Selenium: an essential trace element

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SELENIUM
An Essential Trace Element

SELENIUM is one of the rare elements. In most soils it occurs in such minute quantities as to escape attention. Plants, however, can concentrate selenium in their tissues and, in the U.S.A. in areas where the soils contain more selenium than usual, this facility can result in selenium poisoning in grazing animals. Only minute traces of the element are required to produce these toxic effects. "Wheat grown on soil containing two parts per million of selenium might concentrate this element to the extent of 25 parts per million in the grain, more than double the quantity needed to produce a grave poisoning in farmstock" (Daniel, 1939). As little as five parts per million of selenium in the edible fraction of pasture is considered to be dangerous for grazing animals.

Fortunately, none of the common soil types in Australia appears to contain enough selenium to affect the quality of the herbage. Research workers have remained alert to the possibility, however. Some years ago, for example, the suggestion was made that certain stock losses in the Kimberleys could be due to excessive selenium. Analyses of fodder samples gave no indication of any accumulation of this element.

NECESSARY FOR WELLBEING
Selenium is now attracting attention for reasons quite distinct from its toxic properties. It has now been shown that minute quantities of selenium are essential for the health and wellbeing of living creatures. About ten years ago research workers found that disease symptoms in rats, previously considered to be due to lack of Vitamin E, could be prevented by a "factor 3" which contained no Vitamin E (Schwartz, 1951). Subsequent work (Schwartz and Foltz, 1957) showed that traces of selenium salts added to the basal diet effectively prevented the development of the disease in question.

For many years, breeders of sheep and cattle in specific regions throughout the world have been troubled with losses of calves and sheep from a condition known variously as "white muscle disease," "stiff lamb disease," or "muscular dystrophy." These losses have been ascribed to lack of Vitamin E, but treatment of breeding stock and affected young animals with the vitamin, has not always given the response to be expected. When it became known that selenium could prevent and cure abnormalities in laboratory animals previously attributed to Vitamin E deficiency, tests were carried out with farm animals. It soon became apparent (Hogue, 1958; Grant et al, 1959) that traces of selenium could produce remarkable improvements in sheep affected with "white muscle disease." These beneficial results were obtained by the administration of minute amounts of selenium to the pregnant ewe, or to the new-born lamb.

NEW ZEALAND EXPERIMENTS
The discovery that selenium is an essential trace element appears to be of great importance to farmers in New Zealand. In the South Island of N.Z., in particular, "white muscle disease" has caused serious losses of lambs for many years. Vitamin E injections have been used with varying success but workers at the Wallaceville Research Station have now shown that selenium is much more dependable in the prevention and cure of the disease. Workers in Great Britain (Sharman et al, 1959) have likewise shown
that selenium is much more effective than Vitamin E in preventing muscular dystrophy in calves. In New Zealand, Jolly (1960) likewise found that an ill-thrift problem in calves on pumice soils could be corrected by two injections of sodium selenite. One month after the first injection the treated calves showed an average increase in body weight of 41 lb. compared with only 27 lb. in the controls.

As would be expected, a considerable volume of research work is now in progress in the affected areas of New Zealand. It has been clearly established that the proper use of selenium salts will provide an effective and economical control of white muscle disease. Much remains to be learnt, however, concerning the best method whereby the selenium should be supplied. In the affected areas, injections of minute amounts into lambs soon after birth and at intervals thereafter have given excellent control. So also have equally small doses given per mouth. No definite recommendations can yet be given, however, as to which is the best method, or how many doses are required. It is to be expected, of course, that methods of treatment will vary according to the severity of the deficiency. In some areas, the disease only appears in lambs for a short period after marking, while in other areas many lambs die soon after birth. In the latter case it would appear preferable to treat the ewes rather than the lambs. In some of N.Z. trials, selenium given to the ewe has not resulted in absolute control. It seems logical, however, to provide the essential trace element to the ewes as well as the lambs.

Providing selenium to the ewes may be important for another reason. Recent work in New Zealand (Hartley et al, 1960) indicates that inadequate intakes of selenium could contribute to the low fertility characteristic of many flocks in afflicted areas. In the South Island on 21 properties where "white muscle disease" occurred in the lambs, ten of the flocks contained 30 per cent., or more, of barren ewes. Controlled experiments were carried out to determine if fertility could be improved by giving each ewe 5 mgm. of selenium at monthly intervals from one month before mating to just prior to lambing. Not only did these injections eliminate "white muscle disease" in the lambs, but there were many less barren ewes and a marked increase in lambing percentages. In one experimental flock, for example, the lambing percentage increased from 61 per cent. to 95 per cent., while the percentage of barren ewes fell from 31 per cent. in the control group, to 8 per cent. in the treated group.

WEST AUSTRALIAN OBSERVATIONS

In Western Australia there are many farmers who are concerned with low lambing percentages, failure of lambs to survive after birth, and with the slow rate of growth of lambs and weaners. The successes obtained with selenium in New Zealand can be expected to raise hopes that this element may provide the solution to similar problems in Australia.

It is possible that areas suffering from selenium deficiency will be found but it is well to remember that selenium has proved beneficial mainly, if not entirely, in areas where white muscle disease occurs. As far as is known at present, white muscle disease is of rare occurrence in West Australia. During the last ten years only two or three supposed cases have been reported to the Animal Health Laboratory, but no clear-cut diagnosis has been made. Nonetheless, it is possible that border-line selenium deficiency could be reducing the well being of lambs and calves in some districts of this State.

Controlled experiments were started in Western Australia some months ago, to determine whether selenium will increase the growth rates of lambs in districts where lamb losses have been excessive, or where weaners do not thrive. With the co-operation of local farmers, District Advisers and Veterinary Officers injections of the requisite traces of selenium have been given at monthly intervals to half the animals in flocks of at least 100 lambs or weaners. The test animals are being weighed at the beginning and end of each trial.

In New Zealand where selenium has been beneficial, such injections are followed by obvious increases in growth rates. In results which have already come to hand from the Albany district (Bornholm and Mt. Manypeaks) the treated lambs and weaners have not gained any more weight than the controls. Further trials are being commenced in other dis-
tricts as lambs become available for treatment. By carrying out these experiments on selected farms where symptoms suggestive of "ill thrift" have occurred it should be possible to determine if lack of selenium is a disability. The tests will have to be carried out in several successive years, if negative results are obtained, because trace element deficiencies do not necessarily show up every season. In borderline areas, for example, cobalt deficiency may only cause losses in one year in five. When the losses do occur, however, these can be costly.

The recent discoveries which have been made concerning the importance of selenium in livestock rations will be of great economic value to farmers in the affected areas of New Zealand. In all parts of the world students of animal nutrition will now be carrying out trials to see whether selenium is needed in a host of different environments. As trace elements have played such an important part in the development of Western Australia it is natural that our farmers will be interested to learn if selenium is another element which must be provided. The current series of trials should give a definite answer. Meantime, it may as well to remind farmers that as little as five parts of selenium in a million parts of herbage will be toxic to grazing animals. Selenium supplements should not be used until there is definite evidence that these are needed.

REFERENCES


CORRECTIONS

In the article on Cape Tulip (Pages 593 to 599 in the July issue of "The Journal of Agriculture") some words were omitted from the seventh line on Page 598. Instead of reading "On 3 hundred gallons per 48 square yards"—this should read "One hundred gallons per acre, that is one gallon per 48 square yards, is a convenient rate, etc."

In "Studies in the Mulga Pastoral Zone" (Pages 581 to 586) the first line in Table I should read 137.0 not 13.7.

In the article on Lamb Marking by I. K. Stott (Page 604 of the July issue), the instructions on ear-marking should read:

Mark males on the right or off ear.
Mark ewes on the left or near ear.
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