acres of copper-deficient peat throughout New Zealand." Much of this known copper-deficient country has been mapped and farmers in these known areas regularly supply supplementary copper to pastures.

By 1954, however, complications had arisen and in the April "Journal" of that year Cunningham says:

> Copper deficiency in New Zealand was first recognised about 1940, causing unthriftiness, low production, and disease in cattle and sheep pastured on reclaimed swamplands. Soon it was learnt that copper deficiency was not always the full story for in some areas molybdenum also came into the picture. An excess of this element, especially when associated with a low supply of copper, was responsible for some of the disease symptoms. On peat lands therefore two disease states were recognised: the first, a straightforward deficiency of copper and, the second, a copper deficiency accompanied by poisoning due to excess molybdenum in the grass.

Peat was not the only soil type to be affected: "Further work has shown that copper deficiency with or without molybdenum poisoning is not confined to peat soils. Sandy soils, marine and alluvial silts, and other soils . . . are also affected. At present about 1½ million acres of farmed land are known to be involved and about an equal area not yet developed is regarded as likely to prove deficient." The problem had grown.

Much work had to be done on molybdenum, finding the type of soils in which a dangerous excess of this mineral occurred and determining how to prevent the toxic action of molybdenum. Cunningham's 1954 article commented on the interaction of molybdenum and copper:

> It is known that copper and molybdenum act against each other inside the animal. An excess of molybdenum in the ration tends to drive out stored copper and to interfere with the use that can be made of the copper present. On the other hand extra copper in the diet will, within limits, neutralise the effect of excess molybdenum. The position is even more complex, for Australian workers have recently shown that sulphate, in its turn, affects molybdenum storage in the body and if sufficient sulphate is present, molybdenum is got rid of quickly.

In Somerset, England, there is a similar disease to our peat scours called "teart" due to excess molybdenum, but our copper deficiency is not quite allied. A high molybdenum excess causes scouring as in teart, but in New Zealand a low copper intake, plus some excess molybdenum, produces a similar condition. Cunningham goes on:

> For copper deficiency with or without excess molybdenum a method of treatment or prevention is to increase the copper supply.
>
> Prevention should be the objective, as it is the only method that gives results against enzootic ataxia. The scouring symptoms of peat soils can be removed by a short course of dusting with copper solutions, but unless a regular supply of copper is given throughout the year, thrift and production will not be improved.

By 1957 it was possible to inject copper as a copper cerate to control the disease. Cunningham in the September issue of the "Journal" in that year lists the dangerous soils and their approximate areas (where known) and states:

> There are clearly large areas in New Zealand which produce pastures high in molybdenum. [Investigations had by this time proceeded very far from those up to 1944.]
>
> . . . the similarity of chemical composition of pastures from [all] the soils listed . . . suggests the strong possibility that disease controllable by supplying copper could occur on any farm situated on any one of the soils. It is, indeed, likely that such diseases already occur but have been overlooked because they might not recur every year and because the unthriftiness, the greying [of the animal's coat], or the scouring have not been recognised as signs of a disease.
>
> The situation now is changed. It is known that when these signs occur in cattle, it is probable that they are caused by too much molybdenum and too little copper in the fodder, and that probability is very high indeed if the cattle are kept on any of the soils named. It is advisable therefore for farmers on these soils to keep this possibility in mind when inspecting their stock. Copper cerates are effective and economical for treatment of single animals or whole herds.

This is not the whole story, as there are a few areas in which copper in large quantities has apparently not prevented a disease which has the appearance of copper deficiency. Work is still going on, but for most of the known areas the recommendations in the 1957 article have proved satisfactory.

Control of Disease by Vaccination

VACCINATION effectively controls some diseases of both animals and man, but no example emphasises the limitation of vaccination as a means of disease eradication better than does blackleg, an acute and generally fatal disease of calves and sheep. Blackleg is one of the group of gas gangrene diseases characterised by the production of gas in the tissues and death from the toxic products liberated by invading bacteria. *Clostridium chauvoei*, the cause of blackleg, is a spore-forming bacillus and the spores survive in the ground for years to perpetuate the disease.

BLACKLEG spores arrived in New Zealand with unsterilised bone fertiliser from India about the end of last century. The disease was first noticed in Taranaki and is first referred to in the "Journal" in February 1916, in which attention is drawn to an amendment to the Blackleg Regulations. Formerly these had applied only to Taranaki, but the disease had spread to Auckland Province, and parts of the following counties were also declared infested areas: Franklin, Raglan, Piako, Thames, Ohinemuri, Waipa, and Waikato Counties.

Later in 1916 C. J. Reakes, then Director of the Livestock Division, fully described the disease (which had become well established) and its control. At this time and for many years blackleg was thought to be limited in New Zealand to calves.

"The disease," said Reakes, "fortunately is present only in limited areas of New Zealand, but the mere fact of its limited distribution renders it necessary to take all possible precautions to prevent its further spread and at the same time to keep it under control in the already affected localities. This can be done effectively at but slight cost and with but little inconvenience to farmers, provided they cooperate with and assist the departmental officers in carrying out the necessary measures."

Discussing the introduction of blackleg into the country Reakes said: