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BRISKET DISEASE

(Dropsy of High Altitudes)

By

Geo. H. Glover and I. E. Newsom

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BRISKET DISEASE

(Dropsy of High Altitudes.)

Preliminary Report.

INTRODUCTION.

For a number of years the Station has received letters from stockmen, living in the mountainous region of Colorado, giving accounts of a disease in cattle in which the most prominent symptom seemed to be a swelling of the brisket. Outside of a few visits made by the Veterinarian of the Experiment Station and the State Veterinarian; nothing of importance was done to determine the nature of the malady. In April, 1913, two South Park stockmen, Lew W. Robbins and David Collard, advanced one hundred dollars each, to be placed at the disposal of the Station for a study of the disease. Upon explanation of their action, the Park County Stockgrowers Association, which is composed of members who live at elevations of from eight to ten thousand feet, agreed to take over the expense and the two men were reimbursed. This money has been used only for work done in South Park and to meet incidental and traveling expenses. The Station has at all times paid the salaries of the men engaged in the work and furnished practically all of the necessary equipment. Since that time the State of Colorado has by special appropriation added materially to the fund thus broadening the scope of the work.

The work is still in progress and much of the detail is purposely left out of this report to be embodied in a later and more technical treatise on the subject, the idea being to give in a later report a rather complete and exhaustive description since to our knowledge the disease, as such, has not been described.

The plan of procedure mapped out was, first, to determine whether the disease could be transmitted from one animal to another; second, to find the cause; third, to make a complete study of its various manifestations; and fourth, to find a remedy.

We are indebted to the two gentleman named above, to Messrs. George Clark, W. H. Lilley, Howard Wright and Archibald Head of Jefferson; to Mr. T. W. Forman of Divide; to H. L. Guiraud of Garo, and to Erhardt and Felding of Nathrop, for furnishing animals and rendering great assistance in the work. We are also under obligations to the Cox-Jones Commission Company of Den-

ver for assistance in caring for the animals that were shipped there, and to Dr. J. C. Exline, U. S. Inspector in charge at Denver, for making observations.

This report is based upon personal observations made on thirty-two cases and autopsies held on six. In addition to this, several cases have been seen on which no special observations were made and no records kept.

HISTORY AND DISTRIBUTION.

This disease has been known in South Park, which is a high mountain park, varying in altitude from nine to ten thousand feet, since 1889 and in all probability existed before that time. It has been reported from North Park, which is approximately eight thousand feet, on numerous occasions. The people around Divide (about nine thousand feet) have reported many cases. It does not seem to exist to any extent in the San Luis Valley, which runs in altitude from seven to eight thousand feet, but is frequently reported from the high ranges surrounding it, when the cattle pasture on the forest reserves during the summer. It seems then to exist in the mountains of Colorado from the Wyoming line on the north to the New Mexico line on the south. We have not personally seen cases at altitudes below seven thousand feet, although we have talked with men who believe they have, and it would seem that an occasional case of a similar nature might occur at any altitude.

Thinking that other mountain states must suffer to some extent, we addressed letters to either the State Veterinarian, the Station Veterinarian, or both, of the States of Utah, Wyoming, Montana, Idaho, Nevada and California. We received replies from all except Idaho, stating that such a disease had not been brought to their notice. In spite of these negative replies, we have good reason to believe that the disease exists in the high altitudes of some of these states, although it has never seemed to assume such proportions as to be called to the attention of the veterinary officials.

In a conversation with Dr. John R. Mohler, Assistant Chief of the U. S. Bureau of Animal Industry, he expressed himself as having read something in Swiss literature of a similar disease. He has so far, unfortunately, been unable to find the article. We have addressed a letter to the Veterinary College at Berne, Switzerland, with the hope of gaining information from that source and if successful will include it in a later report.

ECONOMIC IMPORTANCE.

It is very difficult to estimate the cost of this disease to the State. During the winter of 1913-1914 one South Park stockman

estimates that out of between four and five hundred cattle, he lost thirty calves and ten or twelve older animals. Another man lost twelve during the winter of 1912-1913. Still another says, after several years' experience, he has lost practically all bulls that he shipped in from a low altitude and he figures his loss at about five per cent. It seems conservative to estimate the annual loss at one or two per cent of all cattle above eight thousand feet. While this may seem small, yet in the aggregate it means many thousands of dollars.

TRANSMISSION.

We have tried only twice to transmit the disease, as the nature of the malady and the further investigation did not seem to warrant more work along this line. One cubic centimeter of blood was drawn from the jugular vein of case one, a seven-year-old cow, and injected into the jugular vein of a two-year-old steer. The steer was under observation for more than a year following and showed no symptoms of the disease. Ten cubic centimeters of serum were taken from the pleural cavity of case two (a calf that was slaughtered for the purpose of making the autopsy) and injected subcutaneously into the brisket of a healthy calf. This calf was under observation for more than a year and developed no symptoms of the disease.

Several cases have been known where an affected animal ran with numbers of healthy ones for weeks with no spread of the disease. No attempt has ever been made to isolate diseased animals and yet it does not appear that this practice has had any effect in spreading the disease. Later in this article we will have something to say as to the cause and it will then appear why we do not regard the disease as transmissible or even as infectious.

ANIMALS AFFECTED.

The disease has been investigated in cattle only, and seems to be much more prevalent in these animals. Man and the horse probably suffer similarly under the same conditions in occasional cases. Animals of all ages are affected, although it is not commonly recognized in young calves since these animals often die without showing the swelling of the brisket. Case number nine showed the typical lesions on post mortem examination, although at the time it was only six weeks old. Many calves die from this disease when the owners believe it to be diphtheria or some other malady.

EFFECT OF CLIMATE.

At the lower altitudes, eight thousand to nine thousand feet, the disease is more prevalent in the winter, in fact seldom appears

in the summer, while at the higher levels up to thirteen thousand, it is a summer disease, largely, however, because cattle do not remain at these elevations in the winter. A wet cold summer is associated with a marked increase in the disease, and an especially hard winter may make a difference in the number of cases. This is rather easily explained by saying that more work is put upon the heart during cold weather and this would break down an already weakened organ all the more quickly.

SYMPTOMS.

The first evidence of the disease is a dull, listless appearance, the hair stands on end and the ears droop. The animal appears gaunt owing to failure to take the usual amount of food. There may be a slight moist cough. A diarrhoea usually appears soon after the other symptoms, or it may even be the first symptom noted. The respiration is increased and the pulse is rapid and weak. Many calves die in this stage without showing any swelling of the brisket. In some instances the appetite remains good up to within a few days of death.

Later, there appears a swelling of the loose tissue under the jaw and a swelling of the loose tissues of the brisket. Either swelling may appear first, but gradually the two merge into each other as the whole under part of the neck becomes dropsical. In male animals, the sheath may swell considerably and the hind limbs become puffy. The fore limbs may stock in extreme cases. The swelling of the brisket may become enormous in size, extending out in front of the fore limbs as a rather firm doughy mass. There is no pain on pressure and the part is not increased in temperature. The abdomen may swell markedly in its lower portion due to accumulation of fluid.

The respiration becomes increased but labored only on exercise. A moist cough is very commonly noticed. A clear mucous discharge comes from the eyes and nostrils. There is no fever. The heart-beats are increased, especially on slight excitement or exercise when they may run one hundred to one hundred and twenty per minute. Under these circumstances the beat is tumultous but lacks force as evidenced by a very weak pulse. A pronounced jugular pulse is common in the later stages.

Forced exercise in this later stage will cause labored breathing, coughing, hemorrhage from the nose, and if continued, rapid death. Consequently it is difficult to drive them to a point where they can be shipped.

The animals become very weak, so that the slightest exertion or excitement causes them to fall. This has been noticed repeatedly when attempting to restrain them for close observation.

The blood in all cases observed has shown an increase in hemoglobin and a rather decided increase in the number of red blood corpuscles, counts averaging near twelve million per cubic millimeter for adult cattle and somewhat more for calves.* Counts made at an altitude of 9,000 feet on four normal cows, running in age from four to ten years, varied from 6,880,000 to 11,320,000. Those made on six calves from three to six months old at the same altitude ran from 11,960,000 to 21,200,000.**

The urine has never in our observation shown the presence of either albumen or sugar, although we rather expected to find the former. We have developed no suitable method for determining whether there is a greater or lesser quantity excreted in a given time.

The usual course of the disease is from two weeks to three months, although a few animals have been known to apparently recover in the spring, only to be taken down again the following fall. We may say that most animals die within a month after symptoms are first noticed, the older cattle living longer than the younger.

Death seems to be due either to suffocation, or exhaustion and paralysis of the heart.

LESIONS.

The carcass is usually emaciated. The subcutaneous tissues in the region of the brisket, lower side of the neck, and under the jaw are infiltrated with a clear serum. It does not flow freely when incised, but can be squeezed out. Sometimes the subcutaneous tissue of the limbs is similarly affected.

When the abdomen is opened, a considerable quantity of straw colored fluid escapes, sometimes as much as six or eight gallons. The peritoneum may show a few hemorrhages and occasionally one is large enough to form a considerable mass of clotted blood (case 2.) The membrane itself in all of its folds is much thickened with the fluid above mentioned which can be squeezed out.

The walls of the stomach and intestines are thickened from the same cause. The mucous membrane of the fourth stomach and of the intestines may show small hemorrhages.

The liver is always much enlarged and is tough, firm and leathery. On section it has a grayish mottled appearance, the cut veins being very large. The condition of the liver is very noticeable and seems to be constant. On microscopic examination the grayish appearance is seen to be due to new fibrous tissue that entirely surrounds the lobules and has compressed the secreting cells until many

* In nearly all cases the blood for counting was taken from the capillaries of the ear.
** Counts made in November.

have undergone fatty degeneration and others have entirely disappeared. The central veins are engorged with blood.

The spleen appears normal both on autopsy and under the microscope. The kidneys show passive congestion and under the microscope there is considerable dilatation of the vessels with the cells of the tubules undergoing degeneration and loosening. The pancreas and bladder are normal.

In the thorax a large amount of fluid is to be found as in the abdomen. The lungs are edematous and therefore near the lower borders a few reddened solidified and slightly depressed areas. When the animal has died of the disease the lungs may be reddened and the bronchial tubes show hemorrhages. The heart is enlarged, dilated and usually flabby. It is pale in color and may or may not be thicker than normal in its walls. It has been our experience in the limited number of cases that the hearts of the young animals are dilated and flabby with thin walls, while in the older ones there is hypertrophy with dilatation. No vegetations have been found on the valves nor any lesion that would lead to the belief that a valvular disturbance existed.

Under the microscope in three cases there has been noted excess fibrous tissue with more or less round cell infiltration. Some degeneration exists, the degenerated fibres being replaced by new fibrous tissue. Numerous *sarcosporidia* are found in every section, but no special importance is attributed to these, as they are rather common in normal animals.

The pericardium and epicardium are edematous and thickened.

DIFFERENTIAL DIAGNOSIS.

It simulates traumatic pericarditis, but can be differentiated by the fever which usually accompanies the latter disease. On post mortem examination the finding of pus in the pericardium would eliminate "brisket disease" and point to traumatism.

It could easily be mistaken for pneumonia, especially if complicated with pleurisy, in which case the brisket might be swollen. The diagnosis here would be based on the presence of fever in the live animal and on autopsy, signs of inflammation in the lungs and pleura.

We see no reason for confusing the disease with diphtheria, but since it has been done, will say that diphtheria can only be diagnosed when there are ulcers and an extremely foul odor in the mouth.

TREATMENT.

From our experience in six cases and from the experience of several stockmen, shipping to a lower altitude seems to be sufficient

to effect a cure and where feasible is always to be recommended. The difficulty arises, first, in getting the animals to the railroad, and then in the expense of shipping after they are taken there. However, since the animals may be considered worthless, all that is received for them over and above expenses should be looked upon as clear profit. Animals can usually be hauled to the railroad and it is perfectly feasible to pay for a car for two or more of them. In some localities the affected animals can be slowly driven to a lower altitude, thus effecting a recovery. This is frequently done in the San Luis Valley, where the belief prevails that practically all recover when driven from the mountains to the valley, where the elevation is between seven and eight thousand feet. Just how much lower it is necessary for them to go cannot be said at this time, but certainly a change from nine thousand to five thousand two hundred and eighty feet has proven effective. Men in South Park believe some calves have been saved by driving them from eleven thousand to nine thousand feet elevation. In the San Luis Valley a difference of two or three thousand feet has proven sufficient. With our present knowledge, shipping or driving to a lower altitude should be first considered. If this is not possible, then medicinal treatment can be tried.

Much digitalis has been used in the form of a drench, with some quite favorable reports. It was given in the form of the fluid extract in doses of one-half to one teaspoonful once to three times daily. It appears to have been of more value in older animals, as little if any relief was noticed in calves. On the whole, it is doubtful if digitalis in this form is dependable. The fluid extract was used because of its easy administration in the hands of stockmen, although we were cognizant of the reports that have been made concerning its being rendered inert in the stomachs of ruminants. Two cases, Nos. 30 and 31, were given digitalin without favorable results. This drug is quite irritating when used hypodermically.

Certainly the animals should be kept as quiet as possible and under the minimum amount of exertion and excitement. The question arises as to whether they can be successfully treated at the altitude where they contract the disease and this we cannot answer at this time. At least it is hoped that the disease can be held in abeyance until a convenient time for taking them to a lower altitude. Strychnine given hypodermically has given no good results.

Lancing the swollen brisket and placing various medicaments within can do no good and is to be considered barbarous. It is in line with slitting the tail and putting in salt and pepper, and like the latter practice it should be eliminated as soon as possible. The

swollen brisket is merely a symptom of a general dropsy, and a weakened heart and surgical manipulation of it can be of no value. We must either strengthen the heart or lessen its work.

PREVENTION.

Since the disease is far more prevalent in cattle shipped in from low altitudes than in natives, it would seem only wise that importations be somewhat curtailed or, if practiced, that the animals be brought more gradually to the extreme altitudes. For instance, hold them for a few months or seasons, at a moderate elevation, say seven or eight thousand feet. This practice is not likely to prevent all cases as is evidenced by reading the history of case eight, but would probably be worth while.

Since extreme exertion on first arrival at the higher level seems to play a part, more care should be taken in the handling of the animals during the first weeks to see that they are not subjected to long hard drives. Realizing that these animals are usually wild, we are aware of the difficulty in complying with this suggestion.

The practice of buying pure bred bulls from low altitudes, while praiseworthy in its intent, seems to be responsible for some of the difficulty. Not only do the bulls themselves in many instances die of the disease after some months' residence under the new conditions, but their calves appear to be much more susceptible than calves sired by native bulls. In order to reduce this source of trouble it is recommended that bulls be purchased from altitudes more nearly approaching that at which they are to be used. We believe that this practice, if followed, would do much toward eliminating the disease. Finally, it may become necessary to abandon some of the higher ranges, especially during cold and wet summers. Since the disease has not been seen in sheep it may be possible to range these animals at the higher levels where the cattle do not thrive.

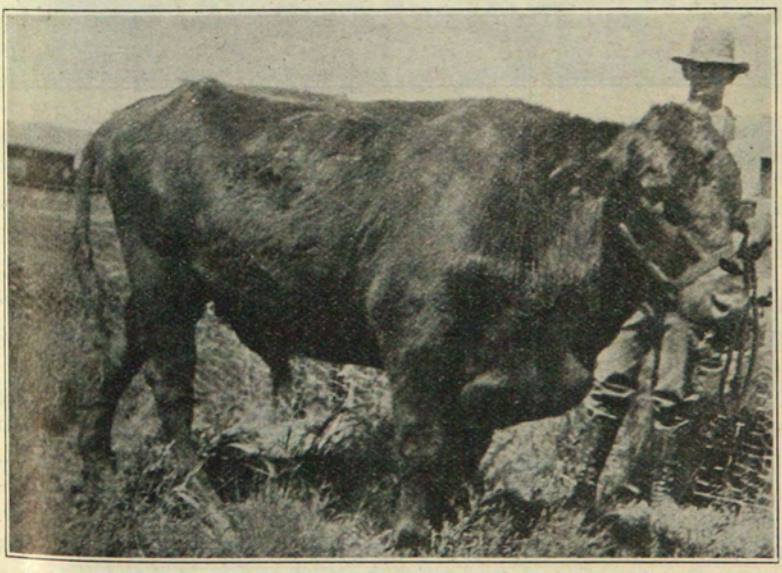
CAUSE.

Whatever may be the real cause of the malady, it would seem from our work thus far, that the matter of barometric pressure as influenced by the altitude is the deciding factor in the disease. About November 10, 1913, two two-year-old steers (cases 5 and 6), affected with the disease, as evidenced by a profuse diarrhoea and marked swelling of the brisket, were shipped from Jefferson, the altitude of which is nine thousand five hundred feet, to Denver (altitude five thousand two hundred and eighty feet). They were kept in the stockyards at the latter place for a little over two weeks when the diarrhoea was checked and the swelling of the brisket had entirely disappeared. On November 28th, they arrived at the

Station at Fort Collins (altitude five thousand feet), having been driven the same afternoon about six miles. Outside of a rapidity of respiration which might have been due to the drive, they appeared perfectly normal. They were under observation until December 17th, when, having been apparently normal since their first arrival, they were sold to a local feeder. The feeder reported that these steers fattened as well as any others in the lot and that they were sold for slaughter about April 10, 1914. No medicinal treatment of any kind was given them.

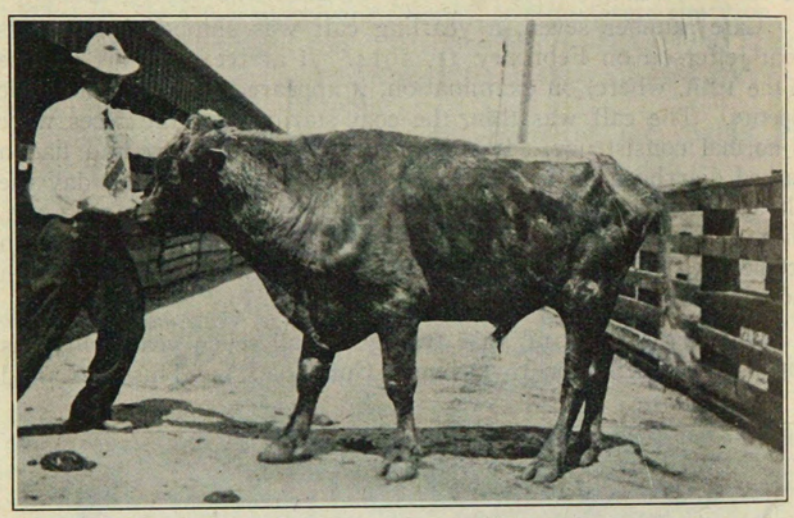
Case number seven, a yearling calf was shipped by express from Jefferson on February 11, 1914. It arrived in Fort Collins on the 12th, where, on examination, it appeared dull and had little appetite. The calf was thin, the coat staring, but the feces were of normal consistency. It was reported that the calf had had a marked diarrhoea on leaving Jefferson. After the second day the calf appeared entirely normal and remained so until March 9th, when it was returned to Jefferson, where it has since remained. On October 25, 1914, it was reported that the calf was in perfect health and had shown no return of the trouble.

On August 5, 1914, case twenty, a bull seven years old, was shipped from Jefferson to Denver (Cut No. I.). This bull had



Cut No. I. Case XX. Taken at Jefferson, Colorado, August 4, 1914, the day before shipping.

been on a range between 11,000 and 12,000 feet above sea level. He was driven to an altitude of about ten thousand feet two weeks previous and on the day before shipping was hauled eight miles in a wagon. He arrived in Denver on August 6th, where he was unloaded in the yards and allowed to remain there under observation until August 31st. Improvement was noticed, beginning about two days after arrival, until when seen on the 19th, all swelling had disappeared, and except for being thin, he appeared normal and re-



Cut No. II. Case XX. Taken at Denver, Colorado, August 19, 1914, just thirteen days after arrival. Animal normal except for being thin.

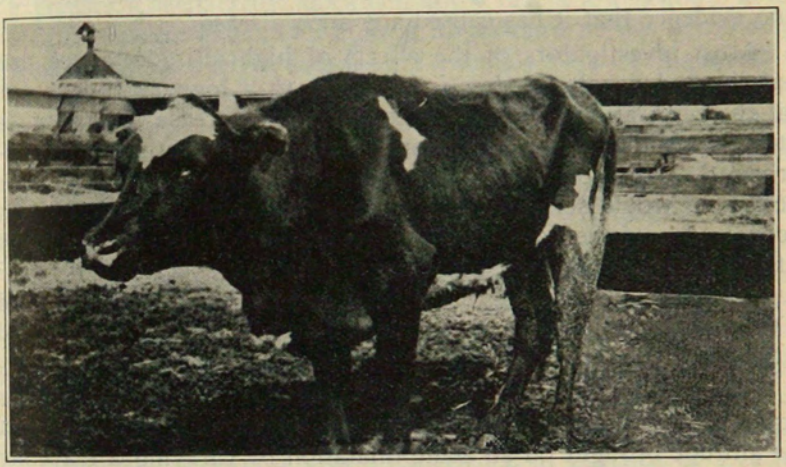
mained so until the 31st, since which time he has not been seen. The photograph for Cut No. II. was taken on August 19th.

Case twenty-one (Cut No. III.), a steer three years old, was shipped with case number twenty, and was given the same treatment. On the 19th he appeared much improved (Cut No. IV.), and on the 23rd he had entirely recovered.

On September 14, 1914, case number twenty-three, a yearling steer, was shipped by express from Jefferson to Fort Collins. On arrival the animal was weak, the respiration and pulse were rapid, the tail and hind limbs were soiled with dried feces, showing a previous diarrhoea; the feces at the time were of normal consistency. The steer continued to improve in general appearance until this writing, October 14th, when he seems to be normal. It has been a rather common practice among the stockmen of the San Luis Valley, when their animals became affected on the high ranges, to drive

them down to their ranches, altitude about seven thousand five hundred feet, where they usually recovered.

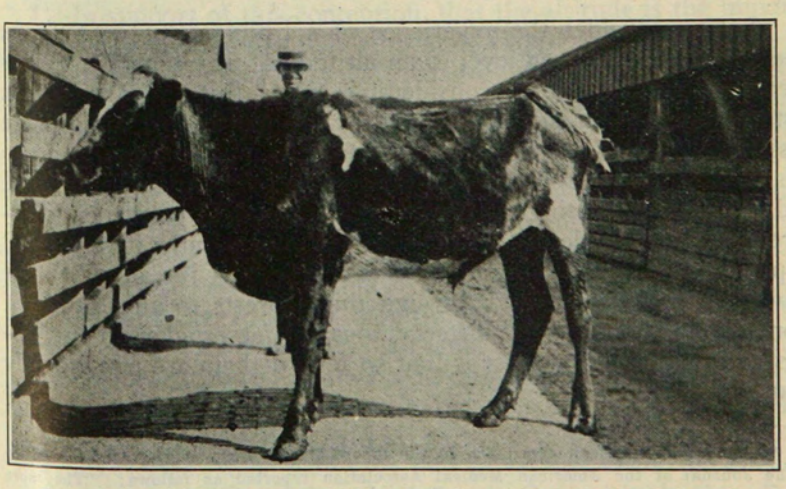
Altogether then there have been six cases shipped from a high altitude (9,500 to 11,000 feet) to a lower one (5,000 to 5,280) and



Cut No. III. Case XXI. Taken at Denver, Colorado, August 6, 1914, on the day of arrival, from Jefferson.

in each case prompt recovery followed. In no case was any medicinal treatment given.

One might suspect that a change of diet has something to do with it, but animals become affected both in the summer when at



Cut. No. IV. Case XXI. Taken on August 19th, thirteen days after arrival at Denver. Brisket still slightly swollen. All swelling had disappeared by the 23d.

pasture on the mountain grasses and in the winter when the food is entirely of hay cut in the parks. Furthermore, the hay in North Park is quite different from that of South Park. Hay from both places is shipped out in large quantities to lower altitudes but there is no evidence that it has caused any such disease.

Most investigators of the effects of high altitude, agree that unacclimated people passing from a low to a high altitude notice that the respiration and heart-beat markedly increase, that there is extreme weakness on slight exertion and even fainting and hemorrhage.* Is it not conceivable that at this time extra exertion or excitement would seriously dilate the heart, which dilatation might become so extreme as to cause degeneration of the muscle walls with chronic insufficiency, resulting finally in generalized dropsy? Several cases of dilatation of the heart in man have been attributed to ordinary exertion in high altitudes before becoming accustomed to the changed conditions.

Babcock in his book entitled "Disease of the Heart" details a case where a gentleman of fifty-seven, who was accustomed to a low altitude brought on an acute dilatation by carrying a traveling bag for several blocks in Denver (altitude 5,280). He died some two years later, with typical symptoms of chronic cardiac dilatation the inference being that the injury to the heart had taken place at the time of the extra exertion in Denver.

The same author attributes another case to an exhausting journey through a snow storm at an altitude of eighteen thousand feet.

Let us consider the experience of a trainload of wild Texas steers brought from sea level to an altitude of, say ninety-five hundred feet, unloaded amid considerable excitement and driven to a distant ranch. Already the altitude with its rarefied atmosphere has made it necessary for the heart to beat much faster. Add to this the excitement and exertion incident to the animals being wild, and it is not surprising that some of them would permanently injure the heart muscle so that in some weeks or months it would fail to perform its work. Presuming that a little later the animals were driven up rocky trails and through thick forests to an altitude of from eleven thousand to thirteen thousand feet, and with this excessive exertion the wonder is that so few of them are permanently injured.

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* The Anglo-American expedition to the top of Pike's Peak as given by the editor of the Journal of the American Medical Association reported as follows: "The more immediate effects after arrival were blueness of the face and lips, nausea, intestinal disturbance, headache, fainting in some persons, and periodic breathing, besides great hyperpnea on exertion or holding the breath a few seconds."

The horses that follow these cattle are practically all raised in districts where they do their work. When asked if low altitude horses were ridden, one man answered, "They are of no use." This expresses it well. Most stockmen know that a low altitude horse is of little value for work in high altitudes until he has become acclimated. We ourselves saw a very valuable Percheron stallion that had been shipped from a low altitude to an altitude of nine thousand five hundred feet. In less than a year he suffered from heart insufficiency to such an extent that the excitement of a man passing into the corral would cause him to fall. Just previous to falling no pulse could be detected at the jaw.

A physician who practiced at Fairplay, Colorado, altitude ten thousand feet, says that most old people at that altitude die with generalized dropsy. The same man reports two cases of generalized dropsy associated with other conditions as being much improved on going to Denver. It is rather a common practice for physicians to send heart patients to a lower altitude. In a spirit of fairness, however, we should add an extract from a letter written by a physician of several years' experience in practice at Leadville, Colorado, altitude ten thousand feet. "We have acute cardiac dilatation which will cause edema, but I believe with proper treatment they will recover as well at this altitude as lower down. It is my experience as well as the experience of other physicians here that the injurious effects of high altitudes have been much exaggerated, especially so in those born at this elevation."

In support of this contention, that the altitude is the important factor, we submit the following additional facts. There are four stockmen in South Park who seem to have more trouble than any others. These men range their cattle in the summer above timber line at an altitude above eleven thousand feet, which is one of the highest ranges in the United States.

The range near Buena Vista that runs from eleven thousand to thirteen thousand feet had not been used by cattle previous to the summer of 1914 when, as detailed under case twenty-four, twelve animals were lost out of one hundred and sixteen. The owners had ranged cattle at altitudes approximating eight thousand feet for several years, with no bad results. Cattle shipped from a low altitude are always more affected than those native to the country. There are several instances where a number of low altitude cattle have been shipped to South Park with markedly disastrous results. One man says that in several years' experience he has never yet shipped in a bull from a low altitude that did not sooner or later die of this disease. Is it not probable that some of the calves from these bulls would show a similar weakness in this

respect, thus explaining the high mortality in calves? That is, as we look upon the problem, it requires a stronger heart to carry an animal through the vicissitudes incident to an existence at a high altitude than it does at a low one. Some hearts, in fact most of them, have sufficient reserve force to meet the new conditions, as is evidenced by the rather common observation that hearts of cattle at high altitudes are heavier and thicker (hypertrophy) than those lower down. Some animals, however, do not have this reserve force and exhaustion of the heart with dilatation results. Such animals would undoubtedly give rise to a certain number of offspring whose hearts would be insufficient to meet the vigorous conditions.

CASE REPORTS.

CASE No. 1.—Black and white cow, age seven or eight; weight nine hundred and fifty. **History**—Noticed to be ailing the previous summer; swelling appeared under jaw about three weeks before; later, swelling of the brisket. About the 27th of March she refused food for a couple of days. On March 30 the swollen brisket was lanced, after which she seemed to improve, and drank more water than usual. Seen on April 5, 1913, near Jefferson, Colorado; altitude nine thousand feet; in fair flesh; rather wild, so that restraint was resisted and only accomplished after much excitement on the part of the animal. Following this, the temperature was 103° F.; respiration rapid with whistling sounds in trachea. An attempt was made to tap the swelling under the jaw without results. There was no weakness, feces very thin, and watery discharge from the nostrils, owner thinks animal better. One cubic centimeter of blood was removed from the jugular vein and injected into the jugular vein of a healthy steer. Cow remained in poor condition throughout the summer and was shipped out in the fall, passing from observation.

CASE No. 2.—Hereford steer, short, yearling, South Park, altitude nine thousand feet, raised there. **History**—Noticed to be sick about a week previous; seen on April 6, 1913, in fair state of flesh; respiration not labored but slightly increased, moist cough; temperature 102.6; appetite good; feces quite thin and dark in color; no mucous or blood; brisket swollen and flabby; April 7th, temperature 101.9. Calf eating, appears strong. Brisket swollen more than on day previous and rather more firm on pressure. Diarrhoea marked, feces dark in color. Abdomen enlarged. April 8th, increase in swelling of brisket with thickening of lower part of neck. Diarrhoea continues. Temperature 102.5. Jugular pulse well marked. April 9th, symptoms same as on previous days. Temperature 101.8. Slaughtered for examination. Post mortem examination.—Large edematous area at the brisket estimated to be ten inches long by eight inches wide. About three gallons of straw-colored fluid in the thoracic cavity. Considerable in the pericardium. Large blood clot the size of one's fist in the right lung near the dorsal part and just above the point where the bronchus enters. Collapsed red areas in the apical and cardiac lobes near the lower margin. By far the larger part of the lungs appear normal.

Estimated three gallons of fluid in the abdominal cavity. Mesentery very much thickened throughout its whole extent. Fluid can be easily squeezed out. Large blood clot near anterior mesenteric artery. Several small hemorrhages under the serous membrane. Liver enlarged and hard, on section is mottled gray. Spleen normal. Interior of rumen and reticulum black. Folds in the fourth stomach very edematous.

Many ulcers in the mucous membrane most of which are healed. Several reddened areas, some sand present. Mucous lining of intestine loosened and easily torn off. Intestinal contents thin, watery, no bad odor. Kidneys petechial. Bladder normal.

CASE No. 3.—Grade Hereford, black with white face, age one year, weight three hundred pounds. Found sick four days before. Altitude nine thousand five hundred feet. Seen on September 29, 1913. Grunting with every breath, dull, listless, mucous discharge from eyes; mucous membrane pale; jugular pulse very marked; jugular veins so full that they stand out and are plainly visible some yards away; no appetite; drinks freely; thin fetid diarrhoea; temperature 101.6; respiration 30 and audible; pulse 90; heart tumultous; brisket enormously enlarged and rather firm on pressure; some regurgitation of gas; coughs frequently; animal died during the night of September 30. **Post Mortem**—Subcutaneous tissue markedly edematous over brisket and under surface of the neck, extending as far back as umbilicus and forward to the symphysis of the lower jaw; enormous quantities of fluid in the thoracic cavity; heart enlarged and dilated; lungs congested in spots; bronchitis, due to a considerable number of lung worms; hemorrhagic spots in tissues about the pharynx and trachea; hemorrhages under the peritoneum at several places, an especially large one under the spleen; spleen normal; liver hard, enlarged and mottled on section; kidney passively congested; mucous membrane of the fourth stomach and intestines reddened throughout; a large quantity of fluid in the abdominal cavity; the serous membrane of the intestinal walls is much thickened by edema.

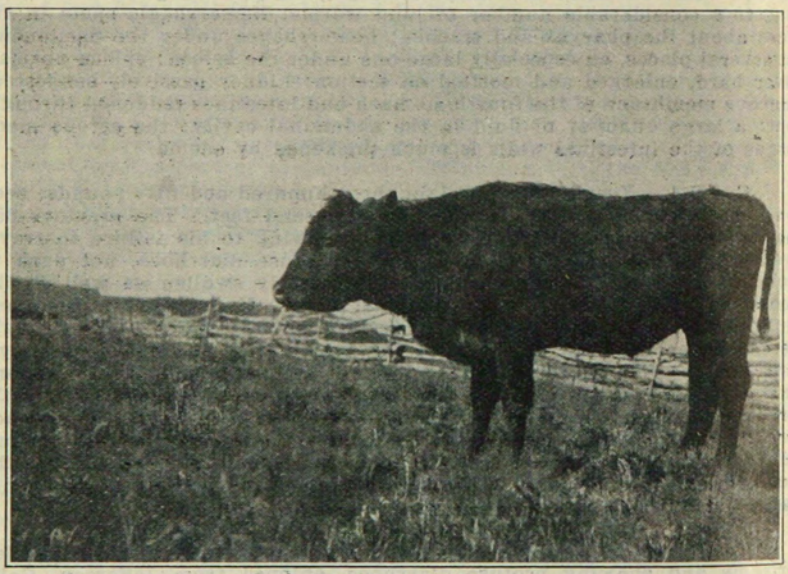
CASE 4.—Yearling calf, weight three hundred and fifty pounds; seen on September 29, 1913; altitude nine thousand feet. The previous day he had been driven in off the range, but owing to his failure to travel well has been left behind. **Symptoms**—Profuse diarrhoea, not dark in color; very weak and grunting; brisket greatly swollen as well as the loose tissues under the jaw; mucous and watery discharge from the eyes; dull; listless; temperature 101.1; respiration 18; pulse 100. Slaughtered on the morning of the 30th for examination; a few hemorrhagic areas on the rumen; estimated a couple of gallons of fluid in the abdominal cavity and as much in the thoracic; mesentery edematous; four rather large ulcers in the fourth stomach; no reddening in either the stomach or intestines; liver enlarged and quite hard, being mottled on section; lungs normal except a few small areas in dependent portions of the cephalic and cardiac lobes, which are solidified and depressed; heart not large but quite flabby; no lung worms and no bronchitis.

CASES No. 5 AND 6.—Two two-year-old steers with badly swollen briskets and showing profuse diarrhoea, shipped from Jefferson, Colorado, altitude nine thousand feet, to Denver, where they remained in the stockyards for three weeks, during which time they completely recovered. They arrived at the Station at Fort Collins on November 28, 1913, in a normal condition, were kept under observation until December 17th, when they were sold as feeders. The purchaser reported that they fed out as well as any others in the lot and were sold for slaughter about April 10, 1914. One of these steers came originally from either New Mexico or Arizona and the other from Marysville, Utah.

CASE 7—A calf raised at Jefferson, Colorado, altitude nine thousand feet, shipped to Fort Collins by express on February 11, 1914, because of a marked diarrhoea, dullness, swelling of the abdomen and droopy ears, denoting brisket disease. On arrival the following day the feces were normal, the animal was weak and dull with little appetite. No swelling of the brisket; temperature 102. It became brighter in a few

days and continued to improve until within a week it was normal. The calf was returned to Jefferson on March 9, 1914, since which time there has been no recurrence of the disease.

CASE 8.—July 1, 1914. Three-year-old steer, grade Shorthorn, altitude nine thousand two hundred feet, Divide, Colorado. **History**—One of a bunch of yearlings brought from Nebraska to an alaiaude of about eight thousand feet, near Manitou. Present owner bought them the spring previous and had lost one other steer similarly affected; been sick for four weeks. **Symptoms**—Brisket moderately swollen, no appetite, dull, thin, staring coat, swollen under the jaw; scouring badly but feces not black; respiration hurried. He was given a teaspoonful of fluid extract of digitalis by the mouth on July 2 and 3. On the 4th he was given two doses of a teaspoonful each, one in the morning and one in the evening. On the 5th three doses were given. He grew steadily worse until some time during the night of the 5th, when he died. **Post Mortem Examination**—Subcutaneous tissue markedly edematous throughout the region of the brisket, neck, intermaxillary space and over all four limbs;



Cut No. V. Case VIII. Taken on July 2, 1914, at Divide, Colorado, three days before death.

lungs collapsed in a few small areas, the left one showing a few hemorrhages; tracheal and bronchial mucous membranes hemorrhagic; no parasites; a large quantity of fluid in the thorax; heart enlarged with thick walls; epicardium edematous; several gallons in the abdomen with all of the serous membrane and walls of the hollow viscera decidedly thickened with fluid; mucous membrane of fourth stomach and intestines reddened over entire area. Liver very dark, hard and enlarged, mottled on section; spleen normal and kidneys showing congestion. An abscess estimated as holding a pint of pus was found in the wall between the reticulum and the omasum; there was a blackened wire nail in it; it did not, however, extend through the diaphragm into the thorax.

Case 9.—Female, calf, aged six weeks, Shorthorn. **History**—Been on the range at an altitude between eleven thousand and twelve thousand feet along with cases ten to twenty-one, inclusive. This case is given especially because it represents a typical one picked out from a number of others that were supposed to have diphtheria. It was also stated that one man had lost thirty calves during the previous year similarly affected and that this year many were dying from the same affection. An examination of the mouth of a considerable number revealed no ulcers nor any diseased condition, consequently this one was picked out for autopsy. It had been sick for two weeks, brought to ranch nine thousand feet, a week before. **Symptoms**—In good flesh, but the flanks are sunken, due to failure to suck; hair is standing on end and ears droop; seems to have considerable strength; no noticeable swelling of the brisket or submaxillary space; coughs occasionally; some diarrhoea. **Autopsy**—Edema of the loose tissues surrounding pharynx and larynx; estimated that there was a gallon of fluid in the thorax, as much in the abdomen and a pint in the percardium; lungs normal except for a few collapsed and red areas near ventral border; heart flabby and dilated; peritoneum and walls of the hollow abdominal organs markedly edematous; liver enlarged and hard, being mottled with gray on section. The interior of the intestines and stomach are pale, being due probably to the fact that the animal was bled before examination.

CASE 19.—August 3, 1914. A calf that was presumed to be sick like the others, but had been in pasture at about nine thousand five hundred feet. It had developed a swelling of the brisket during the night previous to our visit and was very dull and grunting when seen; diarrhoea marked; died on the night of August 4.

CASE 20.—Shorthorn bull, pure bred, age 4 years; raised at Golden, Colorado, altitude about five thousand five hundred feet; was purchased and shipped to South Park (nine thousand feet) in June, 1913. During the following winter he developed a considerable swelling of the brisket. Digitalis was given at the rate of one-half teaspoonful of the fluid extract daily. He recovered in about a month and in the spring was sent with the other cattle to the range between eleven thousand and twelve thousand feet. He was noticed to be ailing about the middle of July and a week later his brisket was swollen and he was driven down to an altitude of about ten thousand feet; seen on August 1. **Symptoms**—Stands in shade, seldom moves, dull, no appetite; brisket swollen enormously; sheath swollen; legs thickened and edematous, the hocks being especially puffy; ears drooped; no diarrhoea. On August 4th he was hauled eight miles in a wagon to Jefferson, where he was loaded with Case 21 and shipped to Denver. On the 6th of August he was apparently gasping for breath, his mouth was open and he was very dull. (It was a very hot day and the animal was in the sun.) However, his appetite seemed good. On August 10th the swelling of the brisket had decreased fully one-half; appetite good; on the 19th all trace of swelling had disappeared and he was normal except that he was thin. He was sold on the 31st as a feeder and passed out of our observation.

CASE 21.—Grade Shorthorn steer, three years old. **History**—Raised in Texas and purchased in Denver a year previous; found ailing the latter part of July on the range at altitude above eleven thousand feet; driven to ranch (nine thousand feet) where he had for two weeks received digitalis daily without avail. Shipped to Denver on August 5, 1914, where he showed the following symptoms on arrival. **Symptoms**—Dull, little appetite, ears drooped; respiration labored, panting; brisket swollen enormously, rather firm and hard on pressure; feces normal. On August 10th he was eating well and appeared brighter, but the swelling

was about the same as on the 6th. On the 19th much brighter, swelling of brisket nearly all gone, that which was left being flabby. On the 23d he appeared entirely normal and was sold as a feeder on the 31st.

During the time cases twenty and twenty-one were in the stockyards at Denver, they were under close observation by the inspectors of the U. S. Bureau of Animal Industry.

The following data is appended as kindly submitted by Dr. J. C. Exline, Inspector in Charge.

Denver, Colorado, September 25, 1914.

Dr. J. C. Exline,
Inspector in Charge,
Denver, Colorado.

Sir: August 5, 1914, there was received at the Denver Union Stockyards from Jefferson, Colo., one red bull, weight about 1,200 pounds, and one red and white steer, weight about 1,000 pounds, held for observation, account so-called "Brisket Disease." Animals found to be emaciated, an edematous condition noted, extending posteriorly from sub-sternal to scrotal region; between forelegs it was from 12 to 15 inches wide, pit on pressure, apparently filled with an exudate which involved the inferior thoracic-abdominal region, and legs. The following temperatures have been recorded:

Aug. 6.	Bull— 3:00 p.m.	101.8	Aug. 6.	Steer— 3:00 p.m.	101.4
Aug. 7.	Bull— 9:00 a.m.	101.4	Aug. 7.	Steer— 9:00 a.m.	101.2
Aug. 8.	Bull— 8:30 a.m.	100.3	Aug. 8.	Steer— 8:30 a.m.	101.2
Aug. 8.	Bull— 3.00 p.m.	101.2	Aug. 8.	Steer— 3:00 p.m.	102.4
Aug. 9.	Bull—11:00 a.m.	101.2	Aug. 9.	Steer—11:00 a.m.	102
Aug. 10.	Bull— 8:30 a.m.	100.8	Aug. 10.	Steer— 8:30 a.m.	101
Aug. 10.	Bull— 3:00 p.m.	104.4	Aug. 10.	Steer— 3:00 p.m.	103.2
Aug. 11.	Bull—11:00 a.m.	101.6	Aug. 11.	Steer—11:00 a.m.	103
Aug. 11.	Bull— 4:00 p.m.	104	Aug. 11.	Steer— 4:00 p.m.	104
Aug. 12.	Bull— 9:00 a.m.	101.8	Aug. 12.	Steer— 9:00 a.m.	102.6
Aug. 13.	Bull— 9:00 a.m.	101.8	Aug. 13.	Steer— 9:00 a.m.	102.2
Aug. 14.	Bull— 9.00 a.m.	101.2	Aug. 14.	Steer— 9:00 a.m.	100.6
Aug. 27.	Bull—10:00 a.m.	101.8	Aug. 27.	Steer—10:00 a.m.	102
Aug. 28.	Bull— 9:00 a.m.	101	Aug. 28.	Steer— 9:00 a.m.	101.2
Aug. 28.	Bull— 3:00 p.m.	102.6	Aug. 28.	Steer— 3:00 p.m.	101.8
Aug. 29.	Bull— 9:00 a.m.	101.6	Aug. 29.	Steer— 9:00 a.m.	101.2
Aug. 29.	Bull— 3:00 p.m.	102	Aug. 29.	Steer— 3:00 p.m.	101.8

Pulse found soft and weak first few days. Urination frequent, normal in color—the high temperatures probably due to being in open pens several days. Animals apparently regained normal condition and were shipped as feeders to Omaha, Neb., August 31, 1914.

Very respectfully,
A. W. SWEDBERG,
V. I., Yards.

Denver, Colo., October 6, 1914.

Dr. J. C. Exline,
Inspector in Charge.

Sir: The following observations were made and temperatures taken for a period of eleven days, on two cases of brisket disease—bull and

steer—at the Denver Union Stockyards:

Subject: Shorthorn bull, about five years old, in poor condition, with considerable swelling of brisket.

TEMPERATURE.

	10 a.m.	3 p.m.
Aug. 15.	101.6	
Aug. 16.	No temperature taken.	
Aug. 17.	100.8	102
Aug. 18.	101	101.6
Aug. 19.	101.4	102
Aug. 20.	100.6	100.8
Aug. 21.	100.6	101.8
Aug. 22.	101.4	100.2
Aug. 23.	100.4	
Aug. 24.	101.4	101
Aug. 25.	101	103.8

The swelling of brisket generally lessened from day to day until on the day of the last observation it had almost entirely disappeared.

Subject: Steer, grade, about four years old, in poor condition, brisket very much swollen.

TEMPERATURE.

	10 a.m.	3 p.m.
Aug. 15.	102	
Aug. 16.	No temperature taken.	
Aug. 17.	102.6	102.4
Aug. 18.	101.6	102.4

Diarrhoea was present up to this date when the evacuations became normal.

TEMPERATURE.

	10 a.m.	3 p. m.
Aug. 19.	101.8	101.8
Aug. 20.	101.4	102
Aug. 21.	100.8	101.4
Aug. 22.	101	101.4
Aug. 23.	100.6	
Aug. 24.	100.6	101.2
Aug. 25.	100	103

There was still considerable swelling of brisket on this date, but it had lessened from day to day during the period of observation.

The high temperature of both bull and steer, at 3 p. m., on August 25, were probably due to the animals being removed from a covered shed to an open corral.

During the period of observation, both animals ate well and drank freely.

Very respectfully,

H. B. CHANEY, V. I.

CASE 23.—Yearling steer, grade Hereford; raised at an altitude of about nine thousand feet; was noticed to be ailing some two weeks before shipping out. Two days after shipping the brisket was markedly swollen and diarrhoea was profuse. On the day of shipping, however, the brisket was not swollen. Arrived at Fort Collins September 15, 1914. He was extremely weak and rather dull, appetite good, hind limbs covered with feces showing a previous diarrhoea; respiration 120; heart-

beat could not be obtained under normal circumstances; no swelling of the brisket. Animal became brighter and added flesh until this writing, when he is perfectly normal.

CASE 24.—Two-year-old Hereford steer, one of a bunch of one hundred and sixteen steers shipped from Panhandle, Texas, in March, 1914, to Nathrop, Colorado, altitude seven thousand six hundred and ninety-six. On May 1st they were driven to a range between ten thousand and thirteen thousand feet, where they remained until September 27th. During this time seven had died with what appeared to be brisket disease and on September 27th six were sick and four were missing. Case 24 had been driven the previous day to an altitude of a little less than eight thousand feet, where, owing to exhaustion he and one other had been left, the other sick ones being taken to an altitude of a little less than eight thousand feet. On September 28th, the brisket and loose tissue of the jaw were badly swollen; there was profuse diarrhoea; the animal was very weak and grunting; respiration 36; pulse 120 and very weak; heart bating tumultously; moist cough; did the following day while being transported in a wagon to a lower altitude. Two others of this group died within the next two weeks in spjite of the fact that they were removed to an altitude of eight thousand feet.

CASE 28.—Seen August 16, 1913, ten miles above Morrison, on Bear Creek, altitude seven thousand feet. **History**—Jersey cow, seven years old; taken from Littleton, January 10, 1913, driven to Canfield's ranch, stood the journey well. Canfield thinks the brisket might have been slightly swollen at that time. A month later the cow was constipated, had desire for salt and drank much water. A nasal discharge was noticeable. The brisket enlargement partially disappeared for a time; heart beating violently. July 15th diarrhoea was present and feces had offensive odor; weakness, anorexia, malaise, indisposed to move. **Symptoms**—Temperature 102.5; respirations labored; fore feet wide apart; offensive diarrhoea; temperature of body evenly distributed; heart beating fast and labored; pulse full and hard; jugular on right side was corded, the size of a man's wrist, extending from the bifurcation near angle of jaw downward for ten inches; an old scar was found in the region of the throat and over the jugular, looked as though it might have been surgical. **Post Mortem**—Cow was destroyed by bullet in head and bleeding; test with hemoglobin scale indicated one hundred per cent; edema of brisket extreme and not extended to the lower pectoral region; edema not present in extremities; great quantities of sera found in thorax and abdomen; edema of mesentery and areolar tissue in region of brisket; heart muscles flabby and showing some degeneration; right side of heart dilated and no excessive accumulation of fluid around the heart; lungs normal save a wash-out appearance; spleen normal; liver much enlarged, hard and nutmeg appearance; blood seemed to coagulate normally; bowel contents fluid and nearly empty; a thrombus fully six inches long in jugular vein; kidneys appeared slightly congested but otherwise normal. The cow was in good flesh when symptoms first appeared and did not show debility, fever and disturbances of reflexes, volition, etc., that would be expected in case of infection.

CASE 30.—Yearling, Hereford heifer; weight 500 pounds; altitude nine thousand feet; near Hartsel, Colorado. **History**—One of a bunch of southern heifers shipped into South Park on May 13, 1914, and pastured at an altitude of about nine thousand feet during the summer. She was noticed to be sick about the middle of October when the roundup took place. Seen on November 6, 1914, at which time there was a moderate swelling of the brisket, a puffiness under the jaw and a very much distended abdomen. She was thin, weak, had little appetite and a rather profuse diarrhoea.

November 7.—Pulse 120 and weak; temperature 103.2. The thorax was tapped with trocar and cannula, but not to exceed a pint of fluid was obtained. Four gallons of fluid were drawn from the abdomen, which noticeably reduced its size. At 8 a. m. ¼ gr. digitalin was given hypodermically; at 1.30 p. m. ¼ gr. digitalin and ¼ gr. strychnine; 5 p. m. ¼ gr. digitalin.

November 8.—Brisket swollen more than on previous day, abdomen slightly fuller than after tapping. One-fourth gr. digitalin and ¼ gr. strychnine given morning and evening.

November 9.—Brisket and abdomen same as on previous day. Same medicament as on previous day. Red blood corpuscles 14,120,000.

November 10.—Weak; temperature 102.3. One-fourth grain digitalin and ¼ gr. strychnine morning and evening.

November 11.—One-eighth grain digitalin and ¼ gr. strychnine given in the morning. Animal very weak. Died within thirty minutes after the last dose of medicine.

Post Mortem.—Carcass emaciated. Subcutaneous tissue edematous on under surface of jaw, neck, chest and part of abdomen; probably a gallon of fluid in the thoracic cavity and a small amount in the pericardium; lungs normal except lower portion of cephalic and cardiac lobes which appear reddened and collapsed; heart much dilated and flabby even the left ventricle collapsing as does the right in some cases; no macroscopic valvular lesions. Abdominal cavity contained a small amount of fluid, the mesentery and subserous tissues throughout being markedly edematous. Liver enlarged and hard. mottled on section. Spleen normal, other organs normal except for generalized edema. Areas of necrosis on the side of the neck evidently resulting from the digitalin.

CASE No. 31.—Hereford heifer, yearling, shipped to South Park from the South previous spring in same bunch as No. 30. Noticed to be sick on week previous to date of our first visit by exhibition of diarrhoea followed later by a distended abdomen. Seen on November 6, 1914. Animal in fair state of flesh, rather strong, appetite good, diarrhoea, slight swelling under jaw, none of the brisket, abdomen distended moderately. Was treated approximately as No. 30 until November 11, when she, being very weak and the swelling of the brisket being quite marked, treatment was discontinued. The swelling of the neck due to the digitalin was very noticeable. Her pulse ran between 100 and 120 during the time of observation with a temperature varying from 102 to 105.5, the high temperatures being charged to the abscesses produced by the digitalin. The red count on November 9th was 16,200,000.

SUMMARY.

A disease occurs in cattle in the high altitudes of Colorado, the principle symptoms of which are swelling of the brisket and of the loose tissues under the jaw, usually diarrhoea and a moist cough with gradual emaciation and death.

It is chronic in character but is fatal in practically all cases.

On autopsy the most marked features are general dropsy, enlarged and hard liver and dilated heart.

In six cases shipped to a lower altitude (about five thousand

feet) all recovered without other treatment, although it seems reasonable to believe that they would have died had they not been shipped.

It appears to be caused by an exhaustion of the heart muscle associated with a varying degree of dilatation and hypertrophy and this being brought about by exertion before acclimatization at high altitudes, or in the case of calves, inherited cardiac weakness.

Medical treatment has so far proven of little avail, but where possible shipping the affected animals to a lower altitude is recommended.

Preventive measures include the use of bulls that have been raised at altitudes of eight thousand feet or more, with a view to building up a hardier strain of cattle, also the curtailment of indiscriminate shipping of low altitude cattle to high altitudes.