could easily lead to confusion.

In my opinion farmers should not use minerals in a lick if it has not been made sure by means of a foliage test that these specific minerals are lacking. Especially with regard to copper, as an over-supply could be dangerous.

Topdressing minerals

The application of a standard mixture of trace elements as a topdressing is not as dangerous, but certainly expensive.

For example, in a case where only cobalt might be needed, the other minerals would not be applied to any advantage. Their application could even be of disadvantage in upsetting the mineral balance of the soil.

* Nitrite (N02) is a harmful form of nitrogen for living organisms.

With regard to high nitrogen content of soil, and its necessary decrease, the cropping with wheat as suggested by Mr Trotter is a very useful tool and certainly the best one to obtain direct relief. However, from a farm management view it is only a secondary measure. Farmers should try to keep their pastures in a state suitable for healthy stock right from the beginning.

Recommendations

Primary measures would be:

(a) The use of less clover in pastures.

(b) The use of a large variety of grasses instead of only perennial rye or H1.

(c) Not to destroy weeds which stock like to eat, especially flat weeds.

The following additional points may be useful to farmers who have encountered ill-thrift on their farms:

(d) Be careful with your application of lime and phosphate. Both can cause trace element deficiencies if overdone. Soil analysis can be a guide in this respect.

(e) Make sure that your pasture growth contains sufficient of those trace elements which are important for stock health.

(f) Preferably apply trace elements which appear to be deficient, not more than 6 weeks before the time when ill-thrift usually occurs.

(g) If ill-thrift occurs in spring as well as in autumn, an application of trace minerals in spring may not last long enough, and a repeated application before the autumn attack can be useful.

(h) Do not put young stock in pasture which contain much clover, especially during spring or second growth.

(i) Do not put stock in fast growing ryegrass or H1 pasture.

(j) Try to keep a number of paddocks in pure grasses only, such as cocksfoot, dogstail, etc, and grown on soil which has not had too much nitrogen build-up from previous clover growth, or from which the nitrogen has been decreased by one or two wheat crops. Graze your stock in these paddocks during the critical period.

(k) Do not put young stock on brassica type plants grown on land rich in nitrogen.

However, slow growing types such as rape, turnips, etc, will be satisfactory. But a fast growing crop will contain too much nitrogen and water. Stock will not thrive on them.

(l) Young, fast growing lucerne does not seem to be very satisfactory for young stock, but lucerne toward the flowering stage does not seem to cause much trouble, probably because it contains a high percentage of dry matter and fibre, and less protein and water.

Mr W. B. Trotter sums up the debate on ill-thrift in lambs

Timaru Herald, 12th April, 1958.

Analysing the contentions on ill-thrift in lambs which have appeared in The Timaru Herald during recent weeks, Mr W. B. Trotter who initiated the discussion states:

If the purpose of this debate is to be fulfilled, may I point out the differences in the sequence of events which lead to ill-thrift, according to Mr Walker, Mr Armstrong, Mr Menrath, and myself.

Mr Walker places his sequence as follows:

1. Pasture unpalatability.
2. Marginal mineral deficiencies.
3. Parasites.

Then goes on to say that parasites promote anaemia.

Mr Armstrong says:

1. The provision of cobalt is necessary on six out of seven farms.
2. The addition of copper and iron to cobalt was of no additional value.
3. Worm control measures are essential and uses the phrase that *"a cobalt deficiency could be an important predisposing factor in the parasitic problem."*

Unfortunately for consistency, Mr Armstrong stated in your paper of January 25 that ill-thrift in lambs locally is caused mainly by internal parasites.

May I request Mr Armstrong to clarify his opinion.

Mr Menrath says:

1. Trace element deficiencies.
2. An unbalanced grass-clover content in the pasture.
3. Too much nitrate in the soil at certain periods of the year.
4. Too little variation in pasture mixtures.

My own sequence is:

1. Anaemia, caused by the attack made by surplus major minerals on the copper-iron-cobalt combination necessary for the formation of haemoglobin or red cells in the blood.
2. Parasites. The above anaemia leaves the lamb in a weakened state and a ripe subject for worm attack.

Anaemia precedes worm attack

Now sir, no one in this debate can have their cake and eat it.

If the school of thought which believes that the worm attack is the first step in ill-thrift is right, then the farmers who have ill-thrift should be heartily ashamed of themselves. All that is necessary is that stock should be adequately drenched with phenothiazine and everything will be righted.

Yet all farmers who have ill-thrift on their properties know very well that a good deal more than phenothiazine is necessary to cure ill-thrift.

If however, the anaemia comes before the worm attack, then the farms and farmers concerned are the victims of an unsound agriculture system

which has built up surplus major minerals and caused the attack on any one or all of the combination of copper, cobalt and iron.

I say that I can produce conclusive proof that the anaemia precedes the worm attack.

Consequently then, farmers should make their first step the attack on anaemia, by topdressing with copper, cobalt and iron.

Summary

Mr Armstrong mentioned drenching trials in the Fairlie district. Unfortunately this is sulphur deficient country. The cobalt deficiency is certainly severe, but the best results will only be obtained when the sulphur deficiency is corrected.

Mr Menrath and myself have very little to argue about. I think that his observations concerning the short term for which cobalt top-dressings are effective, the change from nitrates to poisonous nitrites, and clover predominant pastures, can all be summed up in two words, high nitrogen.

As far as my blanket recommendation for topdressing trials with copper, cobalt and iron are concerned, this is the correct treatment for anaemia.

Failing precise information that pastures contain adequate supplies of iron, 11-18 ppm of copper, and .68 to 1.1 ppm of cobalt, I fail to see how it can be altered.

May I thank 'Tried It' and Mr R. J. Moore of Lynford, Ashburton for telling of their experiences with copper, cobalt and iron in your issue of April 2.

Worms in lambs by R. V. Brunsdon

NZ Journal of Agriculture, Sept 1976.

A summary of 31 trials in New Zealand were reported in 1975 to show that treating lambs for worms at weaning had little effect and was not worth doing. Wallaceville were not happy with these results and have repeated the trials.

They point out that weaned lambs are vulnerable to over-wintering worm larvae, to those dropped by their mothers, and later to worms from their own droppings. Therefore drenching can have little useful effect against this high level of potential re-infection.

If however the lambs were moved at weaning to a pasture grazed only by cattle, from August to December, and hence 'safe' and then drenched, an appreciable live-weight gain was obtained.

Even if the lambs were not drenched but put on this safe pasture, their improvement was better than drenched lambs left on the contaminated paddocks.

So it was concluded that the importance of worm infection in lambs during the early postweaning (summer period) has been considerably underestimated in New Zealand.

Chapter nineteen

Approval given for a pasture trial on animal ill-thrift

Christchurch Press, 13th September, 1958

Farmers are becoming increasingly conscious of the need to tackle problems of animal thrift on the broad basis of soil, plant and animal relationships, recognising that the trouble may lie somewhere in the complicated pattern of interactions.

At recent sessions of the Meat and Wool Boards, support was given to a resolution put forward by Mr W. B. Trotter representing South Canterbury, calling on the two boards to give every assistance, and possibly some financial support to proposed nutritional studies at Canterbury Agricultural College, Lincoln.

In making this proposal Mr Trotter said this week that he was "concerned in finding out how to obtain and maintain a mineral balance which was suitable to stock health." In the final analysis he said that this was "a highly scientific study."

Pasture trial details

The proposed study at Lincoln would involve a trial in which say four pasture species would be sown in pure stands, with the grasses being given nitrogen fertiliser to compensate for the absence of clover.

The production and rate of growth of the different species would be measured and related to changes in the chemical composition of the pasture from year to year.

The chemical composition would include the so-called trace elements and other chemical substances required in larger amounts.

These plots would be grazed by experimental young sheep, their rate of growth measured, a check kept on parasite infestation, and general signs of thrift noted in relation to changes in chemical composition of the pastures.

Unanimous approval

Mr T. P. Lowe (Ashburton) of the Wool Board moved that a systematic and scientific investigation of ill-thrift be undertaken at an early date "because of the widespread and severe nature of ill-thrift, which if allowed to spread further unchecked, will have serious effects on New Zealand's production and economy."

This proposal was given unanimous approval.

Mr Lowe referred to a Canterbury property where losses in the last year have amounted to thousands of head of stock.

Second grade lamb rate more than doubled

Mr Lowe also drew attention to another loss, apart from actual deaths which were being suffered from unthriftiness in the South Island. He said that between the 1950-51 season and the 1956-57 season, the number of export lambs down graded to second grade had increased from 14.1% of all lambs

in the 1950-51 season, to 35.8% in the 1956-57 season.

Let's all co-operate

Mr Lowe also urged that scientists in the fields of soils, plants, and animals should work together on the problem.

His remarks were echoed this week by Mr C. Hilgendorf of Sherwood, Mid-Canterbury, who at a recent meeting of Federated Farmer said, "Ill-thrift was not a specific disease. It was on the cards that ill-thrift was quite a number of different things, probably basically nutritional, though that might not be so. It seemed that facial eczema was not nutritional, though it had formerly been believed to be nutritional."

"Obviously the first thing was for a team of scientists to define the problem more closely. It was really over to the scientist to work out a programme, scientists being rightly unwilling to have the design and basis of their experiments dictated by farmers."

"Canterbury Agricultural College had obvious advantages as the centre for these studies, as it had people working there from all the related sciences, and it was from the work of a team looking at the problem from all angles that most progress could be made."

"The lack of co-operation among workers in soil, plant and animal fields was a fundamental weakness of New Zealand animal research," said Mr Hilgendorf. "My solution for that is an agricultural research council that covers the whole lot."

Chapter twenty

Copper, cobalt, iodine and molybdenum

Trace elements

An address by Dr Cunningham of Animal Research Division, Wallaceville

"There is an idea prevalent among some farmers that deficiency of trace elements is the cause of all problems. Because of this misplaced faith they have become fair game for people who make a living by selling these mixtures," said Dr I. Cunningham of the Animal Research Division, Wallaceville in an address on trace elements given at the winter farm school held in Waimate.

"Departmental officers don't like to see the farmer wasting his money," said Dr Cunningham, "and I want to put the matter of trace elements before you in its proper perspective and tell you what we know. Information we have gathered not by guesswork."

Only four trace elements to consider

"Trace elements, as the name implies, are present in foods or in the animal in small trace quantities. They are no more important than the elements there in large quantities, but their smallness has some sort of attraction that causes the farmer to think they must be given either by stock lick or topdressing."

Dr Cunningham warned farmers that trace elements should be treated in the same way as the major elements, and the advice of the livestock instructor sought before any action was taken.

"In New Zealand there were only four trace elements to consider; copper, cobalt, iodine and manganese, with another, molybdenum important in promoting growth," Dr Cunningham said.

Effects of copper deficiency or excess molybdenum

"There were about 1,750,000 acres in New Zealand deficient or probably deficient in copper, with another 1,000,000 affected but not yet brought into production," he said.

"The effect of copper deficiency on dairy cattle was usually associated with the results of too much molybdenum. Copper deficiency and excess molybdenum poisoning caused persistent scouring, and production and condition of the animal suffered, with occasional deaths."

"The effects on sheep were usually shown only in young lambs, which lost the power to walk, and being unable to follow their

mother, starved to death. Wool fibre also suffered among Merino and halfbred sheep."

To offset the deficiency Dr Cunningham recommended giving copper either in licks, or better still, by topdressing with 5 lb of bluestone to one acre each year.

"Some of the Waikakahi land showed a slight copper deficiency or a little too much molybdenum," he said.

Cobalt deficiency

"There were some 9,000,000 acres of land deficient in cobalt or requiring treatment for cobalt deficiency," Dr Cunningham said. "As a result of treatment, it was now rare to find cobalt deficiency in cattle in New Zealand. The symptoms at least had ceased to exist.

But sheep had proved more susceptible. Where cattle were only affected, sheep would die," he said. "Sheep showed no distinct symptoms, the animal simply did not thrive. Weaned lambs were most susceptible, yet in the same environment the mothers could do reasonably well."

The only way to prove the deficiency was to examine the pasture or examine the sheep's livers. One way to prove the deficiency was to feed a small amount of cobalt to part of the flock, and if there was a deficiency those treated would show a marked difference in about three months.

Regular drenching with cobalt, preferably weekly, was one way of counteracting the deficiency, but was not really economic. The best method was to topdress with about 5 oz of cobalt sulphate in the spring of each year.

Iodine deficiency

"Deficiency of iodine was found usually in sheep and more often in lambs, the greatest incidence in the South Island occurred on the alluvial plains of Canterbury," Dr Cunningham said. "Iodine deficiency was the cause of goitre through enlargement of the thyroid gland."

Lambs were susceptible, although the trouble did not necessarily occur each year on the same farm. The trouble was frequently associated with feeding on brassicas such as chou moellier and turnips.

If the goitre was very large the lamb would die at birth or within a few days. The deficiency was serious during the first few days after the lamb was born, but after that it did not affect the growth.

If iodine could not be supplied by topdressing and had to be provided by licks, it should be remembered that such licks were often not stabilised and should be fed out each week.

Manganese

Dr Cunningham said, "Manganese had never been shown deficient in any grass-eating animal. It never occurred in cattle, sheep, or pigs and could be disregarded as far as they were concerned. But it was important in poultry. It caused a disease known as "slipped tendon," and was also important in the fertility of eggs.

Molybdenum

"These are the only four trace elements we need to consider," said Dr Cunningham. "However there is one other, molybdenum that is important in promoting growth. It has spectacular effects, but ill effects where too much is used. Even a moderate application can be harmful if copper gets on the low side."

All peat areas were high in molybdenum content and low in copper, except one area near Ashburton. Waikakahi had this problem in some places, but the South Island was better off than the North Island.

"I don't want to frighten you, but it is important to use molybdenum wisely and in the right place. Your agriculture instructor will tell you," said Dr Cunningham.

"Some farmers have been told to put on 1 to 2 oz and they apply 8 to 10 oz. Stick to 1 or 2 oz, and only do it on land you have been told to topdress."

Dr Cunningham said it appeared that putting on all sorts of mixtures containing trace elements was only a waste of money when the farmers did not know if they would have any effect.

"It's a shot in the dark that blows a hole in the pocket," he said. "I am quite convinced there is no need to use complex mixtures other than those I have mentioned. It is not wise to play with minerals by putting on all sorts of mixtures."

"We know copper and molybdenum inter-react. There are a whole lot of other inter-relationships which are not understood thoroughly. They are however sufficiently understood for us to know that we should not go ahead and make ill-judged use."

Abuse of molybdenum in North Canterbury pastures

NZ Journal of Agriculture.

Molybdenum, a good servant but a bad master, is causing serious upset to pastures with resultant stock losses in some areas in North Canterbury where copper deficiency is pronounced.

It seems that in most cases the first intimation to farmers that something is amiss with the mineral balance of their pastures has

been a disturbing outbreak of what passes for 'ill-thrift' in their hoggets. *

Hoggets break ricketty legs

On several farms this spring, farmers observing their hoggets unaccountably lame, have tried to drive them to a holding pen for treatment only to see a number break their ricketty legs when called upon to walk.

In a recent investigation of the situation, the writer was assisted by the North Canterbury veterinary authorities whose observations and records were freely made available.

The inescapable conclusion reached is that in many cases, the high molybdenum level in pastures is due to injudicious top-dressing with molybdic superphosphate. For where pasture is already low in natural copper content, the position is aggravated by adding molybdenum. The result is to worsen the effect of low copper. Subsequently signs of copper deficiency and/or molybdenum poisoning are manifested.

Affected areas

As to the background of this trouble among hoggets, it would appear that one has no need to go to the peat swamps of the North Island to see symptoms of copper deficiency. They can unfortunately be seen regularly over large areas of North Canterbury.

Particular areas concerned include a large portion of the Amuri basin, about 16 squares miles of the Waiau district, the Waikari flat, Scargill valley and patches of the coastal country from Waipara to Motunau.

Osteoporosis a symptom of copper deficiency

The symptoms of copper deficiency observed in these areas appear to vary. In the Amuri district one is presented with outbreaks of spontaneous fracture of one or more long bones (the femur, humerus, etc.) of hoggets, due to bone fragility (osteoporosis).

These fractures occur usually in a number of sheep all at once. In one incidence, 7 were encountered in 2 days, and in another, 26 over 10 days.

When outbreaks of this type of bone fragility occur, they are extremely difficult to deal with. For whilst it is known that copper is the essential element required, drenching cannot be carried out because the stock affected cannot be yarded for fear of further fractures.

All that can be done is to move them on to pasture of higher copper content and provide a copper lick.

---

* A hogget is a sheep up to the age of one year.

Furthermore, on this type of copper-deficient country, scouring of hoggets on spring and autumn growth, with progressive emaciation, anaemia and death are common.

Where these symptoms occur, it is found in most cases that the pasture level of copper is low, only 1.7 to 8.2 ppm of copper per dry matter in grass, against a normal of 11 to 15 ppm.

The molybdenum level of these pastures is relatively high at 2 to 8.6 ppm.

Sheep dying on lush pasture

Veterinary authorities whom the writer consulted were of the opinion that on areas that already have a high molybdenum content of the soil relative to copper, there is no place for molybdenum in providing pasture improvement. By pasture improvement is meant pasture suitable for healthy stock.

For example, on one farm in North Canterbury, where sheep were rotated around four paddocks topdressed with molybdenum, the pasture growth was lush and magnificent, but the hoggets grazing it showed steely wool and were scouring and dying.

Pasture analysis showed a low average copper level of 2.8 ppm, and a higher than average molybdenum level of 2.3 ppm.

One authority said to the writer, *"Too often farmers consider an animal's requirements last. They should consider the healthy animal's requirements first, and try to provide the right pasture according to their copper requirement. If copper makes the animal healthy in reducing steely wool, broken bones, etc, give him copper, not molybdenum just because it made grass grow well in another district hundreds of miles away."*

Molybdenum outlasts copper

On soil where molybdenum is high and copper relatively low, it now appears in some cases that more than an annual application of 5 lb of copper sulphate to the acre is necessary to restore proper balance.

The reason for this is that the molybdenum appears to last longer than the copper topdressing. Indeed in some cases in North Canterbury where copper was added to the soil, the level of copper six months later was as low as before the application. In one case the symptom of broken bones in hoggets appeared the following year, even though the farm concerned had been topdressed after the previous year's outbreak.

In the light of veterinary experience in North Canterbury, it now seems possible that copper cerate injections offer a more convenient and reliable method of providing copper to stock, with considerable reduction of the annual cost of treatment in some cases.

Swayback and copper deficiency

Swayback in lambs, a condition where the lamb is either born with the inability to control its hind limb movements, or develops the inability at a later stage, is seen in odd cases from the Waikari district and the Motunau area.

The incidence is not high, but the more important symptom of steely wool (wool where the lustre and crimp are lost) can occasionally be seen in these areas, mainly occurring in Merinos. There is also evidence that a less marked steely wool occurs in halfbreds and Corriedales.

Again these symptoms are due to copper deficiency. Just how far lack of copper could be responsible for loss of wool quality is hard to assess, but it is a factor worth considering.

Copper deficiency in cattle

On some of the coastal country north of the Waipara, an interesting aspect of copper deficiency is seen among some beef cattle.

This country could be termed marginal, in that analyses of sheep livers for copper content show only a moderate level. There one finds sheep living quite well with no significant signs of copper deficiency, while the animal affected is the breeding sow.

Cattle are healthy through the dry period, but after the latter half of pregnancy, progressive wasting, anaemia and scouring become evident. In a few cases the beast later lies down because of weakness and is unable to rise.

Liver analysis for copper in one case showed a level of 8.4 ppm from the cow, and 130 ppm from the liver of her calf in utero. The cow had drained her reserves of copper to supply the calf, which must be born with a high natural reserve of copper to survive as the copper supplied in milk is low.

Another suspected symptom of copper deficiency in cattle is infertility. One beef-breeding herd achieved less than 60% of cows in calf.

Space limitations preclude this article from covering the ground as fully as one would like. Yet perhaps sufficient data has been presented to arouse consciousness of stockowners to the wisdom of being fully posted on trace element minerals before ‘playing around’ with their pastures. Where necessary they should not hesitate to seek advice from the right quarter, be it veterinary services or the Dept of Agriculture, which nowadays is so freely available to them.

Chapter twenty-one

My mineral and feeding experiments on 'Coulmore' up to 1967

Lame and with a bad heart at 60

By 1967 at age 60, I was rather decrepit, very lame, and with a bad heart, (more about this later) so I turned to cattle.

I soon found that it was impossible to run ewes in conjuction with the cattle, as I could not find lambing paddocks. So I returned to hogget farming.

In the last ten years, the stocking rate has been 400 cattle, and 2,000 hoggets wintered. Up to 7,000 lambs bought in, and killed back down to the 2000.

Coulmore today could best be described as some of the best hogget country I know.

Fat hoggets

I purchase second and third grade lambs, fatten the best and carry the tiddlers over. After shearing, these tiddlers make fantastic growth and are fit to market as fat hoggets before Christmas.

Grain feeding cattle

With the cattle, I installed a crushing plant and fed the fattening cattle a ration of crushed grain. This worked extremely well for 9 years. The cost per bullock was $2.50 a month, with feed grains at round $1 per bushel.

Now that feed grain prices have virtually doubled to $2 a bushel, and beef prices are poor, grain feeding is just not on.

So I have reduced the cattle numbers to 250 head and now have 2200 hoggets. I still hope to market 250 fat cattle and the hoggets each year.

I still will keep some grain, but more as insurance against drought than as a regular programme. Storable surpluses appear to be the answer to drought. That extra barn of hay and grain which of course will keep for some years, worked very well here when we ran out of moisture.

My search for perfection in soil science

Experimenting in soil science is progressive. It leads on and on in a search for perfection, and becomes extremely complicated for this reason.

To try and some shed light on it, I think it would be helpful if I try to state clearly the basis of my work done at 'Coulmore.'

1. Science tells us that minerals in various combinations carry out every function of the body.

2. Professor Comber of Leed University points out that it is impossible to alter one soil condition and keep existing conditions constant. Whatever we add will cause widespread actions and interactions. Some minerals will be stimulated, some depressed.

3. Waksman in his book *"Microbial Antagonists and Antibiotic Substances"* claims that a healthy balanced soil creates conditions where the health-giving bacteria live and thrive.

On the contrary, where the balance of the soil is destroyed, the health-giving bacteria can no longer survive and are replaced by nematodes* such as Anthrax and Blackleg.

I have yet to meet anyone who has challenged any of these statements. So hence my search for a formula of how to obtain and maintain a mineral balance suitable to stock health and human health.

This aim can best be described as the basics of agriculture. It is not beyond the ability of modern science to achieve. It does however demand a comprehensive and accurate study of the mineral requirements of animal and man.

Minerals work in combinations

The combinations of minerals used to perform certain functions and the ratios are of vital importance.

So much research has been wasted in this direction, in particular, taking one mineral out of a combination and spending a lot of time on it alone, without ensuring that its co-partners are in adequate supply. This common practice only leads to dead ends and wrong conclusions.

I will now list the minerals which have been under trial (excepting fluorine) on Coulmore in the last 32 years, and then attempt to sort them into combinations.

We will start with the 'big four:'

phosphorus	calcium,
potassium (potash)	nitrogen.

Then come the trace minerals:

copper	cobalt
iron	selenium
fluorine	boron
manganese	zinc
iodine	magnesium

* Nematodes are microscopic worms. A handful of soil can contain thousands.

carbon	hydrogen
nitrogen	oxygen
sulphur	molybdenum
tungsten	vanadium
sodium	chlorine

Two others which have not been used but which do appear in overseas writing are:

chromium	nickel

Bone structure. Now, for bone structure we need a combination of:

phosphorus	calcium
copper	sodium
magnesium	fluorine

Red blood cells. For the formation of haemoglobin or red cells in the blood, we need a combination of:

iron	copper
cobalt	selenium

(Young sheep also need these for growth.)

Reproduction and development. For reproduction and development we need a combination of five minerals. These also have other vital functions which are wide ranging. But all come together in the production of healthy hormones:

magnesium	selenium
zinc	iodine
manganese	

Wool growth. Wool growth requires:

carbon	hydrogen,
nitrogen	oxygen
sulphur	

These are the five elements in wool fibre. They appear to be necessary in ordinary farming practice.

The above list should serve to show how easy it is to be led up the garden path in research. Only a partial result will be obtained if single minerals are taken out of their combinations.

Potassium and nitrogen. Potassium, one of the 'big four' is not mentioned in the above groupings.

This mineral (which is part of potash) and nitrogen are required extensively for plant growth and both have to be watched.

Animal requirement for both, especially nitrogen, is very low, for in grassland farming they are mostly excreted by the animal and returned to the soil. Therefore the supply remains almost static. However, under heavy stocking, the nitrogen builds and causes an

ebb and flow of clover growth.

On Coulmore this results in two years of grass-predominant pasture followed by two years of clover-predominant pasture.

Common salt. Sodium chloride (or common salt) is a very necessary digestant for animals on inland areas.

Molybdenum, tungsten and vanadium. These are the three heavy minerals. All three are used in steel hardening.

The Dept of Agriculture claim that molybdenum is necessary for the fixation of nitrogen by clovers. However I would outlaw this mineral from farming. It is dangerous to health where we have a high soil pH. It is anti-copper and will release all the copper which an animal has stored up in the liver. This is a direct cause of anaemia.

With this in mind I began trials with tungsten and vanadium as an alternative to molybdenum. What I wanted to find out was whether the clovers needed molybdenum or just a heavy mineral.

I gave the first prize to tungsten. I cannot claim that the growth response is better than molybdenum. What I am quite certain of however is the stock preference. The area I topdressed with 2 ozs of tungsten per acre 20 years ago is still the first grazed.

Vanadium was also much preferred to molybdenum.

Boron. This leaves boron, which is known to be essential in preventing brown heart in swedes, when grown after liming.

Not nearly so well known is its function in promoting chlorophyll in pasture, and thus allowing the pasture to accept and develop vitamins from the sun's rays.

Soil pH. In my search for the reasons for trouble which developed following topdressing of pastures as recommended by the Dept of Agriculture, I first asked myself this question. "What must we do to change the soil from acid to alkaline, or the pH (which stands for potential of Hydrogen) from 4.8 to between 6.3 and 6.6?" A pH from 6.3 to 6.6 is the point at which most plant growth takes place.

Quite obviously we must apply enough lime (up to 4 tons per acre) to neutralise all the acid content of the soil. However, when we set out to neutralise the soil acids, we tie up the iron, zinc and boron. Iron has to be the number one mineral tied up as it is the bitterest thing known to medicine.

For minerals to become plant food, they must first go into solution. So they must be either water soluble, or soluble in the soil acids. Therefore by this action of liming , we have deprived the grasses of essential nutrients and prevented certain minerals from becoming plant food.

I feel sure no shepherd or farmer would agree to this as good farming practice.

So the bright eyed doctors, professors and Dept of Agriculture have conned the farmers into tying up essential minerals of the soil and making them unavailable. And also destroying countless billions of health-giving bacteria in the soil at the same time.

Stock health remedy costs increased 100 fold

The Department will doubtless defend themselves by pointing to the vast increase in stock numbers which has occurred as a result of their development recommendations.

But they are not nearly so keen that anybody also quote the resultant rise in the money spent on stock health remedies.

In 1953, the year I was first elected to the Electoral College of the Meat and Wool boards, government spokesmen asked us to use our influence to substantially increase stock numbers, as it was in the best interest of New Zealand to increase exports. A similar request was made to Federated Farmers.

From memory, our meat exports in 1953 were 276,000 tons, with 11 million lambs killed for export.

Farming income was excellent at the time. Most farmers had a surplus to invest in topdressing. The results were spectacular. In four years the lamb kill rose to 25 million and the export of meat on a comparable basis was trebled.

Now stockmen are paying the price for that. Nowadays the drenching gun is one of the main implements on too many properties.

From an estimated cost of $1 million for stock health remedies in the 1950's, we now see an estimated cost of about $100 million.

More stock, yes, but obviously requiring a great deal of attention to keep them alive.

Selenium a profit goldmine for vets

Selenium first came into prominence in the mid 1950's, following the successful banning of the importation of Japanese sulphur at that time, which contained selenium.

When selenium's need first became apparent, its control was handed over to the veterinarians. The cost of selenium at the time was so cheap that it was mooted that it be made available to farmers for free, but on second thoughts the vets decided to make a small charge to pay for the mixing and bottling. The vets soon learnt to profit from this little goldmine.

Selenium was imported at 8 shillings a lb, from which 912 bottles of drench could be made up, a cost of 10 bottles for just one penny. Yet the Ashburton vet club charged farmers in that area 25 shillings

a bottle. Most folk would have to agree that £1,143 was a good return for 8 shillings* worth of ingredients.

Selenium was at first to be made freely available to farmers, but then the vets described it as a restricted poison and farmers had to sign the poisons book.

In some areas I understand that sale to farmers is refused by veterinarians unless drench is purchased as well. They will add selenium to a drench if requested. Now there is nothing but pure greed which could make veterinarians demand that drench be purchased to obtain selenium. They are definitely exceeding their authority and responsibility in the distribution of selenium and are wide open to prosecution in those areas where this practice is prevalent.

Selenium is not cumulative in the body and I would challenge the fact that it should be rightly described as a poison. Or did the vets just tell a gullible Government Dept a white lie to get control of a goldmine?

It would take a truly massive dose to kill anything. Consequently it is no more poisonous than any other element. Today the price of selenium has risen 500%. So they can only make 2 bottles of drench for 1 penny instead of 10.

Leaching of magnesium, selenium, zinc and iodine

Now here is a conundrum* which has to be unravelled.

There are five minerals which are very necessary for reproduction. Four of these, magnesium sulphate, sodium selenate, zinc sulphate, and iodine are probably the four most water soluble of all the minerals.

Manganese on the other hand is one of the heavy minerals (it is used in steel manufacturing). Manganese therefore does not appear to belong to the same complex as these others.

Because of solubility, the first four are going to be difficult to correct in the soil, for they will leach very rapidly. The form in which they are used as a topdressing therefore needs careful checking.

A dressing with magnesium sulphate works like magic on staggers, but the benefit can be short-lived if heavy rain follows.

I have found a much longer control of staggers with the use of magnesite, the content of which is 48% magnesium. The release of magnesium is slow by comparison with magnesium sulphate which is just too soluble. Similarly with selenium.

It was reported this season that selenium was to be released to

* In the imperial currency of the time there were 12 pennies to one shilling and 20 shillings to £1.
* A difficult problem.

the industry for topdressing. Then it was reported that it was to be withheld, the reason being that a dressing of sodium selenate only lasts 3 to 4 months.

I think it can be proven that the correct way to use selenium is to add raw Japanese sulphur (in which selenium is found as an impurity) to superphosphate as fortified super. This is the best way I have ever found to use it. Sown at the rate of 10 lbs per acre, the dressing proved very satisfactory for 14 months.

However Japanese sulphur is currently banned from importation into New Zealand.

Iodine leaching

On the next page is an official test carried out by the DSIR on my 'Coulmore' creek water. It shows the iodine content as being 74 times higher than the Fairlie water supply.

Mr Millar's remarks in regard to this test are quite justified. But it shows just how difficult it will be to overcome iodine deficiency by topdressing, because of leaching.

The headwaters of the creek supply had been topdressed eight months before these tests were taken. The amount of iodine in the creek water makes it clear where the iodine is heading. It is heading for the ocean so it can be reprocessed again from the kelp and sold back to me again.

The topdressing I used contained 1 lb of potassium iodate per ton, which allowed for a dressing of 4/5ths of an ounce of iodate per acre. Potassium iodate is recommended as the most stable form of iodine.

Zinc the great healer

Now we come to zinc. Dr Hickey revived interest in zinc with his recommendations to the British Medical Association on the use of zinc as a marvellous healer when taken internally.

Zinc is one of the oldest minerals known to medicine. Zinc ointment was used in older days as a regular healer for cuts and any skin abrasions.

I first started using zinc five years ago for my stock. The best description I can make of zinc is that it is probably the most versatile of all minerals. Zinc is the great healer, the great purifier, and the great protector against bacterial disease.

We find zinc playing a very important role in protecting our flocks against pizzle rot, footrot, dermatitus, eczema and so on.

In my search for information I read in an old 'Cyclopedia of Medicine' brought to NZ in 1866 as a treasured posession of my grandmother, that zinc was used extensively in old medicine as an emetic and as such was quite safe. So it is not cumulative in the body.

Yet included in the next chapter is a newspaper article warning farmers not to use zinc in control of facial eczema. This Departmental warning has a familiar ring. It recalls vividly the warnings of 20 years ago regarding using trace minerals.

Now would it not be beneficial for human health if our meat products did carry a residue of zinc? Or do we continue to insist, in our hygiene-mad society, that all such nutrients be banned from our food products? And at the same time actively encourage vegetable growers to use lethal amounts of molybdenum in growing of vegetables for sale to the public.

The logic of such a system astounds me. On the one hand we have perhaps a residue of zinc, one of the outstanding healing minerals. On the other hand, a recommendation to use one of the proven killers in the stock world.

Iodine analysis of 'Coulmore' water

Wallaceville Animal Research Centre
Upper Hutt New Zealand,
December 17, 1976.

Dear Mr Trotter

I apologise for the delay in sending the results for the iodine analyses in the water samples, but we were in the middle of a large number of analyses when the samples arrived.

The results are as follows:

Farm water: 7.4 mcg iodine/litre.
Gorge water: 0.2 mcg iodine/litre.
Fairlie water: 0.1 mcg iodine/litre.

As mentioned in my letter of September 27, it is generally accepted that the soil iodine is the main source of iodine upon which man and animal alike depend, usually through the medium of vegetable food.

As your farm water is high in iodine, this would suggest that the soil which it drains has adequate iodine and hence the pasture should also have plenty of iodine.

Yours sincerely,
K. R. Millar.
Bio-chemist.

Chapter twenty-two

Zinc and facial eczema

Zinc protects against facial eczema

Herald Agricultural Correspondent.

The importance of zinc, not only in the control of facial eczema, but in animal health generally in New Zealand, seems likely to arouse considerable interest among farmers when the topic is discussed tomorrow at the Ruakura farmers' conference.

In recent trials at Ruakura Agricultural Research Centre, zinc in the diet of sheep and cattle has been shown to have a protective function against facial eczema.

Why so long delayed?

But what has puzzled many people, including veterinarians, is why such work should have been so long delayed, and why work done at various times since 1949 by a man in the commercial fertiliser business should appear not to have received much official recognition.

Mr Fergus Hickey is known to many people in New Zealand and overseas for his work over 30 years as technical director of a fertiliser and stock food company Wonder Distributors Ltd. He has long been convinced that zinc has an important role to play in animal health, both as an addition to diet and as an element to be included in fertiliser.

Mr Hickey says he diagnosed zinc deficiency in South Island sheep flocks in 1952, and overcame the problem by drenching with zinc.

Wool rich in zinc

Sheep had been persistently eating wool from the backs of other sheep. Wool on analysis was found to be a fibre relatively rich in zinc.

Following a discussion with Mr Hickey, a grazing trial on pasture topdressed with fertiliser containing zinc was carried out by the grasslands division of the DSIR in 1956.

As a result of the trial, the DSIR supported the practice already adopted by some runholders of using a compound of trace elements on pasture to control facial eczema.

The recent 'discovery' puzzles them he says, and has caused a good deal of correspondence.

Mr Hickey, who edits the New Zealand Agriculturist, a journal widely distributed in New Zealand and overseas, has collected a large amount of information on zinc and other elements during 48 years of reading and research.

He made his information on zinc available to Te Aroha farmer Mrs G. M. Reid who has taken a great interest in the element over more recent years. It was she who spurred Ruakura Agricultural Research Centre to carry out the trials.

Human health also

Mr Hickey who is now 74 and still working, has taken a great interest in both human and animal health.

He has addressed medical and veterinary groups in various parts of New Zealand.

As a man whose studies have covered a wide field and whose main interests have been in metabolism and mineral nutrition, he said last week that there was a

lack of knowledge in New Zealand about nutritional matters.

Basically, he believed, it was a question of replacing the various elements lost in output from the farm. Zinc had an important role to play but it was not the only thing that mattered and he feared that too much emphasis could be placed on it.

Farmers not heeding zinc warning on facial eczema problem

Timaru Herald, Saturday, June 17th, 1976.

Despite repeated warnings from the Ministry of Agriculture and Fisheries, many farmers apparently are still using zinc salts to protect or treat their stock against facial eczema.

The registrar of the Animal Remedies Board, Mr B. G. Johnston said it appeared that some private companies were promoting zinc products as cures for the disease and were advising farmers to put them in water troughs.

"With the facial eczema season fast approaching, it cannot be emphasised enough that this is not an effective method for dealing with the disease," said Mr Johnston.

Completely useless

"As a form of treatment, zinc in water troughs is completely useless and farmers who rely on it will suffer stock losses from facial eczema."

Mr Johnston said trials had shown that only high dosages of zinc had any protective value, and a sufficiently high dosage could really only be achieved by heavy drenching of cattle and sheep at the time of sporidesmin challenge.

"It appears that blood zinc levels do not build up or accumulate, but return rapidly to normal after dosing, so for zinc to be effective it has to be fed to animals at high levels, and almost continuously for anything up to three months."

While such treatment might offer some protection from sporidesmin, farmers were strongly advised not to try it, Mr Johnston said.

Dangers of excess zinc

"There are still numerous problems to be solved before scientists can advocate zinc's safe use.

Experiments undertaken so far suggest that exposure to high levels may produce a number of undesirable side effects."

Mr Johnston said that toxicity was a particular problem.

"Sheep and lambs dosed by hand with large amounts of zinc, or grazed on zinc-sprayed pastures, have shown depressed growth rates, while extensive damage to the pancreas of lambs has also been discovered.

In cattle too, toxicity has shown up in body weight losses.

It is known from trials that zinc dosed at the high levels necessary for it to have any protective influence at all, interferes with the metabolism of other essential minerals such as copper and iron. In marginal copper areas this can quickly precipitate a copper deficiency syndrome."

"The digestive process in the ruminant is also interfered with as abnormal levels of zinc damage the

micro-organisms in the rumen."

Mr Johnston said there were also indications that large doses of zinc caused unacceptable residue levels in animal products and these could jeopardise overseas markets.

At the Wallaceville Animal Research Centre last year, monitoring of heavy metals in muscle tissues showed that only zinc exceeded tolerance levels laid down in Food and Drug Regulations.

The Ruakura Research Centre had also discovered that prolonged use of zinc salt at high rates could increase zinc levels in offal organs tenfold and in milk twofold, Mr Johnston said.

Mr Johnston said the Animal Remedies Board had been inundated with requests for licences to sell zinc preparations as a facial eczema preventative.

"Because there are a number of unanswered questions concerning the use of zinc, the board is not prepared to issue any licences."

"Questions to which the board must have answers before zinc use may be approved, have been placed before scientists who are in controlled experiments, attempting to untangle the web of uncertainty and danger in which the product is enmeshed."

"When, and if these trials supply all the information considered necessary for the safe use of zinc in facial eczema control, then recommendations will be made to both farmers and manufacturers on the correct timing, dosage and method for its application."

Farmers wasting money

"In the meantime the Animal Remedies Board wishes to remind those farmers who are putting zinc sulphate or other zinc salts in their water troughs that they are wasting their money.

We also want to warn those farmers who are giving their stock more concentrated zinc preparations that markets will be endangered by high residue levels."

Mr Johnstone said anybody offering zinc salts for sale as a cure for facial eczema risked prosecution under the Animal Remedies Act.

"There were a number of other safe and effective ways of preventing facial eczema," he said.

"Farmers should continue to use fungicides, and consider learning spore-counting techniques to combat sporidesmin."

"Consideration should also be given to the selection of animals which show definite resistance to the disease."

Chapter twenty-three

My further mineral experiments on 'Coulmore' since 1973

'Wonder Mineral' fertiliser results

Since 1967, when I changed to cattle and hoggets, the topdressing programme on 'Coulmore' has been; half the farm with 1 cwt superphosphate, half with 100 lbs of Wonder Mineral, alternated year by year. This has worked reasonably well.

But since coming home from Auckland Greenlane Hospital in 1973, I have been checking this method out and find a lack in Wonder Mineral. The results should be even better than they are.

All the minerals included in Wonder Mineral really need to be water soluble. In some cases I find the minerals used are oxides combined with sulphates. Oxides are usually only soluble in soil acids, while sulphates are water soluble.

As stated earlier, heavy liming has undoubtedly neutralised the soil acids on 'Coulmore.'

Salt

Again, salt applied as topdressing could so easily be an agent necessary for the release of minerals. We use a lot of salt for the stock. Our hay is always salted in the barns and a salt lick is freely available to all stock. It could be that I am just a little impatient and expect results too quickly.

Selenium

The trouble could also well be the result of lack of selenium. The only supply available to the stock is through the drenching gun. All drenches used have selenium added, but at times our stock goes for three months without drenching.

Should the stock become deficient in selenium, this would automatically stop the manufacture of red cells and cause a tail end problem to develop in the hoggets.

Here again, until the Dept of Agriculture does something sensible such as releasing the control of selenium so that farmers can at the very least include selenium in licks, it may well be necessary to yard sheep and give them straight selenium as a drench.

Iodine

I have used a lot of iodine on 'Coulmore' in the last ten years, as iodate (the stable form) in a lick, and potassium iodide as a drench. The lick method I find chancy. One will never know which stock gets sufficient, or vice-versa. The sure way is to drench.

By this means we know that every sheep gets the approved quantity. The majority of sheep I buy in have come from the tussock lands of Mackenzie and North Otago.

On arrival I give these lambs 2 cc of iodine, mixed at the rate of 1 oz potassium iodide to 500 cc water, and repeat in 10 days. These lambs invariably respond very well and become darker in colour.

I cannot help thinking, how much better if the mothers had a pre-lamb drench at 5 cc. The response is so good that I am forced to the conclusion that these high country sheep have an inferior thyroid.

There are surely three types of thyroid. The normal, the abnormal and the sub-normal. Consequently I do not think that sheep have to show goitre before they respond to iodine.

Better results with better sheep?

This season I have changed my methods yet again. While time permits, my curiosity has to be satisfied. I want to know, considering the fine job 'Coulmore' does with low grade tiddlers, what sort of a job could be made with really good sheep.

So this season I bought a good line of Romney wether lambs, sheared them the first week in February and have held on to them.

Yes, I used the copper, cobalt, iron and selenium on them after shearing, three drenches.

They are big sheep already, and if they follow the usual pattern they will certainly make top sheep in any market.

They play in the paddocks like long tailed lambs and I enjoy watching them. They are undoubtedly healthy and fit.

Barley grass problem

Since changing to cattle and hoggets, there has developed a serious problem with barley grass. It is quite impossible to graze pasture as closely with this type of stock as with a ewe flock.

'Coulmore' is very rich, and barley grass loves this condition. I have been very reluctant to use total poisons which kill everything, but I have spent $45 per acre on Paraquat and Gesatop to try and kill barley grass patches in my hay paddocks. But there are still two or three patches surviving.

Several patches of barley grass hard grazed

This last season I noticed something which gave me cause for thought. In several paddocks, several patches of barley grass were hard grazed by the wether hoggets until such time as the wethers were delivered as fats, and what I thought to be good pasture alongside was untouched and six inches tall. The barley grass evidently carried some mineral which the sheep relished.

What I intend to do this season is to topdress these patches with salt. If this works, then maybe the stock will graze the barley grass

hard and just may control it entirely.

Coulmore is situated in salt hungry country. Possibly a salt dressing may so improve the palatability that the stock will prefer barley grass to other species.

Animal nutrition and fertiliser companies

The activities of animal nutrition and fertiliser firms such as Wonder Distributors, which claim to test soils and pastures for trace elements are causing a great deal of concern in official quarters as I write this. Yet it is a free country and there is no law that could put a stop to them.

The attitude of the Dept of Agriculture is, *"All we can do is educate the farming community on the subject. If they fall for the blandishments and claims with which they are pestered, and waste money on procedures that are unnecessary and unfruitful, then it is their own lookout."*

The Department maintains a laboratory service which undertakes the analysis of soils where it is considered it could be of use, but this service is restricted to the determination of soil pH and an estimate of the level of two or three major elements. It does not analyse soils for trace elements.

Private companies claim to do so, but reputable scientists maintain that this is impracticable.

Scientists regard soil tests of little worth

In the opinion of many scientists, even the limited range of tests the Department carry out has little worth. But the Department has never made more than modest claims for the service it provides.

Any recommendations made by Advisory Officers are founded basically upon their knowledge of the district and the management practices of successful local farmers.

Over the years, the Dept of Agriculture has frequently stressed the fact that it is not feasible, for many reasons, to test for trace elements. The same view has been expressed by numerous other authorities, perhaps the most notable in this country being Professor T. Walker of Lincoln College. This man has certainly done his best to alert farmers to the true position, not only in public addresses but in countless publications.

It might be argued that the Department has been a little backward in educating farmers in this respect, although goodness knows they have published enough warnings.

However it must be remembered that a Government Department is always reluctant to attack private enterprise, unless a law is being broken. And there is no law to protect the farmer in this matter.

Limitations of soil and pasture analysis

A further difficulty in regard to trace elements, is that it is impossible at the present time to state just what the level of trace elements is desirable, even if a soil were static or not influenced by the activities of grazing animals.

In short, practical experience, the clinical condition of the stock, their level of production, and their efficiency in reproduction remain the most reliable guides in this matter.

The mineral outgo from the farm in animal products such as wool, meat and milk, provide the most dependable indication as to the type and amount of replenishment that is necessary.

It cannot be said that this approach to soil fertility has failed. The experience of many years is ample testimony to this effect, and South Island readers in particular must be well aware of the striking improvement recently effected in animal outputs and health in the southern regions by the correction of nutritional disabilities over a wide area.

Expert opinion

Authoritative opinions condemn the *"wild and ostentatious claims"* of private soil-testing organisations.

Of special interest is the view of hundreds of Advisory Officers in Australia, who when asked point blank whether they found soil-testing to be of any help in their work, replied that it possessed no more than *"a psychological value."*

Gullible farmers who have swallowed the costly bait presented to them would hardly feel flattered if they were to regard themselves as victims of a psychological gimmick.

What was apparent in the NZ debate which lasted for years was the appalling ignorance of high ranking Departmental scientists.

Take the statement by Dr Cunningham of Wallaceville Research Station, a recognised world authority on copper, he states that there are only four trace minerals to need attention, copper, cobalt, iodine and manganese.

Obviously he has a lot of blanks in his knowledge, or my information is faulty. *"Molybdenum perhaps,"* he adds. In return I say "Baloney."

Practically every farmer in New Zealand can give him the lie. Selenium for example, is so necessary on most properties. Iron also, without which no haemoglobin can be manufactured.

Take the statement by Mr Fergus Hickey, that soil or pasture testing cannot produce information of any value in relation to animal nutrition. Again I am forced to say baloney. I agree that it is inconceivable that pasture analysis will be steady for 12 months of

the year. Of course there will be fluctuations. As an instance of this, a pasture would be unlikely to carry the same quantity of nutrients in a period of rapid growth, after heavy rain following drought, but undoubtedly it will soon return to normal.

Now I respect Mr Hickey, and think it a pity that he is not a farmer.

The long and sustained attack by a host of veterinarians has defended the use of drenches and injections They appear very reluctant to see stock so healthy that they do not require either.

Now, all of a sudden, the veterinarians, scientists and Departmental officers become all holy and indignant, and warn farmers against the use of trace minerals and the waste of money involved.

Would be amusing if it were not so serious

It really would be quite amusing if it were not so serious.

How much better for our farm lands had they known what they were about and warned farmers about the wasteful and dangerous application of minerals at the rates recommended by the Department.

90% of Coulmore lambs drafted second week in January

Coulmore ran ewes until 1967, and while I did not see the lambs at 38 lbs again, we could rely on a first draft, second week in January of 90% of the lambs available.

In the early 1950's I had three studs, Romney, Border Leicester, and Southdown. By the mid 1960's I had to give them up, as the handling of 300, two tooth rams became beyond me.

Chapter twenty-four

Report on NZ minerals and plant and animal health

By K. R. Middleton and G. S. Smith, Plant Nutrition Group, Ruakura Agricultural Research Centre.

Nutritional quality of pasture is a most important factor in managing grazing animals.

Quality measures the ability of pasture to supply the necessary digestible carbohydrates, proteins, minerals and vitamins.

This article is about the relation of chemical elements and fertiliser in plant and animal health.

Plants and animals have many similarities but some important differences in their needs for chemical elements, notably for potassium and sodium.

This is shown in the following table, which lists the concentrations of 16 elements found by chemical analysis of leaf tissue.

Element	Plants	Animals
Phosphorus	0.35 %	0.45 %
Sulphur	0.30 %	0.25 %
Chlorine	0.20 %	0.20 %
Potassium	2.20 %	0.80 %
Sodium	*	0.20 %
Magnesium	0.20%	0.15 %
Calcium	0.25%	0.60 %
Boron	25.00 ppm	*
Cobalt	*	0.10 ppm
Copper	6.00 ppm	10.00 ppm
Iodine	*	0.80 ppm
Iron	50.00 ppm	100.00 ppm
Manganese	25.00 ppm	40.00 ppm
Molybdenum	0.15 ppm	*
Selenium „	*	0.10 ppm
Zinc	17.00 ppm	50.00 ppm

* Uncertain, but relatively low.

The following generalisations can therefore be made concerning grazed pasture as an animal diet:

Concentrations of calcium, chlorine, cobalt, copper, iron, iodine, magnesium, manganese, phosphorus, selenium, sodium and zinc, which are barely sufficient for plant needs, will be insufficient for animal needs.

Concentrations of boron, molybdenum, nitrogen, potassium and sulphur which are barely sufficient for plant needs, will be more than adequate for animals.

Animals need relatively large amounts of calcium, phosphorus, sodium and chlorine as these elements are built into skeletons, or occur in large amounts in blood serum and soft tissues.

On the other hand, plants are mainly carbohydrate, so the need for skeleton-forming minerals is much lower. Also the dominant element in plant sap is potassium, not sodium.

Not all stock disorders caused by nutritional imbalance

A balanced nutrient supply promotes vigorous, hardy growth in both plants and animals, but to link dietary imbalance directly with such stock disorders as bloat, grass staggers, facial eczema, infertility, and mastitis, is an exaggeration.

Such constitutional or infectious diseases are caused more by poor management, by lack of pasture hygiene, climatic conditions, genetic factors, or the interaction of one or more factors in this list.

The case for balanced fertiliser mixtures has substance, but exaggerations of the above kind weaken the case.

Nutritional imbalance lowers resistance to disease

However, a justifiable statement is that nutritional imbalance predisposes or lowers the resistance of plants and animals to disease. Certain elements have a role in relation to some stock disorders, for instance, magnesium for grass staggers, or cobalt for bush sickness.

Replacing lost nutritional elements from pasture

Most of the loss of nutritional elements from pasture is the result of animal activity, such as removal in saleable animal products or inefficient return of excreta.

In low-producing pastoral agriculture, particularly where the stocking rate is low, many major and minor elements are released from soil reserves fast enough to make good such permanent losses from the system. These soils need only a few fertiliser elements, for example some grass-clover pastures need only a potassic superphosphate, supplying phosphorus, sulphur, potassium, calcium and indirectly, nitrogen.

High-producing systems are different for three important reasons.

1. At a high stocking rate animal losses are obviously greater.
2. Accumulated usable reserves of nutrients will have been depleted, and the rate of release from more permanent reserves is too slow to maintain high productivity.
3. At the prevailing high level of fertility in the soil and the

associated high nitrogen status, shoot per root ratios are high. A high shoot per root ratio means that the main absorbing part of the plant roots is confined to a relatively shallow surface layer of soil. This aggravates the limitations imposed by slow release of nutrients from natural sources.

Logically then, the fertiliser needs of high-producing soils should be considered in terms of complete fertiliser mixtures that will satisfy both plant and animal needs. Such needs as shown in the table above, do not coincide exactly.

Many soils deficient in elements from beginning

A mixture complete in all 16 essential elements above, would only be needed for plants grown in a sand culture. And while more and more essential elements will become deficient the longer a soil is maintained in a high-producing state, there will be sufficient reserves of many elements to last for a long time. For example, most soils contain enough iron to last indefinitely.

Nevertheless, according to their geological origin, many soils are deficient from the beginning in certain minor elements.

Research by MAF is in progress to describe pastoral regions of New Zealand in terms of sufficiencies and deficiencies of trace elements. Such work is essential, to make use of the very practical concept of balanced fertiliser mixtures.

Sodium

Sodium is an exceptional element, because to animals it is a major essential element, whereas for plants it is either not needed or only a minor or trace element.

A minor element is one whose role is fulfilled by a very small amount compared with that needed for a major element.

Many, if not most soils in New Zealand appear to be deficient in sodium for animal needs. A clear-cut picture has been obscured in the past for three reasons.

1. Large amounts of sodium chloride are deposited by sea spray in certain areas, extending in favourable circumstances, up to ten kilometres inland.
2. The ceasing of supplementing hay with salt, as the haystack has been replaced by the hay bale and barn. Also, topdressing of land with salt, which had been common practice in the past when meatworks were a cheap source of sodium chloride, has been discontinued.
3. There has been an increase in the use of potassic fertilisers in New Zealand. The potash status of the soil has an important influence on the sodium content of the plants which it supports.

Potassium depresses the uptake of sodium by plants and also accelerates leaching of sodium from the root zone.

Not surprisingly, a reduction in animal production has lately been found for all classes of stock on a sodium-deficient diet in the central plateau of the North Island.

A similar result is likely in other areas, where feed is grown on sodium-deficient soil, or where the feed comprises sodium-hating types of plant, even where enough sodium is present in the soil.

Sodium-loving and sodium-hating plants

Plants may be classified as sodium-loving (natrophilic) and sodium-hating (natrophobic).

Sodium-loving plants readily transfer sodium from root systems into the aerial parts, whereas sodium-hating plants, for reasons not fully understood at present, retain the sodium in their root systems.

Research is in progress at Ruakura Agricultural Research Centre to designate agriculturally important plants as one or other of these two types.

To date, an incomplete classification is as follows:

Sodium-loving plants. White clover, subterranean clover, lotus, cocksfoot, phalaris, ryegrass, sweet vernal, yorkshire fog, cabbage, and the beet family.

Sodium-hating plants. Red clover, lucerne, soya bean, browntop, chewings fescue, kikuyu grass, paspalum, timothy, maize, oats, and potatoes.

The presence of a number of high-yielding fodder crops in this second group is very important, and needs to be taken into consideration when deciding their suitability for grazing animals as an unsupplemented diet.

Chapter twenty-five

Effects of iodine deficiency

By C. H. Irvine, Senior Lecturer in Veterinary Science, Lincoln College 1967.

Iodine is an element like copper, cobalt, and selenium. Its importance in animal nutrition has been recognised longer than copper, cobalt or selenium but there has been some doubt about whether it is an essential trace element. Now it seems certain that it is essential.

Iodine is used in the body for only one purpose, the manufacture of thyroxine and another similar substance by the thyroid gland.

The purpose of the thyroid gland

The thyroid gland extracts iodine from the blood passing through it, normally taking out about 30%. In the gland the cells are arranged in tiny spheres, and the interior of each sphere provides a reserve storage capacity for the thyroxine formed.

When the thyroxine level in the body falls, the brain releases a substance which stimulates the thyroid cells to work harder, and then releases the stored reserves of thyroxine which travel out into the blood stream to restore the level to normal.

All this functions very well, as long as the thyroid gland receives blood with sufficient iodine in it, and the thyroid cells are efficient in their manufacturing processes.

Goitre

When because of deficiencies in either of these mechanisms the level is not restored to normal, the brain continues to send out its messenger in increasing amounts. As a result each cell works harder, and additional thyroid cells are formed, enlarging the gland in the process. This increases the efficiency of iodine extraction from the blood and the production of thyroxine.

The increase in size of the gland which results is called goitre.

In many cases, this enlarged gland is able to manufacture sufficient thyroxine for the body's needs, and a new balance is struck where the thyroxine level in blood is kept at, or very near the proper level.

This is only because the thyroid has increased in size. However the gland is working under stress and has little reserve. Thus is not as well able to cope with any increase in demand.

Often such demands do not occur, and the animal with a goitre can perform its functions reasonably efficiently. Also once the enlargement of the thyroid gland has occurred, it will remain

enlarged for many months, even if the initial cause is corrected. Therefore the presence of a goitre does not necessarily indicate any present inefficiency, but does indicate that in the not-too-distant past, thyroid function has been a problem.

Sometimes, in spite of increasing in size, the thyroid gland is not able to maintain a normal blood level of thyroxine. The animal then becomes affected in many ways, for thyroxine is necessary for the normal functioning of nearly every cell in the body.

How thyroxine works

If we look at the way thyroxine works, we will better appreciate what happens when it is deficient.

Thyroxine works in two main ways, it increases the growth rate in growing tissues, and increases the rate at which chemical processes are carried out in most cells.

The effects of a lack of thyroxine on growing animals have been clearly demonstrated by the removal of the thyroid gland in calves at 10 weeks of age. These animals grew to less than half their normal size.

The same thing has been observed in foals and lambs.

In these animals in which growth has ceased, some tissues are still actively dividing and producing new cells, mainly in the skin and reproductive system. However the deficiency in thyroxine leads to decreased function in these systems.

Effects of lack of thyroxine in adult stock show up as a decrease in milk yield, wool growth, work output, and a general sluggishness of the animal.

Other causes of goitre

Goitre can also occur when abnormal substances that stimulate the thyroid gland enter the system. In these cases the thyroid is overstimulated, even though it has been maintaining a normal output of thyroxine.

As a result the thyroid enlarges and there is an excessive output of thyroxine. Blood levels become very high. This occurs commonly in man but much less commonly in animals.

Therefore goitre can be associated with a low, normal, or high level of thyroxine in the blood, and the symptoms will vary accordingly.

However most goitre arises when the manufacture of thyroxine is reduced, usually due to inadequate amounts of iodine in the diet.

The amount of iodine in the diet will be low when animals are grazing on pasture or crops deficient in iodine, or are feeding on concentrates deficient in iodine.

Sources of iodine

A small amount of iodine is taken up by the grazing animal from

contamination of the pasture with soil, as soil is usually 5 to 20 times richer in iodine than the pasture itself.

Some iodine may be derived from water. Water obtained from deep wells may be a good source, but surface run-off, rain, glacial and snow-fed rivers are usually poor sources of iodine.

Iodine bound up by alkaline soils

With many elements there is a relationship between soil and crop concentration, but this does not occur with iodine. In fact, soils which are richest in iodine are often those in which it is most firmly bound and has therefore been unavailable to plants.

This occurs in alkaline soils. Therefore increasing the acidity of the soil will result in more iodine being released to plants. Increasing the alkalinity will bind the iodine more firmly.

Iodine concentration in pasture

Pastures containing less than 300 mcg per kg dry weight are regarded as iodine deficient, while 300 to 600 mcg is marginal.

Iodine concentration in pasture is related to growth rate, being highest when the growth is slowest.

The most important factor in determining the iodine content in pasture is the grass species (and even the strain within a species). Perennial ryegrass has about 1500 mcg per kg, italian 800, short-rotation 250, cocksfoot 100, and yorkshire fog 70.

Increasing Iodine content in pasture

In land near the sea in which the prevailing wind blows on to the land, pasture iodine is high.

Iodine content of pasture and crops can be increased by the application of iodine in various forms.

No matter in what form the iodine is taken in by the animal, it is efficiently digested and absorbed into the bloodstream.

Thiocyanate can fool the thyroid gland

As pointed out earlier, the thyroid gland takes about 30% of the iodine out of the blood passing through it. However the gland is unable to distinguish between iodine, which exists in the blood as iodide, and another pasture ingredient, thiocyanate.

If the concentration of thiocyanate in the blood is high, it will be absorbed instead of iodine, with a consequent reduction in iodine uptake. Thiocyanate is widely distributed in pasture and crops in New Zealand.

For example, linseed contains thiocyanate, which will produce goitre in sheep, so will clovers, especially white clover, and lucerne.

Even a small amount of thiocyanate can affect iodine uptake. But fortunately the goitre-producing action of thiocyanate is readily overcome by increasing the amount of iodine in the diet.

Thiouracils

As also mentioned earlier, goitre can be produced when abnormal substances that stimulate the thyroid gland enter the system.

This happens in our animals because their diet often contains substances known as thiouracils.

Brassica species are the commonest source of thiouracils in New Zealand, and many outbreaks of goitre from feeding chou-moellier, turnips or swedes have been reported.

The seeds of these plants are the richest source of thiouracils, but they are also found in the foliage and roots.

Some plants, such as the cabbage family contain both thiocyanate and thiouracil, for example thousand-headed kale.

Thiouracil does reduce the iodine uptake of the thyroid gland but prevents it from using its iodine.

Consequently iodine is of little or no value in the prevention or treatment of this type of goitre.

Unfortunately little data is available on the concentration of thiouracils in these plants, or on the factors which affect this.

Most stock loss occurs during six weeks before birth

Before concluding, I would like to emphasise that the thyroxine requirement of an animal is at its maximum in the last six weeks or so before it is born.

For this reason, most losses occur in animals which die before birth and are subsequently aborted.

Chapter twenty-six

Effects of lime on soil acidity

By Mr C. C. McLeod

It has long been recognised, that at certain levels of soil acidity, the application of lime can raise soil fertility.

The result is improved pasture production, stock numbers and crop yields.

Lime can also improve the structure of heavy soils and make their cultivation easier.

Lime can decrease availability of plant minerals

On the other hand, what is often not realised, is that liming can decrease the availability of many essential plant minerals, such as boron, iron, zinc, copper, manganese and magnesium.

Because a good response to lime is obtained when farm improvement is commencing, it does not follow that continued heavy application of lime will necessarily be beneficial.

In South Canterbury, the aim should be to maintain soil pH in the 5.8 to 6.2 range. On most of the district's soils, 2.5 tonnes of lime per ha will raise pH by 0.4 to 0.6.

Where the original pH is less than 5.4, raising it to the recommended range can usually be achieved by applying 5 tonnes lime/ha.

Where the pH is above 5.4, with 2.5 tonnes lime/ha.

Under South Canterbury's soil and climatic conditions, soil pH is maintained at adequate levels for a considerable number of years after topdressing. This means that once soil pH has been raised to the recommended range, it can be held at this level by applying no more than 2.5 tonnes lime/ha every six or seven years.

Over liming

It is evident from the numerous local soil tests with pH values over 6.2, and often between 6.6 and 7.2 that many South Canterbury farmers have been exceeding this recommendation.

Too much lime brings the risk of soil fertility problems such as deficiencies of boron, manganese, zinc molybdenum, and increasing the need for phosphate through its fixation on lime pellets.

Because of over liming, a number of soil fertility problems are occurring in South Canterbury.

Molybdenum

South Canterbury fertiliser trials have shown molybdenum to be widely deficient. So many good responses to molybdenum on pasture, lucerne and brassica crops have been obtained, that the

application of sodium molybdate is recommended approximately every six years.

One of the important functions of lime is to increase the availability of molybdenum. Unfortunately, when lime and molybdenum are applied together, or if the soil pH level is high when molybdenum is applied, the rate of molybdenum uptake by plants is accelerated.

For example, below are the results of a molybdenum trial on Timaru silt loam, measuring the ppm of molybdenum in herbage.

Molybdenum trial on Timaru silt loam

Molybdenum applied	No lime (pH 6.1)	2.5 tonnes lime per ha (pH 6.6)
No molybdenum	.23 ppm	.27 ppm
87 g per ha	1.13 ppm	1.42 ppm
175 g per ha	1.62 ppm	2.66 ppm
350 g per ha	3.20 ppm	4.86 ppm

These results show that, with high pH levels, applied molybdenum is used up more rapidly through increased plant uptake, stock transfer, and by leaching.

Also the rate of molybdenum depletion is increased, and molybdate has to be applied more frequently.

Risk of copper deficiency

In addition, an excessive release of molybdenum through heavy liming may increase molybdenum concentration in the herbage to the detriment of animal health, for example the occurrence of molybdenum induced copper deficiency. For this reason care should be taken not to overlime or apply molybdenum too often.

Lime-induced zinc deficiency

In recent years, numerous farmers at Waitohi near Pleasant Point have encountered problems in pasture growth.

Newly sown pasture usually established well, but at the height of 5 to 6 cm the ryegrass often went brown-black at the tips, grew poorly and sometimes died, while white clover often had poor and patchy establishment.

In numerous paddocks, large areas of unproductive pasture were evident and the amount of feed which should have been available was considerably reduced.

Trials carried out showed that all affected areas had high soil pH, for example 7.2, and that plant mortality and poor pasture growth were due to lime-induced zinc deficiency.

This was overcome by applying 10 kg/ha of zinc sulphate as a foliar spray. Below is example:

Zinc trial on Waitohi silt loam

	No spray	Zinc treated	Paddock 3*
Soil pH	7.2	7.2	6.6
Soil zinc (ppm)	0.84	1.22	0.79
Ryegrass zinc (ppm)	15	18	18
Pasture production (kg dry matter/ha)	1390	2640	2980

(*Paddock 3 topdressed with 375 kg/ha sulphate of ammonia).

Extremely marked responses to zinc sulphate were seen a week after spraying. Sprayed plots showed a marked improvement in perennial ryegrass height, density and vigour, with plants dark green and very leafy.

These results confirmed that induced zinc deficiency was the problem and that herbage levels of zinc below approximately 16 ppm are associated with pasture ill-thrift.

Sulphate of ammonia reduces soil pH

In paddock 3 the application of 375 kg/ha sulphate of ammonia reduced soil pH from 7.2 to 6.6. This raised zinc levels in the herbage and improved pasture production.

The results indicated that zinc deficiency could be overcome by applying high rates of zinc, or by using low rates and reducing soil pH by applying fertilisers such as sulphate of ammonia.

Waitohi soils may be borderline for zinc and therefore may not require a marked increase in soil pH to cause deficiencies of this element. However the results described highlight the need for more prudent application of lime on Waitohi and possibly on a much wider range of soils.

Whether or not excessive liming is causing zinc deficiency on soils other than at Waitohi is at present being investigated.

Manganese deficiency showing up in wheat crops

Manganese deficiency in wheat is recognised in parts of Canterbury, particularly on sandy soils in a dry spring.

Crop symptoms are the appearance of pale olive to yellow patches, with plants soft in texture, stunted in growth, and tending to collapse.

On sandy soils, the deficiency can be caused by liming.

For example, marked symptoms were seen in a wheat paddock on Rangitata Island. This paddock had previously been divided into both lucerne and pasture.

The lucerne section had received 5 tonnes lime/ha over the

previous six years, while the pasture section had received only a little lime.

Analysis showed that the high lime lucerne section had a high soil pH compared with the pasture section, and low levels of manganese in both soil and plants.

As a result, when 20 kg /ha of manganese sulphate was applied to unthrifty wheat plants in the lucerne section, marked differences were observed within three weeks, and marked increases in grain yield were obtained.

Manganese trial - Rangitata Island

Previously	pH	Manganese ppm		Yield (tonnes /ha)
		Soil	Wheat Plants	
Lucerne	7.2	11	15	1.62
Pasture	5.7	21	54	3.62

The results indicate that on sandy soils care should be taken not to induce manganese deficiency by applying too much lime.

Reduced pasture growth by over-liming

In other South Canterbury investigations, for example on the downs, the application of more than 2.5 tonnes lime/ha at pH above 5.8 has often reduced pasture growth.

For example, consider this rate of lime trial on Timaru silt loam on a soil of pH 6.1.

Lime trial on Timaru silt loam

Lime applied 1973 (tonnes/ha)	Dry matter yields (kg/ha) 1976
No lime	8640
1.25	8340
2.50	8440
5.00	7940

Such yield drops may be due to factors such as marginal zinc deficiency, the fixation of phosphate on lime pellets, or some plants may not grow well on lime rich soils.

Low pH soils benefit most from liming

Despite large quantities of lime being quarried and topdressed in South Canterbury since the 1930s, many parts of the district would still benefit from liming. This is particularly true of land that is being developed, has a low pH, and hasn't previously been limed.

Unfortunately, because of the topography of much of the land which would benefit from liming, the application of lime is often economically impracticable.

On the other hand, there is much land in South Canterbury that is being limed too often.

Too many farmers seem to consider that if one or two applications of lime give good results, frequent liming will have a cumulative beneficial effect. The idea that one cannot have too much of a good thing. This concept is probably encouraged by lime cartage and application being subsidised.

Liming once every six to seven years usually sufficient

It is obvious, that although soils can benefit from liming, excessive amounts can cause problems.

It should be remembered that under South Canterbury's mostly low rainfall conditions, lime will have a considerable residual effect, usually lasting at least five to seven years. This means that lime need not be applied more frequently than once every six to seven years.

So therefore, because of the costs involved and the disadvantages of over-liming, more prudent application of lime is required.

Two further points from myself to the above

Congratulations to Mr McLeod. There can be little doubt that he is on right lines. Surpluses of any kind are very wrong in our soils. We must concentrate on the usable amount of mineral and so avoid the interference with the supply and availability of other minerals.

Just two further points: Lime is well known to sink quite rapidly in soil. On clay downs in particular this is very important in the storage of moisture. On Coulmore in 1932, downs we ploughed at 4" to 5" turned up a lot of clay. One inch of rain and we had a flood, a fortnight of dry weather and there was a drought.

With the addition of 4 tons of lime per acre in the late 1930's and early 1940's, today that ground can be ploughed at a depth of 15" and not show as much clay as before. It will take 4" of rain and nothing will run down the gullies. Give it 6 weeks of sunshine and it will just grow faster than ever.

Optimum soil pH is 5.8 in my opinion

The second point: The pH recommended by the Dept of Agriculture has been for many years 6.3 to 6.6. I notice Mr McLeod has settled for 6.2. I would place 5.8 as better from a stock raising point of view.

One thing I do notice, there does seem to be a new breed of farm advisers about. I notice many of the younger men are very interested in experiments. I for one cheer them on. Nothing but good can result.

Also please remember the old saying, *"Lime without fertiliser, makes both farm and farmer poor."*

Chapter twenty-seven

More interesting research findings

The Cawthron Research Institute at Nelson

New Zealand Farmer, June 9th, 1977, by Colin Little.

For over 50 years the Cawthron Institute at Nelson has notably contributed to agricultural research in NZ, especially when the original bequest of its founder effectively doubled.

Now, after an impressive record of solving many agricultural problems, Cawthron is moving into a new field – the microbial and biochemical transformations of organic materials, both natural and man-made.

One pressing need is to find out more about the relationship between microbes and the enrichment of lake water. Using the latest techniques, the mechanisms of the breakdown of organic matter and the cycling of nutrients in lake water will be explored.

An interesting feature is the possible transference of resistance to antibiotics from bacteria which have developed this dangerous character in the complex environment of sewage.

Other work on waste products include the microbial degrading of bark and whey into useful by-products.

Also a modern research issue financed by a grant from the New Zealand Energy Research and Development Committee is energy production from wastes by fermentation, to produce alcohol and methane.

The Institute helps support itself by a section devoted to servicing industry and local authorities. Their work ranges from analyses, to process studies for fruit, forestry, food, hops, wine, pine needles, water testing, pesticide residues and environmental impact reports.

Hairy Shaker Disease

NZ Agricultural Science, Vol. 10 (2):62, May 1976, by R. H. Thornton.

Hairy Shaker Disease is the expressive name for a virus attacking lambs which affects their birth coat and causes trembling and other symptoms.

The disease is one of a group of mucosal viruses which are found in the UK and USA and beginning to cause increasing concern in Australia where it has been discovered in recent years.

Mucosal disease typically attacks maiden ewes, causing up to 100% foetal death or abortion if the onset occurs in early pregnancy.

If the ewe gets it later in pregnancy, her lamb may be born, but it

is usually unthrifty. It is suspected that this disease may be the cause of the 'weak lamb mis-mothering syndrome' which field workers often blame for many lamb deaths.

The different strains of the disease vary considerably in their effect. The deadliest strain would make itself obvious to the farmers by a high casualty rate. But when milder strains are present the farmer may not notice them because all he sees are a few dry ewes.

A particularly disturbing feature is that apparently cattle can be affected by the same disease, and can transfer it to sheep.

In an infected flock, young ewes carrying their first lambs are probably most at risk because older sheep may have become immune.

Vaccination against the disease is possible (and is carried out for cattle in USA) but in Australia it has not yet been decided whether the losses are sufficient to justify the cost.

I believe Hairy Shaker Disease may be caused by Iodine deficiency

This description is almost the perfect description of iodine deficiency. There is only one further thing which does occur with lack of both iodine and zinc – deformities, malformed progeny, and hairless calves.

I would recommend trial drenching, both pre-tup* and pre-lamb, with at the very least, iodine and zinc.

Considering that this concerns breeding, go further and use the whole mix – magnesium, selenium, zinc and iodine as I recommend.

Iodine deficiency, if my information is correct, first appeared in horses on the Taieri*. In the earlier days when Dunedin City Services were all horse drawn, the Taieri was a breeding area of Clydesdales. Foals were dying too regularly. It seemed impossible to get them to suck the mares.

It was found that a couple of doses of iodine to the mares in late pregnancy acted well. All foals were on their feet promptly and just as prompt to suck the mare.

These foals made a demand on the mare for iodine in the late stage of pregnancy sufficient to form a swollen thyroid. If sufficient iodine was still not available, the foal would die and be aborted.

---

* Pre-tup means 'before putting ewes to the ram.' Tupping is another name for mating.

* A coastal region just south of Dunedin.

Chapter twenty-eight

Summary of my findings

So here is a summary of my findings:

(a) If farming is to survive for another thousand years, we farmers must play put and take with the soil. We must restore what we take out from the soil.

(b) Intestinal worms do not become a menace in stock health until nutrition fails.

(c) The dry ewe problem which exists in our flocks can be resolved very simply.

Mineral replacement

In regard to (a), there is no crop grown which cannot be analysed on a property which produces five fat lambs per acre, and one fat ewe.

If the production is burnt, the residue will be mineral content.

Some surprising results will be revealed. If the highest figure of 90% loss is taken, we see a gross output per acre of five lambs at 70lbs live weight, one fat ewe at 120 lbs, five fleeces at 10 lbs. A total of – lambs 350 lbs, one ewe 120 lbs, wool 50 lbs per acre.

The minerals to be replaced must be spread among not less than 24 minerals in various proportions.

Even allowing reasonable mineral losses from leaching, based on rainfall, and with special allowance for irrigated areas, I wonder just how much superphosphate and lime we are wasting. Quite obviously we are not sending it all down the road in grassland production.

If it doesn't go down the road to the freezing works, or down the creek to the sea, then it stays on the farm and builds up undesirable surpluses in the soil.

Worm drench rates

With (b), the worm problem, in the case of young stock which are vulnerable to attack, this becomes noticeable with scouring. To me this proves that the worms are drawing off more blood through the bowel than the lamb is manufacturing. Unless action is taken, deaths are due to occur.

By all means give a worm drench, there are brands which are quite good, but don't stop there, you can be certain that those lambs will not thrive until they manufacture more haemoglobin or red cells in the blood.

In view of the widespread iodine deficiency, I would recommend a

follow-up drench in four days of 4 ozs potassium iodide and 8 ozs zinc sulphate. Put into a hot water solution and build up to one gallon. When it has cooled down, add 2000 ccs of selenium.

The drench rate is 5 cc. Don't starve beforehand as with other nutrition drenches, better utilisation will be obtained into a full stomach, as the mineral will remain in the digestive system for a longer period.

Blood-building drench

Then to ensure the manufacture of haemoglobin, take this mix, 2 lbs sulphate of iron, 1 lb bluestone, l oz cobalt, and 1¼ bottles of Blue Brand selenium (4 to 1 strength).

Dissolve the three powdered minerals in solution and build to 5 gallons. When cool, add 3000 ccs of the selenium. Use plastic or earthenware containers.

Drench 7 days after the worm drench. Again no starving. Drench rate is 15 ccs or ½ oz for weaned lambs. Enough here for 1600 drenches. Give not less than three drenches at 10 days intervals. Judge the results at 30 days.

This drench rate is graduated. About March and April they would require 1 oz. Adult sheep 2 ozs.

This drench has the great advantage that it is dirt cheap and very good. I don't think anyone will argue that proprietary drenches are not cheap. Now to move on to the situation where sheep or lambs should not be drenched.

The sheep is the natural host of the worm, and under high nutrition, worms can render service to the sheep rather than be a menace. Under high nutrition, if we kill the worm we could endanger the life of the lamb from high blood pressure.

Experiment using rape plants to supply copper

By far the best acceptor of copper which I have noted in my experiments is the rape plant.

I print here the results of an experiment at Oamaru where 60 acres of rape was sown. Three 20 acre blocks sown at fortnightly intervals. Half of each 20 acre block was given 6 lbs of bluestone per acre as an extra dressing.

1360 lambs were put through the race and drafted one each way, 680 lambs per side.

I arranged for the lambs who were to feed on the bluestone-dressed rape plants to go on to the feed without drenching, claiming they would need all their worms to save their lives. I expected them to thrive.

The lambs to be fed on the non-bluestone dressed rape were all drenched.

After 3 weeks feeding on the rape, a draft was taken:

Bluestone lambs	180 at 38.8 lbs.
Non-bluestone lambs	120 at 38.2 lbs.

After 5 weeks another draft was taken.

Bluestone lambs	482 at 43.6 lbs.
Non-bluestone	106 at 31.2 lbs.

At this stage half left. The non-bluestone lambs, 452 in number, ate all of their rape and had to be put on to the bluestone rape to get them to the works.

It is quite apparent that this would have been a better trial still, had the lambs been drafted off the mothers.

I would recommend rape growers use bluestone under rape. Any who doubt can easily prove this for themselves by a similar experiment to that used above.

Overcoming the dry ewe problem

(c) Now we come to the dry ewe problem. An awful lot of baloney is being talked about the dry ewe problem. The claim is made that the all important thing is body weight of the ewe.

I disagree. I think dairy-men and experienced flockmasters alike will agree that it is a rarity that an overfat cow, 4 feet across the hips, will either have the best calf or give much milk. They put the nutrition on their own backs instead.

Similarly, a tallow-backed ewe with 3 inches of fat on the rump rarely produces a decent lamb, and if she produces twins they will likely be runts. These ewes also have a very short lactation period.

No, for good breeders, give me a roomy female in reasonable order, rising in condition when mated.

Magnesium cured staggers and infertility

To me the lambing percentage in New Zealand is very poor. The reason is not far to seek. Among my experiments I have certainly had some surprises. Here is the first surprise.

I had 600 ewes in trouble with staggers. Over the fence were the rams. The date was the end of March. The ewes should have been in season, but there were no ewes on the fence-line, and no rams showing any interest.

In desperation, I put the plane over them and sowed 12 lbs of magnesium sulphate, or Epsom salts, per acre. The results were magic so far as the staggers was concerned, but better still, on the third morning not less than 200 of these ewes were lined up to the fence, with the rams fighting on the other side.

Epsom salts have also been tried on a breeding herd with similar results.

Selenium and iodine can greatly improve fertility

These results led me to the belief that the whole business revolved round the hormone production of the female.

In the last 16 years I have come across several things which confirm this. It is obvious that the rams are powerless to put ewes in lamb if the ewe does not come in season properly.

Also, this testing which is being done on the ovulation and conception rate of ewes doesn't go far enough. It fails to register the abortion rate which follows conception quite quickly with unhealthy hormone production by the female.

There are at least four minerals concerned. Selenium on some properties plays an important role in hormone production. One station owner has told me that a pre-tup drench of selenium changes his lambing percentage from about 25% to round 100%.

A nearby neighbour with 2000 ewes, a high lambing property in the 130% to 140% range tells me that drenching with iodine alone, pre-tup and pre-lamb, his weaning rate is substantially up. He no longer has those mis-mothered twins who refuse to suck the ewe and are cast off.

Startling results fertility increases on my son's properties

In 1967 my two sons took over land on their own account. One a block of 900 acres on Raincliff. The other a tussock block. We initially bought in ewes with the intention of breeding a standard flock.

On the Raincliff property, halfbred ewes were put to Border Romney rams and then to Corriedale. In the five years it took to get a mixed age flock established it became apparent that the lambing percentage was settling down to a low 66%.

I advised a try with a pre-tup drench of magnesium, selenium and iodine. The last two lambings have risen to a satisfactory figure. In 1975, 106% and 1976, (a wet spring) 104%.

On the tussock block, Merino ewes were put to Border Leicester rams. When the Border halfbred flock was established and bred to 1st Cross Border Merino rams we had a similar picture. The lambing ranged from 68% to 71%.

The pre-tup and pre-lamb drench used here has been iodine and selenium.

The lambing figures show. 1975 lambing, 111% and 1976, 106%. More lambs born in 1976, but also more storms.

So here we see, by a simple pre-tup drench, over 50% more lambs. On the 3000 ewes involved we gain over 1000 extra lambs.

Zinc added to mineral complex for rams

Then finally we have zinc. Zinc is claimed to be very important in

the semen of the male, and also in the healthy growth of the foetus after conception.

At the time this drenching was started, our understanding of zinc was in its infancy. This season a neighbour with 1400 ewes is following the Raincliff programme.

I myself have arranged for an additional 4000 ewes to be pre-tupped and pre-lamb drenched with the total mineral complex this season.

Time did not permit the inclusion of the rams. To be effective a start should be made on the rams about 2 months before season.

Again, the iodine, selenium and zinc should be used about 10 days before the rams go out. Epsom salts will give best results 3 days before tupping. Both ewes and rams were drenched 3 days before tupping.

This is early days to release this information, but any action which can show such startling results as we have to report, is in my opinion too important to hide until we are certain, and may well make a contribution to offset those ever rising costs which are plaguing our industry.

Where the lambing percentage is too low, I recommend its use. It's dirt cheap and will prove itself.

Ewe fertility drench

Mix for 1000 ewes:

10 ozs potassium iodide.
20 ozs zinc sulphate.
20 ozs Epsom salts.
8 bottles selenium (3000 cc at sheep strength or 1½ bottles of the Blue Brand 4 to 1).

Dissolve the powdered minerals into hot water solution.
When cool, add the selenium. Build to 1½ gallons.
The drench rate is 7cc. Again no starving.

This drench should be repeated 3 weeks before lambing. If the ewes have been wintered on lucerne or lucerne hay, it may be necessary to drench with potassium iodide 6 weeks before lambing as an additional drench, to prevent abortion.

It is in the last 6 weeks that the lamb makes the greatest call on the ewe for iodine. If the ewe cannot provide sufficient iodine the lamb dies and is aborted.

The iodine drench rate is 1 oz potassium iodide to 500 cc of water.
Drench rate 5 ccs. No starving.

My apologies to flockmasters for too early a release of this information, but perhaps I will be forgiven.

The use of these four minerals has already been explained. I cannot overemphasise their importance.

Zinc treatment for rams

I hope in the coming season to give the rams the full treatment, starting two months before season. One drench of the four minerals. Then a weekly drench of 10 ccs of zinc, until a fortnight before they go out.

At this point I will give another drench of the four minerals and also, one week before they go out, give the zinc again. This should greatly enhance the ability of the rams to deliver live semen to the ewe.

This drench does not store very well. Iodine is volatile and is apt to deteriorate. So try to use it as soon as cool, and when stock stomachs' are full.

Common salt on pasture

The application of common salt on pasture is a programme yet to be tried out. I still have quite a bit of work to do on this matter.

Chapter twenty-nine

Setting a healthy soil standard using a spectrometer

My work unacceptable to Department

Recently, I was approached by a Departmental officer and asked "if I would be prepared to do further experiments along the lines which I had followed."

When I replied that I would do so, but that I had done this work 30 years ago and could see little purpose in repeating it, I was told quite clearly that my work was unacceptable to the Department because of my lack of controls.

What more do these innocents want? They have available to them:

1. A killing sheet from 2600 wether hoggets, obtained without drenching.

2. A killing sheet from 1679 lambs killed off the mothers without drenching. Every lamb killed at 38.6 lbs. (Nine years of turning 2000 tiddler carryover lambs into fat sheep after 8 months.)

3. 3000 ewes with a lambing average of 67% and a dry-dry ewe* problem of 1000 ewes. The lambing raised to an average 105% and the disappearance of the drys by just a simple drench pre-tup.

What a load of nonsense, and in my view just an excuse for Departmental shortcomings.

To qualify for acceptance by the Department ,I would need to have kept at least 100 tiddler lambs untreated and allow 50% of them to die, and 50 culls kept. The cost, borne by me, not less than $2000 a year. In the case of the dry-dry ewes, not less than 100 in each mob left untreated. The cost to a farmer, $400 per year.

These Departmental officers put their chests out a bit and are delighted, provided the farmer pays for all their mistakes.

Now, all of a sudden, there is great activity among Departmental officers on mineral research. What a pity they could not have been convinced of the need for this 30 years ago. If so they would have been welcome to these findings, and would have done the job they are paid to do, for the benefit of farming and land utilisation.

Bankrupting our soil

The soil, our great store house of mineral wealth, is being crucified by soil development methods as practised today. By ignoring the

* Dry-dry ewes are ewes that have never had a lamb.

trace minerals (which are a vital part of production) the recommendations of our Dept of Agriculture in so called 'land development' are drawing on our capital reserves of trace minerals, in other words, using up our capital.

I do not know of any business on earth which can afford to live on capital.

If present practices continue, we will drain our soil bank of its riches in trace minerals. Sooner or later that capital will disappear and bankruptcy will result. The punishment will be disastrous to animal and man.

The striking thing about this whole investigation from a farmer's point of view, is that when challenged by a mere farmer, the Dept of Agriculture, the people who induced farmers to try to grow two blades of grass where one grew before, have not yet attempted to answer any of the accusations which have been made. They have simply hidden behind the veterinarians.

Also, equally striking, this is a world wide problem.

We need to set a health-giving soil standard

It amazes me that nowhere in the world has any worthwhile attempt been made to set a health-giving standard of mineral content of the soil to work towards.

The old dynasties created their own dust bowls by cropping the city surrounds until the soils were drained of essential nutrients and humus. They finally disintegrated and those old cities were buried.

Today we have perhaps a more civilised method, under the disguise of land development. Sacrificing long-term prosperity for a short-term spectacular increase of production.

We have a system which chooses to ignore essential minerals known as trace minerals, and advises farmers to rape the soil.

I have talked all round the mulberry bush, but feel it is necessary to summarise and pull the whole concept together.

The Aim – "To obtain and maintain a mineral balance suitable to stock health and human health."

We must first establish a standard. This can be done by careful and complete analyses of high-producing areas, the soils, the plants, the milk of the ewes, and finally to burn a healthy carcase and analyse the balance of minerals contained by the animal concerned.

By this means we can establish, not only the minerals required, but also the optimum ratios of the various minerals concerned.

A Spectrometer can do this work

The DSIR MS30 Spectrometer located at the Lower Hutt DSIR can

do this work.

Many people think that because of the wide variations of soil types in New Zealand, that such a project has little value.

I challenge this thought, because by simple arithmetic we can establish the amount of minerals sent down the road.

If just one lamb is analysed, 5 lambs per acre would require 5 times the amount of mineral.

Here then, with suitable allowances made for leaching, based on rainfall, and special attention paid to irrigated areas, we can establish a system where the farmer can play put and take with the soil, and so maintain, long term, the mineral balance which is so necessary to health, both animal and human.

Setting a mineral standard with a Spectrometer

I have used all the trace minerals that we know about at this point to be necessary to stock health. But being only a mere farmer I can now make little further progress without technical help.

This remarkable machine, the MS30 spectrometer, under the control of the DSIR in Wellington is just what we need for further research to establish the optimum balance of mineral in stock health.

I will certainly be asking the DSIR for help in trying to set a standard in the mineral content.

In my opinion, it seems a pity that as reported recently in the Timaru Herald, a machine of this quality should be used to test deer antlers to see if there is any residue from the narcotic darts which are used to put the stag to sleep so that he can be robbed of the velvet from his antlers. Quite frankly I do not care whether those amorous gentlemen of the East become sleepy or frisky when they use the aphrodisiacs manufactured from the velvet.

Why the fantastic returns from red tussock soil?

What I would like to do, is to try to measure the goodness of our soils. For example, around 1950 some areas in Southland which had been ploughed out of the red tussock, were given 2 tons of lime and planted in swedes. These swedes were then ploughed in and the soil was then given a further 2 tons of lime and finally sown out to pasture.

This pasture gave fantastic returns for a period of from 10 to 15 years. Five to six ewes per acre, around 145% lambing percentage, and most killed off the mothers at 43 lbs.

Now I would like to know what those sheep got in their pasture. This was the alpha and omega of production. I am sure most sheep farmers would also be pleased to know.

Since those 10 to 15 golden years, lambing percentage has

dropped to about 100%, and despite careful shepherding and plenty of drenches they kill at only around 28 lbs.

But by soil testing, testing of plants, and analyses of the milk of the ewes, this spectrometer could have established just what those lambs got.

And by comparing with the more recent period, it could also find out what has gone wrong.

I also know of a small paddock in Marlborough where the lambs are first away at around 43 lbs. By this means I believe we can establish a standard to work towards.

If I can obtain the co-operation of the DSIR in full access to the MS30 Spectrometer, I would like to try and establish a standard of mineralisation for our soils.

This would take at least two years. One year to experiment, and one year to confirm the correct ratio of minerals and the plants necessary to act as conveyers from the soil to the animal.

This work is a must as far as the long term future of farming is concerned.

Mineral content of animals

As far as the mineral content of an animal is concerned, I have been given all sorts of figures. From 73% fluid up to as high as 90%, leaving a dry mineral content ranging from 27% to 10%.

Many minerals fight

A blanket application of all necessary minerals may cause quite dramatic activity in the soil. Many of the minerals will fight. While the fight goes on, the minerals will however be active.

There is no need to have any concern until the fight is over.

Health-giving bacteria will live and thrive

Such a project, carried on year after year, will not only maintain a mineral content in the soil suitable to stock health and human health, but also create conditions where the health-giving bacteria will live and thrive and give protection against bacterial disease.

The restoration of the bacterial population of the soil will take time, but progressively the stock health will improve.

Substantial financial savings will be made

The amount of mineral required is very small and substantial financial savings will be made.

Also the drenching recommendations, if followed, will give very pleasing results and save a lot of money.

Remember farmers, there is a bit of work involved, but '*money saved is money earned*.' This is important in our industry which is plagued by ever-rising costs.

Chapter thirty

I heal my own heart disease with minerals

The health problems in the animal world have no doubt a parallel in human health.

Careless and costly health policies have created a huge health bill in all countries. $85.000,000 million dollars for drugs* with a population of only 3 million is New Zealand's share.

The drug companies doubtless pay excellent dividends.

Now we must move to the question of the relevance of this mineral business to human health.

Surely we are products of the soil. It seems logical to believe that if a paddock reaches the point where the pasture will not sustain life in animals, it would not be wise to plough this paddock and grow vegetables for human consumption.

The results could and would be quite disastrous to health.

I see a mighty sick society nowadays

I am an oldie now and while I do not have vivid memories of the early war years of 1914-1918 war, my memories are still quite vivid from the time I first went to Timaru Boys High in 1920.

Let's take the period from 1920 to 1930 and compare our society of today with that of that period. I must admit that I am shocked by what I see, for I see a mighty sick society.

Far too many mentally and physically handicapped children being born. Shocking figures on defective ears in school children.

Then we have the alarming increase in heart disease and cancer, the two big killers.

Finally a drug bill of 85 million dollars, as palliatives for a population of 3 million. Going some aren't we? Surely something is very wrong in our health, both mental and physical.

Yet all of this is paralleled in the animal field. A huge bill for drenches, and injections for this and that health disorder.

My own sorry health record

I will now tell you the story of what happened to me personally, and try to explain why, as a farmer, I have the temerity to broach the subject of human health.

I left school in 1923, and being a keen footballer gave up smoking to help my wind.

Then I broke my nose, and had an operation in 1932. After that I

* This has increased to about 600 million in 2005.

started smoking again, to ease headaches following the operation, and I have spent the rest of the time trying to make up for the years I gave up smoking.*

Appendicitis operation in 1932 also. Broken shoulder in 1934, (football again). Two operations on the shoulder in 1935 and again in 1940. Lost my teeth in 1940.

Blackouts for 20 years

In 1952 had three blackouts in one day while mustering. Perhaps I should have started pushing up daisies at that stage. A duodenal ulcer was blamed for this.

The blackouts continued until 1956, gradually getting closer together. I had the duodenal operation in 1956. Ruptured the incision 7 months after the operation. Put up with the same until 1967. Had a repair job done but it was unsuccessful.

Blackouts continued. In 1969 I had the cartilege removed from my left knee, and my right knee in 1970. By this time the blackouts were becoming so frequent that any excitement or hurrying caused me to flop over.

My friends were rather reluctant to play golf with me as they claimed I was too heavy to lug back to the clubhouse. I was pronounced dead on three occasions between 1970 and 1972.

In October 1972 my wife took me to Timaru hospital and demanded, *"He's to stay here until you find out what's wrong with him."*

I was put in intensive care for 3 days, then pronounced fit and well and put in a ward to be sent home. Dr Hawes came along and said, "How are you this morning?"

"Fine, thanks," said I.

He put a stethoscope on me and said, "Good God, this fellow shouldn't be here. He should be in Greenlane, and a good while ago too by the sound of it."

Many thanks to Dr Hawes. I had been under various doctors since 1952 and he was the first to find the trouble.

When a bed was available I went to Princess Margaret hospital in Christchurch and after testing of all sorts I was sent on to Greenlane in Auckland. I was marked as so critical that I was loaded on the plane by fork lift and also unloaded by the same means.

I lose 3 stone in hospital then have my operation

The Greenlane team decided I was far too heavy at 17½ stone*

* Brown Trotter regularly smoked about 500 roll your own cigarettes every week from this point on, which makes the story of his heart healing all the more impressive. In 1932 Brown Trotter would be aged 25.

* 111 kgs or 245 lbs.

and told me that for my height I should be 10 stone.

"Can't be done," said I. "I'll have you know that when I was 19 years of age I played football at 14 stone and was fit enough to go for 80 minutes in any company. If and when you blokes get me down to 10 stone, you'll only have the bones left and nothing to tie them together with."

However, from the first week in November 1972 I was put on a diet of 600 calories daily. By the 11th January 1973 I was down to 14 stone 2 lb and I had my operation.

It was a perfect take and I came home to Fairlie on the 25th January, 1973.

During that long two month period of waiting to have the operation done, it was only good company in the ward and a daily visit from my wife that made it bearable.

I had to smoke a pipe in hospital

It always annoyed me to have various doctors come into the ward and demand, "No smoking," while puffing away at a pipe.

I had them on to such an extent by saying "Surely this is a case of 'Don't do as I do. Do as I say." Finally I was allowed to smoke, provided I smoked a pipe.

Poor recovery – I was turning into a cabbage

On arrival home I had a very poor recovery period for about four months. I couldn't read. As soon as I tried I dozed off, about two lines and I fell asleep. Then in about a minute I would wake and try again. But it would be a repeat of what happened.

So I gave up and didn't even read my mail. This was an existence that I came to dread. I realised I was turning into a cabbage.

I begin taking magnesium, zinc, selenium and iodine

After about six months of this, at the end of July 1973, I determined to try the minerals which had proved so successful on the animals I was handling.

So I took a pinch of Epsom salts* in the first cup of tea in the morning (a tonic as old as the hills and regularly used by our grandparents).

Then zinc sulphate after, or with the mid-day meal. One of the oldest minerals known and used in medicine.

Selenium, one of the newer elements, I took this every night to tone up my muscular action.

Iodine, necessary in the production of thyroxine (to be handled with care, easy to overdo) I took only once a month.

* Magnesium sulphate.

The results of taking these minerals became apparent some time later.

I wean myself off digoxin

So far as drugs were concerned, I was told in Auckland to take one digoxin* tablet daily and warned to go steady on alcohol, as it was unwise to take a drug to steady things down, and then take alcohol to speed things up.

I have some appreciation and sympathy for druggies who try to give up, as about a year later, when told to drop the digoxin tablet, I found that by about 9.30 in the morning my knees would knock when I tried to go without even this one tablet daily.

It took 6 months to wean myself. I accomplished this by cutting the tablet in half for about 3 months, and then reducing to ¼ of a tablet for three months.

I was required to report annually to Princess Margaret Hospital for tests. I received notice to report in September 1973.

Many will be familiar with the procedure. Firstly an X-ray, followed by a cardiograph. Then a meeting with your doctor for instruction. Dr Hull in my case. Dr Hull on that occasion said, "I will see you again in 12 months."

I said, "No, you will see me when you send me the next notice."

"I'm blowed if your heart hasn't returned to normal!"

The next notice to report came on the 5th April 1975. The same procedure was followed.

Dr Hull came into the surgery and said, "What the devil have you been up to? You came to us late October 1972 with a badly ruptured heart, very much enlarged, and after investigation we sent you to Auckland to get a new valve, which you had to have to survive. There is your X-ray."

"In September 1973 you report back and we are very pleased with you. We have held the situation, and this is all the Medical Association hope to do. Here is the X-ray.

Now you come to us on 5th April 1975 and you give us a perfect cardiograph, and I'm blowed if your heart hasn't returned to normal! It has never been known in medical history. Now what have you been doing?"

"Well," I said, "if you must know, I have just been taking what I would give my sheep if they were crook."

And I explained the four minerals (magnesium, zinc, selenium and iodine).

---

* Digoxin is a drug that increases the amount of Calcium in a weak heart muscle and causes it to beat stronger.

He replied, “Well it all sounds like baloney to me, but I concede that it has worked in your case.”

My last visit to Princess Margaret was in January of this year, 1978. The report was a repetition of that of 5th April 1975, and now I am told that I do not need to report for two years.

I am still a heavy smoker

I am still a heavy smoker. Since my return from Auckland I have consistently smoked 14 ozs of tobacco a week or a 2 oz packet a day. I am trying to cut down and have managed (I hope it lasts) to get by on five 2 oz packets of cigarette tobacco a week.

I am a farmer. I am not looking for a cure for anything. Certainly not cancer or heart disease. But I am looking for the cause, or the trigger which allows these great killers to become the menace which they undoubtedly are.

I do not pretend to know it all, but 32 years of field research with animals have taught me a great lesson, just how little we know.

Healthier now than last 25 years

What should be emphasised here is that since taking those four minerals, magnesium, zinc, selenium and iodine over the last four years, I am healthier now than I have been in the last 25 years.

Since coming home from Auckland I have not had a cold, have not had influenza, have not had a headache. In fact have been very well.

My moles have dropped off

I should also record that, like many people who have worked bare to the waist in the hot sun for long periods, I had at least a dozen moles on my back. One big one just about belt height was becoming troublesome. These moles have all split into four quarters and dropped off.

I have a knee which is rather troublesome. This was the result of a two-ton annie of a ewe which I did not see coming, jumping into me, hitting me in just the wrong places.

Wine and zinc react

Perhaps to be fair I should record that I was very ill one night. We had been out to a party and I had had sufficient wine. Not being used to wines very much since I came home from Auckland, I had probably had more than sufficient.

When we arrived home I realised that I had not had my zinc ration, so I took some and went off to bed.

I would not recommend this practice. It very soon became evident that wine and zinc do not live very peaceably together.

A ruptured hernia.

Recently I have been to Dunedin for a further operation, a

ruptured hernia. They mended it using stainless steel mesh, rather like a gravy strainer.

This stainless steel mesh is not at this moment lying quietly, it could well be that my carcase feels insulted at being supplemented with a foreigner.

Still 16 stone of me

As I re-read this personal history, I feel like tendering an apology for inflicting such a rigmarole on readers. I almost think that I have been cut about until there is little left. But there is still about 16 stone of me here.

Chapter thirty-one

My circular on cancer and heart disease

My concern for the many sufferers from ill health has led me to send the following circular to people who have the facilities to test properly, in the hope that what has happened to me may save others.

THE CIRCULAR

Cancer and heart disease are so closely allied and interwoven that I cannot separate them. My findings are that they arise from a lack of essential health-giving minerals which are being progressively leached from our soils, and which will be found in the oceans of the world.

These minerals are magnesium, selenium, zinc and iodine.

Background information

I will give the background information to explain how I arrive at these conclusions.

Circumstances forced me into this field of research in 1945. I am a farmer. The death rate of my stock in those days when ill-thrift was so prevalent was such that I had the option of doing something about it, or going broke.

I successfully overcame my problems with copper, cobalt and iron in the form of a drench or lick.

Selenium and other soil minerals

Since Japanese sulphur was banned in the mid 1950's, because of its high selenium content, it also became necessary to add selenium to this drench or lick to ensure the manufacture of red cells in the blood of an animal.

I have continued to make an intensive study of the functions of minerals and have found it a fascinating and absorbing study.

Having 20 paddocks to work on, I was able to compare stock reaction by altering the topdressing by just one mineral. I read the results by conparing wool weights and killing sheets of lambs.

I have run field experiments of all the minerals which are currently known to be useful in agriculture.

Here is the theory

Here is the theory. Science tells us that minerals in various combinations are necessary to carry out every function of the body.

So, surely it is logical to say, "If we receive the correct minerals in the correct proportions, every function of the body should be carried out correctly." This must mean perfect health.

As these minerals are not all used in the same quantities, the ratio of requirement is an all important aim.

An over supply will throw strain on the metabolism, a shortage of any one will prevent some other elements from being used, and the total absence of any essential mineral spells death.

Healthy soil bacteria

Waksman in his book, *"Microbial Antagonisms and Antibiotic Substances"* points out that a healthy soil, balanced with all the necessary minerals, creates conditions where health-giving bacteria thrive, and that these bacteria will defeat nematodes* such as anthrax, blackleg and odema.

Should the soil minerals go out of balance, then the health-giving bacteria die and are replaced by the nematodes.

It seems ironical that in this so called scientific age we can make an atomic bomb, or send a man to the moon, yet the mineral requirement of animal and man is being ignored.

Huge health bill in New Zealand

I am greatly concerned at the huge health bill in New Zealand, and more concerned that both cancer* and heart disease have progressed to the stage where even our children are not immune.

I am not guessing, for the four minerals mentioned are four which I find will not remain in the soils, and on this farm of mine require constant attention.

I concede that all my experiments were carried out with animals, but it is surely relevant to use these as a guide to human health, as statistics show that the general public are highly at risk.

Hope for cancer and heart disease patients

I would like to give some hope to terminal cancer patients and those suffering from heart disease.

It is the solubility of these minerals which is causing an imbalance in the diet. This problem is not confined to developed land, but

---

* Nematodes are microscopic worms. A handful of soil can contain thousands.

* Brown Trotter eventually died of cancer, which spread from treatment of a cigarette burn to his lip. In the 1930's, an Australian sheep farmer Percy Weston, was experimenting with his sheep along similar lines to Brown Trotter and claims to have found the cause of cancer and arthritis to be an imbalance of the ideal 4-2-1 Calcium-Phosphorous-Magnesium ratio in the human body, in particular, excess Phosphorous and low Calcium through excessive use of superphosphate. This lowers the optimum pH of the human body. He also found a lack of the same important minerals mentioned above by Brown Trotter, due to lifeless soil. Percy Weston cured himself and his wife of cancer with the use of powdered minerals, which he later called "Percy's Powders".™ He lived to be a 100 years of age and at age of 97 wrote a very interesting book of his life and experiments called *"Cancer: Cause and Cure."* This important book is highly recommended to readers.

every time we have a flood, these ultra-soluble minerals are leached to the sea.

The recommendations of the heart foundation sound a bit like the ten commandments. They recognise the imbalance in diet, but are trying to cope by recommending cutting out of our diet many good and essential things. I believe these recommendations are back to front and are wrongly based.

Magnesium, selenium, zinc and iodine

A good deal of research has been done on magnesium, selenium, zinc and iodine singly, but no one has yet noted that while all are good, it is necessary to use them in combination.

My own dramatic healing

Being a heart patient myself since January 1973, when I was given a bonus issue of life, a new heart valve in Green Lane Hospital, Auckland I have taken these minerals orally.

That something dramatic took place in my condition afterward can be proved by an examination of my X-rays in Princess Margaret Hospital, Christchurch, dated November 1972, September 1973 and 5th April 1975.

Dr Hull was my doctor. It should be quite a simple matter to prove my findings.

Cancer fighting minerals

I believe the following minerals will prove to be essential in the fight against cancer – selenium, copper, cobalt and iron. Plus magnesium, zinc and iodine. I think these last three minerals are also justified.*

W. B. Trotter, Fairlie.

Some examples

The above circular can be further clarified by giving some examples.

Example 1 – Why copper can build up

Haemoglobin in red blood cells is manufactured using iron, with catalysts of copper, cobalt and selenium.

The ratio of requirements are, 2 parts iron, 1 part copper, l/16th part cobalt and l/120th part selenium.

Suppose the cobalt supply is halved from 1/16th part to only

* Modern research supports these findings, especially in the case of Selenium Magnesium, Zinc and Iodine. Balance is also critical. The ideal appears to be a 4-2-1 Calcium-Phosphorous-Magnesium balance and a 50-50 Potassium-Sodium balance. Iodine (as potassium iodide) is regularly given to nuclear power station workers as a protection against radiation cancer. Boron is another crucial mineral in human health, especially in bone and joint health.

1/32nd part. Cobalt then becomes a limiting factor in the manufacture of haemoglobin.

This also means that only half of the iron, copper, and selenium can be used. Then copper, being cumulative in the body, becomes the danger man. The buildup of copper becomes a prime cause of yellow jaundice. If it builds still further, the result is copper poisoning and death.

However, in such cases a superficial examination and diagnosis will normally result in a recommendation to reduce copper intake to avoid the trouble of over supply.

But surely this is stupid, for the following two reasons:

1. Such a course of action will not correct the lack of haemoglobin in the blood.

2. An in-depth examination would reveal that the real cause of the problem is lack of cobalt, not excess copper. When the cobalt deficiency is dealt with, the whole problem will be solved, as the copper will be used instead of building up.

Surely this illustration of the interdependency of minerals also has a parallel in the work of cancer research and the Heart Foundation.

Example 2
A higher standard of health should allow the body to cope with smoking and diet excesses

Warnings against smoking, in the case of cancer, and against fatty foods, and high body cholesterol levels in the case of heart disease, are also diagnosis of effect, not diagnosis of cause.

This type of diagnosis surely explains why both cancer and heart disease are increasing at an alarming rate.

Every effort must be made to establish the 'trigger' or situation which sets both of these scourges in motion.

Rather than continually warning against smoking, or a diet of high fat food, why not an intense study of how to allow the body to attain a sufficently high standard of health that it will be able to cope with smoking and high fat foods and maintain its own healthy cholesterol level?

The real search needs to be for cause, not diagnosis of effect.

Health-building properties are available through the proper handling of our soils.

This will lead to the natural strengthening of muscular action as the healing force in heart disease and render cancer inactive.

In other words, let us study how to obtain and maintain a mineral balance in our soil, suitable to stock health and human health.

Disturbing response to my circular from cancer researcher Dr C. M. Goodall

22nd June, 1976.

Dear Mr Trotter,

A copy of your circular letter about minerals, cancer, and heart disease has reached us. You can rest assured that the points you mention have already been considered by fully qualified cancer research workers.

The observations you have made as an experienced farmer on the effect of trace elements on animal health are interesting, however we already know that cancer is not actually caused by minerals (or their lack) at all.

We are always glad to hear from people interested in helping us in the struggle against cancer. You might like to meet other people sharing your interest by contacting the branch of the Cancer Society nearest to your district (address given below).

Yours faithfully,
Dr. C. M. Goodall,
Director of Cancer Research. University of Otago.

I had 50 of my circulars printed and was somewhat disturbed by the reply received from Dr Goodall.

Perhaps it is natural for people who have a few letters after their name to resent any suggestion from a mere farmer.

But it is also quite natural for the same farmer, who perhaps is on much firmer ground with agriculture as his base to work from, to retaliate.

However the articles in the following chapters will, I think, be an adequate reply to Dr Goodall.

There are far too many people dying needlessly. The problem must be resolved. Neither Dr Goodall's indignation, nor anyone else's should be allowed to stand in the way.

Chapter thirty-two

Two recent articles on Selenium

Human disease linked to soil deficiency

Timaru Herald, May 3rd, 1975.

A South Canterbury farmer, Mr W. B. Trotter of Fairlie whose experiments with minerals to improve stock health caught the attention of scientists, sees a link between soil deficiencies and those two big killers of human beings, heart disease and cancer.

In the 1940s following a field experiment Mr Trotter recommended as an additive to normal topdressing the use of copper, cobalt and iron, aimed at the production of haemoglobin or red cells to save the lives of millions of lambs.

Minor minerals important

Mr Trotter says, "I have carried out quite extensive field trials over the years in search of the perfect topdressing to give maximum results in production and also in stock health."

"I have come to regard the soil as a living thing which responds extremely well to correct treatment, but also punishes bad handling severely."

"Science says that minerals carry out every function of the body. Logic, surely should tell us that our search then should be for health by establishing just how to obtain the correct minerals in the correct quantities."

Mr Trotter says that Wakeman in his book *"Microbial Antagonisms and Antibiotic Substances"* explains how a healthy, balanced soil creates conditions where health-giving bacteria thrive and how they can defeat the nematodes such as anthrax, tetanus, blackleg and other undesirables.

Noting that life in his time has speeded up ten times, Mr Trotter says that with just half the manpower, farm production of meat was trebled from 1953 to 1973, placing a heavy strain in those concerned.

"In the process we have exported a lot of our minerals."

"The major minerals, calcium, phosphorus, potash and nitrogen, are watched carefully, but the minor or trace minerals are largely taken for granted."

"These so-called minor minerals are only minor in quantity, not in importance. The absence of any one necessary mineral writes death on the record."

"Surely, long term it is impossible to separate soil, plant, stock and human health," Mr Trotter says.

"Granted we humans have an advantage over the animals. No one puts us in a paddock and shuts the gate. But long term we will be what our soil makes us."

Selenium critically deficient

Mr Trotter says that a basic dressing of copper, cobalt, and iron worked very well until the early 1950's.

"At this stage Japanese sulphur was successfully banned from import into New Zealand because of its high selenium content. This triggered off one of the biggest rackets ever imposed on the farming industry, but it also

demonstrated the importance of selenium."

"South Island soils are critically deficient in selenium, magnesium, iodine, and zinc."

"Without reservation I state that we are all living at risk."

Mr Trotter says that selenium is a catalyst in the formation of red cells. It is a very necessary muscle stimulator, greatly strengthening muscular action and plays a vital part in hormone production.

Magnesium

"Magnesium deficiency causes staggers, which is severe in lactating animals."

"It causes death from heart failure in the presence of high potash content."

"It is the best of minerals to restore normal nerves and placidity and is very important in hormone production."

Iodine

"Iodine is well known for its work on the thyroid and is important in the survival of young stock."

"It stops hairless calves and other deformities and is also very necessary in hormone production."

Zinc

"Zinc is the greatest purifier and healer known among the minerals."

"I have tried to show that the very minerals which could make it possible for people to cope with life about ten times the speed of 50 years ago, are at deficiency levels."

"The heart, being the main muscle of the body needs help. This is available from selenium, magnesium and iodine."

"Magnesium could also help alleviate mental strain."

Breast cancer

Mr Trotter says that breast cancer points the finger directly at a breakdown in hormones which should deal with surpluses in the breast. Zinc will clear this condition if it should develop.

He also suggests that the Cancer Research Organisation should carry out an experiment.

"The claim has been made that cancer can be induced in rats by feeding them nicotine residues. A batch of rats could be split into two equal groups. Feed both groups equal amounts of nicotine residues, one group also to receive selenium, magnesium and iodine."

"If and when cancer is diagnosed, dose orally with zinc sulphate."

"This will, I believe, demonstrate the incompatibility of zinc, the great healer, with cancer, the greatest of the nematodes," Mr Trotter says.

"Such an experiment should make a positive contribution to human health and can do nothing but good."

Selenium, essential for human health, or a dangerous poison?

Timaru Herald, October 12th, 1977.

A number of South Canterbury residents in rural occupations are dosing themselves with selenium, a restricted poison usually given to sheep to combat a muscular disorder.

According to one doctor, the medical profession would deprecate

the use of anything of which the ultimate effects are not known.

"We do know that there are certain side effects from this drug, and if it is used in an irresponsible way, people could do themselves some damage," the doctor said.

Professor Marion F. Robinson of the Home Science Nutrition Department, University of Otago said that selenium was very toxic.

However, the department with support from the Medical Research Council had been investigating selenium, and the New Zealanders who were taking the element. Research was continuing to see if it were important in human nutrition.

Another researcher said that people had drawn the analogy between the effectiveness of selenium to prevent white muscle disease in lambs, and the possibilities for curing arthritis, but it was a tenuous analogy.

Inquiries by The Timaru Herald in the last two weeks show that there is apparently a widespread use of this trace element.

A Timaru man, who declines to be named says he had been taking the animal remedy for the last 12 months with no ill-effects.

"On the contrary it's been good, and I know of one veterinarian who prescribes it to his customers," he said.

Veterinarians opinions

Two veterinarians who were approached denied that they prescribed selenium for use by human beings.

Mr D. A. Walker of Timaru said selenium would be of doubtful value to human beings, but he had heard of people taking it as a tonic. He would certainly not recommend it.

However a spokesman for the South Canterbury Veterinary Club said he had heard of people, including other veterinarians taking selenium at a rate of about 5 mgs* a month. It was considered a cure for rheumatics.

Selenium is also an ingredient of some hair shampoos.

Mr Trotter's views

One of South Canterbury's most prominent advocates for the use of minerals and trace elements for animal health, Mr W. B. Trotter of Fairlie has claimed benefits from dosing himself with selenium.

Mr Trotter has exchanged fire with agricultural scientists over his theories on the use of magnesium, selenium, iodine and zinc to improve the health of his sheep flocks, and to increase lambing percentages.

"I have had 8000 ewes on a dosing trial this year and so far the lambing percentage has been the highest ever," he says. "Selenium is one of the biggest factors."

Doctor amazed

Mr Trotter says that after having a heart valve operation in Auckland in 1972, and returning to hospital for a check-up in the following year, he felt weak and lethargic. He then decided to regularly take a small pinch of Epsom salts (magnesium sulphate).

"I also took 4 cc of selenium every night (about the same rate as for sheep) and a small amount of zinc."

"I had an enlarged heart when I received the new heart valve. X-rays were taken in 1972, 1973 and 1975. The 1973 X-ray showed that after the operation the situation had been held, and the doctor was

* About 160 mcg a day.

very pleased. In 1975 I got a perfect cardiograph and my heart had gone back to normal."

"The doctor was amazed and asked me what I had been doing. I told him I had been dosing myself with the minerals I gave to my sheep."

"The doctor thought it was a lot of bull, but agreed it had apparently worked in my case."

Mr Trotter says he had been taking selenium every night for the last four years with no apparent ill-effects. "If it's a poison, then it's like whisky to a Scotsman."

He agreed there was a danger of people taking over-doses.

"You will always have people who think that they can go one better and double the amount. A small dose two or three times a week would be sufficient. I took larger amounts because I was a critical case."

Mr Trotter says that the 'rape of the soil' has been going on for 4000 years, and in taking certain minerals, or giving them to his sheep, he was just 'putting back what had been taken out.'

Multiple sclerosis

Selenium has been quoted as a possible remedy for the crippling illness of multiple sclerosis, but the publicity officer of the South Canterbury Multiple Sclerosis Society, Mrs K. E. Rose said she knew of one case where a patient had taken selenium but it had not done any good.

"As yet there is still no cure and medical science has not even found the cause of multiple sclerosis," Mrs Rose said. "None of our member patients are taking selenium."

"Good heavens no," said one horrified Rosewill farmer when asked if he had ever taken selenium or knew of others who had.

"About five years ago I had a semi-diluted form of selenium, and the labelling on the container was very clear. It was a highly dangerous substance. I got the impression that it was as poisonous as paraquat and I was keen to see the last of it."

The farmer explained that today his vet put a highly concentrated form of selenium in a worm drench.

"To obtain selenium you must sign the poisons register," he said.

Another farmer said he understood it was excreted fairly quickly from the body and was not cumulative.

A Timaru veterinarian said it stays in a lamb's system for about three weeks.

A Ministry of Agriculture and Fisheries farm advisory officer in Timaru was dismayed at the thought, and said that the Ministry would certainly not recommend selenium as a medicine for human beings.

However, a MAF agricultural scientist in Timaru, Mr C. C. McLeod thinks that a lot more research should be carried out on the value or otherwise of selenium to human beings.

Canterbury soils deficient

"I think there should be more work on it because there is undoubtedly a selenium deficiency in South Canterbury soils, with corresponding deficiencies in stock and cereals," he says.

"It follows that people too, may be suffering as a result."

He said the selenium is administered to lambs to prevent muscular problems, as well as ill-thrift. People too, suffered from back ailments and muscular disorders.

"Selenium deficiency is very widespread in South Canterbury and is particularly acute in the high country," Mr McLeod said. "We have had marked responses with lambs, calves, pigs and poultry to selenium dosing."

"Compared with imported grains, New Zealand wheat is very low in selenium."

"About 2-3 mgs are given to lambs, 5 mg to ewes, and for calves the rate is 30 mg per 100 kilos live-weight."

"The critical level for selenium in pastures for stock feed is about 20 ppm, and the level in New Zealand wheat is about 11-15 ppm."

Mr McLeod said he too had heard of human beings taking the trace element, including professional people in agricultural research.

According to the reference work *"Fertilisers and Soils in New Zealand Farming"* by C. During, the fact that selenium is essential for higher animals is a relatively recent discovery by the American workers Schwar and Foltz in 1957. Their findings were applied very quickly in New Zealand in I960.

"In New Zealand, selenium deficiency is responsible for congenital white muscle disease of lambs. Lambs are born dead or die suddenly after exertion within a few days of birth."

"Owing to the toxic nature of selenium, its application by aerial topdressing, by lick, and by addition to drinking water carried considerable risks. At present the only recommended administration of the material is by oral dosing. However, other methods are under investigation."

"Some methods, though illegal, are in fact used by many farmers."

Selenium deficiencies widespread

Selenium deficiencies in stock are widespread over New Zealand, especially on the light, stony soils of the east coasts of both islands and on the sandy soils of the west coast areas of both islands.

Selenium is one of the rarer elements and occurs only in small quantities in ores, usually as the selenide of a metal. Selenium for commercial use is extracted from these ore deposits and collected in lead chambers of sulphuric acid plants.

Apart from its agricultural use, the industrial application of selenium includes the red staining of glass for church windows and traffic stop lights.

Chapter thirty-three

Report on the seriously low selenium status of New Zealanders

By J. H. Watkinson, BSc. PhD. MNZIC, Ruakura Soil Research Station, Hamilton.

The mean selenium content of blood from 24 human subjects living in the region around the Ruakura Agricultural Research Centre, Hamilton was found to be 0.07 ppm.

This is appreciably lower than values reported from other countries, but consistent with the estimated NZ dietary intake.

Low dietary selenium is considered to be the result of the low concentrations in New Zealand agricultural soils.

New Zealand wheat is very low in selenium, and animal products are lower than those in North America in relation to the pasture levels. The latter is attributed to the smaller amount of selenium given to New Zealand livestock through supplementary feeding and oral dosing.

Apart from a relatively small area of peat soil, Hamilton is not in an area that is deficient in selenium for farm animals. It is predicted that in the deficient areas, the blood levels of New Zealanders would be less than those in Hamilton.

Hamilton human Selenium levels lower than any recorded worldwide

The most unexpected finding from the study was that some selenium levels in the control group were lower than any recorded in the literature.

Hamilton soils are not low in selenium, yet the mean blood level was about half that of persons in North America living in areas known to be deficient in selenium for livestock.

The North American intake is two and a half times that of the New Zealand. The main difference is in the levels from cereals, which differ by a factor of 25. American wheat being grown on selenium-rich prairie soils.

Wheat from these areas averages 0.50 ppm selenium. In contrast, New Zealand wheat is grown on soils very low in selenium and wheat averages only 0.02 ppm. Oats and barley are similar.

Table 1 The table below compares the selenium content of blood from subjects in Hamilton, New Zealand with those of other countries.

Average Selenium content of blood in ppm	
England	0.32
Guatemala	0.23
United States	0.21
Canada	0.18
Sweden	0.12
New Zealand (Hamilton)	0.07

Table 2 The table below compares the average selenium content of the NZ diet with the Canadian diet, in mcg per day.

Average Selenium content of food in ppm		
Food type	**Canada**	**NZ**
Cereals	78	6
Dairy products	23	8
Meat and fish	58	42

Selenium in meat products

In contrast to those from plant products, meat levels never fall below a certain minimum, since selenium is an essential element for mammals.

Consequently they become of prime importance when the cereal values are low. They reflect levels in the local soils, except where dietary supplements to the animals become significant.

The effect of supplementation to animals of feed naturally high in selenium is evident in North America in the selenium content of milk. Of seven samples of milk from low areas, six are higher than the highest value in New Zealand from a non-deficient area.

Oral dosing of sheep and cattle with selenium in New Zealand raises the meat levels only marginally above deficiency levels.

Where selenium is added to the animals' diet the levels are somewhat higher. In this respect not only the level of selenium in the soil, but the type of crop it grows becomes decisive.

In New Zealand, the selenium content of soils varies over a wide range, from less than 0.1 ppm to over 4 ppm. Where the soils contain less than 0.5 ppm, there is a higher incidence of selenium-responsive diseases in sheep. These areas include most of the South Island, and all of the central volcanic plateau of the North Island.

People of New Zealand with low Selenium status

At least three classes of New Zealander's would have a lower selenium status than average:

1. People in areas with soils low in selenium. Mean blood values in

these areas could be as low as 0.03 ppm.

2. Vegetarians in Hamilton, consuming no dairy products could also have a blood value of 0.03 ppm. The level would be lower in deficient areas of NZ, and enhanced if foods high in selenium, for example field mushrooms (at about 5 ppm) were consumed in appreciable amounts.

3. Infants fed cows' milk (containing as little as 0.002 ppm from cows in a low selenium area) could have a particularly low intake.

Is selenium necessary for humans?

According to the criterion that essential trace elements show a normal distribution in human tissues, while non-essential elements show a low-normal distribution, it is concluded that selenium is an essential element for man.

Virtually no investigations undertaken

However there is no direct evidence supporting or refuting this contention, as virtually no investigations have been undertaken on the subject.

It is very likely that certain classes of people in New Zealand have blood levels of selenium within the range of those quoted for sheep associated with selenium-responsive diseases.

It has been reported that a blood level of 0.15 ppm in chicks and turkey poults is verging upon a deficiency.

It has been shown that sudden death in piglets is associated with low levels of selenium, and it has been suggested that some instances of this occurrance in infants could be similarly associated.

Sudden death in foals has not been observed in the Waikato since their regular injection with selenium.

Finally, researchers have associated low levels of selenium in the soils and vegetation of an area with an increased incidence of some forms of cancer in man.

Table 3 Below are listed the Selenium levels of blood from sheep with selenium-responsive diseases.

Selenium blood levels in diseased sheep

Disease	Mean Selenium level in ppm
Unthriftiness	0.01
White muscle disease	0.02
Muscular dystrophy	0.03

After this paper was accepted for publication, a note on the selenium blood values of 16 Dunedin women was brought to the attention of the author. They ranged from 0.06 to 0.09 ppm.

This is similar to the Hamilton group and is consistent with the Dunedin soil ranking of C which is the same as the Hamilton average. Soils are ranked on a high to low scale of A to E.

Toxicity of selenium

Three members of the staff of the Ruakura Soil Research Station have become involved in handling relatively large amounts of selenium in farm scale experiments.

In view of its toxicity, the selenium concentrations in the blood of the staff concerned were monitored, together with those of a control group.

The results showed that exposure to selenium posed no health problem. The third member, with the greatest exposure to selenium, was 50 percent higher than the mean of the control group, but was still only half the North American average.

Chapter thirty-four

More health findings on selenium and other trace minerals

Influence of soil selenium on human blood selenium levels in in New Zealand

J. H. Watkinson. BSc. PhD. MNZIC by Ruakura Agricultural Research Centre, Hamilton, 1977.

Whole blood samples were taken by the New Zealand Blood Transfusion Services from 307 people at 16 NZ locations.

There was no difference between blood Selenium levels from the seven high, and five low selenium areas within the North Island.

However, the mean 0.08 ppm North Island value was significantly higher than the mean South Island value 0.06.

The lack of difference throughout the North Island is attributed to the siting of abattoirs, in that meat from high and low soil areas is mixed.

Because there are no high South Island soil areas, the low blood Selenium reflects the overall soil level.

Maoris 0.08 were significantly higher than Europeans 0.07, probably from a diet higher in Selenium, ie, seafoods.

There was no effect from age, sex, source of or frequency of consumption of eggs.

Low iodine and breast cancer

Research workers at the Einstein Medical Centre in Philadelphia, USA have recently produced rather startling evidence indicating that iodine-deficiency may be an important factor in causing cancer of the breast in women, and in the udder of cows.

It had been noted that diets lacking in iodine, when fed to animals led to abnormal growth of breast tissue known as dysplasia.

It was also found that animals which had been experimentally exposed to a known cancer-inducing substance developed malignant tumours much more quickly if iodine was deficient in their diet.

On the other hand, this overgrowth did not appear in animals supplemented with adequate iodine.

Dysplasia is recognised as a pre-cancerous change, inasmuch as cancer usually develops following the appearance of this excessive growth. The research group reported that they were able to reverse the dysplasia with iodine replacement therapy if it were continued for a sufficient length of time.

Of particular interest was their demonstration that the now well-established hormone treatment for cancer of the breast failed to work in the presence of iodine-deficiency.

Soil minerals and human health

New Zealand Agriculturist, November, 1972

In an address delivered at the Royal Society of Health in London, Dr H. M. Sinclair, Lecturer in Human Nutrition at the University of Oxford, discussed the several diseases which are either known to have, or are now thought to have a nutritional origin.

He pointed out that despite the great advances made in medical science, the chronic degenerative diseases such as cancer, heart disease, and disorders of the blood vessels are now much more prevalent than was the case 100 years ago.

This appears to be so, even allowing for the fact that victory over many of the diseases which formerly took such a toll of young lives, means that a greater proportion now survive to the older ages, at which, failure due to degenerative diseases is more likely.

Dr Sinclair believed that the only environmental factor causing this increase must be diet, and that trace elements and possibly fats seemed to be involved.

Probably it is yet too soon to affirm that mineral deficiencies are directly concerned in the causation of certain forms of cancer. The full elucidation of the actual causes of malignant disease involves the unravelling of many tangled skeins.

Mineral requirements of pregnant women

Interest in this important question is not confined to Western countries. Russian Professor, N. P. Sokolov in a survey and critical review of the investigations reported by medical scientists throughout the world, pointed out that many of the degenerative diseases of man, as with animals, are often associated with the level of certain minerals in the soil.

He quoted examples of this and made special reference to the trace element requirements of pregnant women.

The Russian studies have shown that trace elements such as copper, zinc, cobalt, iron, manganese, and even nickel, have been found in appreciable amounts in the foetal bones and tissues as early as the tenth week of gestation, and it is recommended that the trace element content of the mother's diet should be carefully examined, certainly not later than the third month of pregnancy to ensure that the supply is adequate.

It is also recommended that in areas where soils and water are low in iodine, special attention needs to be paid to this element.

Cows' milk and cot death in New Zealand

Nearer to home it would appear that we have a serious nutritional problem on our own hands. In an article published in the NZ Medical Journal, Doctors C. P. Anyon and K. G. Clarkson of the Hutt Hospital review their studies which present evidence that cows' milk, which is particularly low in iron, is a contributing factor in the development of iron-deficiency anaemia in infants.

Their view is that one, or possibly more than one of the proteins of cows' milk is the substance which produces bleeding, and the consequent development of the severe anaemia. They suggest that for this and other reasons, it may yet be found that cows' milk is an undesirable food on which to feed New Zealand babies. This has been suspected on more than one occasion previously, but good evidence had not been presented.

It may well be that one of the unspecified 'other reasons' proposed by the authors for casting doubts on cows' milk could be its suspected involvement in the Sudden Deaths of Infants Syndrome, commonly known as 'Cot Death.'

NZ milk low in selenium, vitamin E and iron

Milk produced in New Zealand is very low in both selenium and Vitamin E, as well as iron. A local scientist has proposed that this could be a causing factor in this alarming and distressing syndrome.

Although not yet fully documented, the theory is supported by persuasive evidence derived from investigations which are still proceeding.

Magnesium may also be lacking

A recent paper from America, where cot deaths are likewise of great concern, suggests that yet another mineral, magnesium may be involved.

The evidence incriminating a deficiency of magnesium is much less convincing, but it does support the theory that the underlying defect in 'Cot Death' is a deficiency of one or more trace elements in milk.

Milk is of course of supreme importance in the diet of infants and no doubt if and when the part played by mineral deficiency has been firmly established, appropriate correction can be made by adjustments or additions to the diet of cows.

Vegetables

However, adult humans can also be affected by deficiencies and one of the principal dietary sources of trace elements under ordinary conditions is vegetables.

It is not sufficiently appreciated that vegetables, like other plants,

can grow to maturity and look green and healthy whether they have an optimal mineral content or not.

It is not a difficult matter to supply growing vegetables with trace elements.

Conclusion

It is surely a matter for concern, that in a country so richly endowed in the agricultural sense as New Zealand, there should be any question of dietary defects affecting the human population.

Unfortunately, as we have said on previous occasions, anyone who raises his voice to stress the ills that arise from faulty human nutrition is apt to be branded as a food faddist or crank.

Yet a farmer who takes steps to safeguard his animals against mineral deficiencies to enhance their health, production and reproduction is not regarded with any scorn, but is considered inefficient and negligent if he fails to do so.

New Zealand colon cancer rate one of world's highest

Christchurch Press. Sept 17, 1977.

New Zealanders have one of the highest rates in the world for contracting cancer of the colon (large intestine) according to a visiting cancer researcher Dr R. MacLennan of the International Agency for Research on Cancer.

"One in thirty New Zealanders gets it, although it is only half as common among Maoris," he said.

He said that the New Zealand diet, which apparently included a high intake of meat and fat, combined with a low consumption of fibre, could be responsible for the high incidence of cancer of the colon. International research had also indicated that certain foods may be carcinogenic.

In Japan there was a low incidence of cancer in the colon, but among Japanese who emigrated to the United States the incidence increased. A likely factor was believed to be the higher intake of meat by those living in the United States.

High meat intake may not cause colon cancer

But studies in Scandinavia showed that a high meat or fat intake did not necessarily mean a high rate of colon cancer.

It appeared that fibre in the diet might provide some sort of protection, although it was only relevant if a potential carcinogen was present. Studies so far were not sufficient to prove the causes and effects of various foods.*

There needed to be much more study, including research into the New Zealand diet, about which a lot more needed to be known.

Much study had been done on the treatment of cancer. However, it

---

* Modern research has discovered that adequate Folate (Folic Acid) reduces the incidence of Colon Cancer 75%. Folate is found mainly in vegetables and fruits.

was being realised increasingly that the results of treatment were not good. Authorities around the world now considered that a better approach might be to investigate prevention rather than cure.

"We know from international variations of cancer that a very high proportion of cancers are related to environmental factors and therefore, theoretically at least, preventable," said Dr MacLennan. Smoking was one factor, and chemicals from industry was another.

All those attending the workshop had been assured that the monitoring procedures carried out in New Zealand were effective.

Selenium in human diets

New Zealand Agriculturist, November, 1975

It seems quite likely, that as investigation continues into the role of selenium in human nutrition, a health problem of some magnitude will be revealed.

The large body of evidence in the animal field is not yet available in respect of humans, although it is accumulating.

But bearing in mind that animals and humans live basically upon the same soils and waters, it would be surprising if some diseases were not in due time traced to nutritional deficiencies now recognised in livestock, of which selenium is an example.

A disturbing aspect of the matter is that the level of blood-selenium in New Zealand residents appears to be among the lowest in the world.

Studies at the University of Otago have shown that the mean level of selenium in the blood of a large number of apparently normal adults this country is 0.07 ppm.

This is only about one-third of the average of adults in the USA, Canada, Great Britain, South America and Sweden, which is about 0.20 ppm.

Levels of American scientists in NZ fall

One study at Otago produced striking evidence as to the poor selenium status of New Zealand citizens.

The blood Selenium level of four American scientists who visited this country on research fellowships was determined on their arrival in this country.

And then again, about 7 months later, just prior to their return to home it was checked once more. In that short period of time the level of selenium in their blood had fallen to the low levels found in New Zealand residents.

Such a significant drop naturally indicated a defect in the local diet so far as selenium is concerned.

In following up this line of inquiry, workers at the Ruakura Animal

Research Centre computed that the total daily intake of selenium by New Zealanders from an average diet is of the order of 55 mcg per day, while in the overseas countries quoted above, it is about 140 mcg per day.

Selenium in human disease

It has been reported that in various parts of New Zealand, most notably South Canterbury and Central Otago, there appears to be a high incidence of the severe and crippling disease known as Progressive Muscular Dystrophy.*

In these same general areas, a similar disease of livestock, White Muscle Disease is very prevalent. Since this disease responds well to treatment with selenium, many farming families have for some years been treating themselves with selenium and claim marked benefits therefrom.

It should however be emphasised that although we have found a correlation between low blood selenium levels in livestock and muscular dystrophy in human patients, and this has been supported in Canadian studies, it has not yet been proven beyond doubt that this disease arises from a deficiency of selenium in the diet.

The same applies to other ailments such as certain forms of arthritis in humans, and the dreaded syndrome termed 'cot deaths' which have also been tentatively allied to selenium/vitamin E deficiency. All that can be said at present is that the evidence is at least persuasive and is the subject of investigation.

The question was critically discussed a year or so ago by Professor M. L. Scott of Cornell University, USA. He drew attention to an inverse relationship between human cancer and the selenium content of soils, and thus foodstuffs. He discussed the known inhibitory effect exerted by selenium upon several carcinogens (cancer-producing substances) and put forward the intriguing viewpoint that by not exploiting selenium supplementation of livestock feeds, the human population is depriving itself of protection from certain forms of cancer.

Very low levels of blood selenium are a marked characteristic of New Zealand residents, so it is only reasonable to suppose that such a situation will be in some measure be reflected in health impairment.

Cows' milk

Since the products of our farming industries are the principal source of our foods, it is disquieting to find that cows' milk sampled

* A weakening and wasting away of muscles.

in many parts of New Zealand show levels of selenium almost universally low. Many are markedly deficient.

Researchers at the Wallaceville Animal Research Station administered selenium to dairy cows and obtained a sharp increase in the level of milk selenium. Unfortunately this benefit was short-lived as within about 3 weeks the level had fallen to its pre-treatment concentration. So it would appear that this particular avenue for improvement is not very promising.

Another disturbing feature is that New Zealand exports thousands of tons of dried skim milk, much of which finds its way to the West Indies and is there being fed to infants and children suffering from the severe disease of malnutrition called Kwashiorkor.

Medical scientists report that these children have blood selenium levels much below normal and in the past have responded quite dramatically when given selenium while hospitilised.

It is difficult to see how New Zealand agriculture can escape responsibility for this tragic state of affairs. Not all children in that area have the advantage of hospital care, yet our dried skim milk forms a significant part of their daily diet.

Chapter thirty-five

My conclusions

What part does selenium play in heart health?

The last time I met Mr Fergus Hickey, he came into our kitchen, and being a North Islander he backed up to the fire and said, "Well, my friend, what is troubling you today?"

I replied, "I'll tell you what is troubling me, the number of my friends who are rolling over with heart disease. I want to ask you a question. What part if any does selenium play in this?"

Mr Hickey replied, "None whatever. Selenium as you well know cures white muscle in lambs, plays an important part in hormone production of the ewes on some properties, but its main function is in the muscular action which it promotes."

"Agreed," said I. "But what is a heart if it isn't the biggest muscle in the body. This is the bloke we expect to keep ticking 24 hours a day regardless. Here we have a situation, where to keep sheep alive, we have to use selenium regularly on most properties. What show have we humans got if we ignore selenium?"

Mr Hickey thought hard for a few seconds and then said, "My word, you might be right."

Three questions on selenium

Now Mr Hickey was lecturing at that time at the Otago Medical School, and my information is that this was placed on the plate of the medical school.

I am therefore forced to ask three questions.

1. Did the medical school find that the key to cot deaths is that babies are vulnerable when changing from the breast to the bottle because of the critically low level of selenium in the milk supplies of Dunedin?

2. Was an attempt made to add selenium to certain baby foods?

3. I am informed that the drenching of some dairy supply cows raised the selenium content of the milk for only a brief period. Is this true?

Now folk, the last thing I have in mind is to rubbish the medical profession. I have too many very good friends who are engaged in that profession, many dedicated people, who make themselves available at all hours of the day and night to help the sick.

Also I have so much to be grateful for in my many trips to hospital. Timaru, Christchurch, Auckland and Dunedin are all places where I have been. In all cases I would like to record my

thanks for the courtesy which has been extended to me.

However, I feel that the discussion and argument which I have been engaging in, is justified in the public interest.

In depth research will prove very rewarding

I am trying to lead research into deeper water. To convince health researchers that agricultural research will prove very rewarding.

Dr Goodall in particular, to take his head out of the clouds and look under his feet. Look at the sea and consider what it contains in the way of minerals. A study of cause and effect.

It should be remembered, that many years ago, to fight goitre a regulation was introduced to iodise salt for household use.

Molybdenum can drain the body of copper

Now we come to the vegetables. It is well known that brassicas boom if fertilised with molybdenum.

Now this is highly dangerous to health. On soils which have been limed as well, the plants can well carry a lethal amount of a molybdic carbonate (molybdenum) and some of these vegetables are not fit for human consumption.

I say without reservation that sheep would die in a short period if grazed on these vegetables.

Molybdenum has the dangerous ability to drain all copper from an animal's body, and when taken in excess will be the direct cause of anaemia.

A statement has been made that vegetables grown for the canneries will double in yield if fertilised with 2 to 3 cwt of molybdenised super. The same applies in market gardening.

The Dept of Agriculture recommend this fertiliser treatment. A big yield, yes, but hardly in the best interests of human health.

If I had the power I would certainly have these vegetables tested for molybdenum content.

This practice is not universal, for I know of some farmers who refuse to use molybdenised super because of past experience with stock health.

It would perhaps serve if all vegetables for sale to the public had to carry a ticket stating what fertilisers were used.

Research in New Zealand, if judgment is to be made on results, has obviously gone off the track. Somewhere it has deviated into dead ends, or has it been based on insecure foundations?

Manganese-deficient mice lose all sense of balance

The bill for drugs has consistently grown. What I have proposed by way of experiment is simple and can so easily be proved or disproved.

According to recent American research, mice fed on a manganese deficient diet lose all sense of balance. If put in water they drown quickly, being just as liable to swim upside down as right side up. This is caused by defective development of cells in the ear.

So do the defective ears prevalent among today's school children point the finger directly at manganese?

Magnesium could also be tested in conjunction with manganese, considering its control of the nervous system of animals.

Better soil analyses need

The whole problem of health, if it is to be obtained and maintained through our food, is of course a soil problem.

It seems however that there will be quite a bit of water run under the bridges before the veterinary associations and the Dept of Agriculture mend their ways and learn the basics of agriculture.

So how do we obtain and maintain a mineral balance in the soil, suitable to stock health and human health?

The present system, as practised by the Dept of Agriculture, of testing for four minerals out of a necessary number of not less than 20 has to be discarded. Otherwise we will destroy our soils.

Ancient history confirms that this is possible. By similar ignorance the ancient walled cities created their own dustbowls by robbing the soil of all nutrients.

My own personal mineral intake

The dosage rate which I have taken for the last five years is:

(a) A pinch of magnesium sulphate (Epsom salts) in that first cup of tea in the morning.

(b) A dose of iodine (perhaps once a month). This one needs care. Should the eyes water after a dose it is time to stop.

The mixture: 1 oz potassium iodide to ½ litre of water. Limit your dose to 5 ml (5 cc) a month.

(c) Zinc. 1 oz zinc sulphate to ½ litre of water. Dosage rate up to 17 ml (17 cc) daily, to be taken with food, or immediately after, as approved by the British Medical Association.

(d) Selenium. 500 mgs of sodium selenate to ½ litre of water. This is sheep strength, normally used in farming. Selenium is marked as a restrictive poison, but as proved by the drenching of the cows in Otago milk supply, is not cumulative in the body.

Just how poisonous it is maybe hard to judge. I now take 4 ml (4 cc) a day, * but in the last four years I have taken some 6 litres. If

* This is the equivalent of 400 mcg of selenium a day, about double the recommended intake by modern researchers. Toxic symptoms normally show up in adults at amounts exceeding 1200 mcg daily.

it is indeed a poison, then it is a bit like whisky to a Scotsman, and is awful slow.

One thing you can be certain of, there are many families in New Zealand already taking selenium regularly, some once a week, others once a month.

Some one had to agree to be a guinea pig in using these minerals. So it was me.

To get results minerals must be combined

The results surely justify in-depth investigation by researchers. Most of these food minerals have been examined, but have led to dead ends. Why? Because of the failure of researchers to realise that, while these minerals are each good in their own right, they need to be used in particular combinations if results are to be achieved.

Copper, cobalt, iron and selenium is one combination that is necessary to form haemoglobin (or red cells) necessary to the health and growth of the young.

A lot of work has been done on copper. But without ensuring that adequate supplies of iron, cobalt and selenium are available, such research leads to a dead end, and is highly dangerous.

The use of copper by the body is prevented by the lack of its partner minerals, and being cumulative in the body it can build and cause yellow jaundice and poisoning.

Health of the human foetus and fertility

The combination of magnesium, selenium, zinc and iodine come together in a hormone complex, important in the formation and health of the foetus and prevention of deformities.

So to you pregnant ladies, think about this.

And to those who love children but seem unable to produce the same, this combination of minerals has proved very successful in the animal world and would certainly be worth trying.

Manganese may have to be added

In view of American research, manganese may have to be added to this mineral complex. I have tested manganese but have not yet seen anything from it. But this is understandable when tests show that the supply of manganese in my soil is adequate.

Poisonous sprays

Recently a good deal of attention has been paid to the use of poisonous sprays in the control of noxious weeds and to the effect on health of the unborn.

It is hard to know how effective the protection afforded by attention to the above hormone complex would be in controlling these side effects, and counter-acting them.

I can only urge people to pay particular attention to the mineralisation of your vegetable gardens. When the storms come, that kelp on the beach will prove to be one of the finest things you can put in your garden.

However all of these minerals are used in such small amounts that most gardens can be fertilised at the cost of only two or three dollars.

Attitude of research workers

I have no hesitation in recommending the use of comprehensive fertilisers. I just hope that Dr Goodall's reply does not reflect the attitude of all research workers in New Zealand.

There is an all too familiar ring about that reply, it is paralleled almost exactly by the attitude of the Department chiefs when I sought to interest them in a study of mineral requirements of animals 32 years ago.

Cancer unknown among Hunzas

I cannot close without reference to the controversy concerning the use of laetrile as a cure for cancer. In my search for information on nutrition, I ran across quite a bit of information on laetrile.

The apricot kernel business arose from a study of the Hunza Indians, where cancer is unknown, and where a person's standing in the community is gauged by the number of apricot trees he owns. Apricots are the staple diet of these people, both ripe and dried. The apricot kernel is never wasted.

The elders of the tribe are all over 100 years of age and average 110 years.

Laetrile found in apricot kernels and apple pips

The compound contained in the apricot kernel is thiocyanate. There are also many other sources of this compound and it can be found in the kernels of most stone fruits, all the plum family, and also in apple pips.

The recommendation is made that anyone eating an apple should also eat the pips. Chew them well.

The warning is also given however, that although to eat the pips of an apple is health giving, to eat half a cup of pips risks death. Too much cyanate taken at one meal can result in cyanide poisoning.

In the same publication was a statement that a health clinic in America was unceremoniously closed down and the doctors arrested and jailed 'for malpractice' just for using this laetrile treatment for cancer.

The health clinic was later moved to Mexico and Americans flocked to it for treatment.

Now the most intriguing part emerges. Those who read carefully the lecture given by C. H. Irvine at the Lincoln College Conference in 1967, (pages 142-145) may have noted the close association which thiocyanate has with iodine.

The three plants which are apt to supply thiocyanate to animals are lucerne, white clover and linseed. The risk is in the failure of the thyroid to distinguish between iodine and thiocyanate, and also the fatal result to the unborn if the mother cannot supply the iodine necessary to form a sound thyroid before birth.

Many people do very nicely out of sick people

Anyone who pauses to think must realise that there are vast numbers of people in the world who are doing very nicely out of sick people. There are many millions of research workers who are very comfortably off as funds become available.

Among them undoubtedly are many dedicated people. And then of course there are the drug companies. Probably the most lucrative business in the world.

The trigger of heart disease and cancer

In a world where a desperate search is going on to try and locate the trigger that is making heart disease and cancer such a menace, I believe that through my experimental work with animals, I am mighty close to that trigger.

Certainly I am close enough to justify further research along the lines on which I have worked.

Unfortunately the attitude of the various research teams which I have contacted make such research highly unlikely.

I am only a farmer and do not pretend to be anything else, but at least from my own experiences I can surely show a sound enough case to justify research.

Again I might point out the almost complete lack of progress made by the so called 'qualified people' of the research teams.

Only public demand will force this matter

Public demand is what is necessary to force this matter.

If I have been logical in my debate and sound in the interpretation of results obtained, then we need, above all things, vocal public support in demanding research on the basics of agriculture.

Then, hopefully, some progress will be made on defeating the scourge of heart disease and cancer.

What I have been writing about is an insidious thing. Gradually these soluble minerals in our soils are decreasing.

Further imbalances have been increased by so-called 'land development' which has doubled the call made on the trace minerals.

Yet the situation is not nation wide. Parts of our coastal lands,

those lashed with sea storms are certainly receiving partial replenishment from the sea spray.

A healthy foetus essential

All life begins with the development of the foetus. A healthy foetus during the whole of the gestation period is essential if the offspring of both animal and man are to be allowed to start life as healthy beings.

Quite recently the British Medical Association claimed that a high percentage of children in Britain are born with sub-normal intelligence due to a defective thyroid.

Their recommendation was that all babies be blood-tested at 11 to 12 days of age, and the affected ones injected with iodine. They could then be cured and save the state much money in later years. The cost per child was 59 pence.

However this is a classic foolish example of diagnosis on effect, instead of acting upon cause.

If we as stockmen were to follow this recommendation of the British Medical Association, we would have many thousands of lambs dying in the womb and being aborted, many more being stillborn, and more still, not surviving long enough to even have the 11 to 12 day blood-test taken.

The cause of the trouble is undoubtedly the inability of the mother to supply sufficient iodine to the unborn during pregnancy. Exactly what I have been trying to say:

Healthy ovulation with live eggs. = Healthy conception. = Healthy development of the foetus and consequently a healthy child.

Importance of magnesium, selenium, zinc and iodine

Lack of health-giving minerals to the unborn, predisposes them to all types of diseases and physical weakness which can be easily overcome during pregnancy.

There can be no doubt that the combination of magnesium, selenium, zinc and iodine play a very important part in ensuring a healthy foetus in our flocks and herds.

Manganese also belongs in this complex. I do not use it myself as our region is rich in manganese. However there are two forms in which it could fit into the complex; as manganese sulphate, or as Condy's Crystals (potassium permanganate).

Making researchers accountable

Wouldn't it be lovely if all those millions of research workers worldwide who have a commercial interest in sick animals and sick people, and whose funds come from the public purse, were forced to make an annual report to the public on their work?

Such a report would be well justified. Many teams would be

disbanded and put to more rewarding work, which could prove more beneficial to their various countries.

Suitable mineral balance for both animal and human health

Before closing down I must try and make it very plain. I must once more repeat the processes which have led me to the conclusions I have reached in my search over 33 years for knowledge on "How to obtain and maintain a mineral balance suitable for both animal health and human health."

I have been led to the beginning of life, to the twinkle in the father's eye, to ovulation, to impregnation, to conception, to the gestation period and finally to birth.

So in the beginning it is necessary to have healthy hormone production of both male and female if we are to produce a healthy infant.

These four ultra-soluble minerals – magnesium, selenium, zinc and iodine, unstable because of their solubility, play a vital part in the purity and health of the hormones.

If maintained at correct levels they will ensure a healthy infant born to both animal and man.

And surely, if these minerals are vital before birth, they are important right through life, to continue the protection which they gave before birth.

So what has happened to me is understandable. At the age of 65 years, after 20 years of ill-health, I have returned to the beginning of life, and can claim to be healthy today.

So simple. Perhaps too simple for scientists to comprehend.

New Zealand rightly named 'God's own Country

Do you know folks, I think I have shown excellent restraint in writing this book.

I think New Zealand is rightly named 'God's own Country.'

I love most of all that small corner called 'Coulmore.'

I love all our animal population and I care about our people.

I have been highly concerned for a long time, since 1938 ever since I realised how our farmers had been conned into raping our soils.

I was 25 years of age in 1932 when I was told by the scientists that by spending an extra £100 a year I could have double the fat lambs to sell. Along with many others I swallowed the bait, hook, line and sinker.

I have tried to show in this book just how destructive those recommendations were.

Brown Trotter

Chapter thirty-six

Where we are today

by Ewan Campbell

Ewen Campbell is a successful Waihi beef farmer and managing director of the NZ-wide natural fertiliser company Probitas Ltd.

Brown Trotter a man of true science

I first read Brown Trotter's book a year ago. It gave me very mixed emotions for two major reasons.

Firstly, here was a man concerned with the health of his farm, his livestock, and in the end his own health. He had the ability to understand what he observed on his farm, and then the determination to track down the science to measure and explain what he had observed.

Ewan Campbell on his Waihi farm.

To me this is what true science is all about. Nature really holds all the answers to our health and well being. When reading books from men like this, the statement *"great minds think alike"* springs to mind.

Secondly, I had the feeling that nothing has really changed with the so called *'powers that be.'* These individuals feel they have the right to take our money and then dictate how we are to run our farms. This I can attest to myself in my endeavours to make my own farm and others, far healthier, happier, and profitable places to live.

Professor William A. Albrecht

The great modern breakthrough that Brown Trotter did not have at his finger tips was communication in the forms of fax machines and the internet. Had he had the ability to communicate with other like-minded researchers around the world, unbound by bureaucracy, he would have made even more progress.

He would have had access to one of the greatest soil scientists of his century, Professor William A. Albrecht, head of soils at Missouri University, USA.

Albrecht is down in history as one of the great observers of nature. That in itself may be no great claim to fame, but it led him to ultimately understand just what the soil required to produce food fit for human consumption.

Albrecht's work included a lot of Trotter's findings. Like Trotter, he was more interested in the cause than the symptom, and having a team of dedicated workers he was able to eventually produce mineral profiles and ratios for all types of soils.

Accurate 15 element soil tests

Professor Albrecht's His work has now been refined to the point where we can make accurate 15 element soil tests. These tests in the hands of trained people, not interested in selling certain products, are one of the most powerful tools on earth.

Albrecht knew that the soil was the beginning of all life. He wrote four volumes on his work. These volumes are published as *'The Albrecht Papers'* and are available from the website of Acres USA America's oldest and largest monthly magazine covering eco-agriculture. The website address is www.acresusa.com.

Dr Maynard Murray and sea minerals

Other great researchers were also working around the same time as Brown Trotter. Dr Maynard Murray, a medical doctor who researched the use of sea solids as a soil fertiliser. Murray had tremendous results using pure sea water to fertilise soils, and also to run profitable hydroponic operations.

One of his great assertions was that clean sea water had the same chemical composition as human blood, and that humans also needed the 70 different elements found in sea water. He reasoned that if humans needed the elements, the soil would probably benefit from the application of these elements as well.

It was too complex a task to discover exactly what interactions the elements had with each other, but the results were certainly there. His work is also written up in a book called *"Sea Energy in Agriculture"* also available from Acres USA.

Travelling dentist Dr Weston A. Price

Another world renown researcher was Dr Weston A. Price, an American dentist who travelled the world in the 1930's, researching native tribes' diets.

His main focus to start with was to find the cause of rapid tooth decay in his patients. What he found was to be even more profound.

The whole physical structure of humans was more defined by nutrition than genetics.

In his great classic book *"Nutrition and Physical Degeneration"* he uses many comparitive photographs to prove over and over again the effects of nutrition on physical and mental prowess.

He even travelled to New Zealand to study native New Zealand Maoris. Interestingly the Maori were regarded, not only by Price, but by many other researchers, as being physically the most perfect of all native tribes researched in their native state.

100 year old Australian farmer Percy Weston

Percy Weston, an Australian farmer would have surely been a great mate of Brown Trotters had they had known each other, even though he was Australian.

Weston went through numerous experiences similar to Trotter with problems on the farm. He too had health problems, cancer on more than one occasion, which he managed to treat himself and live to 100 years of age.

His studies were based around the over-use of superphosphate and the effects on his animals and himself.

Percy Weston's book *"Cancer: Cause and Cure"* is well worth reading. Like Trotter, he too researched the importance of mineral nutrition and proved beyond all reasonable doubt the importance of mineral nutrition for our soils and animals, and ultimately ourselves

Things are about to change

I could go on and on about the outstanding work done by tireless individuals who truly cared about our future. And also about the heartfelt comments made by them as they wrote up their work about the deterioration of health and environment back over half a century ago. These comments now bite very deep. We have not made the progress we should have. With the body of information available to us nowadays there is really no excuse.

I do believe however that things are about to change. The work we have been doing on the soil's electrical system, combined with the findings of these great researchers, are bringing some outstanding results in all types of agriculture.

The picture that is developing is one of pure beauty. Beauty created by nature, not by scientists.

This beauty from nature is always available to us, but we have to nurture it, and not think we are smarter than nature. All the researchers above were observers of nature. When they wanted to find out the truth, they spent time observing nature at its best. Only then did they go into the laboratory to put it into scientific terms.

Hopefully we farmers of today will take note from all this. We really are the only experts on our own farms. All we have to do is get a hold of the information which is out there and utilise it for our own benefit.

When we farmers understand that we are the most important people in the world we will all make huge strides forward.

Farmers are some of the very few people on earth who have the ability to create true production. That is, to take the sun's energy and turn it into a product. Most other producers only utilise forms of energy that are not sustainable and have been produced in former times, ie fossil fuels.

We farmers are in charge of the health industry. It is the food we produce that dictates the health of our nation.

Farmers should also understand that true production does not cost very much. There is no real need for high chemical fertiliser costs, nor high animal health costs due to poor practices. True production is the ability to harness nature and turn the sun's energy into products fit for human consumption.

At this stage in farming we can have real change, because economically, which seems to be our greatest regulator, there is only one way to go – UP!