ALASKA AGRICULTURAL EXPERIMENT STATIONS
SITKA, ALASKA
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 5

ERADICATION OF TUBERCULOSIS IN CATTLE AT THE KODIAK EXPERIMENT STATION

BY

C. C. GEORGESON, Agronomist in Charge
AND
W. T. WHITE, Assistant

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ALASKA AGRICULTURAL EXPERIMENT STATIONS, SITKA, KODIAK, RAMPART, FAIRBANKS, AND MATANUSKA

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture.]

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INTRODUCTION.

Southwestern Alaska is eminently fitted for cattle raising, particularly Kodiak Island, where nutritious grasses grow in abundance and there is little timber, the vegetation being mainly bushes, grasses, and other low-growing plants. This region, including the several other islands lying off the mainland, has a moist climate accompanied by no great variations in temperature, the thermometer in summer seldom registering as high as 75° F. and in winter rarely reaching zero. The shore skirting Kodiak Island is cut by numerous deep bays, at the heads of which lies most of the tillable land. The remainder of the island is mountainous, the land gradually rising from near the seashore to a height of 1,000 to 3,000 feet. Kodiak Island was chosen in 1907 as the location for a cattle-breeding station to determine the adaptability of cattle to the climatic conditions prevailing there.

SELECTION OF A BREED FOR ALASKA.

After due consideration of the merits of the various available breeds, it was decided to select Galloway cattle for experimental purposes because of their great constitutional vigor and hardiness and natural adaptability to a cold and moist climate. The Galloway is strictly a beef breed and originated over 200 years ago in south-

western Scotland, where the climate differs very little from that of southwestern Alaska. The animals are solid black in color, polled, and have a long, curly coat of hair which enables them to withstand severe winters with little discomfort. In form they are low set, long, of medium depth, and short of leg. In size they are smaller than any of the other beef breeds, but weigh more than appearances would indicate, a mature bull averaging between 1,700 and 1,900 pounds, and a mature cow between 1,000 and 1,300 pounds. Their chief fault is that they are poor milkers.

Since general-purpose animals are needed in Alaska, it was planned to develop a breed combining the dairy qualities with a rugged constitution and the ability to rustle. It was believed that such a breed could be developed from the Galloway herd, but the process would require so many years that the object in view would be practically defeated by the delay. Reciprocal crosses were therefore made between the Galloways and the Holstein-Friesians.

HISTORY OF THE STATION HERD

The first Galloways, consisting of 11 head— 2 bulls and 9 females— were introduced into Alaska in the spring of 1906. One of the bulls, Henry of Lochside, No. 23525 (8809), an unusually fine specimen, had been imported from Scotland as a yearling and was recorded in the Scotch herd book. Of this stock, 1 bull and 5 cows and a calf were sent to the Kenai Experiment Station on Cook Inlet, and the remainder, 1 bull and 3 heifers, were sent to Wood Island, 2 miles from Kodiak. In the spring of 1907 the herd was augmented by the purchase of 19 head of Galloway stock from herds that had become somewhat renowned for their stock. The animals were tested by a Government inspector before they were purchased. They were therefore free from tuberculosis upon their entry into Alaska. These cattle were shipped to the experiment station at Kodiak, for which purpose a tract had been reserved by Executive order dated March 28, 1898. The four head on Wood Island were added to the herd, and later in the summer all the cattle at the Kenai station were also sent to Kodiak, where the grazing season is longer and shipping facilities are better.

The station in 1912 purchased 11 head of the best milkers of Galloways obtainable in the States in order to develop a milking strain of the breed. These reached Seattle for transshipment to Kodiak when the news came of the volcanic eruption of Mount Katmai. They were therefore placed temporarily on pasture at Kent, Wash.

ERUPTION OF MOUNT KATMAI AND SHIPMENT OF THE HERD TO WASHINGTON STATE.

On June 6, 1912, the dormant volcano known as Mount Katmai, on the Alaska Peninsula, suddenly became active and threw out enormous volumes of ashes, which covered the country and sea for thousands of square miles. The northern end of Kodiak Island was covered with an ash deposit to an average depth of 18 inches, and the Kodiak station, although 100 miles from the volcano by airline, was totally submerged. Vegetation was buried, all pasture was destroyed for the time, and cattle were on the verge of starvation.

Various means of meeting the situation were considered. The freight charges to Kodiak prohibited the shipment of feed to the sta-

tion, and it was found impracticable to put up hay for the winter in the southern end of the island, where the fall of ash was light. It was decided, therefore, to ship the herd to Toppenish, Wash., where pasture and hay could be had at reasonable price. In early August, 1912, all the purebred stock from Kodiak, numbering 70 head, and likewise the dairy cattle which had been purchased and temporarily placed at Kent, were shipped to the new location, where they soon picked up in flesh.

In the spring of 1913, the cattle were transferred to Chehalis, Wash., it having been discovered, too late to prevent harm, that, some years prior to the arrival of the Kodiak herd, cattle had died of blackleg on the very pasture which was rented by the station. Several calves of the station herd were lost in consequence, and it became necessary to move the remaining herd elsewhere. Many calves were dropped soon after the arrival of the herd at Chehalis, and in December, 1913, 60 head of all ages were sold with the guarantee that they were free from tuberculosis, having been tested for that disease before the transfer was made. No reactors were found among the tested animals, and the cattle which were kept appeared to be so eminently sound that they were not tested.

REVIVAL OF VEGETATION AT KODIAK AND RETURN OF THE HERD.

The herd remained at Chehalis until July, 1914. By that time two years after the eruption, the pastures at Kodiak had so far revived that it was deemed advisable to take the herd back to Alaska. The ashes had washed from the hillsides and settled in the hollows, and much of it had been carried into the sea. Layers varying from 6 inches to 2 feet on the level ground developed an intricate network of cracks and crevices through which the native vegetation asserted itself. As a result, the extensive area, covering several thousand acres, in the station reserve was enabled to furnish sufficient feed for the herd, and during the remainder of 1914 and in 1915 the animals were thrifty, the cows bred regularly, and there was a steady increase in numbers by birth.

The native grasses on the hillsides consisted chiefly of *Calamagrostis* spp., and beach rye (*Elymus mollis*), which is much relished by cattle and makes excellent silage, covered the sand dunes and gravel dunes along the beaches. Other grasses making their appearance were *Deschampsia* spp., fescues, and Kentucky bluegrass.

DEVELOPMENT OF TUBERCULOSIS.

In the summer of 1916 an old cow developed unmistakable clinical symptoms of tuberculosis and had to be slaughtered. The subsequent post-mortem examination confirmed the clinical symptoms, and arrangements were at once made with the Seattle office of the Bureau of Animal Industry to have the herd tested. Dr. Jens Madsen, inspector in charge, was detailed to the case, but owing to faulty steamship service did not arrive until September.

The source of the disease could not be determined. The cattle had not been in contact with other animals either during their stay in Washington or in Kodiak. They may possibly have contracted the disease in the stockyards in Seattle, or in the cattle cars in which they

were transported. At any rate, out of a herd of 54 mature animals, 21 reacted and were condemned as tuberculous, 8 were classed as suspicious, and 25 were passed as sound. Of the 29 which reacted or were classed as suspicious, 23 head were in the herd that was returned to Kodiak from Washington in 1914. Of these 23 head, 16 were reactors and 7 were classed as suspicious. Only 5 reactors to the test in 1916 and 1 animal classed as suspicious were dropped after the return of the herd.

NATURE OF THE DISEASE.

An infected animal may show no symptoms of tuberculosis for months and even for years, so slow and hidden in its course is the disease. In the meantime such an animal may infect many others in the herd before the presence of the disease is suspected. Once infected, an animal can not be cured. Slaughter of the affected animals and disinfection

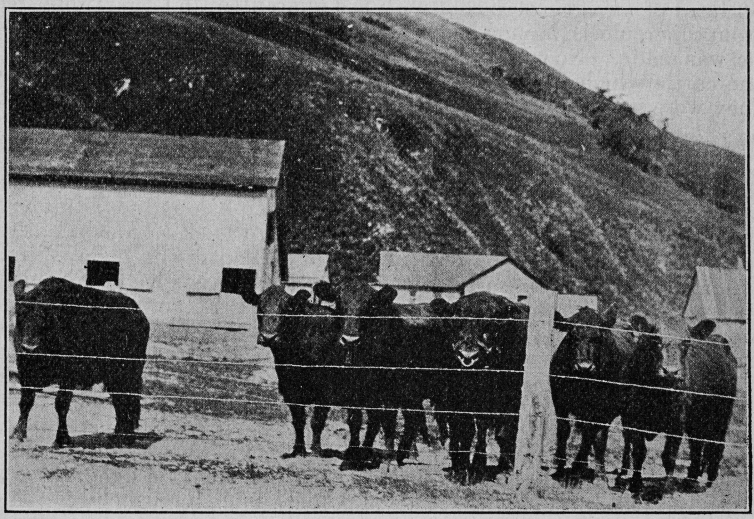

FIG. 1.—Part of Galloway herd reacting to tuberculin test, Kalsin Bay.

of the stables, barns, drinking troughs, and yards are the only known means of eradicating the disease. The failure of clinical symptoms to develop until tuberculosis is in an advanced stage increases the difficulty of keeping the disease in check. Were infected animals to show signs of the disease at once they could be removed from the herd and the danger of spreading the disease to the other animals would be lessened. Unfortunately, however, reactors may be the best-looking cattle in the herd, while their lungs and other organs are full of tubercles (fig. 1). The insidious nature of the disease was well illustrated in the station herd bull, Carnot of Kodiak, No. 39139. He was as fine a specimen of Galloway as could be found, being strong, active, fat, and sleek, and apparently perfectly healthy (fig. 2). He reacted, however, and had to be slaughtered. On post-mortem examination it was found that the disease had progressed so far that the meat could not be used. It was therefore burned.

THE METHOD FOLLOWED FOR ERADICATION.

Doctor Madsen recommended that the herd be treated by the so-called Bang method, which originated with Dr. Bernhard Bang, an eminent Danish veterinarian. This method is briefly described in the following letter of Doctor Madsen:

* * * With respect to the Bang method as described in your letter submitted to me, may I say that Professor Bang advocated and applied consistently in his work in Denmark the following principles:

Submit all cattle of an infected herd to a thorough clinical examination, remove from the herd and dispose of for slaughter purposes all cattle which evince unmistakable symptoms of tuberculosis on a physical examination. Apply the tuberculin test to the cattle of the herd in which no clinical symptoms of tuberculosis are manifest. Remove the ones which do not react to clean and disinfected quarters separated absolutely from those cattle of the herd which on the test indicate, positively or sus-

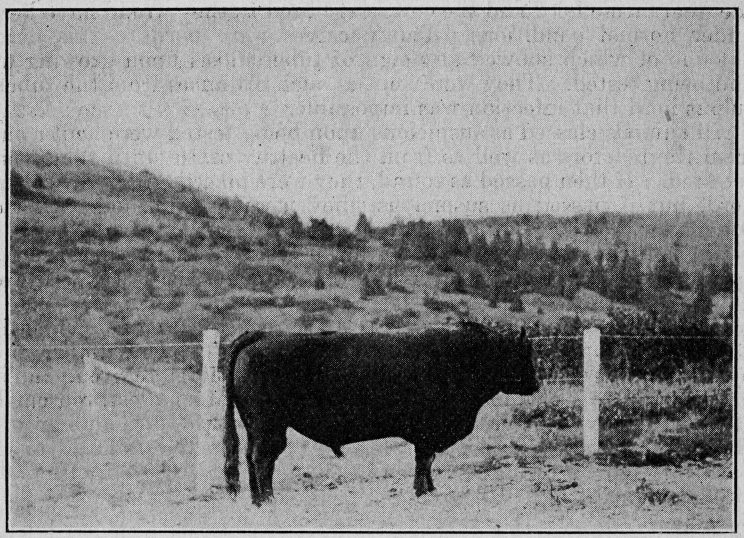

FIG. 2.—Carnot of Kodiak, herd bull. Reacted to tuberculin test.

piciously, the presence in their system of tuberculosis while not evident clinically. Calves too young to test should also be kept separate.

Calves born from tubercular dams should be removed after 24 hours, kept separate and raised on pasteurized milk, or given a physically healthy, nonreacting dam for nursing. When 6 months old, the tuberculin test is applied, and provided no reaction takes place and no clinical symptoms of tuberculosis is manifest, the calf may be admitted to the healthy herd.

The nonreacting part of the herd should be retested yearly, and any which reacted or in the meantime evinced clinical symptoms of tuberculosis were disposed of as outlined above. No animal should be added to the healthy part of the herd unless it was free from clinical symptoms of tuberculosis and also had passed the tuberculin test successfully.

In addition to these principal measures, but of no mean importance in bringing about a nearly complete eradication of tuberculosis from the Danish dairy herd, Professor Bang advocated education of the public with respect to the dangerous nature of tuberculosis in its effect upon the physical well-being as well as the economical welfare of the people. He sought, encouraged, and was accorded in most instances the hearty cooperation of cattle owners and others interested, and he succeeded in having the Government enact beneficial legislation. * * *

The raising of a healthy herd and the rearing of 30 healthy calves from a herd as heavily infected with tuberculosis as those kept at the Kodiak station, demonstrates the practicability of the original Bang system, especially so when the cost of labor is

second in consideration and when complete and efficient separation may be effected. All other factors excluded, the maintaining of the herd free from tuberculosis continually may be incumbent in the final analysis upon the absence of tuberculosis in man.

When Doctor Madsen began the tests in September, 1916, only two or three animals showed clinical symptoms of tuberculosis. All suspicious cattle, together with the reactors showing clinical symptoms, were sent to Kalsin Bay, 15 miles from Kodiak, while the sound herd was kept at Kodiak. Surplus animals which were not wanted for breeding purposes were slaughtered and their carcasses inspected and either condemned or sold for human consumption. Reactors which were retained for breeding purposes were kept wholly apart from other cattle, so that there could be no intermixing or contact with them. A young, well-bred, reacting bull was kept in the quarantine herd and the cows were bred as they would have been under normal conditions. Thirty calves were born to this herd, not one of which showed any sign of tuberculosis upon growing up and being tested. They were kept at such distances from the tuberculous herd that infection was impossible.

All animals classed as suspicious upon being tested were kept away from the reactors as well as from the healthy cattle until they were retested. If then passed as sound, they were placed with the healthy herd, but if passed as suspicious, they were quarantined with the tuberculous herd. Barns and pastures were fenced off so that this herd could not come in contact with the healthy animals. All sound cattle were watered upstream and the infected herd was watered downstream.

Of 15 unnamed Galloway steers (7 dropped by tuberculous herd), 23 bulls (9 dropped by tuberculous herd), and 20 heifers (13 dropped by tuberculous herd) tested, only 2 mature bulls reacted, and 1 mature bull was classed as suspicious. None of 11 crossbred cattle (1 dropped by tuberculous herd) reacted to the test, and only 1 Holstein-Friesian animal out of a herd of 16 reacted and had to be burned. The following list gives the number and reaction of named animals tested from 1916 to 1921:

Results of testing station Galloway cattle for tuberculosis.

Herd No.	Name of animal.	Sex.	Year of birth.	Tested in—						Disposition.	Date.
				1916	1917	1918	1919	1920	1921		
1	Lady Douglas	Female	1901	Reacted						Condemned and incinerated	1916
10	Mollie C. of Red Cloud	do	1904	Healthy	Healthy	Healthy	Reacted			do	1920
19	Miss of Red Cloud	do	1904	do	do	do	Healthy			Died	1920
27	Fidelia of Kodiak	do	1907	do						do	1917
71	Mollie 3d of Kodiak	do	1909	do	Healthy	Healthy	Reacted			Inspected; passed for beef	1920
72	Fidelia 2d of Kodiak	do	1910	Suspicious	Suspicious	Reacted				do	1920
88	Banshee 2d of Kodiak	do	1910	Reacted						Condemned and incinerated	1920
106	Lady Douglas 2d	do	1911	do						do	1916
113	Mollie 4th of Kodiak	do	1911	do						do	1918
114	Fidelia 3d of Kodiak	do	1911	do						do	1920
123	Miss 2d of Kodiak	do	1912	Suspicious	Healthy	Healthy	Healthy	Healthy	Healthy		
140	Bertha A	do	1909	Healthy	do	do	do	do	do		
142	Fauntenil of Otoe	do	1905	Reacted						Condemned and incinerated	1916
144	Lady May of Otoe	do	1907	do						Died	1918
146	True Beauty	do	1906	do						do	1918
147	Hattie B	do	1908	Healthy	Healthy					do	1919
149	Maggie of Sherburn	do	1904	Suspicious	do	Healthy				do	1919
150	Fauntenil of Alaska	do	1911	Reacted						Inspected; passed for beef	1918
152	Mayflower 3d	do	1912	do						Condemned and incinerated	1918
153	Bon Accord Dairy Maid	do	1912	Healthy	Reacted					Inspected; passed for beef	1928
154	Alaska Buttercup	do	1912	Reacted						do	1918
163	Carnot of Kodiak	Male	1912	Healthy	Healthy	Reacted				Condemned and incinerated	1918
164	Adele of Kodiak	Female	1912	Reacted						do	1919
174	Miss 3d of Kodiak	do	1913	Suspicious	Suspicious					Inspected; passed for beef	1918
187	Fidelia 4th of Kodiak	do	1913	Healthy	Healthy	Healthy				Died	1919
191	Locksley 2d	do	1915	do	Reacted					Inspected; passed for beef	1918
192	Fidelia 5th of Kodiak	do	1913	Suspicious	Suspicious					do	1918
195	Hattie of Kodiak	do	1913	Reacted						do	1917
196	Governor Strong	Male	1914	do						Condemned and incinerated	1917
197	True Beauty of Kodiak	Female	1914	do						Inspected; passed for beef	1918
198	Lady Douglas 3d	do	1914	Healthy	Reacted					do	1918
201	Mollie 6th of Kodiak	do	1914	Reacted						do	1917
206	Dairy Maid 2d of Kodiak	do	1914	Suspicious	Reacted					do	1917
208	Mollie 7th of Kodiak	do	1914	do	do					Died	1918
209	Lady May of Kodiak	do	1914	Healthy	Healthy	Healthy	Healthy	Healthy	Healthy		
212	Helen of Kodiak	do	1914	Reacted						Condemned and incinerated	1920
213	Fauntenil 2d of Kodiak	do	1915	Healthy	Reacted					Inspected; passed for beef	1918
215	Fidelia 6th of Kodiak	do	1915	do	Healthy	Healthy	Healthy	Healthy	Healthy		
217	Fidelia 7th of Kodiak	do	1915	do	Suspicious					Condemned and incinerated	1917
218	Prince Douglas 3d	Male	1915	do	Reacted					Inspected; passed for beef	1920

Results of testing station Galloway cattle for tuberculosis—Continued.

Herd No.	Name of animal.	Sex.	Year of birth.	Tested in—						Disposition.	Date.
				1916	1917	1918	1919	1920	1921		
221	Miss 4th of Kodiak	Female	1915	Suspicious	Reacted					Inspected; passed for beef	1917
225	True Beauty 2d of Kodiak	do	1915	Reacted						Condemned and incinerated	1916
227	Hattie's King	Male	1915	Healthy	Healthy	Healthy					
228	Hazel of Kodiak	Female	1915	Reacted						Condemned and incinerated	1916
232	Miss 6th of Kodiak	do	1916		Healthy	Healthy	Healthy	Healthy	Healthy		
239	Bertha of Kodiak	do	1916		do	do	do	do	do		
241	Fidelia 8th of Kodiak	do	1916		do	do					
245	Locksley 3d	do	1916		do	do	Healthy	Healthy	Healthy		
246	Maggie of Kodiak	do	1916		do	do	do	do	do		
247	True Beauty 3d of Kodiak	do	1916		do	do	do	do	do		
252	Mollie 8th of Kodiak	do	1917		do	do	do	do	do		
254	Lady Douglas 4th	do	1917		do					Died	1917
267	Miss 7th of Kodiak	do	1917		do	Healthy				do	1919
268	Bertha 2d of Kodiak	do	1917			do	Healthy	Healthy	Healthy		
303	Ranger of Seven Oaks	Male	1917				do	do	do		

THE TUBERCULIN TEST USED.[1]

The subcutaneous tuberculin test was used for the first five years of the experiment, except with eight animals of the quarantined herd, which were given the intradermic test in the fifth year (1920). The intradermic test was also used in the sixth and final test (1921).

In the subcutaneous tuberculin test prepared tuberculin serum is injected under the skin, usually on the neck or in the region of the shoulders.[2] In this test the temperature is taken three times at two-hour intervals before the injection is made. After the injection the temperature is again taken from the eighth to the twenty-fourth hour at two-hour intervals. If the animal is tuberculous it will show a rise in temperature within that period. If there is no rise in temperature, the animal is pronounced healthy. The temperature is taken by inserting a clinical thermometer in the rectum.

The intradermic tuberculin test is applied by injecting the serum in the skin, not under it. At the Kodiak station the serum was injected in the soft, hairless skin, known as the caudal fold, at the base of the tail. In the reaction to this test a characteristic swelling occurs at the seat of the injection.[3]

TREATMENT OF THE QUARANTINED HERD.

The cattle in quarantine were treated as sound cattle would be treated, being given free access to pastures and receiving the usual feed. During the winter they were fed a ration of native hay and silage and in addition a small quantity of grain feed, depending upon the condition of the animal. From May 1 to November 1 of each year the native pasture grasses constituted their entire ration.

TREATMENT OF CALVES OF REACTING DAMS.

For the first 24 hours after birth, the calves were allowed to remain with their dams in order that they might draw off the colostrum from the udders. They were then removed to separate quarters and fed the pasteurized milk of reacting dams.[4]

As a general rule the calves were fed 5 pounds of milk twice daily at the beginning of the feeding experiment. The quantity was increased 2 pounds per day each succeeding week until 8 pounds were being fed twice daily. Slight deviations were made from this to suit the individual characteristics of the calves. Milk, together with grass and such other forage as was eaten at will, constituted their entire ration until the calves were 6 months of age. They were then fed a small quantity of ground oats in addition to the native hay and silage comprising the basis of their ration.

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[1] The first test, that of 1916, was made by Dr. J. Madsen, inspector in charge of the Bureau of Animal Industry office in Seattle. The test in 1917 was made by veterinary inspector Dr. C. J. Sandwith, and in 1918 by veterinary inspector Dr. C. M. Oliver, both of the Seattle office. The three final tests were made by Dr. B. C. Parker, who, in 1919 and 1920, was veterinarian of the Kodiak Experiment Station.

[2] The tuberculin used in the tests reported in this bulletin was furnished by the Bureau of Animal Industry. The dose used for adult animals was 2 cubic centimeters and for bulls and large animals, 3 cubic centimeters. Yearlings and 2-year olds received from 1 to 1½ cubic centimeters.

[3] For specific directions regarding the approved procedure in making the tuberculin test see U. S. Dept. of Agr. Circ. 249, Tuberculin testing of livestock.

[4] The milk was pasteurized by heating it to a temperature of 145° F. for 30 minutes.

The following table gives the history of the calves dropped by the tuberculous herd:

Calves dropped in quarantine from tuberculous cows and fed pasteurized milk from quarantined herd.

Herd No.	Sex.	Herd number of dam.	Year dam reacted.	Date of birth of calf.	Tested in—				
					1917	1918	1919	1920	1921
262	Female.	72	1916	May 14,1917	.....	Healthy...	Healthy...	.....	
286	Male....	72	1916	July 2,1918	.....	.....	...do.....	Healthy...	
298	...do....	72	1916	May 14,1919	.....	.....	.....	...do.....	
264	...do....	88	1916	May 16,1917	.....	Healthy...	Healthy...	.....	
277	Female.	88	1916	Apr. 13,1918	.....	.....	...do.....	Healthy...	Healthy.
301	...do....	88	1916	June 3,1919	.....	.....	.....	...do.....	Do.
263	...do....	114	1916	May 16,1917	.....	Healthy...	Healthy...	.....	
278	Male....	114	1916	Apr. 17,1918	.....	.....	...do.....	.....	
299	...do....	114	1916	May 26,1919	.....	.....	.....	Healthy...	Do.
258	...do....	144	1916	May 13,1917	.....	Healthy...	.....	.....	Do.
272	...do....	146	1916	Dec. 1,1917	.....	...do.....	.....	.....	Do.
271	...do....	152	1916	Aug. 24,1917	.....	...do.....	.....	.....	Do.
285	Female.	152	1916	June 26,1918	.....	.....	Healthy...	Healthy...	Do.
261	...do....	153	1916	May 11,1917	.....	Healthy...	...do.....	.....	Do.
270	Male....	164	1916	Aug. 12,1917	.....	...do.....	.....	.....	Do.
292	Female.	164	1916	Aug. 25,1918	.....	.....	Healthy...	.....	Do.
287	Male....	174	1916	July 15,1918	.....	.....	...do.....	Healthy...	Do.
273	...do....	191	1917	Apr. 3,1918	.....	.....	...do.....	.....	Do.
254	Female.	198	1916	Mar. 24,1917	Healthy...	.....	.....	.....	Do.
252	...do....	201	1916	Feb. 15,1917	...do.....	Healthy...	Healthy...	Healthy...	Do.
259	Male....	206	1916	May 8,1917	.....	...do.....	.....	.....	
256	...do....	208	1916	Apr. 30,1917	.....	...do.....	.....	.....	
283	Female.	208	1916	May 24,1918	.....	.....	.....	Healthy...	Do.
275	...do....	212	1916	Apr. 6,1918	.....	.....	Healthy...	...do.....	Do.
300	Male....	212	1916	May 28,1919	.....	.....	.....	...do.....	Do.
8HG	...do....	5H	1918	Nov. 3,1919	.....	.....	.....	...do.....	Do.
305	Female.	114	1916	Apr. 14,1920	.....	.....	.....	.....	Do.
306	...do....	72	1916	Apr. 18,1920	.....	.....	.....	.....	Do.
307	Male....	212	1916	Apr. 30,1920	.....	.....	.....	.....	Do.
308	...do....	88	1916	May 17,1920	.....	.....	.....	.....	Do.

SUMMARY.

From 1916 to 1921, inclusive, 140 head of cattle were tested one or more times at the Kodiak Experiment Station.

Of 35 head which reacted to the tuberculin test, 8 head were classed as suspicious on the first or second test.

Two head which were first classed as suspicious were later pronounced healthy and turned in with the healthy herd.

All healthy animals were segregated at once and placed in disinfected quarters.

All reactors and suspicious animals were removed to Kalsin Bay, 15 miles from the healthy herd, and each lot was kept in separate quarters.

A well-bred reacting bull was placed at the head of the reacting herd of females and breeding continued as under normal conditions.

Females showing clinical symptoms of disease were slaughtered.

Reactors had the appearance of being normal, healthy animals in every respect for months. Eventually, however, they developed clinical symptoms of tuberculosis.

Thirty calves were dropped by the tuberculous herd from 1917 to 1920, inclusive. These calves were raised on pasteurized milk which was taken from the tuberculous mothers. When old enough they

were tested, and upon being pronounced healthy were added to the sound herd.

Breeders of purebred cattle probably will not retain reactors for breeding, even though the affected animals are valuable. The experiment proves, however, that highly prized reactors need not be slaughtered. They can not be cured, but they can be isolated and bred for the production of healthy offspring.

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