# *XANTHORRHOEA HASTILE* POISONING OF CATTLE.

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**SUMMARY.**

**Four feeding experiments with** Xanthorrhoea hastile **(swamp grasstree) were done in an endeavour to produce the condition known as wamps or North Coast disease of cattle.**

**The disease was not produced when a 480 lb. heifer was fed 204 lb. of chaffed spikes in 48 days, nor when a 530 lb. steer was fed 305 lb. in 50 days.**

**Typical symptoms of the field condition were produced when 467 lb. was fed to a 200 lb. heifer in 73 days, and when 470 lb. was fed to a 400 lb. animal in 48 days.**

**A delayed effect of the plant toxin was observed.**

**The symptoms are an ataxia in which there is a diagonal progression brought about by swinging of the hindquarters always to the same side. Often urinary incontinence, with the beast in the normal urinating posture, is seen. There is frequently complete recovery, but death may occur from starvation if the animal becomes recumbent and is unable to rise.**

## I. INTRODUCTION.

As part of a programme of investigations into the apparently non-infectious diseases of cattle grazed on the wallum country of south-eastern Queensland, *Xanthorrhoea hastile* (swamp grasstree) was fed experimentally.

The wallum country was described by Young (1946) as the sandy coastal plain stretching north from the New South Wales border to Rockhampton. It takes its name from wallum (*Banksia serratifolia*), a small tree which is common in the area. The soil types and vegetation have been described by Andrews and Bryan (1955). The soil is generally acid and deficient in most plant nutrients.

On the wallum country there are several conditions in cattle in which an abnormality of gait is a prominent symptom. Two of these—phosphate deficiency and poisoning by a species of *Macrozamia*—have been clearly differentiated. The effects of phosphate deficiency (Theiler 1931, Barnes and Jephcott 1955) and of the ingestion of macrozamia (Edwards 1893, Hall 1954) have been described.

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A conspicuous symptom of phosphate deficiency described by Theiler (1931) is a stiffness of gait. For this reason the disease is known in South Africa as "stiff sickness" or "stifziekte," and in Australia as "pegleg." It is most prevalent in young cows, particularly if lactating. Fractures of the bones may occur, and consequently in Australia the disease is also referred to as "soft bone."

Ingestion of macrozamia by cattle causes a permanent disability of the hind limbs. On movement, the hindquarters sway from one side to the other and affected animals are referred to by farmers as being "rickety."

An additional syndrome has been recognised for many years and is known as "wamps" or "North Coast disease" (Fig. 1).

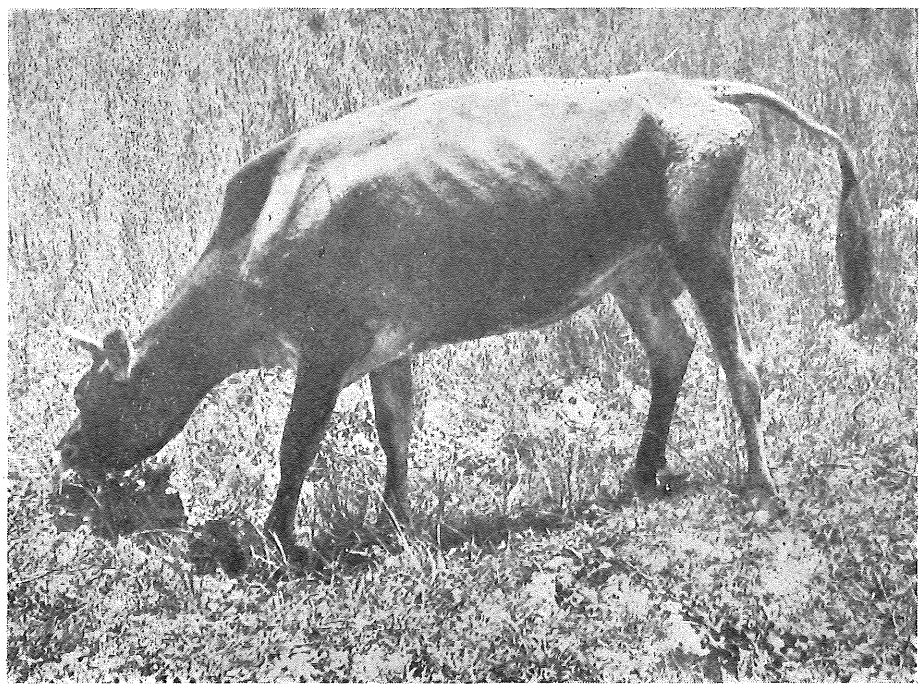

Fig. 1.

A Cow Naturally Affected by *Xanthorrhoea hastile* Poisoning. The back is curved and the animal is dribbling urine. The appetite is good.

Under the heading "North Coast Disease," the condition was described in the Annual Report of the Queensland Department of Agriculture and Stock for 1919-20 as follows:—

"The first indication was a slight stiffness of movement associated in the majority of cases with incontinence of urine. In other respects the beast appears perfectly healthy, appetite good, eye bright, coat sleek, temperature, respiration, and pulse normal. This motor disturbance gradually increases during the following week or so. By this time a paralysis, involving the large muscles of the back, usually on one side, has become manifest. When standing at rest no disability is noticeable, but on movement, the spinal column, posterior to the withers, is acutely flexed. The tail is also noticeably raised and carried to one side. The beast can no longer move directly forward, progression being of a sideways nature. In a small percentage of cases observed the paralysis appeared to involve the muscles on both sides of the backbone . . . At this stage, when the beast lies down it cannot regain the upright position without assistance."

## II. OCCURRENCE AND DISTRIBUTION.

The incidence of the disease is variable and losses are high only in some years.

As well as in the wallum country previously described, "wamps" is seen in an area of so-called wallum north of Townsville (A.A. Seawright, unpublished report, 1953—Queensland Department of Agriculture and Stock Files). The common grasstree in this area was recently determined by the Government Botanist as *Xanthorrhoea* sp. aff. *media* R.Br.

In southern Queensland the disease occurs from October to February. This is during the period of growth of a number of shrubs, among which is the swamp grasstree (*X. hastile*). This grasstree flowers early in its period of regrowth, so flowering plants are present at the time of the year when the disease occurs. Some stock-owners have maintained for many years that the young inflorescence of the swamp grasstree when eaten by cattle caused "wamps."

## III. DESCRIPTION OF THE PLANT.

The genus *Xanthorrhoea* is limited to Australia. All species are popularly known as grasstrees. The larger ones with a caudex or trunk several feet high are often known also as black boy. In most species the caudex exudes a considerable amount of resin. The flowers are borne in a spike at the end of a scape. This scape is smooth, reaches several feet in length, and on maturity becomes stiff.

*X. hastile* has a very short caudex, rising only a few inches above the ground. The inflorescence is four to six feet high when mature. The lower two-thirds is a smooth scape, and the upper third a thicker, rough, flowering spike.

On the area of wallum country outlined in Fig. 2 there were more than 10,000 grasstrees per acre (S. T. Blake 1953, pers. comm.), indicating that this plant constitutes almost the entire cover in certain places.

Fig. 2.

Stand of *Xanthorrhoea hastile* (swamp grasstree). Normally the flower spike is about one-third the length of the scape on which it is borne. The numerous short spikes seen in this photograph are apparently due to grazing when the spikes were young.

As the occurrence of the disease coincided with the growing and flowering period of this plant, and as the spikes are readily eaten by cattle, feeding experiments were done.

## IV. FEEDING EXPERIMENTS.

### (1) Experiment 1 (1953).

*Plant.*—Grasstree identified as *X. hastile* was collected from an area where the disease has occurred.

As stock normally eat only the flower head or spike of the plant, this part was chaffed and fed with lucerne. Many of the spikes had mature, semi-dry seeds, and were rather fibrous.

A fresh batch of plant was obtained each week and was fed 3–10 days after collection.

*Feeding.*—Commencing on Nov. 20, a heifer 480 lb. in weight ate 2½ lb. of plant mixed with 7–8 lb. of lucerne per day for 29 days. The rate was then increased to 7–8 lb. of plant per day with a reduced quantity of lucerne. A total of 204 lb. of grasstree was eaten during 48 days. The animal remained normal throughout.

### (2) Experiment 2 (1954).

*Plant.*—The plant obtained, though less mature than that fed in Experiment 1, was still quite fibrous. Again, only the spike was fed. Mincing was resorted to in the latter part of the experiment to increase the rate of consumption.

*Feeding.*—Commencing on Oct. 18, a steer 530 lb. in weight was fed for 18 days with chaffed grasstree and a mixture of oaten and lucerne chaff. Only 70 lb. of plant was eaten. For a further 32 days the method of feeding was similar, but the grasstree was first chaffed and then minced in a household food-mincer. Fed this way, a further 235 lb. of grasstree was eaten, making a total of 305 lb. in 50 days. The animal remained normal throughout.

### (3) Experiment 3 (1954).

*Plant.*—As in the two previous experiments, only spikes of *X. hastile* were fed. The degree of maturity of the plant varied. At the beginning of the experiment it consisted mostly of young succulent flower heads, but later the greater part of the material used was the older, fibrous seed-heads. A sample of this latter material contained on a dry matter basis:—

| | % |
|---|---|
| Protein .. .. | 6·8 |
| Carbohydrates .. | 45·9 |
| Fat .. .. | 1·2 |
| Fibre .. .. | 42·7 |
| Ash .. .. | 3·4 |
| $P_2O_5$ .. .. | 0·31 |
| CaO .. .. | 0·26 |

*Feeding.*—Feeding of a heifer about 15 months old and weighing 200 lb. was commenced on Oct. 16. During the first 37 days, 117 lb. of grasstree was eaten with 74 lb. of chaff consisting of one-third lucerne and two-thirds oaten. To increase the intake of the more fibrous material it was thereafter minced. During the following 36 days, a further 350 lb. of grasstree was eaten, together with 36 lb. of oaten chaff. The variations in the amount of plant and chaff eaten are set out in Fig. 3. A total of 467 lb. of grasstree flower head was fed in 73 days.

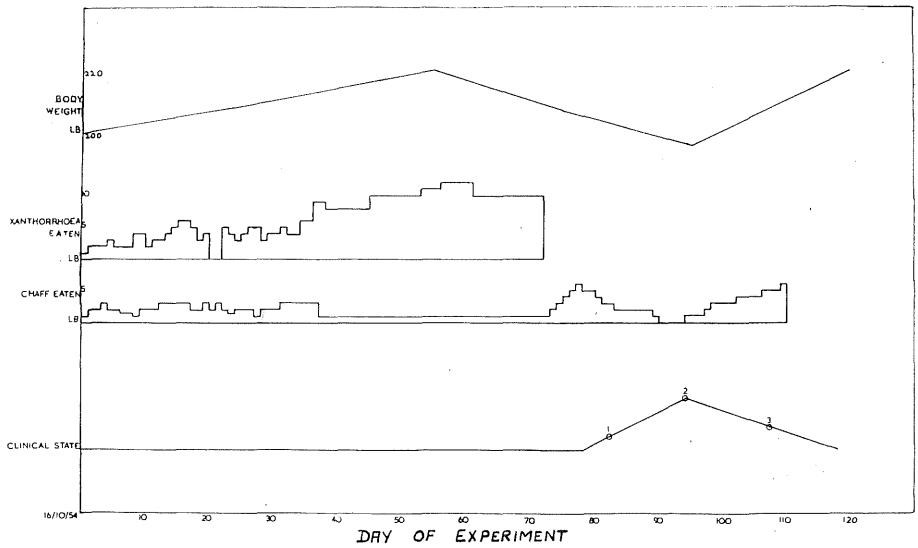


Fig. 3.

Diagram Showing Body Weight, Feed and Clinical State of the Heifer Fed in Experiment 3. The clinical state is shown against a fictitious ordinate. The point 1 is where the first definite symptoms of leg weakness and ataxia, with urination still normal, became evident; at point 2 the beast was down and most severely affected; at point 3 leg weakness was evident as at point 1, but full control of urination had not been regained.

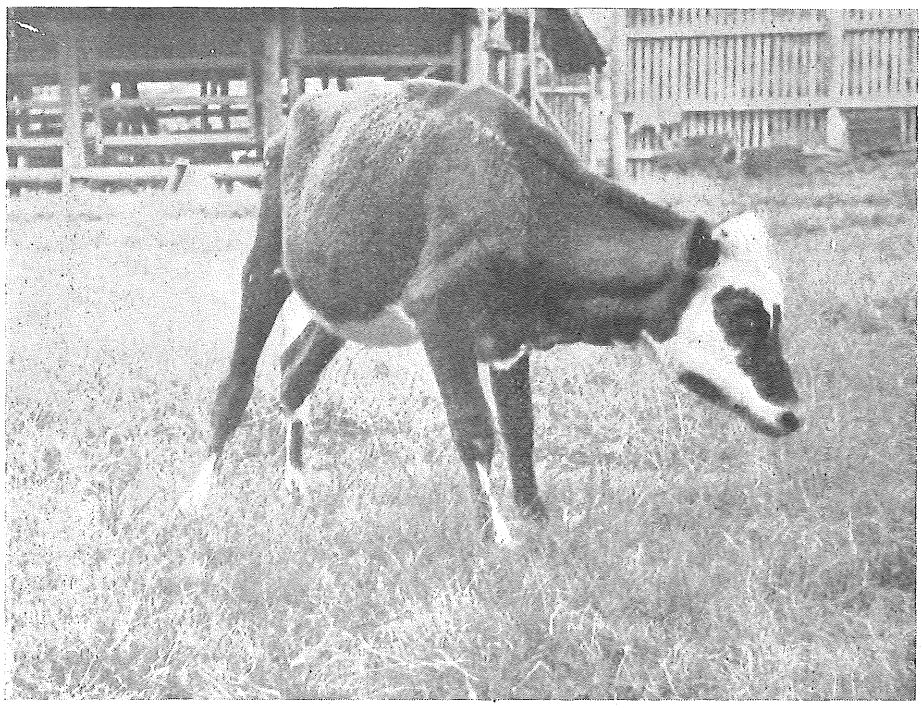

Fig. 4.

Experimental Heifer Fed *Xanthorrhoea hastile*. The back is curved and on movement the animal swings to its left side.

When feeding stopped the beast was normal, but 10 days later definite clinical symptoms of "wamps" were seen. On exercise, weakness of the front legs and swinging of the hindquarters, always to the left side, were obvious. The heifer would step sideways or even turn halfway round in an effort to retain balance (Fig. 4). Fifteen days after experimental feeding was concluded, urinary incontinence was evident, and the urinating posture was frequently assumed (Fig. 5). One week later the beast was recumbent and could be exercised only if helped to its feet and given considerable assistance. The animal was kept alive by attention to bedding, shade, feed and water, and its condition improved in a few days. Recovery was complete after two months.

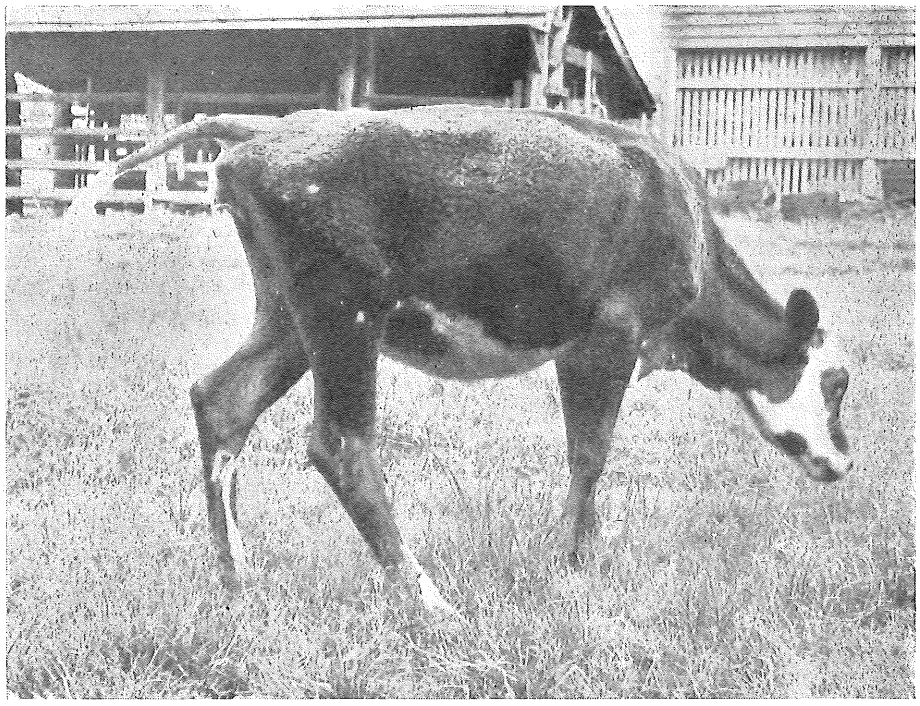

Fig. 5.
Experimental Heifer Showing the Typical Urinating Posture.

The blood concentrations of vitamin A, carotenoid and phosphate were within normal limits when determined on three occasions during the experiment. They were as follows:—

| Day of Experiment. | Vitamin A. (micrograms per 100 ml. plasma). | Carotenoid. (micrograms per 100 ml. plasma). | Inorganic Phosphate. (milligrams per 100 ml. blood). |
|---|---|---|---|
| 54 .. .. .. | 24 | 112 | 4·3 |
| 74 .. .. .. | 36 | 64 | 5·6 |
| 94 .. .. .. | 23 | 160 | 6·0 |

### (4) Experiment 4 (1955).

*Plant.*—Again only the spikes were fed. They were cut into small pieces with a hand chaff-cutter and mixed with oaten chaff. As in Experiment 3, the degree of maturity varied. Analysis of the plant, which was less mature than that used in the previous experiment, showed on a dry matter basis:—

| — | Preflowering Stage. | Flowering Stage. |
|---|---|---|
| | % | % |
| Protein .. .. | 11·1 | 10·0 |
| Carbohydrate .. | 63·7 | 59·8 |
| Fat .. .. .. | 2·2 | 2·2 |
| Fibre .. .. | 19·0 | 23·4 |
| Ash .. .. .. | 4·0 | 4·6 |
| $P_2O_5$ .. .. | 0·47 | 0·36 |
| CaO .. .. | 0·56 | 0·77 |

*Feeding.*—As much *X. hastile* as the animal would eat was fed to an 18-months-old heifer 400 lb. in weight. Commencing on Oct. 20, 470 lb. was eaten in 48 days. During this period the amount of grasstree was gradually increased and the proportion of oaten chaff reduced.

On the 48th day of the experiment, when the feeding of grasstree was stopped, no definite abnormality of gait could be seen. After the 70th day, the heifer was grazed in a small paddock with other cattle. At the beginning of this period there was a slight ataxia, but this was attributed to the previous stalling on concrete. However, five days later the ataxia was apparent and the animal had difficulty in getting to its feet. Typical symptoms were observed after a further four days—that is, one month after the feeding of *X. hastile* had stopped. The symptoms were a swinging of the hindquarters to the left, and lateral flexion of the spinal column to the left side.

The paralysis gradually became more pronounced, and on the 87th day of the experiment, or 39 days after feeding of grasstree was stopped, the animal died. Autopsy showed no macroscopic abnormality except contusion of muscle of the hind limbs and haemorrhages of the fasciae. This is in agreement with the findings in naturally affected animals which succumb.

Sections of liver, kidney, lung, sciatic nerve and femoral nerve were stained with haematoxylin and eosin; the only abnormality detected was oedema of the lungs. Sciatic and femoral nerves treated according to the Marchi technique showed no abnormality.

Blood phosphate, plasma carotenoid and vitamin A figures during the experiment were:—

| Day of Experiment. | Vitamin A. (micrograms per 100 ml. plasma). | Carotenoid. (micrograms per 100 ml. plasma). | Inorganic Phosphate. (milligrams per 100 ml. blood). |
|---|---|---|---|
| 20 .. .. .. | 40 | 550 | 8·3 |
| 40 .. .. .. | 50·5 | 205 | 5·3 |
| 58 .. .. .. | 35·7 | 87 | 5·3 |

## V. DISCUSSION.

In the first two experiments the daily intake was not high and the plant was more mature than when normally grazed. The spikes of mature plants contained 6·8 per cent. and the young spikes 11·1 per cent. protein.

The morbidity is usually not high. It seemed, therefore, that the toxicity of the grasstree might be low, and in the third and fourth experiments every effort was made to feed as much of it as possible. Very little other food was allowed, and as a result the beast in the third experiment lost weight. In the fourth experiment there was a loss of weight during the first 10 days, but over the whole experimental period a moderate gain in weight was recorded.

The complete clinical recovery of one of the affected animals is in keeping with the normal course of the disease in natural cases.

A remarkable feature of this disease is that circling or swaying is always to the one side. There would appear to be an impairment of muscular or nervous function, but no explanation of why it should be unilateral can be given.

Urination is frequent and may be practically continuous. Catheterising while urine was dribbling produced only 10 oz. of urine on each of two occasions. The bladder could not be palpated in the small animal, but the amount of urine produced indicated that this organ was not fully distended. There appeared to be a lack of tone in the urethra and urine was allowed to escape. Sensation in the urethra could not have been entirely lost, as reflex raising of the tail and humping of the back were normal. However, O. H. Brooks (unpublished report, 1951—Queensland Department of Agriculture and Stock Files) has observed that, in field cases which he autopsied, the bladder was fully distended.

Symptoms first appeared in one of the experimental heifers several days after the feeding of grasstree was stopped and were most advanced three weeks afterwards. In the other they were evident after 30 days, and death occurred nine days later. The plant toxin, therefore, had a delayed

effect on the experimental animals. This might suggest a nutritional deficiency such as has been demonstrated in bracken poisoning (Evans, Evans and Roberts 1951); or perhaps the toxin produces direct nerve damage. However, the damage to nerve tissue cannot be extensive or recovery would not be a notable character of the disease.

## VI. ACKNOWLEDGEMENTS.

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