Vinquish (Cobalt Deficiency) in Sheep

AND ITS GEOLOGICAL DISTRIBUTION IN SOUTH-WEST SCOTLAND.

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In recent years certain enzootic diseases of grazing animals in various countries of the world have been shown to be due to a deficiency in the diet of a trace element essential for the animal economy. In some areas this deficiency has been traced from the animal through the herbage which forms its diet to the soil, and finally to the parent rock from which the soil minerals are derived. The present communication presents further evidence of this sequence of events from a study of " vinquish " (cobalt deficiency), a debilitating disease of sheep in South-West Scotland, and a survey of its distribution in that area. The value of various preventive methods is discussed.

Previous studies in other parts of the world have shown that symptoms of cobalt deficiency in the diet of grazing animals occur on areas which geologically are devisible into three main types These are :—

(1) Grey and white limestone sands of aeolian origin.
(2) Granite and other acid igneous formations.
(3) Areas where the solid geological formations are complex.

1. AEOLIAN DEPOSITS OF SAND AND LIMESTONE.

In 1931 Becker, Neal and Shealy reported that a debilitating disease of cattle and sheep, known as " salt sick," occurred in Florida on white and grey sandy soils, residual marls or " muck " lands and peat soils not subjected to overflow from more fertile watersheds. The animals recovered when moved on to red and yellow sands, clays, shallow sands underlaid with clay, and soils subject to overflow from clay lands. The affected formations in Florida are similar to those reported by Greig (1932) for areas on which enzootic diseases occur in grazing animals in the Western Hebrides of Scotland. On Tiree, severe pining in cattle occurs on the Blown Sands, which contain a high content of shell fragments, and which are in places heaped up in dunes. The healthy country is confined to the Raised Beaches consisting of gravel or gravelly sand, rust stained, and containing iron cemented layers or iron pans.

In an exhaustive survey of South Australian " Coast Disease," Thomas (1938) revealed that the disease was associated with the geologically-recent, highly-calcareous littorals composed almost exclusively of comminuted marine and lacustrine shell fragments of aeolian origin. These deposits are superimposed on the normal soils, derived from the basement rocks, and in places are piled up into gently rolling dunes. Bennetts (1940) observed that the " Coast Disease " of West Australia has a similar geological distribution being confined to the fine sandy soils rich in lime and composed mostly of wind-borne shell fragments.

Further south in the Denmark District, where " wasting disease " occurs, Harvey (1937) has shown that the sandy soils generally appear to be deficient in cobalt but Filmer reported (1933) that the unsound country in this area was not obviously demarcated by geological formation from the healthy areas.

2. IGNEOUS FORMATIONS.

The occurrence of pining on certain soils over granite rock has been observed by many writers on areas in the South-West of Scotland (MacLelland, 1875; MacCulloch, 1875; Wallace and Kinch, 1884), and elsewhere in Scotland (Hogg, 1806).

In New Zealand, Bush Sick areas are confined largely to the pumice areas and especially to the very acid rhyolitic beds. It also occurs, however, on the highly leached soils derived from rocks of a more basic type, such as andesite. (MacNaught, 1938).

Granitic formations are also common in the Denmark district of West Australia where " wasting disease " occurs. (E. C. Owen, private communication).

3. AREAS OF COMPLEX SOLID GEOLOGICAL STRUCTURE.

Hogg (1831) and others observed that pining was common on the syenitic porphyry of the Cheviots, but MacGowan & Smith (1923) pointed out that it was not confined to this formation. It occurred also over sedimentary rocks of the Old Red Sandstone and Silurian systems, and they concluded that pining is not confined to any special type of rock or soil. These observations have been confirmed by Corner (1939).

The distribution of the " vinquish " or " pining " areas in the South-West of Scotland, apart from those occurring on granite, do not at first sight appear to be related to geological structure.

Extensive field studies have shown, however, that while they overlie a number of rock types the areas are distributed on the same surface drift. Furthermore, healthy areas on this drift can be separated from the affected areas by other surface geological features.

"VINQUISH."

The first reference to a nutritional disease of sheep in Ayrshire is found in a book by William Aiton (1811) on the agriculture of the county. He mentions three diseases of sheep in the county—Braxy, Sturdy and Vanquish—and says, "The Vanquish, as it is the effect of starvation, is remedied by turning the sheep on to better pasture."

Previously, two references had been made to the occurrence of the disease in the West of Scotland. Under the heading "Pining," "Daising" or "Vanquish" (or "Vinkish"), James Hogg (1807) and Beattie, quoted by Duncan (1807), observed that the disease was common in the West of Scotland, but while the term "Vanquish" or "Vinquish" is peculiar to South Ayrshire and Galloway no particular locality is specified.

Wallace and Kinch (1884) refer to Vanquish occurring on land overlying granite rock. They state that it is not the result of want of food as is often supposed by those who have never seen it and that a farm, subject to the disease, may get quite clear of it by allowing the sheep to run in larger hefts.

The unsuitability of granite land for sheep in the Stewartry of Kirkcudbright was also referred to by MacLelland (1875) who observed that sheep will not live on granite soil more than a year without becoming unhealthy. He states that the "vincus" or "Vinquish" can be cured when observed in time by a change of pasture.

MacCulloch (1875) also refers to the disease in this area and suggests that it is caused by an excess of soda and potash in the granitic detritus. Another theory—the want of sulphur in the granite—is also mentioned.

INVESTIGATIONS ON PINING CONDITIONS.

In 1935 Marston announced at a meeting in Adelaide that he and his colleagues had cured "pining" sheep by the administration of a solution containing small amounts of cobalt salts (Marston, 1935; Lines, 1935). Previously, commercial iron salts or natural

iron ores had been found to cure the disease when fed to affected sheep in physiologically large amounts. When pure iron-salts were used the results were disappointing. Marston showed that it was the small amount of cobalt in the various impure iron compounds that produced the spectacular recoveries from the disease.

Shortly afterwards, workers in Western Australia (Underwood and Filmer, 1935) showed that pining animals suffering from Denmark Wasting Disease could be cured by dosing with small amounts of cobalt, while from New Zealand it was reported that Bush Sickness (Askew and Dixon, 1936) was amenable to the same treatment. Incidentally, this discovery has opened up large tracts of derelict land for sheep farming in the Dominion. "Nakuruitis" in Kenya (Ann. Rep., 1937), "Salt Sickness" in Florida (Neal & Ahman, 1937), "Moor Cling" in Devon (Patterson, 1937) and "Pining" on the Scottish Borders (Corner & Smith, 1938) are, similarly, curable by adminstering solutions of cobalt to affected animals.

Later, Marston and MacDonald (1938) showed that copper as well as cobalt was essential for the prevention and cure of "Coast Disease," a pining malady of sheep in South Australia, while the "Neck-Ail" of Massachussetts was claimed by Archibald, Kucenski, Brooke and Freeman (1938) to be an iron deficiency. The nature of "Lechsucht" another pining disease in Schleswig has not been elucidated although a number of mineral elements have been tried out (Schermer, 1939).

AETIOLOGY.

The severity of Vinquish in sheep in South Ayrshire was reported to the Animal Husbandry Department, Auchincruive, in the autumn of 1939. Although it was late in year fresh cases were cropping up. Solutions containing iron, copper or cobalt were made up and a number of sheep affected with Vinquish were dosed either daily or twice weekly. Sixteen affected sheep receiving 40 mg. of iron (as ferric ammonium citrate) per day showed no improvement compared with a number of undosed sheep. Copper sulphate was also proved to be ineffective when administered in daily doses of 10 mg. Cu. to 17 affected sheep. On the other hand 21 affected sheep dosed with cobalt salts (1 mg. Co. per day) showed marked improvement and recovered in a short time. Some shepherds were able to notice a marked difference in the treated animals within 2 days. The cobalt solution alone proved effective in curing these cases of Vinquish.

It should be pointed out that the experimental sheep, referred to above, had been removed from the affected grazing and confined on enclosed arable pasture. It was possible therefore that the

home pastures contained some elements in addition to cobalt which were necessary for the cure of the disease. During the following summer shepherds were again supplied with solutions of cobalt alone, for administration to sheep remaining on the affected grazings where they had developed the disease. Of 14 animals treated in this way all recovered within one week. The disease in South Ayrshire therefore appears to be a straight cobalt deficiency.

GEOLOGICAL DISTRIBUTION.

The district in which Vinquish occurs has been studied fairly intensively in the past by geologists both as regards the solid and drift formations. Besides the solid and drift editions of H.M. Geological Survey of Scotland (sheets 8 and 14) a soil texture map of parts of the area has also been published (sheet 14).

The Southern Upland Fault is the most conspicuous structural feature in the affected area (Fig. 1). It stretches across Scotland from Ballantrae to Dunbar and traverses Ayrshire south of Pinwherry, Barr, Straiton, Dalmellington and New Cumnock. The

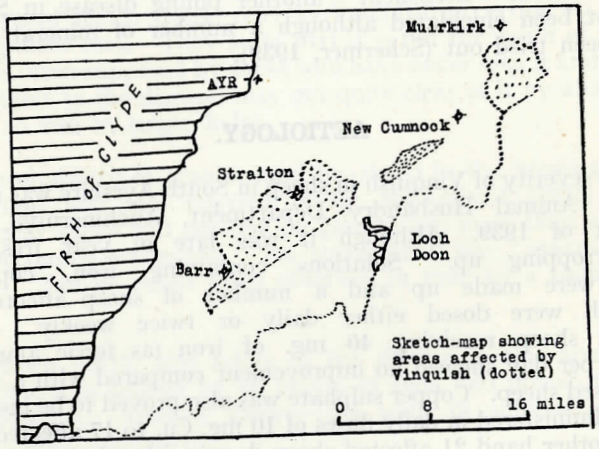

FIG. 1.

actual division follows the Muck Water, Howe of Laggan, Upper Stinchar Valley, Fore Burn, Glessel Burn and Mossdale Burn to Dalleagles, and crosses the Nith and the county boundary on the southern slopes of Corsoncone. In Lanarkshire it passes south of Tinto running through the villages of Crawfordjohn, Roberton and Culter.

Vinquish is unknown in Ayrshire on grazings lying south of this fault, nor can any record of its occurrence in past years be obtained except in the area south of Loch Doon on the Loch Doon-Loch Dee "granite" mass. Here it existed at the end of last century but the sheep stock have since been removed from the grazings.

To the north of the fault, Vinquish is prevalent and occurs mostly on areas composed of Lower Old Red Sandstone rocks which include sediments, lavas and intrusions. A band of affected farms, broken at New Cumnock where Carboniferous rocks overlie the Old Red Sandstone, stretches from near Pinwherry in the west to the county boundary south of Muirkirk in the east—a distance of about 40 miles. Over most of its length the area is five miles wide. The information collected for Lanarkshire shows that there also affected farms occur only to the north of the Southern Upland Fault while those to the south are clear.

The sharp division by the Southern Upland Fault of Vinquish from non-Vinquish grazings may be illustrated by a few examples. (*a*) Vinquish is unknown on sheep farms with the fault as their northern march. (*b*) Sheep farms with the fault as their southern boundary are affected. (*c*) Where the sheep farm extends across the fault the grazings to the north are affected and those to the south are clear. (*d*) The incidence of the disease on grazings lying across the fault depends on the proportion on the north side. Near the head of Loch Doon, four contiguous grazings stretch across the fault. On the most westerly there is only a small proportion of ground to the north of the fault, but this proportion increases with each grazing till on the east the grazing is largely on the north side. Cases occur sporadically amongst the first lot of ewes but increase in number on each heft to the east till the last is regarded as bad Pining ground.

It is noteworthy that besides being the demarcation between the Ordovician and Old Red Sandstone systems, the Southern Upland Fault, in part, forms the junction of the area of predominant morainic drift to the south and the area of predominant boulder clay to the north. The Vinquish-free farms to the south, on the morainic drift, lie at a greater elevation and are characterised by higher hills and deeper glens.

In the affected area, Vinquish is perhaps most severe on the felsite areas but it also occurs where the Old Red Sandstone sediments and igneous rocks are overlain by boulder clay. Further north the land is devoted chiefly to arable farming, but where hill-sheep farms are found the grazings are free from the disease. The northern boundary of the affected area appears to coincide with the

junction of the glacial drifts from the north and from the south as determined by the Geological Survey. The difference in the mineral composition of these two drifts is most marked as was pointed out by Elder & McCall (1936) (Fig. 2). Mineralogical analyses of typical soils show that the ferromagnesian mineral

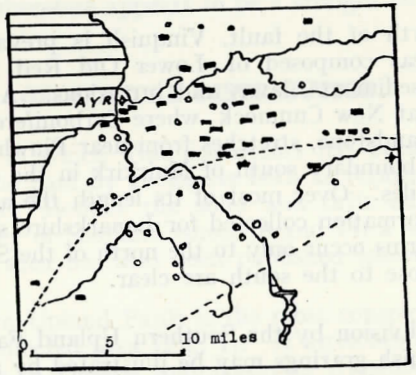

FIG. 2.

Drift and Mineralogical Sketch map of Southern Ayrshire. Upper broken line: boundary between Northern and Southern drifts. Lower broken line: Southern Upland fault. Black rectangles: soil carrying more than 2·9 per cent heavy crop. Circles: Soil carrying up to 2.9 per cent heavy crop. Based on Elder and McCall, *J. Agri. Sc.* (1936) 26, 1.

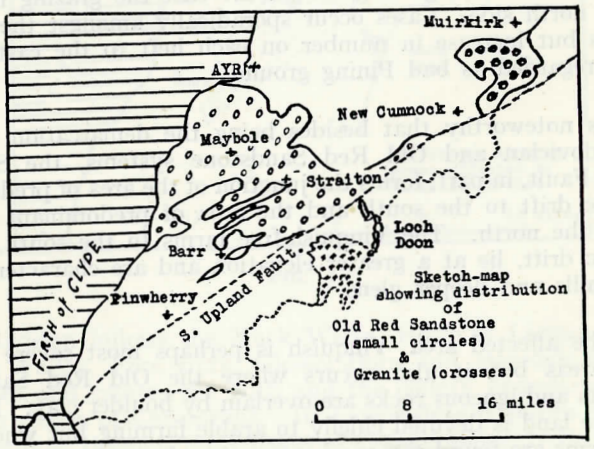

FIG. 3.

crop from soils of the northern drift averaged 4·6 per cent while on the southern drift the percentage was invariably lower (2·1 per cent). It is noteworthy that in the latter group the soils from the Vinquish farms contain the lowest percentages of ferro-magnesian minerals e.g. Auchenroy, Shaws Knowe, Grimmett, Straiton Moor, all with 1 per cent or less.

Altogether in South Ayrshire Vinquish is prevalent on 45 hill-sheep farms carrying a total stock of over 1,600 score of breeding ewes, while in Lanarkshire there are records of 10 affected farms with a stocking of 210 score. Only on 4 Ayrshire farms, however, are all the grazings subject to the disease. A healthy flock may adjoin a grazing where many cases of the disease appear each year.

CONTROL.

For the control of the disease, apart from moving the flock to healthy pasture, three methods have been adopted. These are :—

(1) Feeding of Cobaltized Mineral Blocks (Licks).

(2) Feeding of Cobaltized Salt Mixture.

(3) Individual dosing of the animals at the routine gatherings.

The first two methods have answered well but failures have been reported. On one affected hirsel supplied with half a dozen cobaltized mineral blocks, almost half of the sixteen score of ewes showed symptoms by the end of July. On another grazing carrying 10 score of ewes, and where Vinquish is more prevalent, complete control of disease symptoms was obtained by provision of 40 of the same mineral blocks fixed to posts at as many different points on the grazing. In practice therefore it is necessary to ensure that all the animals have abundant opportunities to obtain access to the cobalt minerals.

The amount of cobalt in the mixture is also important. Analyses of a proprietary brand of cobaltized minerals supplied to one farm showed that the cobalt content was less than 30 p.p.m. While the incidence of Vinquish in the flock was reduced compared with previous years and with untreated flocks in the district, control was far from complete. Cobaltized Mineral Mixtures should contain at least 100 p.p.m. and preferably 300 p.p.m. to suit conditions on most farms in South Ayrshire.

Sheltered troughs are necessary for the feeding of mineral mixtures so that they may be kept free from excessive rain. Some farmers have made these troughs water-tight by sealing the seams. The rain which blows under the roof-shelter on to the minerals may, on occasion, half fill the box, but even in solution the minerals are consumed and none is lost by drainage.

Flocks which are gathered at monthly intervals during the pining season may be treated by the third method. It involves the individual treatment of each animal at the routine gatherings with a single dose of cobalt solution to supply 100 mg. of the element. It has answered well on all affected farms.

From the results of control work it may be recommended that in a susceptible flock one 3-feet trough should be alloted to each score of ewes. This figure will vary slightly with the physical nature of the ground and the severity of the disease. The incidence of the disease is high on those areas of the grazing where the old herbage has been burned off earlier in the year. This common observation of shepherds may find its explanation in an analyses of healthy and sick pastures carried out in New Zealand. McNaught (1939) found that when the growth of herbage is at its greatest the cobalt content is at its lowest and *vice versa*. In winter the cobalt content of the herbage rises, a fact which may explain the absence of symptoms during the winter months and the natural recovery of slightly affected cases which develop in the late autumn. With access to cobaltized salts, sheep grazing on the burned portions of a grazing, continue to thrive without showing symptoms of the disease.

The practice of removing affected sheep from the hill grazing to the home pastures appears to have been the general method of controlling Vinquish in the past. On four farms, however, where there is no healthy low ground it was necessary to remove all the animals to "healthy" arable farms outside the area. With intensive mineral feeding this practice is unnecessary, and the stock may remain on their own hefts throughout their useful life on the hill.

The observation of Wallace & Kinch (1884) that the disease may be overcome by extending the grazing boundaries of the flock is borne out by experience on one farm on the south-western fringe of the affected area. Twenty years ago Vinquish on this farm was very severe. The hefting was subsequently re-arranged so that a large portion of lower ground was included in the grazing of each lot. Since then symptoms of "Vinquish" appearing in the flock are practically unknown and it is now regarded as "clear."

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