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M.O.C.
C.D.C.
Atlanta, Georgia

THROUGH: George A. Spendlove, M.D.
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and: Alexander Langmuir, M.D.
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ATTENTION: James H. Steele, D.V.M.
Chief, Veterinary Public Health Services, C.D.C.

FROM: Monroe A. Holmes, D.V.M., Veterinarian
P.H.S., C.D.C., B.S.S.,
Utah State Department of Health

SUBJECT: Compiled Report on Co-operative Field Survey of Sheep Deaths in S.W. Utah (Cedar City); by the U. S. Public Health Service, U. S. Department of Agriculture, B.A.I., the U. S. Atomic Energy Commission, the University of Utah Medical School, Utah Agricultural College, and Utah State Department of Health.

This report covers a period of time from the latter part of May, 1953, through June, 1953, and several individual investigations made by the contributing agencies.

INTRODUCTION

During the latter part of May, shortly after the shearing time, several sheepmen in the Cedar City, Utah, area began to notice unusual symptoms and deaths in their sheep. Dr. , the local Veterinary Practitioner, was requested to examine the animals and treat them if advisable. Dr. immediately became aware that the lesions and symptoms he had noted were unusual (he has been in practice in this same area for twenty-five or thirty years) in these animals, as well as for the particular area.

He requested the assistance of the State Department of Agriculture Veterinarian and the U. S. Department of Agriculture B.A.I. Veterinarian. During the last part of May, both these men visited the ranches most severely affected. They observed several adult sheep and noted some elevated temperatures and skin lesions, but found no evidence of contagion. One of the affected animals was sacrificed for postmortem study, but still no evidence was found upon gross pathological examination. No tissue was taken at that time for histopathological studies. A diagnosis was not made at that time. Upon return to Salt Lake City, the State Department of Agriculture Veterinarian informed Dr. George Spendlove, Director of Public Health, of their findings, mentioning the possibility of radiation fall-out due to the proximity of these animals on winter range to the Nevada Proving Grounds.

Feeling there might be sufficient reason to believe that if the sheep loss was due to radiation effects then human health also might be involved, Dr. Spendlove requested aid from the U. S. Public Health Service for additional investigation and studies. Upon his request, a team of three Public Health Veterinarians began investigational work in the Cedar City area on June 5, 1953, meeting and cooperating with a team from the A.E.C., who also were investigating the sheep loss.

EPIZOOTIOLOGY

Preliminary investigation, Friday, June 5, 1953:

Upon arrival in Cedar City, the three U. S. Public Health Service Veterinarians, Drs. Monroe A. Holmes, William G. Hadlow, and Arthur H. Wolff, contacted , one of the sheepmen. Through , this group met the Atomic Energy Commission Personnel also investigating the sheep loss. The A.E.C. men were:

Joe Sanders, Deputy Field Assistant, Los Alamos, Nevada
Major R. J. Veenstra, U. S. Naval Radiological Defense Laboratory, Hunter's Point, California.
Dr. R. E. Thompsette, A.E.C. Veterinary Consultant, Los Alamos, Nev.

Through the efforts of and S. L. Brower, the County Agriculture Extension Agent, arrangements were made for the investigating groups to visit the shearing and lambing pens belonging to the owners of the affected sheep.

Sheep belonging to the following owners were seen, and macropathology was noted:

1. Cedar City, Utah
2. City, Utah
3. Cedar City, Utah
4. Cedar City, Utah
5. City, Utah
6. Cedar City, Utah

The following sheepowners' were reported to have winter-ranged in the same area as the above owners, but were unable to contact them during the first investigation. Information given by S. L. Brower indicated that all suffered similar losses with the exception of and

1. , Cedar City, Utah
2. , Cedar City, Utah
3. , Cedar City, Utah
4. , Cedar City, Utah
5. , Cedar City, Utah

We went first to the lambing and shearing sheds of had retained approximately 50 head of adult sheep and some lambs for our inspection. Of this group, approximately twelve were manifesting the symptoms that had been reported. The other sheep had recovered and were showing only scaly areas around the head and face, and a few areas on the body which lacked wool (alpopeca). Four of the adult sheep were weak and in an emaciated condition. Of the four, three had stunted lambs. The denuded areas which had been raw and open had partially healed within three or four weeks after initial appearance.

Blood samples were obtained from these animals and it was intended to sacrifice them for postmortem examination. [redacted] indicated that he had several animals that were in the earlier stages and would be more indicative of the general condition of those animals which had died. It was then decided that the postmortem examination should be conducted on [redacted] animals, and if the macropathological picture was significant, the investigators would return and examine [redacted] animals more thoroughly.

ANAMNESIS

The appearance of symptoms and deaths of the sheep covered a period of time from the middle of March (exact date unobtainable), through the latter part of May. Deaths continued at a lesser rate through June in those adult animals where skin lesions had been noticed previously.

There was no correlation of observation among the sheepmen as to the initial appearance of symptoms. Most of the owners relied upon sheepherders and farm managers to inform them of the condition of the animals. These persons, being mostly uneducated, and untrained, were not capable of detecting trouble until the actual deaths of animals.

Through close questioning, however, it was found that the majority of the adult animals in the affected herds had manifested typical progressive stages of erythema, desquamation, papule, vesicle, pustule and finally squamae, appearing first on the face, lips and ears, shortly before or during trailing to shearing and lambing pens (March 23 to April 27). Body lesions were not noticed until shearing time, when the shearers mentioned that the wool seemed to pull out instead of shearing as normally. After shearing, the wool undercoat which was left would apparently fall or pull out (woolsweat or slipping), leaving eczema-like areas, which were whitish or brownish, with varying degrees of thickness of the scabs or raw spots. Various dorsal areas and some lateral portions of the body were affected. No particular area seemed to be more affected than another (e.g. head over croup).

Deaths in the adult pregnant ewes began to occur a short time after shearing, (April 20 to May 11), in young ewes - 2 to 7 years of age, and with the beginning of lambing (April 20 - May 10). Majority of lambs were born dead in a stunted condition. Ewes died either during lambing or within a few days after. Stunted lambs were considered to be full-term, completely and well-formed (no disfigurements nor monstrosities), but were of approximately one-half normal birth size. These were not aborted lambs, being delivered after full gestation period. Lambs that lived would survive up to 5 or 6 days. They were weak in appearance and action, and, upon lying down, would have difficulty in getting up or standing. A few tried to nurse, but were unable to do so because of weakness or because the ewe apparently had little or no milk. Attempts were made to hand-feed some of these lambs, but, due to the great number involved, it became an impossible task and deaths occurred too quickly to ascertain whether or not hand-feeding was feasible.

Ewes which did not die at lambing time lived for varying periods. Usually they became progressively weaker, although their appetites would remain normal. In the majority of instances, they would even eat up to the time of death if the food was placed in front of them. Death was not lingering, nor did the animals struggle. Dry ewes - those not pregnant and older ewes (9 - 14 years) - seemed to have had skin lesions similar to pregnant ewes, but death losses were not as proportionately great. It is believed such losses were low compared to the younger pregnant ewes.

All the animals involved were of the "fine wool" type, being Rambouillet and mixed breed crosses.

When first notified, Dr. [redacted] the local Veterinarian, took temperature readings of several of the affected sheep. The majority of those readings were normal, but several had readings as high as 106° F.

It was revealed that neither the sheepmen, other livestock men in that area, local veterinarian, nor the State Department of Agriculture veterinarian had ever seen animals similarly affected in previous years. Although u ual losses were expected (an average 3-6% of adult animals), none had occurred before in this manner.

Although there was some speculation among the owners as to radiation fall-out affecting the animals, none would commit himself upon direct questioning. The answers were evasive with the implication that, while they could not render an opinion, they felt radiation may have had some influence.

Normal winter range losses were experienced by most of the sheepowners', however, winter grazing conditions were extremely poor. With lack of precipitation, largely as snow, there was little grass and the sheep had to graze over wide areas to survive. Some of the sheepmen maintained that this was the poorest range year since 1932.

Sheep subsisted on low shrubs, and sage, as well as what grass was available. This whole range area, made up of valleys and low-lying mountains, is in a semi-arid desert-like region.

In Lincoln County, Nevada, drought and overuse of range was severe, the forage being largely 4-wing saltbush, white sage, curly grass (Hilaria jamesii), and Indian ricegrass (Oryzopsis Hymenoides).

Vegetation near Papoose Lake, Lincoln County, is largely wolfberry (Lycium sp.), yucca, bud sage (Artemisia spinescens), Shadscale (Atriplex confertifolia), 4-wing saltbush (Atriplex canescens), horsebrush (Tetradymia glabrata), rabbitbrush (Chrysothamnus), gray molly (Kochia vestita) and white sage (Eurotia lanata).

On the bottom lands, green forage was available locally, contained greasewood (Sarcobatus vermiculatus), mat saltbush (Atriplex nuttallii), and saltgrass (Distichylis Spicata). Scattered loco (Astragallua sp.) occurred around waterholes, but not sufficiently abundant to be dangerous.

Soil showed slight radioactivity, but plants showed none, with all important forages tested. (June 16, 1953).

The main sheep ranges had black sage (Artemisia nova), shadscale, budsage, curly grass, horsebrush, wolfberry and other typical desert forage.

The trail forage was not examined, but through information from the Bureau of Range Management, it was found to have some Tetradymia.

Available water in most instances is found in low lying pools, made up largely of surface drainage or from small streams which eventually dry up or disappear into the ground. It was reported by some of the sheepmen that they were forced to truck in water occasionally to supply the sheep when they moved from valley to valley.

Climatological data, obtained from the U. S. Weather Bureau, indicated that the rainfall and run-off measured at a majority of their stations was below normal for the area, in many instances the lowest reported for over two decades, being 50% less than mean normal.

In Lincoln County, Nevada, there was .64 of an inch of rain at Crystal Springs from October, 1952, to July 14, 1953. There are 120 operators in Lincoln County, representing 13,000 head of cattle County Agriculture Extension Agent for Lincoln County indicated losses to date amounting to 1,000 head. No sheep losses were reported in Nevada.

Report of drought investigating committee indicates Lincoln County is experiencing one of the most severe droughts that it has had in many years. The precipitation for Caliente from September, 1952, until July, 1953, is as follows:

Month	of	September	.61	hundredths	of	an	inch
"	"	October	.0	"	"	"	"
"	"	November	.67	"	"	"	"
"	"	December	.27	"	"	"	"
"	"	January	.18	"	"	"	"
"	"	February	.01	"	"	"	"
"	"	March	.10	"	"	"	"
"	"	April	.09	"	"	"	"
"	"	May	.26	"	"	"	"
"	"	June	.03	"	"	"	"
"	"	July	.38	"	"	"	"

This is probably an overall average of the county precipitation record. In the southern part of the county the precipitation was less than this, and in the northern part records show that there was a little more precipitation. However, it is easy to see that from this amount of rainfall there would be practically no value for the production of forage on the range.

The winter was very mild. Green grass started to appear on the range in February. The latter part of March, April and May was very cold, inhibiting any growth of range plants. When hot weather came in June there was no moisture in the soil, and, therefore the range plants dried up. The sheep on the range during the winter did fairly well because they were not exposed to severe cold weather. Even though the range was dry and there was practically no new growth this spring, cold weather forced sheep to travel farther for feed.

Although it is impossible to make an accurate estimate of cattle losses to date, spring losses seem already to have reached 10%. Most of these are cows, however, there are also considerable numbers of small calves dying, most probably due to malnutrition.

The total number of sheep on winter range, in nine herds investigated, was approximately 18,000 (17,910). Of the nine observed herds on winter range, herd was removed from the range in February and did not suffer the losses others had reported. ' herd was given supplemental feed and did not suffer losses up to the time of the present investigation, and the lesions seen in other herds was not observed. Other herds were not given supplemental feeds, but alfalfa hay, pellets, and protein mix were given when the herds were brought into Cedar City for shearing and lambing. No professional treatment was given the affected animals, although one owner, did administer a few antibiotics (Sulfa preparations and penicillin) with no results.

The sheep involved were placed upon winter grazing range approximately November 1, 1952, in Lincoln County, 45 miles West of Caliente, Nevada, and 25 miles North of Hiko, Nevada, in Southeastern Nevada, varying from 90 to 130 miles North and West of Cedar City, Utah. Grazing ranges were from within a few miles of the Nevada Proving Grounds boundaries to distances of 120 miles North and East. (See attached map). Sheep began to return from winter range by trailing March 23 through May 10 to Cedar City, Utah, being on the trail approximately 20 days, where they were held for lambing and shearing for 3-4 weeks. Dry ewes and old ewes were separated from the younger animals and lambs and kept on feed lots while the younger animals were trailed to the higher summer ranges south and east of Cedar City.

Sheepowners Affected and approximate Location of Winter Grazing Range:

1. _____ Information was not available. Ranged close to sheep.

2. _____ These sheep were the closest to the Proving Grounds. Grazed in the Lincoln Mine area in the valley between Bald Mountain and Coyote Peak; Pahranagat Range to the south and east and the Worthington Mountains and Railroad Valley to the northeast and northwest.

3. _____ These sheep were in several locations, but we were unable to determine whether as a single unit or as several herds. The major range was on the White River, Nevada, approximately 45 miles west of Caliente, Nevada, and 25 miles north of Hiko, Nevada. Some of these sheep were in a community flock with which grazed north of Caliente, Nevada, near Panaca.

4. _____ and grazed their sheep in a community herd, north and west of Pioche, Nevada.

5. _____ Ranged his sheep in same vicinity as , approximately 25 miles north of Hiko, Nevada, in the White River area.

6. _____ In community herd with directly north of Caliente, Nevada.

7. _____ Sheep grazed in Coyote Springs area, north and west of Panaca, Nevada.

8. _____ Winter ranged in the Ely Springs area, Dry Lake Valley, southwest of Pioche and northwest of Panaca.

9. _____ In community herd with .

10. _____ Grazed sheep north and west of Pioche.

11. _____ Grazed close to Panaca, east toward Utah-Nevada Border, near Medina.

STATUS PRAESEN

Although the investigation was begun actually too late to see the more active symptoms and deaths of sheep, the investigators were able to see some of the animals which had recovered as well as cases which were considered mild by the sheepherders. Two sheep of [redacted] herd were separated and kept for post-mortem examination and macropathology. These sheep were considered to be more or less typical by the sheepowners, and the examination results may be indicative of the pathology of the other sheep which were affected.

Macropathology

The head evidenced lesions over the dorsum of the nose, around the nares, which appeared to be dry and scaly. Epidermal thickening was seen with patches of brownish color which were single or confluent. Small blister-like lesions were scattered over this area as well as on the upper and lower lips. On rupturing these areas a clear, straw-colored fluid was emitted. Blisters which had been broken by the grazing of the animal or rubbing of its face were raw and exposed the subcuticular area. The cheeks and ocular regions were not affected. The eyes did not show any change. The thinner, woolly areas of the head and ears were mostly affected, but the blisters were not seen; instead, the skin appeared to be dry and scaly with epidermal thickening. Skin over the ears was scaly and sloughing. The cervical region of the neck was not affected. There was no change in the wool or skin on the chest, abdomen or lower estremities. The skin over the withers and dorsum of the body and lateral areas of the chest, and over the upper areas of the extremities, showed patches of dry leathery-feeling scurfy surfaces. Such areas varied in location with no particular region of the body being affected more than the other. All animals examined had been sheared and had at least three or four week's new wool growth. The wool appeared to be extremely dry and brittle and easily pulled free from the skin. Lanolin content of the wool of the animal seemed extremely low. Skin color of the white animals affected, varied from a brownish to a dull white color.

Sheepowners indicated those animals that we observed, were the animals which possibly were least affected of the groups, as those which were apparently more severely affected had already died with no apparent recoveries. Animals in all herds observed in this initial investigation were in extremely poor physical condition. They were thin and movements were slow; however, no indication of a contagious disease seemed to be present.

The majority of the sheep had varying infestations of ecto-parasites, these being largely sheep ticks. (Melophagus Ovinus and Dermacentor Andersonii). Scabies was not seen.

It was observed that the black ewes, used as "counter" animals were similarly affected as white ewes, but no information was obtainable as to the loss of lambs by these animals.

The male sheep observed were largely one year old, and had been on the winter range all winter. The older breeding males were not held on the range, except for a period of a few weeks. The male animals did not evidence the lesions or deaths.

Special system examination such as heart, lung, digestive, urinary or lymphatic were apparently normal considering these were range sheep which were subjected to all adversities of these animals. Gastro-intestinal tracts were apparently normal with exception of a few stomach worms. No active radiological ulceration could be found, or healed lesions.

Hematological findings

Blood samples were drawn from 25 sheep in 4 of the involved herds. The hemoglobin, total leukocytic and differential counts were completed on 5 of these samples and were found to be well within the normal range.

The additional samples were centrifuged and sera was taken to the U. S. Public Health Service Rocky Mountain Laboratory for further examination. Of the 25 samples, there was no evidence of significant levels of specific antibody titres for Q Fever, Rocky Mountain Spotted Fever, Psyttacosis; however, a titre of 1:40 against tularemia in Sheep No. 1, an old ewe in herd, could be considered significant for possible tularemia in these animals.

Necropsy findings

Two sheep of herd which were sacrificed for postmortem examination in the preliminary study. The general macropathology was apparently normal; (e.g., no serious pathology was noted which would indicate contagious diseases or unusual afflictions).

Microscopic findings

Microscopic tissue specimens obtained from the post mortem examination of the two ewes sacrificed was apparently insignificant. Many of the microscopic findings of the older animals were those associated with age; others apparently to be none specific to which little significance could be attached. The thyroid acini of one ewe with the retention of thick colloid could be significant. The microscopic findings of the second ewe likewise were not significant with the exception of the hyperplasia of the thyroid gland. The micropathology of the skin section taken from one of the sacrificed ewes showed gross thickening of the outer layers with focal areas of edemia and various portions with apparent residue of the pustule formation. Edema was seen in the corium with subjacent muscle bundles showing coagulation necrosis.

Radiological Findings

The affected animals of ranch showed external readings of 2 mr using a M x 5b counter over the thyroid and kidney regions. The 2 ewes examined from herd gave external readings of 2 mr over the thyroid region. These readings were similar to those taken on a herd of 21 horses at the Ranch in Lincoln County, Nevada, by the AEC Investigating Team. The horses also gave a reading of 2 mr over the right kidney. Further examination of the Nevada Lincoln County area by the AEC field teams revealed that water samples taken June 3 and 6 in the region of Papoose Lake showed radioactive levels of 4.77×10^{-3} and 5.0×10^{-3} mc/l. The Papoose Lake area is considered to be where the infinite accumulated dose could exceed 100 r. Other readings taken at the waterhole averaged between 3 and 5 mr per hour and occasional readings up to as high as 20 mr per hour. Such readings were usually on the windward side of the plants or other obstacles. Cattle examined in this same area gave readings of 1 or 2 mr per hour over the backs.

Of the two ewes from herd which were sacrificed for postmortem examination, bone, thyroid and skin specimens were taken for radioassay examination. These samples were divided between Doctor Wolff of the Environmental Sanitation Unit, U.S.P.H.S., Cincinatti, Ohio, and Major R. J. Veenstra of the Navy Radiological

Laboratories, Hunter's Point, California. Doctor Wolff's preliminary report on radioassay of skin, wool, bone and thyroid from old ewe, No. 7, and thyroid from 2-year old No. 6 indicated that on the basis of only Beta radiation the dosage read, extrapolated back to one hour following the detonation would have been 0.1 to 0.5 reps per hour, and the total integrated dosage to the skin would have been less than 5 reps. Such integrated dosage is considered not likely to have caused any appreciative pathology. The thyroid tissues from Ewes No. 7 and No. 6 revealed 1.3 and 0.38 microcuries per gram of tissue, respectively. Extrapolating back to the midpoint of the first week following the May 24 detonation, the thyroid glands of these ewes received a total integrated dose of 800 and 200 reps respectively, with the 800 dose approaching the threshold for acute damage. The concentration of radioactivity in these thyroid glands as of June 9, 1953, exceeds by a factor of 250 to 1000 the maximum permissible concentration of radioactive iodine for humans.

Radioassay on bone specimens on Ewe No. 7 as of June 17 was 3.2×10^{-4} microcuries per gram. Doctor Wolff pointed out this is approximately 50% greater than the maximum permissible concentration of strontium 89-90 for humans, based on the National Bureau of Standards Handbook No. 52.

In summation, Doctor Wolff feels the levels of radiation are not sufficient to produce any serious acute syndrome or pathology, but the greater significance being the surprisingly high concentration of radioactive elements which had become fixed in the thyroid tissues and bone.

Specimens of tissues from the Corry animals examined by Major Veenstra were tested f gamma activity, using a Gamma Photon Scintillation Counter with modified Nuclear Corp. Scaler, Model No. 162 for over a period of five days. These tests gave a consistently higher count, approximately 12 counts per minute, than background. Alpha and Beta emitters were not detected.

Additional Field Examinations

At the request of Doctor Wolff it seemed advisable that further examinations of these affected sheep be conducted with attempts to obtain thyroid glands and skin samples. On June 13, Dr. Monroe A. Holmes, Public Health Service Veterinarian, in cooperation with Dr. Robert Bay, University of Utah Medical School Radiological Laboratory Veterinarian, went to Cedar City to conduct further examinations. While there, contacted the sheepmen previously seen as well as two additional sheepowners which were not present for the first investigation. At the same time, contact was made with Los Alamos field investigator, and William Allaire of the Santa Fe Operations Office, who cooperated in obtaining sheep from various herds for examination and aided in obtaining additional information that was not originally available.

Thirteen sheep were obtained for sacrifice with two sheep secured from herds which had not wintered in the Nevada Lincoln County area, but had remained in the Cedar City area. In addition, two sheep were obtained from one herd which had ranged in the Nevada area, but had not manifested losses or lesions observed in other herds. This herd had been supplemental fed during the winter grazing time, ( ).

Although macropathology was seen, no attempts were made to list any pathological changes. Blood samples were obtained from these animals before death from exsanguination. The following tissues were obtained in most instances: thyroid gland, rib bone, liver, kidney, spleen, feces, urine, adrenals, skin and femur.

External radiation readings using G M. Survey Counter were as follows:

1
14 year-old ewe, background 1.5 mr per hour.
Head 9 mr per hour
Back 5 mr per hour.

.2
3 year old ewe Background 2 mr per hour
Head 3.5 " " "
Back 2.5 " " "

.2
2 year old ewe Background 2 mr per hour
head 6.5 mr per hour
back 6.5 " " "

.0
5 year old ewe Background Not taken
Head and back 6 mr. per hour
Internal viscera 0.15 mr. per hour.

.00
12-15 year old ewe Background 0.15 mr per hour
Head and back 5 mr. per hour
Internal viscera 0.15 per hour

.X
6 hear old Background 0.05 mr per hour
Head and Back 1.4 mr per hour
Internal viscera 0.15 mr per hour

.XX Background Not taken
Head and back 1.4 mr per hour
Internal viscera 0.5 mr per hour.

Lamb Background Not taken
External reading 0.045 mr per hour

No. 2 Background 0.1 mr per hour
External reading 1.7 mr per hour.

No. 3
3 year old ewe Background 0.05 mr per hour
External reading 0.5 mr per hour

No. 4

1 year old ewe — Background 0.05 mr per hour
External radiation 0.5 mr per hour

3 year old ewe — Background 0.1 mr per hour
External radiation 0.13 mr per hour

No. 5

8 year old ewe — Background 0.5 mr per hour
External reading 0.5 mr per hour
External viscera 0.05 per hour

Tissue samples from these animals were examined by Doctor Bay at the University of Utah Medical School Radiological Laboratory and by Major Veenstra from the Navy Radiological Laboratory at Hunter's Point, California. Major Veenstra's report indicated the following values were obtained, using the Gamma Photon Scintillation Counter:

Sheep from Herd:				
Background	1120	counts/5 mi/600 mg.	tissue	
Liver	2376	"	"	"
Thyroid	171,648	"	"	"
Lungs	4175	"	"	"
Bone	4523	"	"	"

Sheep from ?				
Background	1256	counts/5 mi./300 mg.	tissue	
Liver	2631	"	"	"
Thyroid	225,945	"	"	"
Lungs	1734	"	"	"
Bone #1	2988	"	"	"
Bone #2	3944	"	"	"

Major Veenstra conclusions were that these were probably all Beta counts and that levels of radiation received would be far below the amount required for physiological affects and assumed that high thyroid levels represent Iodine 131.

Reports by Doctor Bay through Dr. B. J. Stover, Radiological Physicist, concluded that six of the sheep did not receive a sufficient amount of Iodine 131 to cause acute radiation affects. Gamma measurements on six bone samples were negative. Ashing of the bone with aliquots planted for Beta particle measurement in a 2 counter was not able to find detectable Beta particle emissions. Methods used for Beta measurements were considered sufficiently sensitive so that bone concentrations of SR^{89} or SR^{90} plus Y^{90} can be detected, which were less than permissible bone concentrations for humans.

Conclusions: The six sheep did not fix sufficient amounts of gamma and beta emissions in their skeletons to cause acute radiation affects. Liver, spleen and kidney samples measured by the same methods as used on bone showed negative results. Excreta samples (urine and fecal) indicated that both sick and controlled sheep had ingested some radiological material, but amounts were not considered to be sufficiently

large to cause acute radiation affects, and that the data on liver, bone, spleen, and kidneys showed the ingested radioactivity was not absorbed from the G I tract to any appreciable extent.

Data and comments are applicable only to those sheep which were studied and can be generalized only as these sheep are representative samples of those involved.

Chemical Findings

Chemical analysis was made of blood tissue and stomach contents of cattle obtained from the Nevada area, and additional Cedar City sheep June 16 by Dr. D. A. Greenwood, Biological Chemist, Utah State Agricultural College. Most of the values for the different constituents appear to be in normal range, except for the Specimens Nos. 9 and 10, (see Laboratory reports). Vitamin A, carotene, phosphorus, ether extract, moisture and oxalate determinations were made on the blood tissue and rumen contents of various specimens obtained from animals in the affected area in Nevada. Blood samples had been partially hemolyzed before reaching the laboratory and that would probably account for the relatively high values for carotene and phosphorus.

Satisfactory conclusions could not be reached as values for constituents of animals which are normally fed on desert range conditions are not known.

DISCUSSION

Dates of Atomic Tests:

March 17, 1953
March 24, 1953
March 31, 1953
April 6, 1953
April 11, 1953
April 18, 1953
April 25, 1953
May 8, 1953
May 19, 1953
May 25, 1953
June 4, 1953

Death losses in adult sheep and ewes in the Cedar City area of Southwest Utah posed a problem as to the etiology of the cause of these deaths.

Sheep had been grazing near the atomic proving grounds in Nevada and had possibly been exposed to radiation fall-out particles; however, the lesions, sequence of deaths and lack of specific pathology makes it difficult to conclude from the present investigation the true cause of the deaths of these animals. Radiation could have been a contributing cause largely due to the nearness of the animals to areas where radiation could have been a factor.

Malnourishment could have been an additional cause as these animals were on extremely poor range land. A majority of deaths in adult animals were in the younger pregnant ewes which could have been a contributing factor to the lessening of their resistance to any outside influence whether it was by disease, radiation, malnourishment, plant toxemia, etc. However, no evidence was indicated that any of these factors was the major cause of the deaths of these animals.

The older ewes which were not pregnant and younger non-pregnant animals, although manifesting skin diseases, did not have the high mortality.

The skin lesions which were observed were considered by many of the radiological experts not to be similar to radiation "burns" on other animals, such as cattle and horses. However, it was pointed out that the skin of the sheep is physiologically different from those of other animals as well as having the protective value of heavy wool coat, plus a concentration of oil (lanolin) which may serve as a protective device against the radiation fall out particles.

Although these animals which were apparently in poor condition were trailed (walked) for distances of 90 to 150 miles, deaths which occurred during trailing were not in sufficient numbers to indicate that trailing was a contributing cause.

Another puzzling factor is that in those deaths which would occur, the animals would not linger in dying as seen in contagious diseases or debilitating conditions. They would continue to eat the alfalfa hay and protein supplement fed to them, but would apparently become weaker and when next noticed, would be dead. Animals which are malnourished may produce stunted lambs and will not survive the ordeal of lambing.

Many of these animals had been fed sufficient supplemental feed which could apparently restore them to sufficient vigor to overcome the debilitation of lambing and even though they may lose the lambs, would survive themselves.

In comparing the known radiation (burn affects) on other animals and in humans, the pattern of patbology and healing could not be considered the same as seen in the affected sheep. Usually so-called radiation burn will continue to manifest itself as a ulcerative condition, whereas, the skin lesions in these animals would apparently be healed and returned to a somewhat normal appearance within a period of 3 to 4 weeks after they were first noticed. Again it may be said that those animals that were observed were possibly those which had not received the full effect of the particular affliction as those animals which had died.

Since the original investigation and the follow-up investigation, several meetings have been held with the different interested groups. The conclusion of such meetings has been that there is no direct evidence that radiation was the cause of the sheep losses, nor is there any evidence that malnourishment was the cause of this condition; but, in turn, there is no direct evidence that radiation could not have been the cause or that malnourishment could not have been the cause. There are too many variable factors, and in view of the fact that the investigations were conducted so late in the stage of this affliction, much of the data is by hearsay and not by observation.

With the lack of qualified data concerning action of radiation upon sheep, it was felt that additional investigations should be conducted along with various individual studies which would include experimental radiation and beta "burning" of the sheep, as well as experimental malnourishment studies.

SUMMARY

1. Sheep deaths occurred in the southwest portion of the State of Utah, involving some 17,910 sheep in 11 different herds.

2. Six herds were directly affected with total losses of 1420 ewes and 2870 lambs.

3. There is no evidence to indicate the death losses were due to contagion or toxic plants.

4. There was evidence that radiation was in the area in which the sheep had grazed.

5. Range conditions were considered to be extremely poor; Nevada cattle losses are over normal expected and are increasing.

6. Macro and micro pathology was inconclusive as to the cause of deaths.

7. Radiological examinations of tissue specimens of possibly affected sheep are likewise inconclusive as to the definite cause.

8. The Utah State Department of Health, State Department of Agriculture, University of Utah Medical School, AEC Los Alamos Field Office, U. S. Public Health Service Rocky Mountain Laboratory and the U. S. Public Health Service Environmental Sanitation Unit and various other agencies have been interested in this problem.

9. Conferences which were held by members of the above associations concluded at this time the cause of death of these animals could not be determined and that additional investigations and experiments will have to be done in view of the fact that there has not been sufficient qualified data known about the radiological affects on sheep.

Respectfully submitted,

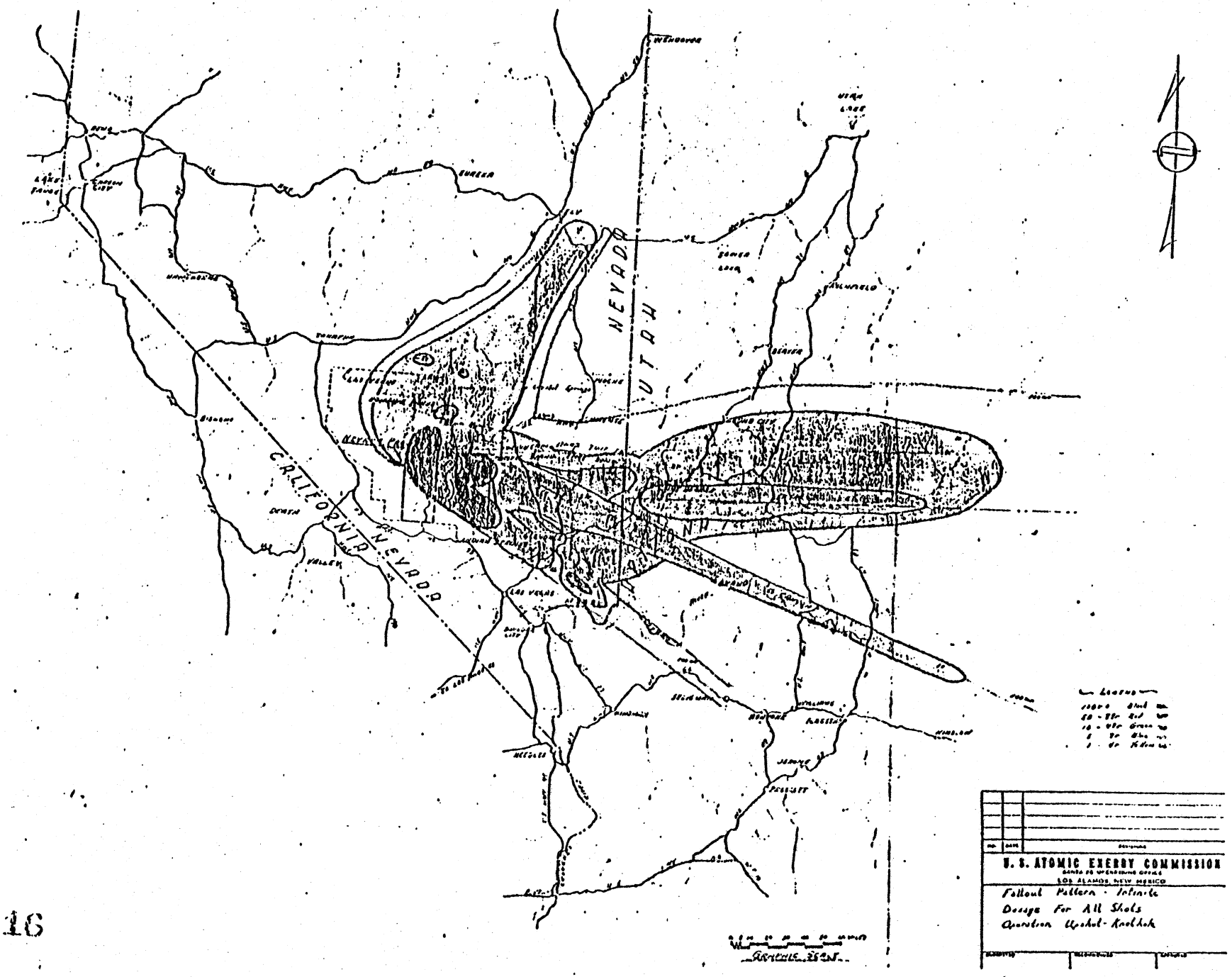
Monroe A. Holmes, Veterinarian
U. S. Public Health Service
Communicable Disease Center

MAH/s

Enclosures:
1. Laboratory reports of contributing agencies.
2. Range area maps
3. Radiation fall-out maps
4. Climatological data

SHEEP DEATH DATA CHART
(Information approximated - Owners were reluctant to commit themselves)

Owner	No. on Winter Range	No. Ewes Lost Lambing	No. Lambs Lost	Trailing Deaths	Trailing Abortions	Time of Greatest Losses	Trailing Date	Shearing Date	Life of Lambs	Skin Lesions First Noticed
1.	1,000	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK
2.	1,835	200	600	35	6-8	5/15-25	4/6,5/5	5/4-5	1 hr-1 wk	3/20
3.	3,200	300	700	6	UNK	5/20	4/20	4/20	3 hr-1 wk	4/20
4.	1,375	200	400	12-15	0	5/5-20	4/1-8	5/7-8	1 hr-1 wk	4/10-15
5.	1,500	****	****	****	****	****	4/10	****	****	****
6.	2,100	120	470	10	10-12	4/5-15	3/23	5/2	1-5days	4/1
7.	Individual figures not available - sheep in community herd with									
8.	1,700	300	200	UNK	UNK	May	UNK	May	1-7days	UNK
9.	2,100	90 (normal)	0	UNK	UNK	****	UNK	May	****	Not seen
10.	1,500	300	600	10	10-12	5/1-20	4/18-27	5/9-11	2 hr-1 wk	4/10
11.	No losses - left winter range early in February									
Total No. of Animals	17,910	1,420	2,870							
Total Affected Animals	Percentage 12.1% 11,710		24.5%							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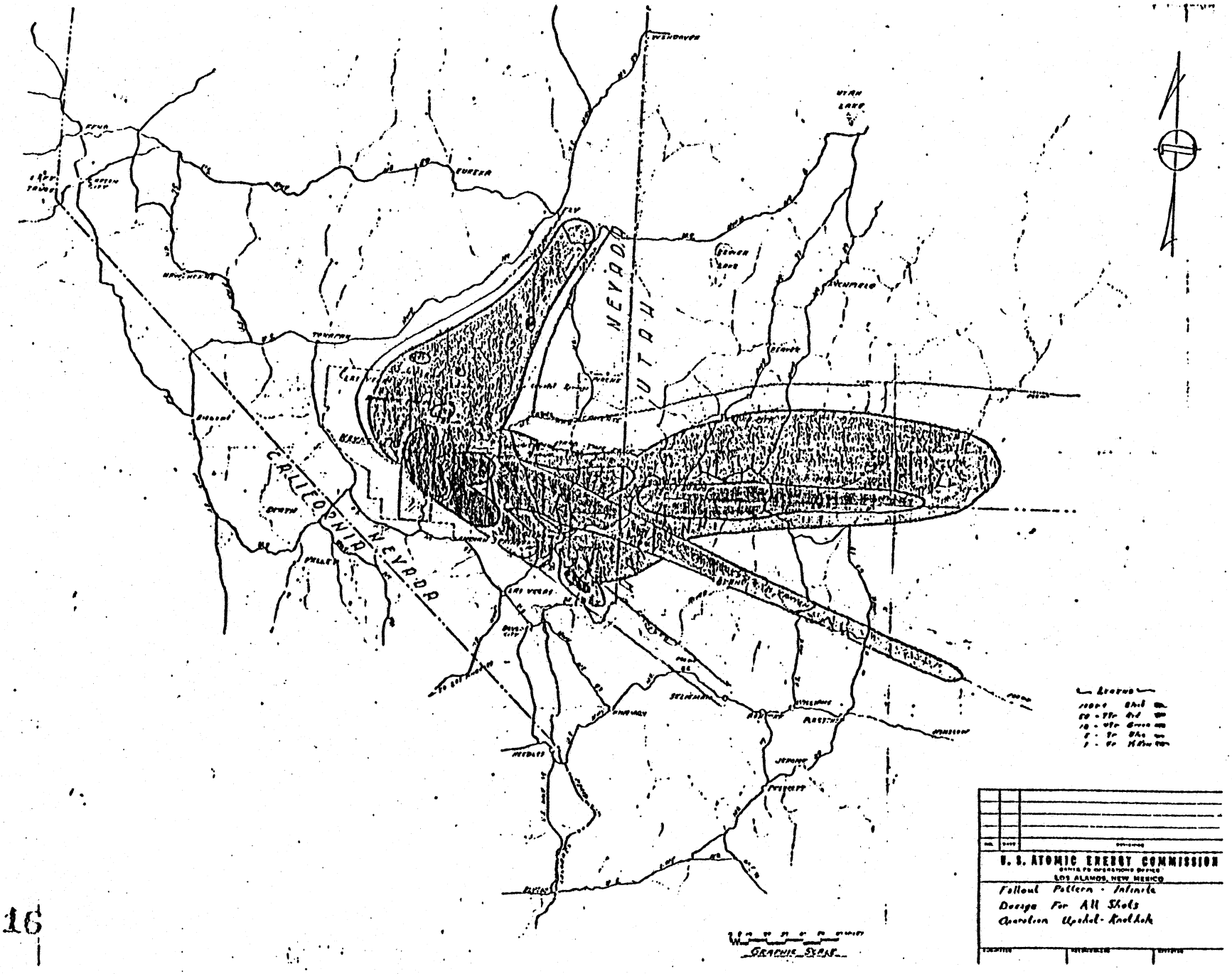
LOS ALAMOS, NEW MEXICO
Fallout Pattern - Infinite
Dosage For All Shots
Operation Upshot-Knothole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U. S. ATOMIC ENERGY COMMISSION
LOS ALAMOS, NEW MEXICO
Fallout Pattern - Infinite
Design For All Shots
Operation Upshot-Knothole

UTAH SHEEP DISEASE INVESTIGATION

Cedar City, Utah
June 5-6, 1953

Hematological Findings: (Oxalated Samples)

Sheep Number	HEMOGLOBIN	TOTAL LEUKOCYTES	DIFFERENTIAL COUNT
#2	11.7 gms (Spencer Hb-meter)	10,400	Lymphocytes 75% Neutrophils 18% Eosinophils 7% Erythrocytes & platelets normal
#4	12 gms. "	10,200	Lymphocytes 39% Neutrophils 61% Erythrocytes & platelets appear normal
#5	12 gms.	12,150	Lymphocytes 76% Neutrophils 24% Many monocytoid forms One eosinophil seen in smear Erythrocytes & platelets normal
#6	11.5 gms. "	10,350	Lymphocytes 73% Neutrophils 25% Monocytes 2% Many lymphocytes with trilobed nuclei Erythrocytes & platelets normal
#7	13.0 gms. "	6,700 (duplicates)	Lymphocytes 87% Neutrophils 11% Monocytes 2% One eosinophil seen Anisocytosis above normal with many macrocytes. Platelets OK

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UTAH SHEEP DISEASE INVESTIGATION

Cedar City, Utah
June 6-7, 1953

Serum Samples:

No.	
	- At Lambing Yards
1.	Old ewe. Slight residual lesions. Pregnant.
2.	Old ewe. Marked residual lesions. Pregnant
3.	3-yr-old ewe. Lost lamb. Sick, thin.
4.	2-yr-old ewe. Few nose lesions. Lamb at side.
5.	2-yr-old ewe. Few lesions on nose and chin. Lamb at side.
	- From Range Band
6.	Old ewe - removed from band because of marked loss of wool. Dry. Sacrificed for necropsy.
7.	2-yr-old ewe. Thin, wool dry, skin scaly. Had not been pregnant. Sacrificed for necropsy.
	- Dry Flock
8.	Old ewe (10 yrs.)
9.	4-yr-old ewe
10.	5-yr-old ewe
11.	Yearling ewe
12.	4-yr-old ewe
13.	Yearling ewe
14.	5-yr-old ewe
15.	3-yr-old ewe
16.	6-yr-old ewe
17.	Yearling ewe
18.	Yearling ewe
19.	4-yr-old ewe
20.	6-yr-old ewe (loss of wool)
21.	9-yr-old ewe
22.	5-yr-old ewe
	- Band of 500 on alfalfa
23.	Old ewe
24.	5-yr-old ewe - scars on ears
25.	4-5-yr.-old ewe

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Source of Samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
8		A	4	tr	0	0						0
		B	4	2	1	0						
		C	4	1	0	0						
		D	1	tr	0	0						
9		A	0	0	0	0						0
		B	4	3	0	0						
		C	2	1	0	0						
		D	3	1	0	0						
10		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
11		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	4	4	0	0						
12		A	0	0	0	0						0
		B	3	4	tr	0						
		C	0	2	2	1						
		D	0	0	0	0						
13		A	4	0	0	0						0
		B	4	1	0	0						
		C	3	3	0	0						
		D	4	3	2	0						
14		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
15		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						

Notes and comments:

RML Form #25

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Source of Samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
16		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
17		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
18		A	0	0	0	0						0
		B	tr	tr	0	0						
		C	1	1	1	0						
		D	0	0	0	0						
19		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	2	0						
		D	0	0	0	0						
20		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
21		A	0	0	0	0						
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
22		A	0	0	0	0						0
		B	0	0	0	0						
		C	1	tr	0	0						
		D	0	0	0	0						
23		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
24		A	tr	0	0	0						0
		B	tr	0	0	0						
		C	tr	0	0	0						
		D	3	3	1	0						

Notes and Comments:

RML Form #25

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Source of samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
25		A	4	tr	0	0						0
		B	3	2	2	0						
		C	1	0	1	0						
		D	2	1	0	0						

Notes and comments:

RML Form #25

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Source of samples: Blood from sheep collected by Dr. Hadlow, Cedar City, Utah 6-5-53 trip

Submitted 6/9/53 — Tested 6/12/53

Sample		Serum Dilutions 10	20	40	80	160	320	640	1280	2560	5120	10240
1	Tul		3	2	0	0						
	Br		0	0	0	0						
2	Tul		0	0	0	0						
	Br		0	0	0	0						
4	Tul		0	0	0	0						
	Br		0	0	0	0						
4A	Tul		0	0	0	0						
	Br		1	0	0	0						
5	Tul		0	0	0	0						
	Br		0	0	0	0						
Lamb from 5	Tul		0	0	0	0						
	Br		0	0	0	0						
6	Tul		2	1	0	0						
	Br		0	0	0	0						
7	Tul		0	0	0	0						
	Br		0	0	0	0						
8	Tul		0	0	0	0						
	Br		0	0	0	0						
9	Tul		0	0	0	0						
	Br		0	0	0	0						
10	Tul		0	0	0	0						
	Br		0	0	0	0						
11	Tul		0	0	0	0						
	Br		0	0	0	0						
12	Tul		2	1	0	0						
	Br		0	0	0	0						
13	Tul		0	0	0	0						
	Br		0	0	0	0						
14	Tul		0	0	0	0						
	Br		0	0	0	0						
15	Tul		1	0	0	0						
	Br		0	0	0	0						

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Source of samples: _____

Sample		Serum Dilutions										
		10	20	40	80	160	320	640	1280	2560	5120	10240
16	Tul		0	0	0	0						
	Br		0	0	0	0						
17	Tul		0	0	0	0						
	Br		0	0	0	0						
18	Tul		0	0	0	0						
	Br		0	0	0	0						
19	Tul		0	0	0	0						
	Br		±	±	0	0						
20	Tul		0	0	0	0						
	Br		±	0	0	0						
21	Tul		0	0	0	0						
	Br		±	0	0	0						
22	Tul		0	0	0	0						
	Br		0	0	0	0						
23	Tul		0	0	0	0						
	Br		0	0	0	0						
24	Tul		0	0	0	0						
	Br		0	0	0	0						
25	Tul		0	0	0	0						
	Br		0	0	0	0						

Summary: None of these agglutinins are high enough in titer to be considered significant. However, the 1:40 titer against tularemia in sheep No. 1 might indicate the possibility of previous tularemia among these animals.

NECROPSY RECORD

Identification No. 6 Necropsy No. P53-353

Species Ovine Breed Rambouillet Sex F Age aged Wt.

Owner Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal thought to show "uncomplicated" residua of disease outbreak. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Patches on the back and sides of the animal show loss of wool. The skin of this area is dry and scaly. Epidermal thickenings are present over the nasal region and on the lips. These are brownish in color and are single or confluent. Similar lesions are present on the ears.

The pleural spaces are obliterated by loosly fibrous adhesions between both lungs and the chest wall. The lung parenchyma is tan colored and somewhat firmer than normal.

The pericardium and heart show no changes other than serous atrophy at the base.

The liver is brownish-orange in color. There are a few minute white foci in the subcapsular parenchyma. The ventral portion of the main lobe shows the "cake frosting" thickening of chronic perihepatitis. On cut section a few small yellow foci are found scattered in the parenchyma. The gall bladder is not unusual.

The splenic pulp is red and soft. The follicles are not prominent.

The kidneys appear somewhat pale, swollen and soft. The peripelvic fat shows serous atrophy. The urinary bladder is empty and shows no changes.

The adrenal glands are not unusual.

The thyroid lobes appear somewhat softer than normal. One lobe contains a 2 mm. cyst with thick yellowish fluid.

The thymus is almost completely involuted. Gelatinous infiltration is present in the area.

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2A

The gastrointestinal tract is not examined in detail. However, no major changes are noted. The mesenteric lymph nodes present a very irregular distribution of the cortical tissue so that many of the nodes appear smoothly nodular. One abomasal node is calcified.

The ovaries are inactive and the uterus show no evidence of a recent pregnancy.

The leptomeninges are thickened, white, and opaque. The brain is otherwise without change. The pineal gland is partially calcified. The pituitary gland shows no gross changes.

The sternal bone marrow is pale white; that of the ribs and vertebrae is deep red in color.

Other than slight atrophy no changes are found in the musculature.

NECROPSY RECORD

Identification No. 7 Necropsy No. P53-354

Species Ovine Breed Rambouillet Sex F Age 1½ Yr. Wt.

Owner Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

The ewe is thin. Large wool-lass areas are evident. The remaining wool (sheared) is dry and the skin is "scurfy." Areas of wool loss extend down onto skin over upper leg region.

The thoracic cavity and its contents are not unusual.

The liver is dark brown in color. There are a few small white foci scattered under the capsule. A somewhat elevated area several centimeters in diameter is found near the gall bladder. On section it appears telangiectatic. The gall bladder appears normal.

The spleen is not remarkable.

The body lymph nodes show no changes of note.

There is a gelatinous infiltration of the peripelvic renal fat. The renal parenchyma is normal. The urinary bladder is empty.

The adrenal glands exhibit small 1 mm. yellow granular foci in the cortices.

The thyroid lobes are of normal size but are dark red and of a meaty consistency.

The thymic fat is gelatinous.

The gastrointestinal tract is not examined in detail. The abomasum is normal. Several trichostrongyle nematodes are observed. The intestinal tract shows no gross changes. The mesenteric nodes present no changes of note.

Several tapeworm cysts are present in the omentum and mesentery.

The ovaries contain several thin walled follicles up to 6 mm in diameter. The uterus is virginal. The mammary glands are not remarkable.

The meninges and brain appear normal grossly.

The sternal, rib, and vertebral bone marrow are dark red.

The skeletal musculature is atrophic.

MICROSCOPIC FINDINGS:

Kidney-

The tubular epithelium of the cortex shows mild regressive changes.

Heart-

There are occasional small lymphocytic foci in the interstitial tissue. Sarcocystis is present. The basilar epicardial fat contains mucoid material.

Liver-

The three sections examined exhibit marked portal infiltration with bile duct proliferation. Fibroblasts, macrophages and lymphocytes comprise the cellular infiltrate. One subcapsular focus of bile duct proliferation resembles an adenoma. A nodular mass of hepatic cells is found in one section. The capsule shows fibrotic thickening.

Lung-

There is slight thickening of most of the alveolar septa.

Spleen-

The pulp contains a small amount of golden brown pigment in macrophages.

Adrenal glands-

Sections from each adrenal exhibit a vacuolated appearance in the zona fasiculata. There are scattered large and small areas of hyperchromatic cortical cells.

Thymus-

No thymic tissue is found in the section. The adipose tissue shows mucoid changes.

Lymph nodes-

Sections of a mesenteric node and several other visceral nodes show a lack of follicular prominence in the cortical tissue. The lymphocytic tissue in general appears somewhat atrophic. Clumps of brown pigment ladened macrophages are present in the cortices and appear scattered in the medullary portions. A section of renal node shows masses of erythrocytes free in the cortical tissue.

Thyroid-

Sections from both lobes are examined. The acini show considerable variation in size from larger than normal to solid cellular masses. The majority of the acini appear smaller than normal. They are lined by cuboidal cells and contain deeply acidophilic (thick) colloid. One section contains a cystic area lined by flattened cells.

Pituitary gland-

The anterior lobe shows areas of coagulation necrosis without inflammatory infiltration. These necrotic areas are most prominent in the peripheral zone of the anterior lobe. The intervening tissue presents no changes of note.

Skeletal muscle-

Sarcocystis is present. There is an apparent increase in sarcolemma nuclei in scattered areas.

Aortic arch-

A focus of calcification is present in the media.

Skin-

Sections from the nasal ridge and the lesions on the upper lip show hyperkeratosis with leukocytes in the cornified debris. There is an occasional clump of lymphocytes in the corium.

Pineal gland-

Areas of calcification are present.

Pancreas, colon, urinary bladder and gall bladder-

Show no changes of note.

Uterus-

The endometrium is unchanged. The uterine arteries show medial hyalinization.

Ovaries-

Sections from each ovary show corpora albicantia and developing follicles.

Brain and Spinal cord-

Sections taken at various levels include cerebral cortex, basal ganglia, thalamus, midbrain, cerebellum, and medulla are examined. There is slight vacuolization of the white matter with an occasional vessel showing apparent perivascular demyelination. Several vessels in the medulla exhibit slight adventitial infiltration by mononuclear cells. The leptomeninges are thickened and hyalinized, especially in the basilar regions. A section of thoracic spinal cord is not unusual.

Bone marrow-

(vertebral) The marrow fat displays some serous atrophy. No changes are apparent in the cellular elements.

Comment: Many of the microscopic changes are those associated with aged animals. Others appear to be of a non-specific nature to which little significance is attached. Probably the slight hyperplasia of the thyroid acini and the retention of thick colloid is significant in the present situation. The significance of the hypophyseal necrosis is not known at this time. The skin lesions do not appear to present any specific picture at this stage of examination.

W. J. Hadlow, D.V.M.
Pathologist

June 30, 1953
WJH:vf

MICROSCOPIC FINDINGS:

Kidney-
Not unusual.

Heart-
Sarcocystis present. There is an occasional cellular focus in the interstitial tissue. Several branches of the coronary artery show slight intimal thickening. Near a coronary artery at the base of the heart there is an area of normal appearing heterotopic bone marrow circumscribed by an osseous capsule.

Lung-
There are patchy areas of septal thickening. No alveolar exudate is seen.

Liver-
No changes of note are observed in the hepatic cells. The portal areas show minimal infiltration by mononuclear cells and a few neutrophils. One section near the bed of the gall bladder shows large areas of subcapsular coagulation necrosis with hemorrhage. Neutrophils are scattered in the surrounding lobules. One large interlobular vein contains a partially occluding thrombus.

Ovary-
Sections show a follicular cyst.

Mammary gland-
Normal appearing non-lactating glandular structure.

Skeletal muscle-
Sarcocystis present. There is an occasional cellular focus.

Adrenal glands-
There is slight vacuolization of the cells in the zona fasciculata and zona reticularis. Areas of myeloid metaplasia (mostly eosinophils) are scattered throughout the sections.

Pituitary-
There is a slight degree of dissociation of the normal cellular pattern in the anterior lobe. No frank necrosis is observed.

Thyroid-
Only one lobe is examined. Most of the acini are small and contain deeply eosinophilic colloid. They are lined by high cuboidal epithelium.

No changes of note are found in sections of pancreas, spleen, thymus, urinary bladder, aorta, colon, abomasum, small intestine, gall bladder, uterus, pineal gland, lymph nodes (visceral), and the central nervous system.

Bone marrow-
(vertebral) The vascular channels are congested. The marrow fat shows serous atrophic changes. No apparent alterations are noted in the cellular elements.

Comment:

The hyperplasia observed in the section of thyroid may be significant in relation to the radiologic findings.

W. J. Hadlow, D.V.M.
Pathologist
June 30, 1953

WJH;vf

Addendum to Report
on microscopic findings

Skin - A section of skin from an ear showing gross thickening reveals thickening of the stratum corneum and areas of parakeratosis. Focal areas of edema and chronic inflammatory cell infiltrate are noted in the corium. Several portions of the skin show apparent residue of pustule formation. Another section of skin (rump region) shows considerable subacute inflammatory cell infiltration of the corium and also extends into the subcutaneous connective tissue. Edema of the corium is evident. The subjacent muscle bundles included in the section show coagulation necrosis. The epidermis over this region of inflammatory change is somewhat thickened. No changes of note are found in the subcutaneous vessels.

PRELIMINARY REPORT OF RADIOASSAYS OF SELECTED TISSUE SPECIMENS OF SHEEP FROM THE

CEDAR CITY, UTAH, AREA

The preliminary phases of this study consisted of radioassaying select tissues of two ewes from the herd. The tissues selected were the skin and wool, bone and thyroid from an old ewe (No. 7) and the thyroid from a two-year old ewe (No. 6).

Based on the decay characteristics of wool samples (assuming exponential decay occurring according to T-1.2) it appears that as of June 15, 8:00 A.M. the age of the wool contaminants is approximately 526 hours (22 days). This would place the time of fission at May 24, 1953. It should be emphasized that there has not been sufficient time for accurate decay measurements to have been completed and that subsequent measurements may reveal older fission product components. Another fact which must be considered is shearing. If the wool being assayed represents new wool grown since shearing, then these data probably can be attributed to fall-out occurring since the shearing date.

This preliminary report is based on the supposition that all contamination and exposure is attributed to a single nuclear detonation occurring on or about May 24. This supposition may be erroneous but will be used as a working hypothesis.

Quantitative data on randomly selected wool and skin samples from dorsal and lateral surfaces of the No. 7 ewe indicate that as of June 11, 1953 there were approximately 1.7×10^{-2} microcuries of fission products per square inch of dorsal and lateral body surface. It is estimated that on the basis of only Beta radiation the dosage rate extrapolated back to one hour following detonation would have been 0.1 to 0.5 reps per hour and the total integrated dosage to the skin would have been less than 5 reps. This integrated dosage is not likely to have caused any appreciable pathology.

The thyroid tissues from No. 7 and No. 6 revealed 1.3 and 0.38 microcuries per gram of tissue respectively. Extrapolating back to the mid-point of the first week following the May 24 detonation the thyroid glands of these ewes received total integrated dosages of 800 and 200 reps, respectively. The 800 rep dose approaches he threshold for acute damage. Incidentally, the concentration of radioactivity in these thyroid glands as of June 9, 1953 exceeds by a factor of 250 - 1,000 the maximum permissible concentration of radioactive iodine for humans as stated in the National Bureau of Standards Handbook 52.

The radioassay on the bone specimen for No. 7 indicates that as of June 17, there was 3.2×10^{-4} microcuries per gram. This is approximately 50% greater than the maximum permissible concentration of strontium 89-90 for humans as stated in National Bureau of Standards Handbook 52.

If we assume that the above data is all associated with the May 24 shot then it appears that the exposure occurred in the Cedar City area rather than on the winter grazing ground. It further appears that the levels of radiation were not sufficient to produce any serious acute syndrome or pathology. Of greater significance, however, is that such surprisingly high concentrations of radioactive elements have become fixed in or on the aforementioned tissues in an area so far removed from the Nevada Proving Grounds.

It should be re-emphasized that this report is only preliminary and tentative.

UNIVERSITY OF UTAH
College of Medicine
Salt Lake City

July 21, 1953

RADIOBIOLOGY LABORATORY

Dr. Monroe A. Holmes
Veterinarian
Utah State Department of Health
Salt Lake City, Utah

Dear Dr. Holmes:

Enclosed is my report on the tissue and excreta samples from the southern Utah sheep. You will note that, while we found some radioactivity, the amounts appeared to be too small to have caused acute radiation effects. Perhaps the most significant finding of this study is that about the same amounts of radioactivity were found in both the sick and the control sheep.

I do not feel qualified to make any comments on the skin lesions and radiation measurements made on the backs and heads of the sheep. However, as an example of an harmless exposure to a small area of skin in man, I would like to mention that the dose rate through the back of a radium dial wrist watch is about 1 mr./hr.

I shall be on vacation by the time you receive this report, and Dr. J. Z. Bowers has kindly consented to answer urgent questions if any should arise.

I hope that this letter and accompanying report will be of help to you in compiling your final report, and I would like to request that you use them only as an aid and do not quote me directly.

Very truly yours,

/s/ Betsy J. Stover,
Radiochemist

BJS:ly
cc: J.Z. Bowers, M.D.
cc: R.C. Bay D.V.M.

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REPORT ON SOUTHERN UTAH SHEEP

To: Dr. Monroe A. Holmes July 21, 1953

From: B. J. Stover

I. Thyroid Samples

Gamma-ray measurements have been made on the six thyroid samples submitted by Dr. R. C. Bay. Since the thyroid is physiologically unique in its ability to concentrate iodine, it is assumed that the gamma-rays are all emitted by I^{131}. These measurements are summarized below. Since it was possible to make the gamma-ray measurements on intact samples, these tissues have been returned to Dr. Bay, who will submit them for histopathological examination.

	Sheep	Thyroid Wt.	Measurement Date	uc I^{131}/g.	ucI^{131}/g. Corrected to 5/19/53	
Controls	No. 0	8.5 gs.	6/30/53	0.021	0.8	1.4
	No. 00	2.5	7/1	0.048	2.0	
	No. 5	1.6	7/3	0.030	1.5	0.6
	No. 2	0.4	7/3	0.018	0.9	
	No. 3	1.4	7/2	0.020	0.9	
	No. 4	0.4	7/1	0.00	0.0	

Comments

1. If Wolff's preliminary data for No. 6 and No. 7 are corrected to 5/19/53, the values 2.2 and 7.6 uc I^{131}/g. are obtained, both of which are higher than any of our values.

2. The National Bureau of Standards Handbook 52 value of 0.015 uc I^{131}/g. for the maximum permissible concentration in human thyroids should be considered ultra-conservative for the following reason.

   In the years since I^{131} first became available for use as a diagnostic and research tool, many reputable physicians all over the country have given tracer doses of I^{131} in order to measure thyroid function. These tracer doses result in concentration in the gland of 0.5 to 5 uc I^{131}/g., depending on the size and activity of the thyroid, and frequently several such studies are made during the course of a year or so. There are no adverse effects from these tracer studies.

3. The data above show that the average I^{131} concentration in the two controls is more than twice as great as the average of the four thyroids from sick sheep.

Conclusion:

It would seem that these six sheep did not receive sufficient amounts of I^{131} to cause acute radiation effects.

II. Bone Samples

Gamma-ray measurements have been made on the six bone samples submitted by Dr. Bay, and the results are negative. Subsequently, the bones were ashed and aliquots plated for beta-particle measurement in a 2 π proportional counter. There was no detectable beta-particle emission. The method used for beta measurement is sufficiently sensitive so that bone concentrations of Sr^{89} or Sr^{90} / Y^{90} can be detected which are less than the permissible bone concentrations for humans as listed in the National Bureau of Standards Handbook 52.

Conclusion:

It would seem that these six sheep did not fix in their skeletons sufficient amounts of beta and gamma emitters to cause acute radiation effects.

III. Liver, Spleen and Kidney Samples

These samples were measured by the same methods that were used on the bone samples. The results were also negative.

IV. Excreta Samples

A. Urine Samples

Gamma-ray measurements were made on the urine samples from . _ No. 2 and No. 3, and . No. 3, and the results were negative. The samples were then pooled, ashed, and plated for alpha and beta measurement. No alpha emission was detected. There was an indication of beta emission, but the amount was of the order of the limit of detection and hence the error is large. The value determined is of the order of 10^{-5} uc/ml. urine, the standard deviation of the beta measurement alone is 55%, and the spread of a pair of samples is 24%.

B. Fecal Samples

Gamma-ray measurements were made on fecal samples from seven sick sheep, (No. 5, No. 1, No. 2 and No. 3, No. 2, No. 3, and No. 4) and four control sheep (No. 0 and No. 00, No. X and No. XX). The result for No. 4 was negative; in all others, (both sick and control), there was detectable gamma-ray emission.

Conclusion:

The excreta data indicate that both the sick and control sheep had ingested some radioactive material, but that the amounts are not sufficiently large to cause

ɔe radiation effects. These data and those for bone, liver, spleen, and kidney ..mples show that the ingested radioactivity is not absorbed from the G I tract to ..ny appreciable extent.

Note: These data and comments are strictly applicable only to the sheep actually studied. They can be generalized only if these sheep are a truly representative sample of all the sheep in question.

CHEMICAL ANALYSIS

By D. A. Greenwood

The attached sheet contains a summary of chemical determinations made on the blood, tissues, and stomach content of animals obtained from Nevada recently.

Most values for the different constituents appear to be in the normal range except the carotene values for specimens No. 9 and 10.

Vitamin A, carotene, phosphorus, ether extract, moisture and oxalate determinations were made on the blood, tissues, rumen contents of specimens collected from animals from Stewart ranch and range allottment in Nevada.

It should be noted that the blood samples were partially hemolyzed when they were reached in Logan. The samples were old but most of the CO^2 had evaporated. The relative high values for carotene and phosphorus may be due in part to the partial hemolysis of blood.

No carotene was found in the rumen of the young heifer which was killed at the ranch. The vitamin A. content of the liver and kidney of the young heifer was lower than other samples of similar tissues from our animals in Logan.

We do not have values for these constituents of animals which normally feed on under desert range conditions. The number of animals studies were inadequate to enable one to draw satisfactory conclusions. Further studies on the nutritive state of animals raised under desert conditions are indicated.

		Vitamin A	Carotene	P	(Na-Oxalate) mgm/gm.	Por Cent	Per Cent
1.	Mr. Hoefs (blood) 9:00 A.M. 12-5-52.	_____	_____	5.76 mgm/100 ml.			
2.	2068 (blood) 6-13.	14.4 2/100 ml.	73.6 2/100 ml.	3.84 "			
3.	Blood Samples.	17.9 "	48.0 "	6.24 "			
4.	No. 2, 32 green (blood).	32.0 "	41.6 "	6.96 "			
5.	S. W. Wells Animal Kidney	250 I.U./100 gm.	0.25 mgm/100 gm.	175 mgm/100 gm.	0	.55	81.8
6.	S. W. Wells Animal Liver.	∞ "	0.54 "	218 "	0	1.3	73.7
7.	3 yr. old heifer kidney.	1116 "	0.38 "	218 "	0	.75	78.5
8.	3 yr. old heifer liver.	1500 "	0.53 "	300 "	0	.75	69.0
9.	Rumen. 3 yr. old heifer		0 "	63 "	0.75		79.8
10.	Papoose stomach.		0 "	212 "	8.25		6.5

∞ = very high reading

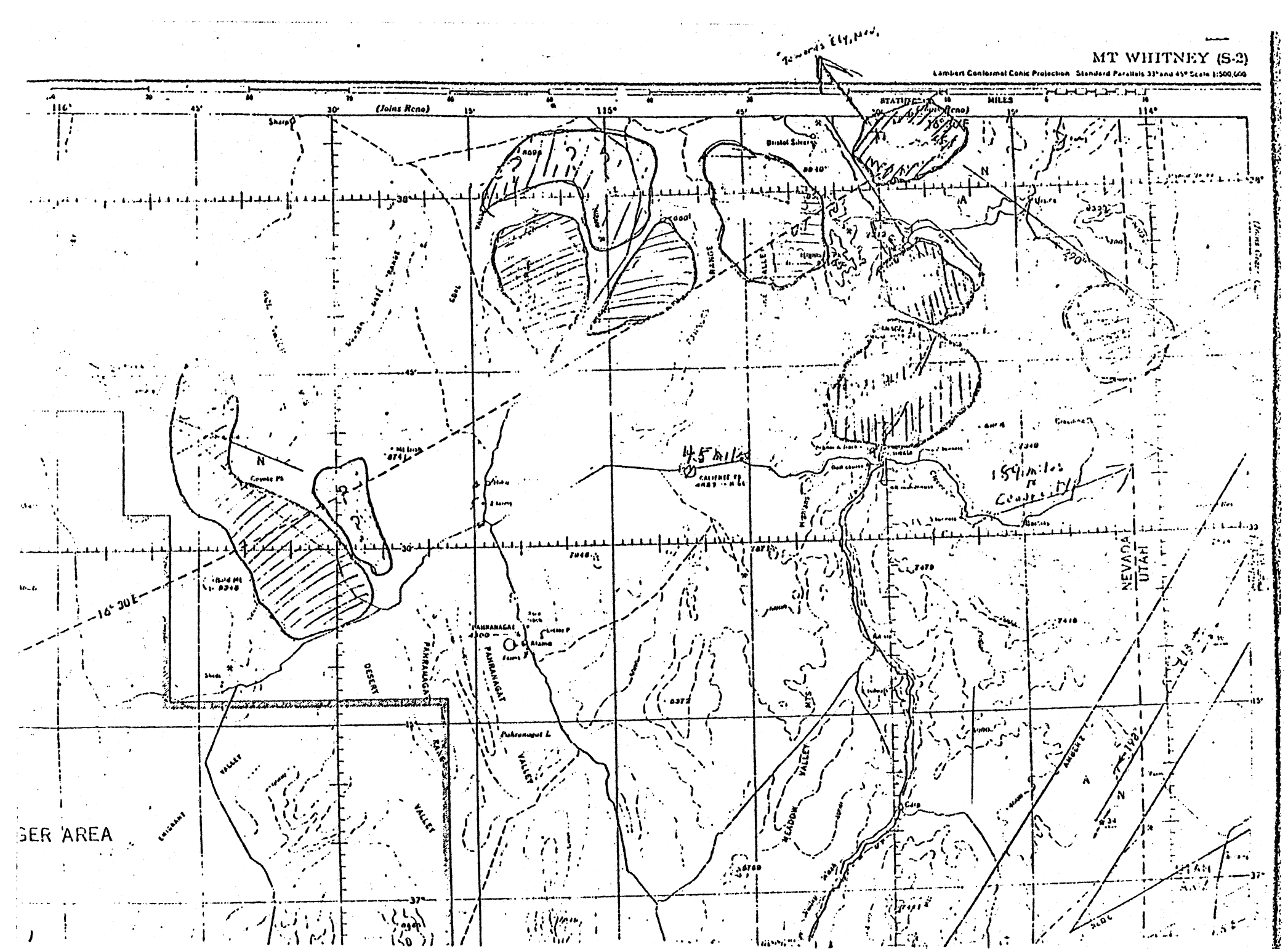
N.B. = The blood completely hemolyzed, so there is a question on the aliquot taken for Carotene.

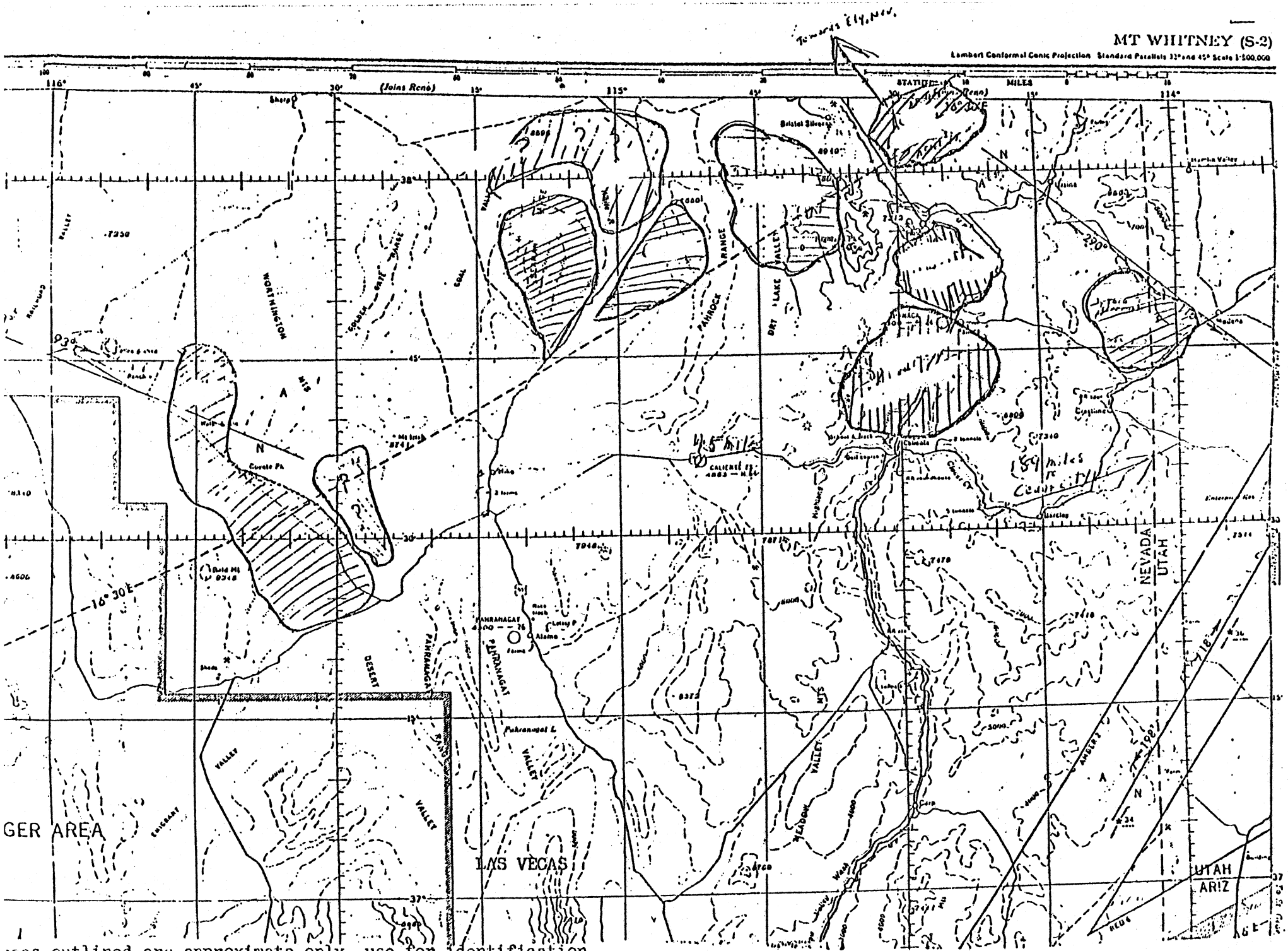
Analytical Procedure:

The Carotene and Vitamin A were determined by the method of Kimble, M. S. J. Lab. Clin. Med., 24; 1055, (1939).

The phosphorous were determined by a modified Fiske and Subbarow method as contained in Koch and Hanke, "Practical Methods in Biochemistry," 5th edition pages 219-222. And the phosphorous in plants were determined by the method in Ref. Ind. and Eng. Chem. Anal. Ed. Vol. 7, P. 167, (1935).

The oxalate were determined by Dakin Modification of Salkowski-Autenrieth and Barth Method. Hawk, Oser, and Summerson, Practical Physiological Chemistry, 12th edition. p. 883


MT WHITNEY (S-2)
Lambert Conformal Conic Projection Standard Parallels 33° and 45° Scale 1:500,000
(Joins Reno)
STATUTE MILES
NEVADA
UTAH
PAHRANAGAT VALLEY
DESERT RANGE
MEADOW VALLEY
ARIZONA
45 Miles
154 miles
16° 30' E
GER AREA



GER AREA

ɔas outlined are approximate only, use for identification
ıther than accurate outline of individual grazing areas.

INTERMOUNTAIN BRIEFS

Experts Continue Probe Of Mystery Sheep Kill

Special to The Tribune

CEDAR CITY — Final report of the Atomic Energy Commission as to causes of the mysterious deaths this spring of hundreds of sheep grazed in the vicinity of the Nevada atom bomb range likely will not be forthcoming for some time, it appeared here Monday.

The strange deaths were object Monday of further investigations by top-level scientists of the AEC, the U. S. Public Health Service and other agencies in this area conferring with stockgrowers and others on the unknown malady which caused deaths of many grown as well as unborn lambs earlier this spring.

The team of experts Monday was attempting to obtain additional information, gathering specimens on which to further base their findings in the case which has baffled all veterinarians and livestock men.

their crashed plane to the southeast.

The youths included the pilot, Larry Denton, 19, and his two passengers, Ronny Stansell, 17 and David Stansell, 18. The latter suffered the loss of several front teeth and all were somewhat bruised but otherwise in good condition, officers said.

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EXAMINER

NOV 1

AEC Is Secret About Deaths Of Utah Sheep

CEDAR CITY (AP) — The Atomic Energy Commission is retaining as "classified" material a set of reports on the mysterious deaths of sheep which grazed last winter near the AEC's atomic test site in Nevada, stockmen whose herds were affected have been told here.

The information came from Dr. M. A. Holmes of Salt Lake City, a U. S. Public Health Service veterinarian who has been working on the case for a number of months. Holmes told stockmen that he recently presented to the AEC a "co-ordinated" report on separate investigations into the deaths, and said that, too, was classified as restricted information.

He met with stockmen here to

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Salt Lake City

SALT LAKE
TRIBUNE

OCT 31 1955

WANTS MORE DATA

AEC Classi Of Sheep D

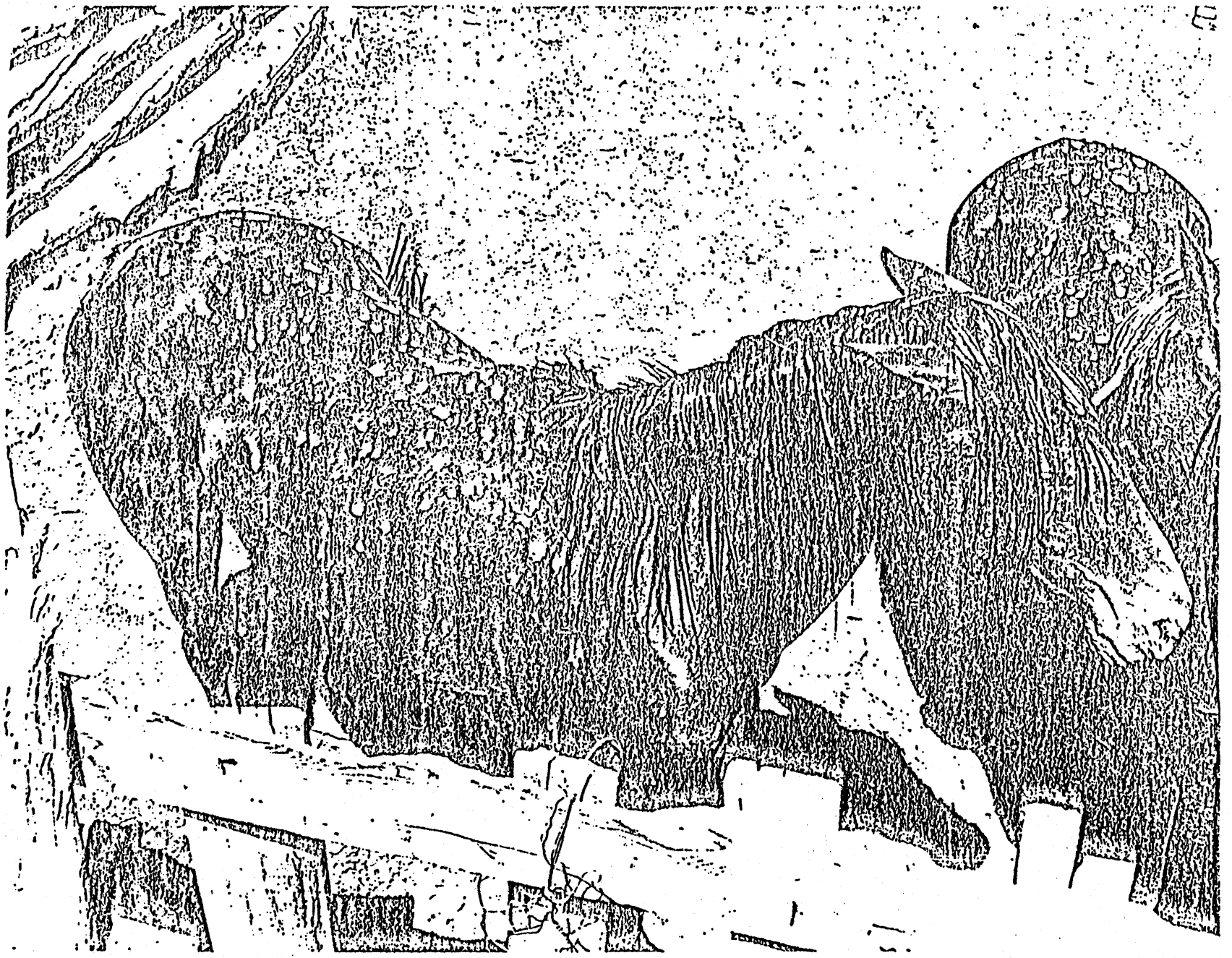
Special to The Tribune

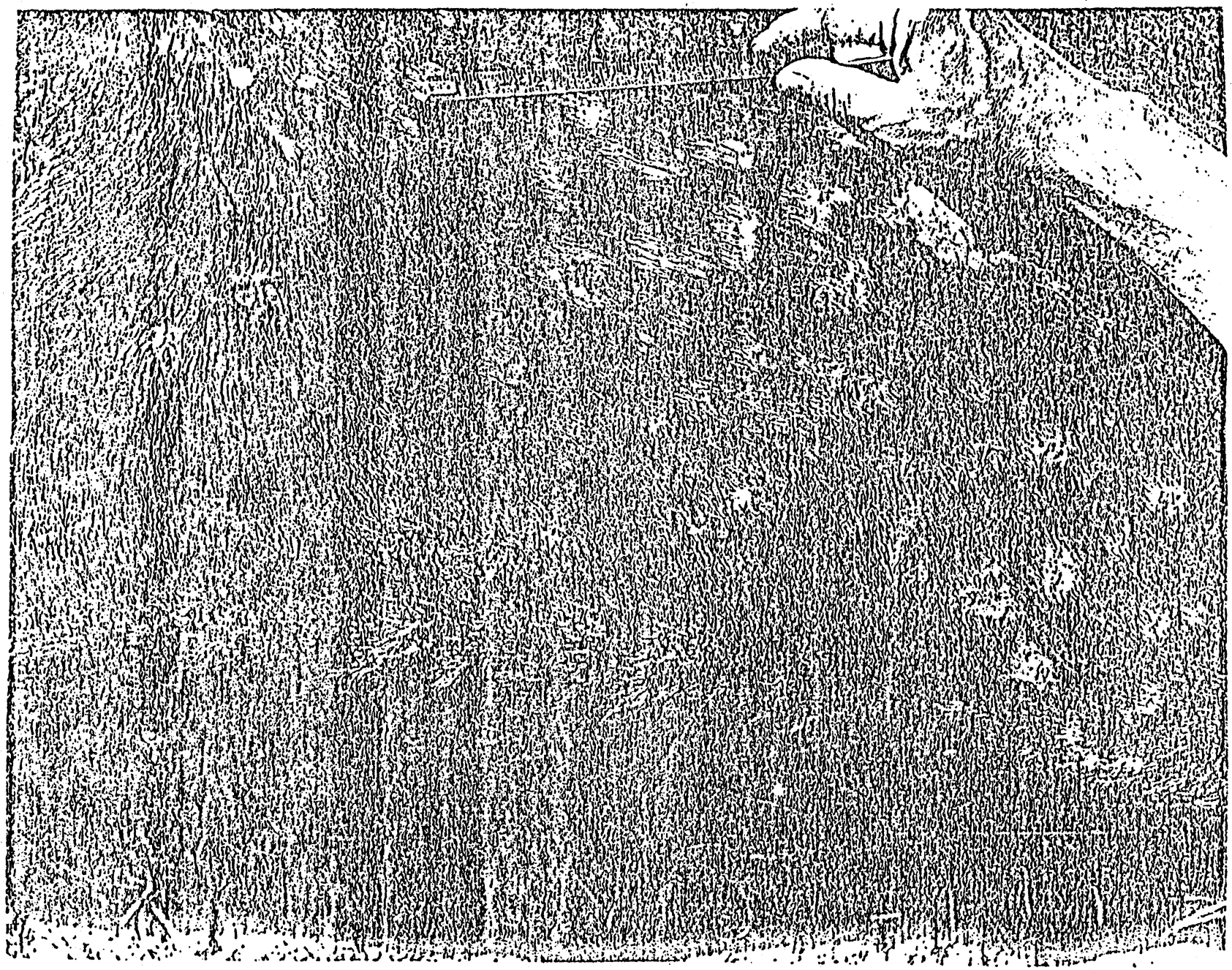
CEDAR CITY—Separate reports of investigations into the deaths of sheep grazed last winter in the general area southwest of Caliente, Nev., are being retained by the Atomic Energy Commission as "classified" information, stockmen whose herds were affected were told here.

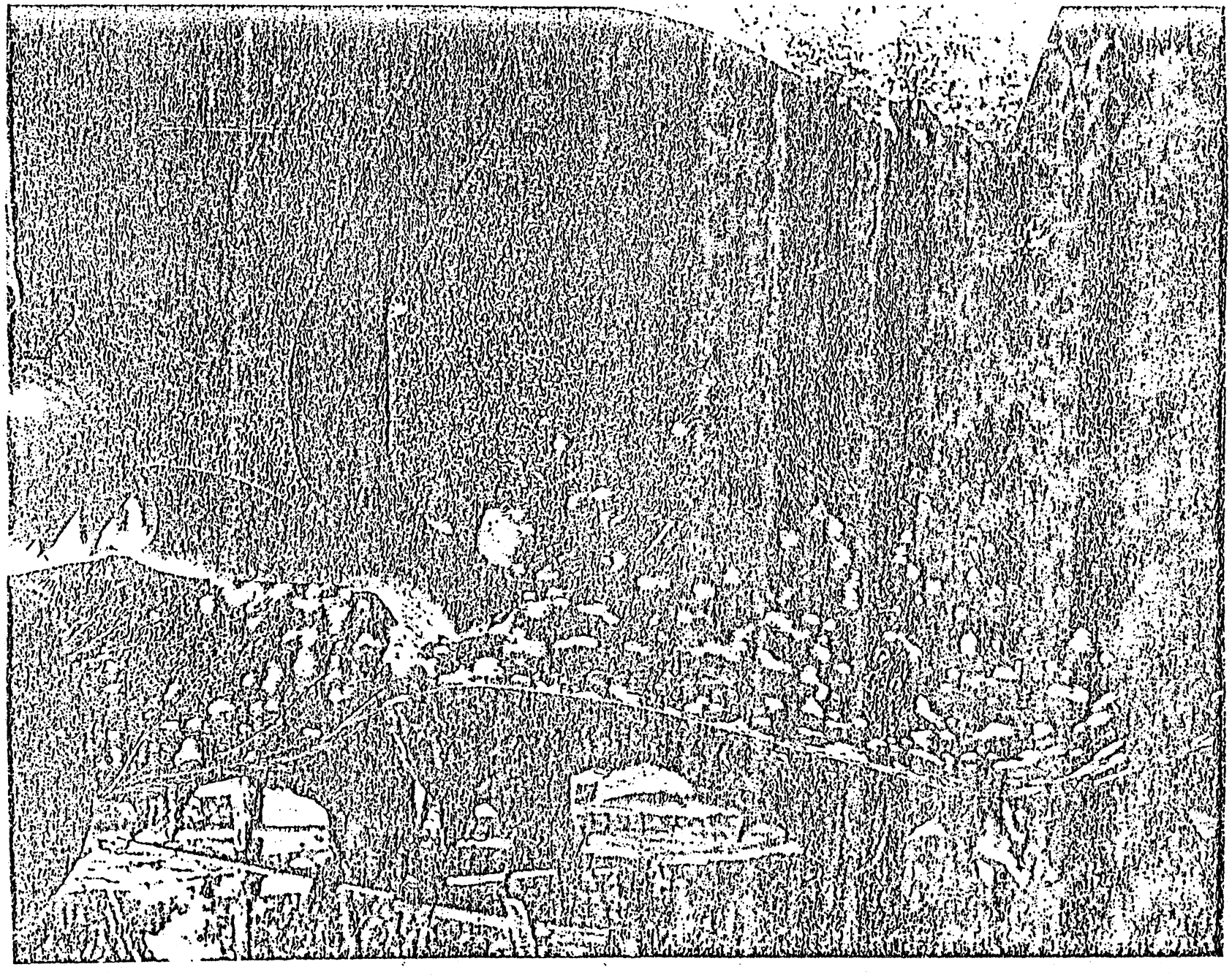
Dr. M. A. Holmes, Salt Lake City, U. S. Public Health Service veterinarian who has been working on the case for a number of months, met here with the stockmen to collect additional information on death losses in the affected herds during the summer, and also made arrangements to gather additional pelt samples.

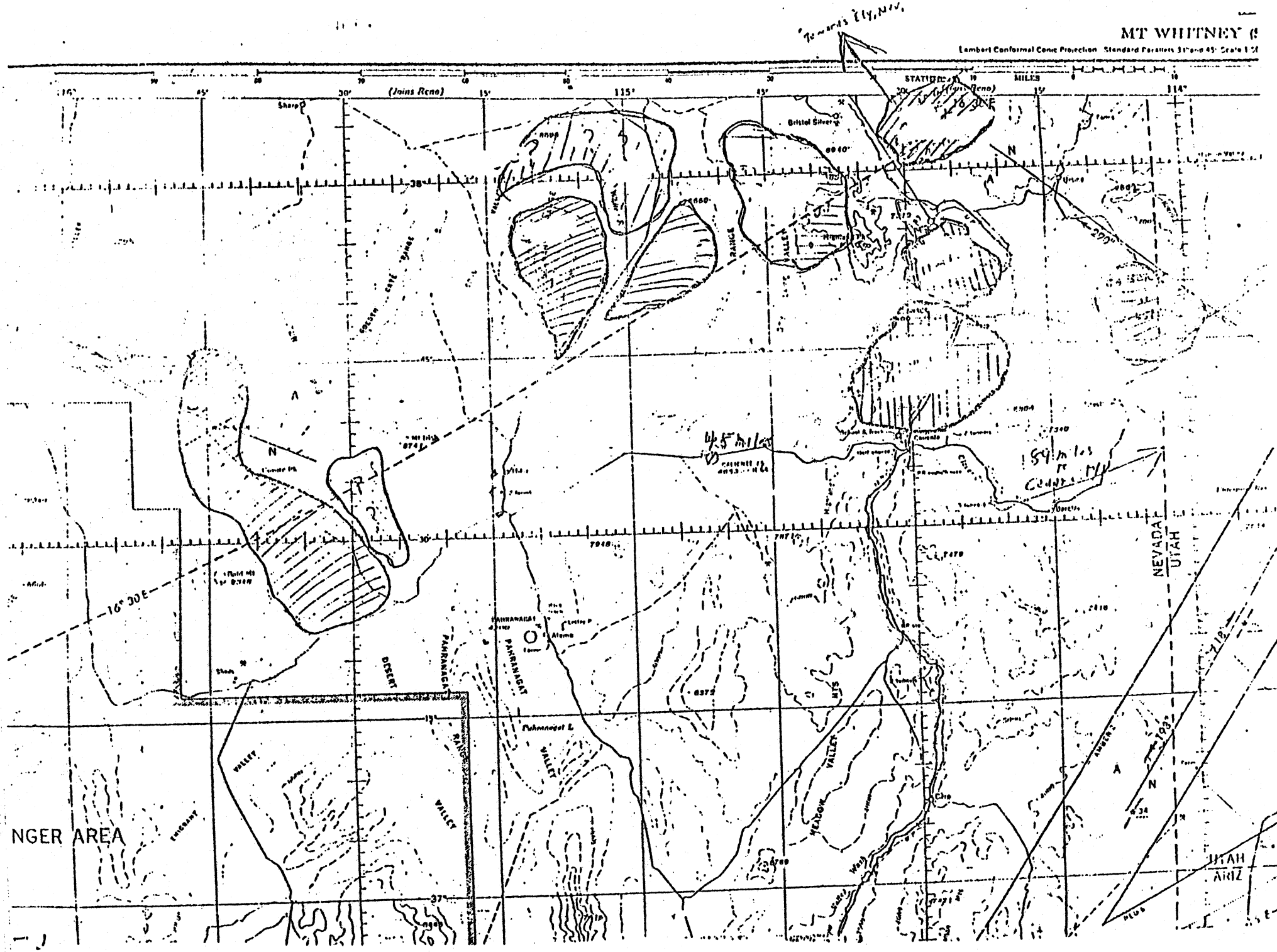
Wants Live Samples

Dr. Holmes also told sheepmen the AEC would like four









NECROPSY RECORD

Identification No. 6 Necropsy No. P53-353

Species Ovine Breed Rambouillet Sex F Age aged Wt.

Owner Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal thought to show "uncomplicated" residua of disease outbreak. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Patches on the back and sides of the animal show loss of wool. The skin of this area is dry and scaly. Epidermal thickenings are present over the nasal region and on the lips. These are brownish in color and are single or confluent. Similar lesions are present on the ears.

The pleural spaces are obliterated by loosely fibrous adhesions between both lungs and the chest wall. The lung parenchyma is tan colored and somewhat firmer than normal.

The pericardium and heart show no changes other than serous atrophy at the base.

The liver is brownish-orange in color. There are a few minute white foci in the subcapsular parenchyma. The ventral portion of the main lobe shows the "cake frosting" thickening of chronic perihepatitis. On cut section a few small yellow foci are found scattered in the parenchyma. The gall bladder is not unusual.

The splenic pulp is red and soft. The follicles are not prominent.

The kidneys appear somewhat pale, swollen and soft. The peripelvic fat shows serous atrophy. The urinary bladder is empty and shows no changes.

The adrenal glands are not unusual.

The thyroid lobes appear somewhat softer than normal. One lobe contains a 2 mm. cyst with thick yellowish fluid.

The thymus is almost completely involuted. Gelatinous infiltration is present in the area.

The gastrointestinal tract is not examined in detail. However, no major changes are noted. The mesenteric lymph nodes present a very irregular distribution of the cortical tissue so that many of the nodes appear smoothly nodular. One abomasal node is calcified.

The ovaries are inactive and the uterus show no evidence of a recent pregnancy.

The leptomeninges are thickened, white, and opaque. The brain is otherwise without change. The pineal gland is partially calcified. The pituitary gland shows no gross changes.

The sternal bone marrow is pale white; that of the ribs and vertebrae is deep red in color.

Other than slight atrophy no changes are found in the musculature.

UTAH SHEEP DISEASE INVESTIGATION

Cedar City, Utah
June 6-7, 1953

Serum Samples:

No.	
	- At Lambing Yards
1	Old ewe. Slight residual lesions. Pregnant.
2	Old ewe. Marked residual lesions. Pregnant
3	3-yr-old ewe. Lost lamb. Sick, thin.
4	2-yr-old ewe. Few nose lesions. Lamb at side.
5	2-yr-old ewe. Few lesions on nose and chin. Lamb at side.
	- From Range Band
6	Old ewe - removed from band because of marked loss of wool. Dry. Sacrificed for necropsy.
7	2-yr-old ewe. Thin, wool dry, skin scaly. Had not been pregnant. Sacrificed for necropsy.
	- Dry Flock
8	Old ewe (10 yrs.)
9	4-yr-old ewe
10	5-yr-old ewe
11	Yearling ewe
12	4-yr-old ewe
13	Yearling ewe
14	5-yr-old ewe
15	3-yr-old ewe
16	6-yr-old ewe
17	Yearling ewe
18	Yearling ewe
19	4-yr-old ewe
20	6-yr-old ewe (loss of wool)
21	9-yr-old ewe
22	5-yr-old ewe
	- Band of 500 on alfalfa
23	Old ewe
24	5-yr-old ewe - scars on ears
25	4-5 yr. old ewe

Test of Utah sheep sera collected by
Dr. Hadlow from trip of 6/5/53

Source of Samples: _____

6/11/53

Serum #		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
Summary: No evidence of a significant level of specific antibodies for Q fever. The other antibodies are too low titered to be considered as specific or significant.												
1	A	Q fever 398	0	0	0	0						0
	B	Psi. 48	0	0	0	0						
	C	BEV 61	0	0	0	0						
	D	RMsf 399	0	0	0	0						
2		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
4		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	3	tr	0	0						
4A		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	3	0	0	0						
5		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	2	1	tr	0						
Lamb with #5		A	0	0	0	0						0
		B	0	0	0	0						
		C	4	4	tr	0						
		D	1	2	0	0						
6		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
7		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	4	3	tr	0						

Notes and comments:

RML Form #25

Source of Samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
8		A	4	tr	0	0						0
		B	4	2	1	0						
		C	4	1	0	0						
		D	1	tr	0	0						
9		A	0	0	0	0						0
		B	4	3	0	0						
		C	2	1	0	0						
		D	3	1	0	0						
10		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
11		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	4	4	0	0						
12		A	0	0	0	0						0
		B	3	4	tr	0						
		C	0	2	2	1						
		D	0	0	0	0						
13		A	4	0	0	0						0
		B	4	1	0	0						
		C	3	3	0	0						
		D	4	3	2	0						
14		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
15		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						

Notes and comments:

RML Form #25

Source of Samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
16		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
17		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
18		A	0	0	0	0						0
		B	tr	tr	0	0						
		C	1	1	1	0						
		D	0	0	0	0						
19		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	2	0						
		C)	0	0	0	0						
20		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
21		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	1	0	0	0						
22		A	0	0	0	0						0
		B	0	0	0	0						
		C	1	tr	0	0						
		D	0	0	0	0						
23		A	0	0	0	0						0
		B	0	0	0	0						
		C	0	0	0	0						
		D	0	0	0	0						
24		A	tr	0	0	0						0
		B	tr	0	0	0						
		C	tr	0	0	0						
Notes and comments:		D	3	3	1	0						

RML Form #25

Source of Samples: _____

		Antigen Used	Serum Dilution									
			8	16	32	64	128	256	512	1024	2048	SC
25		A	4	tr	0	0						0
		B	3	2	2	0						
		C	1	0	1	0						
		D	2	1	0	0						

Notes and comments:

RML Form #25

Source of samples Blood from sheep collected by Dr. Hadlow, Cedar City, Utah 6/5/53 trip

Submitted 6/9/53 Tested 6/12/53

Sample		Serum Dilutions											
		10	20	40	80	160	320	640	1280	2560	5120	10240
1	Tul		3	2	0	0						
	Br		0	0	0	0						
2	Tul		0	0	0	0						
	Br		0	0	0	0						
4	Tul		0	0	0	0						
	Br		0	0	0	0						
4A	Tul		0	0	0	0						
	Br		+	0	0	0						
5	Tul		0	0	0	0						
	Br		0	0	0	0						
Lamb from 5	Tul		0	0	0	0						
	Br		0	0	0	0						
6	Tul		2	1	0	0						
	Br		0	0	0	0						
7	Tul		0	0	0	0						
	Br		0	0	0	0						
8	Tul		0	0	0	0						
	Br		0	0	0	0						
9	Tul		0	0	0	0						
	Br		0	0	0	0						
10	Tul		0	0	0	0						
	Br		0	0	0	0						
11	Tul		0	0	0	0						
	Br		0	0	0	0						
12	Tul		2	1	0	0						
	Br		0	0	0	0						
13	Tul		0	0	0	0						
	Br		0	0	0	0						
14	Tul		0	0	0	0						
	Br		0	0	0	0						
15	Tul		2	0	0	0						
	Br		0	0	0	0						

Source of samples

Sample		Serum Dilutions										
		10	20	40	80	160	320	640	1280	2560	5120	10240
16	Tul		0	0	0	0						
	Br		0	0	0	0						
17	Tul		0	0	0	0						
	Br		0	0	0	0						
18	Tul		0	0	0	0						
	Br		0	0	0	0						
19	Tul		0	0	0	0						
	Br		+	±	0	0						
20	Tul		0	0	0	0						
	Br		+	0	0	0						
21	Tul		0	0	0	0						
	Br		+	0	0	0						
22	Tul		0	0	0	0						
	Br		0	0	0	0						
23	Tul		0	0	0	0						
	Br		0	0	0	0						
24	Tul		0	0	0	0						
	Br		0	0	0	0						
25	Tul		0	0	0	0						
	Br		0	0	0	0						

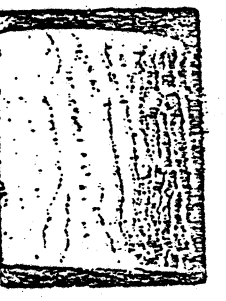
Summary: None of these agglutinins are high enough in titer to be considered significant. However, the 1:40 titer against tularemia in sheep No. 1 might indicate the possibility of previous tularemia among these animals.

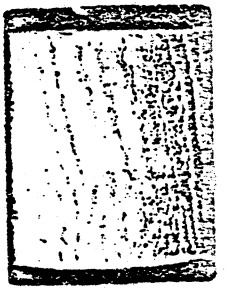
UTAH SHEEP DISEASE INVESTIGATION 32

Cedar City, Utah
June 5-6, 1953

Hematological Findings: (Oxalated Samples)

Sheep Number	Hemoglobin	Total Leukocytes	Differential Count
#2	11.7 gms. (Spencer Hb-meter)	10,400	Lymphocytes 75% Neutrophils 18% Eosinophils 7% Erythrocytes & platelets ~~appear~~ normal
#4	12 gms. "	10,200	Lymphocytes 39% Neutrophils 61% Erythrocytes & platelets appear normal
#5	12 gms. "	12,150	Lymphocytes 76% Neutrophils 24% Many monocytoid forms One eosinophil seen in smear Erythrocytes & platelets normal
#6	11.5 gms. "	10,350	Lymphocytes 73% Neutrophils 25% Monocytes 2% Many lymphocytes with trilobed nuclei Erythrocytes & platelets normal
#7	13.0 gms. "	6,700 (duplicates)	Lymphocytes 87% Neutrophils 11% Monocytes 2% One eosinophil seen Anisocytosis above normal with many macrocytes. Platelets OK





NECROPSY RECORD

Identification No. 6 Necropsy No. P53-353

Species Ovine Breed Rambouillet Sex F Age aged Wt. _____

Owner _____ Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal thought to show "uncomplicated" residua of disease outbreak. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Patches on the back and sides of the animal show loss of wool. The skin of this area is dry and scaly. Epidermal thickenings are present over the nasal region and on the lips. These are brownish in color and are single or confluent. Similar lesions are present on the ears.

The pleural spaces are obliterated by loosly fibrous adhesions between both lungs and the chest wall. The lung parenchyma is tan colored and somewhat firmer than normal.

The pericardium and heart show no changes other than serous atrophy at the base.

The liver is brownish-orange in color. There are a few minute white foci in the subcapsular parenchyma. The ventral portion of the main lobe shows the "cake frosting" thickening of chronic perihepatitis. On cut section a few small yellow foci are found scattered in the parenchyma. The gall bladder is not unusual.

The splenic pulp is red and soft. The follicles are not prominent.

The kidneys appear somewhat pale, swollen and soft. The peripelvic fat shows serous atrophy. The urinary bladder is empty and shows no changes.

The adrenal glands are not unusual.

The thyroid lobes appear somewhat softer than normal. One lobe contains a 2 mm. cyst with thick yellowish fluid.

The thymus is almost completely involuted. Gelatinous infiltration is present in the area.

62

The gastrointestinal tract is not examined in detail. However, no major changes are noted. The mesenteric lymph nodes present a very irregular distribution of the cortical tissue so that many of the nodes appear smoothly nodular. One abomasal node is calcified.

The ovaries are inactive and the uterus show no evidence of a recent pregnancy.

The leptomeninges are thickened, white, and opaque. The brain is otherwise without change. The pineal gland is partially calcified. The pituitary gland shows no gross changes.

The sternal bone marrow is pale white; that of the ribs and vertebrae is deep red in color.

Other than slight atrophy no changes are found in the musculature.

Zinc Cocaine in stirred contents

NECROPSY RECORD 1

Identification No. 7 Necropsy No. P53-354

Species Ovine Breed Rambouillet Sex F Age 1 1/2 Wt. yr

Owner _____ Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal convalescent from band which had losses. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Large wool-loss areas are evident. The remaining wool (sheared) is dry and the skin is "scurfy." Areas of wool loss extend down onto skin over upper leg region.

The thoracic cavity and its contents are not unusual.

The liver is dark brown in color. There are a few small white foci scattered under the capsule. A somewhat elevated area several centimeters in diameter is found near the gall bladder. On section it appears telangiectatic. The gall bladder appears normal.

The spleen is not remarkable.

The body lymph nodes show no changes of note.

There is a gelatinous infiltration of the peripelvic renal fat. The renal parenchyma is normal. The urinary bladder is empty.

The adrenal glands exhibit small 1 mm. yellow granular foci in the cortices.

The thyroid lobes are of normal size but are dark red and of a meaty consistency.

The thymic fat is gelatinous.

The gastrointestinal tract is not examined in detail. The abomasum is normal. Several trichostrongyle nematodes are observed. The intestinal tract shows no gross changes. The mesenteric nodes present no changes of note.

Several tapeworm cysts are present in the omentum and mesentery.

64

The ovaries contain several thin walled follicles up to 6 mm in diameter. The uterus is virginal. The mammary glands are not remarkable.

The meninges and brain appear normal grossly.

The sternal, rib, and vertebral bone marrow are dark red.

The skeletal musculature is atrophic.

MICROSCOPIC FINDINGS:

Kidney-
The tubular epithelium of the cortex shows mild regressive changes.

Heart-
There are occasional small lymphocytic foci in the interstitial tissue. Sarcocystis is present. The basilar epicardial fat contains mucoid material.

Liver-
The three sections examined exhibit marked portal infiltration with bile duct proliferation. Fibroblasts, macrophages and lymphocytes comprise the cellular infiltrate. One subcapsular focus of bile duct proliferation resembles an adenoma. A nodular mass of hepatic cells is found in one section. The capsule shows fibrotic thickening.

Lung-
There is slight thickening of most of the alveolar septa.

Spleen-
The pulp contains a small amount of golden brown pigment in macrophages.

Adrenal glands-
Sections from each adrenal exhibit a vacuolated appearance in the zona fasiculata. There are scattered large and small areas of hyperchromatic cortical cells.

Thymus-
No thymic tissue is found in the section. The adipose tissue shows mucoid changes.

Lymph nodes-
Sections of a mesenteric node and several other visceral nodes show a lack of follicular prominence in the cortical tissue. The lymphocytic tissue in general appears somewhat atrophic. Clumps of brown pigment ladened macrophages are present in the cortices and appear scattered in the medullary portions. A section of renal node shows masses of erythrocytes free in the cortical tissue.

Thyroid-
Sections from both lobes are examined. The acini show considerable variation in size from larger than normal to solid cellular masses. The majority of the acini appear smaller than normal. They are lined by cuboidal cells and contain deeply acidophilic (thick) colloid. One section contains a cystic area lined by flattened cells.

Pituitary gland-

The anterior lobe shows areas of coagulation necrosis without inflammatory infiltration. These necrotic areas are most prominent in the peripheral zone of the anterior lobe. The intervening tissue presents no changes of note.

Skeletal muscle-

Sarcocystis is present. There is an apparent increase in sarcolemma nuclei in scattered areas.

Aortic arch-

A focus of calcification is present in the media.

Skin-

Sections from the nasal ridge and the lesions on the upper lip show hyperkeratosis with leukocytes in the cornified debris. There is an occasional clump of lymphocytes in the corium.

Pineal gland-

Areas of calcification are present.

Pancreas, colon, urinary bladder and gall bladder -

Show no changes of note.

Uterus-

The endometrium is unchanged. The uterine arteries show medial hyalinization.

Ovaries-

Sections from each ovary show corpora albicantia and developing follicles.

Brain and Spinal cord-

Sections taken at various levels include cerebral cortex, basal ganglia, thalamus, midbrain, cerebellum, and medulla are examined. There is slight vacuolization of the white matter, with an occasional vessel showing apparent perivascular demyelination. Several vessels in the medulla exhibit slight adventitial infiltration by mononuclear cells. The leptomeninges are thickened and hyalinized, especially in the basilar regions. A section of thoracic spinal cord is not unusual.

Bone marrow-

(vertebral) The marrow fat displays some serous atrophy. No changes are apparent in the cellular elements.

Comment: Many of the microscopic changes are those associated with aged animals. Others appear to be of a non-specific nature to which little significance is attached. Probably the slight hyperplasia of the thyroid acini and the retention of thick colloid is significant in the present situation. The significance of the hypophyseal necrosis is not known at this time. The skin lesions do not appear to present any specific picture at this stage of examination.

W. J. Hadlow, D.V.M.
Pathologist

June 30, 1953
WJH:vf

MICROSCOPIC FINDINGS:

Kidney-
Not unusual.

Heart-
Sarcocystis present. There is an occasional cellular focus in the interstitial tissue. Several branches of the coronary artery show slight intimal thickening. Near a coronary artery at the base of the heart there is an area of normal appearing heterotopic bone marrow circumscribed by an osseous capsule.

Lung-
There are patchy areas of septal thickening. No alveolar exudate is seen.

Liver-
No changes of note are observed in the hepatic cells. The portal areas show minimal infiltration by mononuclear cells and a few neutrophils. One section near the bed of the gall bladder shows large areas of subcapsular coagulation necrosis with hemorrhage. Neutrophils are scattered in the surrounding lobules. One large interlobular vein contains a partially occluding thrombus.

Ovary-
Sections show a follicular cyst.

Mammary gland-
Normal appearing non-lactating glandular structure.

Skeletal muscle-
Sarcocystis present. There is an occasional cellular focus.

Adrenal glands-
There is slight vacuolization of the cells in the zona fasciculata and zona reticularis. Areas of myeloid metaplasia (mostly eosinophils) are scattered throughout the sections.

Pituitary-
There is a slight degree of dissociation of the normal cellular pattern in the anterior lobe. No frank necrosis is observed.

Thyroid-
Only one lobe is examined. Most of the acini are small and contain deeply eosinophilic colloid. They are lined by high cuboidal epithelium.

No changes of note are found in sections of pancreas, spleen, thymus, urinary bladder, aorta, colon, abomasum, small intestine, gall bladder, uterus, pineal gland, lymph nodes (visceral), and the central nervous system.

Bone marrow-
(Vertebral) The vascular channels are congested. The marrow fat shows serous atrophic changes. No apparent alterations are noted in the cellular elements.

Comment:

The hyperplasia observed in the section of thyroid may be significant in relation to the radiologic findings.

W. J. Hadlow, D.V.M.
Pathologist
June 30, 1953

WJH:vf

NECROPSY RECORD

Identification No. 6 Necropsy No. P53-353

Species Ovine Breed Rambouillet Sex F Age aged Wt.

Owner Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal thought to show "uncomplicated" residua of disease outbreak. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Patches on the back and sides of the animal show loss of wool. The skin of this area is dry and scaly. Epidermal thickenings are present over the nasal region and on the lips. These are brownish in color and are single or confluent. Similar lesions are present on the ears.

The pleural spaces are obliterated by loosely fibrous adhesions between both lungs and the chest wall. The lung parenchyma is tan colored and somewhat firmer than normal.

The pericardium and heart show no changes other than serous atrophy at the base.

The liver is brownish-orange in color. There are a few minute white foci in the subcapsular parenchyma. The ventral portion of the main lobe shows the "cake frosting" thickening of chronic perihepatitis. On cut section a few small yellow foci are found scattered in the parenchyma. The gall bladder is not unusual.

The splenic pulp is red and soft. The follicles are not prominent.

The kidneys appear somewhat pale, swollen and soft. The peripelvic fat shows serous atrophy. The urinary bladder is empty and shows no changes.

The adrenal glands are not unusual.

The thyroid lobes appear somewhat softer than normal. One lobe contains a 2 mm. cyst with thick yellowish fluid.

The thymus is almost completely involuted. Gelatinous infiltration is present in the area.

70-78

The gastrointestinal tract is not examined in detail. However, no major changes are noted. The mesenteric lymph nodes present a very irregular distribution of the cortical tissue so that many of the nodes appear smoothly nodular. One abomasal node is calcified.

The ovaries are inactive and the uterus show no evidence of a recent pregnancy.

The leptomeninges are thickened, white, and opaque. The brain is otherwise without change. The pineal gland is partially calcified. The pituitary gland shows no gross changes.

The sternal bone marrow is pale white; that of the ribs and vertebrae is deep red in color.

Other than slight atrophy no changes are found in the musculature.

MICROSCOPIC FINDINGS:

Kidney-
The tubular epithelium of the cortex shows mild regressive changes.

Heart-
There are occasional small lymphocytic foci in the interstitial tissue. Sarcocystis is present. The basilar epicardial fat contains mucoid material.

Liver-
The three sections examined exhibit marked portal infiltration with bile duct proliferation. Fibroblasts, macrophages and lymphocytes comprise the cellular infiltrate. One subcapsular focus of bile duct proliferation resembles an adenoma. A nodular mass of hepatic cells is found in one section. The capsule shows fibrotic thickening.

Lung-
There is slight thickening of most of the alveolar septa.

Spleen-
The pulp contains a small amount of golden brown pigment in macrophages.

Adrenal glands-
Sections from each adrenal exhibit a vacuolated appearance in the zona fasciculata. There are scattered large and small areas of hyperchromatic cortical cells.

Thymus-
No thymic tissue is found in the section. The adipose tissue shows mucoid changes.

Lymph nodes-
Sections of a mesenteric node and several other visceral nodes show a lack of follicular prominence in the cortical tissue. The lymphocytic tissue in general appears somewhat atrophic. Clumps of brown pigment ladened macrophages are present in the cortices and appear scattered in the medullary portions. A section of renal node shows masses of erythrocytes free in the cortical tissue.

Thyroid-
Sections from both lobes are examined. The acini show considerable variation in size from larger than normal to solid cellular masses. The majority of the acini appear smaller than normal. They are lined by cuboidal cells and contain deeply acidophilic (thick) colloid. One section contains a cystic area lined by flattened cells.

Pituitary gland-
The anterior lobe shows areas of coagluation necrosis without inflammatory infiltration. These necrotic areas are most prominent in the peripheral zone of the anterior lobe. The intervening tissue presents no changes of note.

Skeletal muscle-
Sarcocystis is present. There is an apparent increase in sarcolemma nuclei in scattered areas.

Aortic arch-
A focus of calcification is present in the media.

Skin-
Sections from the nasal ridge and the lesions on the upper lip show hyperkeratosis with leukocytes in the cornified debris. There is an occasional clump of lymphocytes in the corium.

Pineal gland-
Areas of calcification are present.

Pancreas, colon, urinary bladder and gall bladder-
Show no changes of note.

Uterus-
The endometrium is unchanged. The uterine arteries show medial hyalinization.

Ovaries-
Sections from each ovary show corpora albicantia and developing follicles.

Brain and Spinal cord-
Sections taken at various levels include cerebral cortex, basal ganglia, thalamus, midbrain, cerebellum, and medulla are examined. There is slight vacuolization of the white matter with an occasional vessel showing apparent perivascular demyelination. Several vessels in the medulla exhibit slight adventitial infiltration by mononuclear cells. The leptomeninges are thickened and hyalinized, especially in the basilar regions. A section of thoracic spinal cord is not unusual.

Bone marrow-
(vertebral) The marrow fat displays some serous atrophy. No changes are apparent in the cellular elements.

Comment: Many of the microscopic changes are those associated with aged animals. Others appear to be of a non-specific nature to which little significance is attached. Probably the slight hyperplasia of the thyroid acini and the retention of thick colloid is significant in the present situation. The significance of the hypophyseal necrosis is not known at this time. The skin lesions do not appear to present any specific picture at this stage of examination.

/s/ W. J. Hadlow, D.V.M.
Pathologist

June 30, 1953
WJH:vf

P53-354
Ewe #7

Addendum to Report
on microscopic findings

Skin - A section of skin from an ear showing gross thickening reveals thickening of the stratum corneum and areas of parakeratosis. Focal areas of edema and chronic inflammatory cell infiltrate are noted in the corium. Several portions of the skin show apparent residua of pustule formation. Another section of skin (rump region) shows considerable subacute inflammatory cell infiltration of the corium and also extends into the subcutaneous connective tissue. Edema of the corium is evident. The subjacent muscle bundles included in the section show coagulation necrosis. The epidermis over this region of inflammatory change is somewhat thickened. No changes of note are found in the subcutaneous vessels.

NECROPSY RECORD

Identification No. 7 Necropsy No. P53-354

Species Ovine Breed Rambouillet Sex F Age 1 1/2 yr. Wt.

Owner Address Cedar City, Utah

Doctor W. J. Hadlow

Clinical History:

Animal convalescent from band which had losses. Sacrificed by exsanguination.

Necropsy findings:

The ewe is thin. Large wool-less areas are evident. The remaining wool (sheared) is dry and the skin is "scurfy." Areas of wool loss extend down onto skin over upper leg region.

The thoracic cavity and its contents are not unusual.

The liver is dark brown in color. There are a few small white foci scattered under the capsule. A somewhat elevated area several centimeters in diameter is found near the gall bladder. On section it appears telangiectatic. The gall bladder appears normal.

The spleen is not remarkable.

The body lymph nodes show no changes of note.

There is a gelatinous infiltration of the peripelvic renal fat. The renal parenchyma is normal. The urinary bladder is empty.

The adrenal glands exhibit small 1 mm. yellow granular foci in the cortices.

The thyroid lobes are of normal size but are dark red and of a meaty consistency.

The thymic fat is gelatinous.

The gastrointestinal tract is not examined in detail. The abomasum is normal. Several trichostrongyle nematodes are observed. The intestinal tract shows no gross changes. The mesenteric nodes present no changes of note.

Several tapeworm cysts are present in the omentum and mesentery.

The ovaries contain several thin walled follicles up to 6 mm in diameter. The uterus is virginal. The mammary glands are not remarkable.

The meninges and brain appear normal grossly.

The sternal, rib, and vertebral bone marrow are dark red.

The skeletal musculature is atrophic.

MICROSCOPIC FINDINGS:

Kidney -

Not unusual.

Heart -

Sarcocystis present. There is an occasional cellular focus in the interstitial tissue. Several branches of the coronary artery show slight intimal thickening. Near a coronary artery at the base of the heart there is an area of normal appearing heterotopic bone marrow circumscribed by an osseous capsule.

Lung -

There are patchy areas of septal thickening. No alveolar exudate is seen.

Liver -

No changes of note are observed in the hepatic cells. The portal areas show minimal infiltration by mononuclear cells and a few neutrophils. One section near the bed of the gall bladder shows large areas of subcapsular coagulation necrosis with hemorrhage. Neutrophils are scattered in the surrounding lobules. One large interlobular vein contains a partially occluding thrombus.

Ovary -

Sections show a follicular cyst.

Mammary gland -

Normal appearing non-lactating glandular structure.

Skeletal muscle -

Sarcocystis present. There is an occasional cellular focus.

Adrenal glands -

There is slight vacuolization of the cells in the zona fasciculata and zona reticularis. Areas of myeloid metaplasia (mostly eosinophils) are scattered throughout the sections.

Pituitary -

There is a slight degree of dissociation of the normal cellular pattern in the anterior lobe. No frank necrosis is observed.

Thyroid -

Only one lobe is examined. Most of the acini are small and contain deeply eosinophilic colloid. They are lined by high cuboidal epithelium.

No changes of note are found in sections of pancreas, spleen, thymus, urinary bladder, aorta, colon, abomasum, small intestine, gall bladder, uterus, pineal gland, lymph nodes (visceral), and the central nervous system.

Bone Marrow -

(Vertebral) The vascular channels are congested. The marrow fat shows serous atrophic changes. No apparent alterations are noted in the cellular elements.

Comment:

The hyperplasia observed in the section of thyroid may be significant in relation to the radiologic findings.

/S/ W. J. HADLOW

W. J. Hadlow, D.V.M.
Pathologist
June 30, 1953

Adderdum to Report
on microscopic findings

Skin - A section of skin from an ear showing gross thickening reveals thickening of the stratum corneum and areas of parakeratosis. Focal areas of edema and chronic inflammatory cell infiltrate are noted in the corium. Several portions of the skin show apparent residual of pustule formation. Another section of skin (rump region) shows considerable subacute inflammatory cell infiltration of the corium and also extends into the subcutaneous connective tissue. Edema of the corium is evident. The subjacent muscle bundles included in the section show coagluation necrosis. The epidermis over this region of inflammatory change is somewhat thickened. No changes of note are found in the subcutaneous vessels.

Form FS-30 FEDERAL SECURITY AGENCY

ROUTE SLIP

(Fold here)

Date June 4, 1953

To:	Constit. Organ.	Bldg.	Room
1. Dr. Monroe Holmes			
2.			
3.			
4.			
5.			
6.			

☐ Approval	☐ Note and return	☐ See me
☐ Comment	☐ Note and file	☐ As requested
☐ Necessary action	☐ Prepare reply	☑ For your information
☐ Investigate	☐ Signature	☐ Per conversation

REMARKS:

79

(Fold here for return)

From / To: Executive Office, CDC Phone

Bldg. Room

Executive Office

June 4, 1953

Thru : Chief, Epidemiology Branch

Chief, Veterinary Public Health

Epidemic Aid Request from Dr. G. A. Spendlove, Health Officer, Utah

Dr. Clarence A. Dester, Scientist, Greeley, Colorado telephoned at noon Wednesday June 3, 1953 requesting epidemic aid for Utah. Dr. Spendlove earlier had been asked by Dr. Henry Kassel, Acting Regional Medical Director, Region 9 for special assistance in the investigation of 800 deaths among lambs and ewes in southwest Utah.

Later Dr. Kassel called direct and stated that about 700 lambs and 100 ewes had died in the past month along the Utah-Nevada state-line. He stated that autopsies had been made by local officials who were unable to determine the cause of death. The State Health Department was then called in to assist and Dr. Spendlove turned to the Public Health Service for aid.

Following the conversation with Dr. Kassel, I immediately communicated with Dr. Arthur Wolff, Veterinary Radialogist at the Environmental Health Center. Dr. Wolff was very interested and agreed to proceed to Utah. Dr. Wm. J. Hadlow, Veterinary Pathologist, Rocky Mountain Laboratory was requested to join Dr. Wolff and Dr. Monroe Holmes, CDC, veterinary officer assigned to the State of Utah at Salt Lake City to carry out the necessary examinations. Dr. Holmes will arrange for transportation and the necessary equipment. The investigators will proceed to southwest Utah Friday.

James H. Steele

cc: Executive Office - 5
Office of the Surgeon General
Chief, Bureau of State Services
Director, National Institutes of Health
Chief, National Office of Vital Statistics
Dr. G. A. Spendlove, State Health Officer, Utah
Dr. D. J. Hurley, State Health Officer, Nevada
Mr. Howard Spence, CDC Liaison Officer
Regional Medical Director, Region 9, Denver, Colorado
Regional Medical Director, Region 10, San Francisco, California
Dr. Arthur Wolff, Environmental Health Center

Distribution continued -

Officer in Charge, Environmental Health Center
Dr. T. A. Cockburn, Chief, CDC Activities, Greeley, Colorado
Dr. Monroe Holmes, CDC Veterinarian assigned to State of Utah
Dr. A. D. Langmuir, Chief, Epidemiology Branch
Dr. Carl Larsen, Medical Officer in Charge, Rocky Mountain Laboratory
Dr. W. T. S. Thorp, National Institutes of Health
Dr. B. T. Simms, Bureau of Animal Industry
Dr. Frank Todd, Federal Civil Defense Agency
Mr. L. E. Abbey, Budget and Fiscal Officer, CDC

UNIVERSITY OF UTAH
COLLEGE OF MEDICINE
SALT LAKE CITY

June 2, 1953

RADIOBIOLOGY LABORATORY

Dr. ... A. Holmes
Disease Control Section
Utah State Department of Health
State Capitol Building
Salt Lake City, Utah

Dear Dr. Holmes:

In accordance with your telephone conversation of today I am presenting herewith a list of the dates on which atomic detonations occurred at the Nevada Proving Grounds during the recent series of tests.

March 17, 1953
March 24, 1953
March 31, 1953
April 6, 1953
April 11, 1953
April 18, 1953
April 25, 1953
May 8, 1953
May 19, 1953
May 25, 1953
June 4, 1953

I do not have complete information on the fallout in the southern Utah area since that information is handled primarily by the Test Information Office in Las Vegas, Nevada.

I trust the above information will be of help to you. If you have any further questions, please do not hesitate to call.

Very truly yours,

Clarence N. Stover, Jr.

Clarence N. Stover, Jr.
Research Administrator

...;lh

PRELIMINARY REPORT OF RADIOASSAYS OF SELECTED TISSUE SPECIMENS O[illegible] P FROM THE

CEDAR CITY, UTAH AREA

The preliminary phases of this study consisted of radioassaying select tissues of two ewes from the [illegible]herd. The tissues selected were the skin and wool, bone and thyroid from an old ewe (No. 7) and the thyroid from a two-year old ewe(No. 6).

Based on the decay characteristics of wool samples (assuming exponential decay occurring according to T-1.2) it appears that as of June 15, 8:00 A.M. the age of the wool contaminants is approximately 526 hours (22 days). This would place the time of fission at May 24, 1953. It should be emphasized that there has not been sufficient time for accurate decay measurements to have been completed and that subsequent measurements may reveal older fission product components. Another fact which must be considered is shearing. If the wool being assayed represents new wool grown since shearing, then these data probably can be attributed to fall-out occurring since the shearing date.

This preliminary report is based on the supposition that all contamination and exposure is attributed to a single nuclear detonation occurring on or about May 24. This supposition may be erroneous but will be used as a working hypothesis.

Quantitative data on randomly selected wool and skin samples from dorsal and lateral surfaces of the No. 7 ewe indicate that as of June 11, 1953 there were approximately 1.7×10^{-2} microcuries of fission products per square inch of dorsal and lateral body surface. It is estimated that on the basis of only Beta radiation the dosage rate extrapolated back to one hour following detonation would have been 0.1 to 0.5 reps per hour and the total integrated dosage to the skin would have been less than 5 reps. This integrated dosage is not likely to have caused any appreciable pathology.

The thyroid tissues from No. 7 and No. 6 revealed 1.3 and 0.33 microcuries per gram of tissue respectively. Extrapolating back to the mid-point of the first week following the May 24 detonation the thyroid glands of these ewes received total integrated dosages of 800 and 200 reps, respectively. The 800 rep dose approaches the threshold for acute damage. Incidentally, the concentration of radioactivity in these thyroid glands as of June 9, 1953 exceeds by a factor of 250 - 1,000 the maximum permissible concentration of radioactive iodine for humans as stated in the National Bureau of Standards Handbook 52.

The radioassay on the bone specimen for No. 7 indicates that as of June 17 there was 3.2×10^{-4} microcuries per gram. This is approximately 50% greater than the maximum permissible concentration of strontium 89-90 for humans as stated in National Bureau of Standards Handbook 52.

If we assume that the above data is all associated with the May 24 shot then it appears that the exposure occurred in the Cedar City area rather than on the winter grazing ground. It further appears that the levels of radiation were not sufficient to produce any serious acute syndrome or pathology. Of greater significance, however, is that such surprisingly high concentrations of radioactive elements have become fixed in or on the aforementioned tissues in an area so far removed from the Nevada Proving Grounds.

It should be re-emphasized that this report is only preliminary and tentative.

[illegible]

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

June 10, 1953

Dr. William Hadlow
U. S. Public Health Service
Rocky Mountain Laboratory
Hamilton, Montana

Dear Dr. Hadlow:

Enclosed you will find a copy of a letter to Dr. Holmes which I believe is self-explanatory.

As indicated in this letter, preliminary data indicates a surprisingly large concentration of radioactivity, presumably Iodine 131 (I^{131}) in the thyroid gland. It will be several days before I can identify the radioisotope(s) concentrated in the gland and obtain any quantitative data.

Based on the preliminary data and fairly valid assumptions, it appears that the concentration of I^{131} in the ewe's thyroid at time of sacrifice was approximately 1 microcurie per gram of tissue. If we can further assume that this concentration represents a remnant of that differentially absorbed by the thyroid fifty or more days ago, it can be estimated that this particular thyroid gland received a total integrated dosage of several thousand roentgens equivalent physical (reps). Such a dosage could markedly alter the morphology and function of the thyroid gland, in effect producing hypothyroidism.

I should like to receive your comments on whether the syndrome and pathology with which we are confronted could be associated with hypothyroidism? Also, would you please inform me as to the concentration of formalin used for the autopsy specimens. Would you please send me all of the thyroid tissue you can spare of the old ewe autopsied on Friday?

If you desire, I could probably find you quite a few references on the effects of I^{131} as related to its therapeutic usage in humans and associated experimental usage in animals.

It was certainly pleasant meeting and working with you. I shall keep you informed on any significant results I may obtain.

For the Officer in Charge.

Sincerely yours,

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ARTHUR E. WOLFF, Acting Chief
Radiological Health Training Section

Enclosure

cc: Dr. Steele
Region 9

STATE OF NEVADA
DEPARTMENT OF AGRICULTURE
118 W. SECOND STREET – P. O. BOX 1027
RENO, NEVADA

DIVISION OF ANIMAL INDUSTRY

June 11, 1953

Dr. John I. Curtis
State Veterinarian
Utah Department of Agriculture
Salt Lake City, Utah

Dear Dr. Curtis:

Your letter of June 8, 1953 relative to losses in Utah sheep which had been wintering on the desert in Nevada in the vicinity of Caliente and Hiko is received. This department is glad to have your report covering these losses as our only previous information had come through a report from Dr. D. J. Hurley, Nevada State Health Officer at Carson City, and from articles in the press.

There are considerable numbers of live stock including cattle, horses, and a few sheep in the Pahranagat Valley along the highway which runs from Caliente through Hiko and south towards Las Vegas. There are a few cattle and possibly other animals in the canyon known as the Meadow Valley Wash through which the Union Pacific Railway runs from Caliente to Moapa. No losses in that area have been reported to this office by stockmen or southern Nevada veterinarians.

As you probably know, under the Nevada set-up, sheep and sheep diseases are not under the jurisdiction of this department, but are handled separately by the Nevada State Sheep Commission, and a copy of your letter is being sent to Mr. Vernon Metcalf, Secretary, P. O. Box 1429, Reno, Nevada. This department is, however, much interested in this matter and will give every possible cooperation to your office and to the Sheep Commission and Public Health Officials in Nevada.

Very truly yours,

Warren B. Earl

Warren B. Earl, Director
Division of Animal Industry

WBE/dc
cc Metcalf

STATE OF NEVADA
BOARD OF SHEEP COMMISSIONERS
420 CLAY PETERS BUILDING
RENO, NEVADA
P. O. BOX 1429 TEL. 8479

COMMISSIONERS
D. C. ROBISON, PRESIDENT
BAKER, NEVADA
E. R. MARVEL, VICE-PRESIDENT
BATTLE MOUNTAIN, NEVADA
VERNON METCALF, SECRETARY
RENO, NEVADA

July 10, 1953

Dr. Monroe A. Holmes
Utah State Department of Health
Salt Lake City, Utah

Dear Dr. Holmes:

Re yours of July 9.

Following is a list of sheep owners in the region mentioned, taken from the Lincoln County tax rolls:

Range Outfits

Name	Address	No.
	Ely, Nevada	605
	Ely, Nevada	1000
	Ely, Nevada	430
	Ely, Nevada	774

Farm Flocks

	Caliente, Nevada	12
	Caliente, Nevada	4
	Pioche, Nevada	4
	Hiko, Nevada	10
	Hiko, Nevada	2
	Panaca, Nevada	16
	Pioche, Nevada	10
	Pioche, Nevada	8
	Pioche, Nevada	4
	Ursine, Nevada	8
	Ursine, Nevada	4

If any Nevada sheep outfits had any trouble such as you mention, this office never heard of it and therefore is unable to help out. Best suggestion we can think of, considering the need for speed, is that you contact the various parties directly by mail.

Sincerely yours,

Vernon Metcalf
Secretary

VM:tw

Airmail

July 16, 1953

Dear Sir:-

Your name was given to us by Mr. Vernon Metcalf, Secretary of the Lincoln County Board of Sheep Commissioners. As you know, several of the Utah sheep men who were grazing in and around your area suffered considerable loss of sheep this year. Factors which may be the predisposing causes are so numerous it has been difficult to determine which one may have been the actual cause. If you have suffered losses in your sheep this year, we would appreciate that information, as well as the followings:

1. Did the adult sheep show any wool slipping (on body) or blistering on the head and face?
2. Did you suffer over normal loss of sheep at lambing (number of adults and number of lambs)?
3. Were your lambs stunted in size although full-term?
4. Did these lambs die prematurely or did they survive?
5. Have you had any of the above trouble in previous years? When?
6. Exact location of your range from November through March, in relation to the Nevada Proving Grounds?
7. Have you suffered any malnutrition losses in the past?
8. What poisonous plants have your sheep ever eaten where death or sickness has resulted?
9. If you suffered losses in adult sheep with wool slippage or deaths, were these young sheep (2 to 4 years) or older sheep?

Enclosed is stamped self-addressed envelope for your convenience in replying. Your prompt answer to the above questions will be greatly appreciated, and may aid in preventing future sheep losses in this area, in which you yourself are interested.

We thank you in advance for your courtesy and co-operation.

Sincerely,

[redacted] A. [redacted]
Veterinarian

[redacted]
[redacted].

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#1 6/14/53 (Died Early 6-14-53)

External Radiation:
Head----------9 14 Yrs. old
Back----------5
Background----1.5

Thyroid Gland, rib bone, liver, kidney, spleen, feces
(liver badly abscessed)

#2 ———— 3 yr. old ewe

External Radiation:
Head-----3.5
Back-----2.5
Background--2.0

Feces, urine, blood, thyroid, liver, kidney, spleen, adrenals, skin

#3 2yr. old ewe

External Radiation:
Head-------6.5
Body-------6.5
Background 2.0

Thyroid, rib, liver, spleen, adrenals, kidney

#0 5yr. old ewe (Good condition, no visible lesions)

Radiation:
External-----6 mr/ hr
Internal-----0.15 mr/hr

Healed Hydatid Cysts on liver
liver, skin, thyroid, kidney, spleen, femur, rib, blood, feces

#00 Aged Ewe (12-15 yr)

External radiation------5.0 mr/hr
Internal radiation------0.15 mr/hr
Background----------0.15 mr/hr

thyroid, skin, rib, femur, liver, spleen

#4 6 yrs old
External radiation----1.4 mr/hr
Internal radiation----0.15 mr/hr
Background----------0.05 mr/hr
Chronic periadenitis, fibrosed lungs and liver
Liver, kidney, rib, thyroid, femur, skin, spleen

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#11 10 yr.
External-----1.4 mr/hr, Internal 0.5 mr/hr ... kidney, liver, rib, skin

6/13/53 Cedar City

(lamb) External reading------- 0.045 mr/hr

3 yr old ewe died this morning

Background------0.1 mr/hr
External--------0.13 mr/hr General Condition----fair
Liver---(passive congestion), heart (edematous, indurated, multiple abscesses, lungs (indurated), lymph nodes (abscessed)

Caseous lymphadinitis

#2
External radiation-----1.7 mr/hr
Background----------0.10 mr/hr

Kidney, blood, liver, feces, rib, femur, thyroid

#3 3yr old ewe
External radiation .5 mr/ hr
Background--------- 0.05 mr/hr

Liver, spleen, urine, feces, blood, sternum, thyroid, skin, femur

#4 1yr old ewe
External radiation 0.5 mr/hr
Background-------- 0.05 mr/hr weak, emaciated, possible skin lesi

liver, kidney, rib, skin, spleen, thyroid, femur

#5 8yr old ewe
Background--------0.05 mr/hr Scales on back, rt maxilla swollen---
External----------0.5 mr/hr impacted tooth, sinusitis, rhinitis
Internal----------0.05 mr/hr

Heart, lungs, liver, kidney---all normal

Skin, thyroids, marrow, spleen, liver, femur, blood, feces

June 17, 1953

DATA ON SHEEP LOSS - CEDAR CITY, UTAH, AREA

Second Preliminary Investigation.

Engaged in the investigation were:

U. S. PUBLIC HEALTH SERVICE PERSONNEL

Monroe A. Holmes, Veterinarian, assigned to the Utah State Department of Health, Salt Lake City, Utah.
Dr. Robert Bay - University of Utah Medical School, Atomic Energy Cancer Research, Salt Lake City, Utah.
Dr. W. T. Huffman, Veterinarian, Plant Toxologist, U. S. Bureau of Animal Industry, Salt Lake City Office.

ATOMIC ENERGY COMMISSION PERSONNEL

William Allair - Chief, Operations Branch, Office of Test Operations, Santa Fe Operations Office, Albuquerque, New Mexico.
Joe Sanders - Assistant Deputy Field Representative, A.E.C., Los Alamos, N. M.

SHEEP OWNERS IN CEDAR CITY AREA CONTACTED	Date of Trailing
[illegible] Cedar City, Utah	April 20
[illegible], Cedar City	Apr. 6 to May 5
[illegible]., Cedar City, Utah	Apr. 18-27
[illegible], Cedar City, Utah	March 23
[illegible]., Cedar City, Utah	April 1-8
[illegible]edar City, Utah	
North of Hiko	April 10
[illegible] - Coyoto Springs area	April 15-20

DATA ON SHEEP LOSS - CEDAR CITY, UTAH AREA

Preliminary Investigation Begun Friday, June 5, 1953.

Engaged in the investigation were:

U. S. PUBLIC HEALTH SERVICE PERSONNEL

Arthur Wolff - Environmental Health Section, Cincinnati, Ohio.
William Hadlow - Veterinary Pathologist, Rocky Mountain Laboratory, Hamilton, Montana.
Monroe A. Holmes - Veterinarian assigned to the Utah State Department of Health, Salt Lake City, Utah.

ATOMIC ENERGY COMMISSION PERSONNEL

Major R. J. Veenstra - Hunter's Point, California.
Dr. R. E. Thompsette - Los Alamos, New Mexico.
Mr. Joe Sanders - Deputy Field Assistant, Los Alamos (Mercury, Nevada).

COUNTY AGENT

Mr. S. L. Brower - Iron County, Cedar City, Utah.

VETERINARY PRACTITIONER

Mr. A. C. Johnson - Cedar City, Utah.

SHEEP OWNERS IN CEDAR CITY AREA (Initially Contacted)	Date of Trailin
, Cedar City, Utah.	April 20
Cedar City, Utah.	Apr.6 to May
, Cedar City, Utah.	Apr. 18 to 2
, Cedar City, Utah.	March 23
., Cedar City, Utah.	*April 1 to 8
- Cedar City, Utah.	

SHEEP OWNERS (Not Contacted)Originally)

- Brought herd out due to poor range in February. No apparent sickness.
- Some loss; information not available.
(25 miles North of Hiko) April 10
Ely Spring area, Dry Lake Valley
S.W. of Pioche & N.W. of Panaca.

FIRST APPEARANCE OF ILLNESS - APPROXIMATELY MARCH 10 THROUGH APRIL 20.

SYMPTOMS

Opinions varied as to symptoms. Scabby face and ears was the first sign noted in the majority of cases. Small blisters appeared around the mouth and over the nose with generalized reddening of the skin and coalescence of the blisters after rupture. Scabs then appeared.

Opinions varied as to whether the wool "slipped" bc... ...e appearance of the scabs. It was felt that the body wool had covered t... earlier changes which might have occurred at the same time the blisters and scabs appeared on the head and face. During shearing the shearers maintained it was difficult to remove and cut the wool as it pulled loose rather than cut as normally. No one area of the body appeared affected more than any other area. (Dorsal and lateral areas had all the symptoms; ventral surface was not affected.)

Owner	Date of Trailing	Trailing Deaths	Premature Lambing On Trail	Date of Lambing
	April 20	6	~~Less than usual~~	April 20
	*April 1-8	12-15	0	May 2
	April 18-27	12	0	May 2
	Apr. 6-May 5	35	6-8	May 9
	March 23	10	10-12	(Apr. 5 - 270 head
(25 to 30 days to cover between 90 and 130 miles)				(Apr. 15 - 1450 he

Owner	Ewes Lost During Lambing	Lambs Lost at Birth & in 2-5 days	
	300 & over - largely 2-3 yr.	700-	(500 over normal)
	200 - largely older ewes	400	
	300 - young ewes	600	
	200 - many 2-3 years old	500-600	
	120 - 2-6 years old	470	

Owner	Normal lambs Lost (Not Stunted)	Number of Sheep Before Illness (Winter Range)	Shearing Count	Count After Shearing
	?	3,200	?	?
	?	1,375	1,274	1,165
	300	1,500	1,375	1,175
	600	1,835-(community - Adams 1,000)	1,610	1,400
	?	2,100	2,017	?
			6,276	3,740

Owner	Time Lambs Lived After Birth	Time Greatest Loss Occurred	Date Of Shearing
	Few hours to several days	30 days	April 2
	1 hour to 1 week	May 5 - 20	May 7-8
	2 hours to 7 days	May 1-20	May 9-1
	2 hours to several days	May 15-25	May 4-5
	1 to 5 days	April 5-15	May 2

Owner	Skin Lesions First Noticed
	April 20 - Herder saw trouble earlier
	April 10-15
	April 10
	March 10
	April 1

*Arrived Cedar City April 27.

GENERAL OBSERVATIONS

All herds involved were placed upon Winter range approximately November first. They were kept in relatively the same range areas until about April 1st. (See Trailing)

Only one herd fed supplemental hay or grain during Winter ranging. and began feeding later in the Spring - largely a mixture of salt and 32% protein which was a Purina mix of linseed oil meal, cotton oil meal and bran with 1/3 salt. The majority of the sheep owners have been grazing in this area since the 1930s. Winter range varied from 40 to 90 miles West and North of Caliente, Nevada (see supplemental maps). Winter range was extremely poor due to very low percipitation of snow and rain during the late Fall, Winter and early Spring.

Typical range sheep for the Utah-Nevada area are very poor in appearance and size and may be considered actually unthrifty in comparison to farm-raised or sheep on better pasture. However, they are considered a sturdy stock, being a mixed cross with Rambouliet and other breeds.

There was no correlation of observations among sheepmen as to whether wool began to slip before the base lesions appeared. All the owners felt that face lesions appeared first. When trouble began during lambing and with the falling out of the wool, 1/3 of the owners, feeling they had an infectious disease, removed their animals from the lambing pens and placed animals on a larger, temporary home range. Losses, however, continued to occur. 1/3 of the owners did not have lambing pens and were on home range. These had losses. 1/3 of the owners remained in lambing pens but still had losses.

Lambs that were born were stunted and approximately one-half normal size and lived from a few hours to five or six days. The ewes died at lambing or lived several weeks, progressively getting weaker but eating up until the time of death. There were no infectious disease symptoms, such as vomiting, diarrhea, high temperatures or lack of ability to eat. A heavy snow storm during May 8th and 9th caused additional losses but we could not determine how much over the present problem.

At the time of the investigation the majority of the affected sheep and stunted lambs had died, but some herds still had deaths at varying intervals. Affected sheep remained alive apparently only temporarily and were progressively getting worse and losing weight. Some sheep were manifesting central nervous system disturbances, as seen by extreme nervousness and fright upon appearance of handlers or investigators.

e 17, 1953

DATA ON SHEEP LOSS - CEDAR CITY, UTAH AREA

Preliminary Investigation Began Friday, June 5, 1953.

Engaged in the investigation were:

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Mr. A. C. Johnson - Cedar City, Utah.

SHEEP OWNERS IN CEDAR CITY AREA (Initially Contacted) — Date of Trailing

, Cedar City, Utah.	April 20
, Cedar City, Utah.	Apr. 6 to May
Cedar City, Utah.	Apr. 18 to 27
Cedar City, Utah.	March 23
, Cedar City, Utah.	*April 1 to 8
Cedar City, Utah.	

SHEEP OWNERS (Not Contacted)Originally)

- Brought herd out due to poor range in February. No apparent sickness.
- Lincoln Mine Area - Some loss; information not available.
- White Valley Area (25 miles North of Hiko) — April 10
  Ranged in Ely Spring area, Dry Lake Valley S.W. of Pioche & N.W. of Panaca.

FIRST APPEARANCE OF ILLNESS - APPROXIMATELY RANGE TO THROUGH APRIL 20.

SYMPTOMS

Opinions varied as to symptoms. Scabby face and ears was the first sign noted in the majority of cases. Small blisters appeared around the mouth and over the nose with generalized reddening of the skin and coalescence of the blisters after rupture. Scabs then appeared.

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	?	2,100	2,017	?
	?		6,275	3,780

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	1 hour to 1 week	May 5 - 20	May 7-8
	2 hours to 7 days	May 1-20	May 9-11
	2 hours to several days	May 15-25	May 4-5
	1 to 5 days	April 5-15	May 2

Owner	Skin Lesions First Noticed
	April 20 - Border com trouble earlier
	April 10-15
	April 10
	March 10
	April 1

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*Original Notes dated 27.

[redacted] CONDITIONS

All lambs involved were placed upon Winter range approximately November 1st. They were kept in relatively the same range areas until about April 1st. (See Trailing)

Only one herd fed supplemental hay or grain during Winter ranging. [redacted] and [redacted] began feeding later in the Spring - largely a mixture of salt and 32% protein which was a purina mix of linseed oil meal, cotton oil meal and bran with 1/3 salt. The majority of the sheep owners have been grazing in this area since the 1930s. Winter range varied from 50 to 90 miles West and North of Caliente, Nevada (see supplemental maps). Winter range was extremely poor due to very low precipitation of snow and rain during the late Fall, Winter and early Spring.

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There was no correlation of observations among sheepmen as to whether wool began to slip before the face lesions appeared. All the owners felt that face lesions appeared first. When trouble began during lambing and with the falling out of the wool, 1/3 of the owners, feeling they had an infectious disease, removed their animals from the lambing pens and placed animals on a larger, temporary home range. Losses, however, continued to occur. 1/3 of the owners did not have lambing pens and were on home range. These had losses. 1/3 of the owners remained in lambing pens but still had losses.

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June 17, 1953

DATA ON SHEEP LOSS - CEDAR CITY, UTAH, AREA

Second Preliminary Investigation.

Engaged in the investigation were:

U. S. PUBLIC HEALTH SERVICE PERSONNEL

Monroe A. Holmes, Veterinarian, assigned to the Utah State Department of Health, Salt Lake City, Utah.
Dr. Robert Bay - University of Utah Medical School, Atomic Energy Cancer Research, Salt Lake City, Utah.
Dr. W. T. Huffman, Veterinarian, Plant Toxologist, U. S. Bureau of Animal Industry, Salt Lake City Office.

ATOMIC ENERGY COMMISSION PERSONNEL

William Allair - Chief, Operations Branch, Office of Test Operations, Santa Fe Operations Office, Albuquerque, New Mexico.
Joe Sanders - Assistant Deputy Field Representative, A.E.C., Los Alamos, N. M.

SHEEP OWNERS IN CEDAR CITY AREA CONTACTED	Date of Trailing
, Cedar City, Utah	April 20
Cedar City	Apr. 6 to May 5
Cedar City, Utah	Apr. 18-27
Cedar City, Utah	March 23
, Cedar City, Utah	April 1-8
City, Utah	
White Valley Area, 25 miles North of Hiko	April 10
- Coyoto Springs area	April 15-20

Dr. Paul B. Pearson, Division of Biology & Medicine, AEC, Washington 25, D. C.

James E. Reeves, Director, Office of Test Operations, SFCO

REPORT BY R. J. VEENSTRA ON EXAMINATION OF ANIMALS IN THE NEVADA PROVING GROUNDS AREA

SYMBOL: T-3

There is enclosed letter report, dated 17 June 1953, on the above subject, submitted by R. J. Veenstra, U. S. Naval Radiological Defense Laboratory.

Enclosure:
Ltr dtd 17 Jun 53

CC: Dr. M. A. Holmes
Public Health Service
Utah State Dept of Health
Capitol Building
Salt Lake City, Utah
w/cy encl

COPY
RESTRICTED

SECURITY INFORMATION

U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

In reply refer to file:
Code: 3-921A
R.J.Veenstra/lt

17 Jun 1953

Mr. Allare
Atomic Energy Commission
Albuquerque, New Mexico

Dear Sir:

Mr. S. Woodruff of Camp Mercury, Nevada, requested I send my report of the difficulties in Cedar City, Utah to you. I made this field trip with Mr. J. Sanders and R. E. Thompsette. On the 5th and 6th of June 1953, we examined sheep at Mr. Ranch and a neighboring ranch.

At Mr. Ranch we examined his herd for sick animals. Five were not normal and were checked closely. The outstanding lesion was the formation of dried blisters in the area from the nostrils to approximately level with the eyes. This area is quite free from the protection of long wool growth. Along the upper lip a thick dry formation of skin was present. Upon removal the material was horny like and hard to break with my fingers. This hard, horny skin formation is apparently typical of the "fall out" lesions in the Trinity Cattle.

One ewe showed a reading of 2 m r, using an M X 5b counter, over the thyroid and kidney region.

Several animals had lost wool on their backs or sides leaving dry scaly areas present.

The location of the lesions and the nature of sheep to nibble grass short, leads one to suspect the lips and fore face could easily come in contact with material on bushes, grass and etc. that would cause these lesions.

We went to a neighboring ranch and examined two ewes. The ranchers claimed these two animals resembled sheep that had died, but that these apparently were recovering. These animals did look debilitated.

The poorest of these two was caught and a post mortem performed. Before killing a reading of 2 m r was obtained in the thyroid region. Grossly the animal appeared normal. Complete specimens were taken by Dr. Haldow.

I obtained a piece of rib to check the bone marrow for signs of radiation.

The ranch was visited the following day (6 June 1953). Here we inspected a herd of 21 horses. All had lesions on their backs that were hard and horny in character. Two horses were thrown and checked for radiation. Both gave readings of 2 m r over the right kidney.

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COPY

The entire herd had lesions on their backs as if some material capable of causing burns had fallen on them.

Again using the 'Trinity Cattle' as a basis the lesions were typical of what you would expect from a "fall-out".

The bone specimen from the ewe showed a slight hyperplasia on microscopic examination.

A portion of bone was given to Lt. J. S. Reed to test for gamma activity. Using a Gamma Photon Scintillation Counter with modified Nuclear Corp. Scaler, Model #162 over a period of 5 days, a consistently higher (approx. 12 counts per minute) count than background was present. Attempts to detect alpha or beta emittors were made without success.

I was not fortunate enough to see any of the large number of critically ill animals that died. However, it is my understanding that they showed symptoms similar to the ones I saw. I also believe that the majority were pregnant.

In view of the hyperplasia, presence of detectable gamma radiations in the bone marrow, skin lesions, possibility of toxins due to the lesions and the presence of pregnancy in many ewes it is my opinion that radiation was at least a contributing factor to the loss of these animals.

Sincerely yours,

/s/ R. J. Veenstra
R. J. VEENSTRA, MAJ. V.C.

Dr. Holmes:

Enclosed is copy of my report to Dr. Schoening pertaining to the Cedar City case

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF ANIMAL INDUSTRY
LOCAL OFFICE

446 Federal Building
Salt Lake City 1, Utah
June 23, 1953

Dr. H. W. Schoening
In Charge, Pathological Division
Washington 25, D. C.

Dear Dr. Schoening:

You have probably seen the correspondence and newspaper clippings from Dr. Melvin pertaining to unusual losses in sheep in the Cedar City area of Utah. The losses occurred in sheep that had wintered on ranges in Nevada mostly north and west of Caliente. The owners are claiming that possibly some of the loss at the least may be due to beta radiation in the fall-out from dust clouds following atomic explosions on the Nevada desert northwest of Las Vegas.

There were some 10 to 12 thousand ewes involved and the loss is reported to be something over 1000 ewes and more than 2000 lambs. Except for a few weak animals that were supposed to have been affected, the herds are now on the summer range in the mountains east of Cedar City.

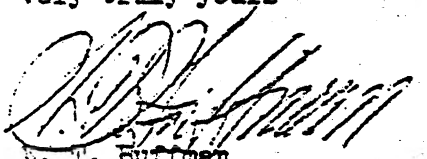
At the request of Dr. M. A. Holmes, veterinarian with the U. S. Public Health Service and now working with the Utah Board of Health, I went to Cedar City June 13 and spent that afternoon and the following day with Dr. Holmes, Dr. Robert C. Bay, veterinarian with University of Utah Medical College, and Mr. Sanders and Mr. Allaire of the AEC. Some 10 or 12 sheep were autopsied, most of which had previously shown symptoms. No macroscopic pathology was present in the internal organs that could be ascribed to any recent infectious disease or to poisonous plants. Tissues from three sheep will be sent to Dr. Davis for sectioning. The skin lesions on the face and back were somewhat similar to those seen following photosensitization but, since black animals were reported to be similarly affected, this can be ruled out. The shedding of the fleece is quite common in sheep that have been maintained at a low nutritional level, especially following a change to a better ration. These few sheep were of mixed ages from yearlings to aged ewes and were kept home because of their poor condition. The winter range used by these herds was reported to be in quite poor condition following a dry period last summer and fall. No supplemental feed was used until the herds were brought to Cedar City for shearing and lambing. However, another herd that wintered about 30

miles northwest of Pioche and had been fed a small amount of supplement consisting of 2 to 1 mixture of protein feed and salt from December to March was reported by the owner to have sustained no unusual loss. This herd was trailed out of the Nevada range about the first of May and is now lambing on the range east of Cedar City. The condition of this herd can not be determined until about July 1 when the lambing will be finished.

The history of losses in the affected herds is not too definite. There was probably some abortion on the trail and all of the lambs were considerably undersized at full-time birth. The skin lesions were noticed about the time shearing started, and the loss of ewes apparently began about this time. The local veterinarian reports some high temperatures but the ewes appeared to eat almost to the time of death without showany particular symptoms other than weakness and depression. The lambs born at full term were weak and many did not survive. A good many of the ewes did not give milk and it was necessary to raise the surviving lambs from these ewes by hand. The lambs carried by ewes that died were reported to be small but apparently normal otherwise. Since most of the ewes carried lambs and a few had aborted, it was not possible during our visit to determine whether or not any non-pregnant animals had been affected. Neither could it be determined that all the ewes that died were showing skin lesions.

Since so many factors enter the picture, it is not possible at the present time to arrive at any definite conclusions regarding the cause. Various agencies are working on the pathology as well as on other angles of the case, and some definite results may be obtained. Our interest has been in determining the status of poisonous plants as a factor in producing the condition. At the present time this does not appear probable.

Very truly yours



M. T. Huffman
Veterinarian in Charge
Stock Poisoning by Plants

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE

June 24, 1953

ADDRESS REPLY TO:
OFFICER IN CHARGE
ENVIRONMENTAL HEALTH CENTER
1014 BROADWAY
CINCINNATI 2, OHIO

Health Officer
State Department of Health
Salt Lake City, Utah

Attention: Dr. Monroe Holmes

Dear Dr. Holmes:

I received the samples you sent me. The wool and skin specimens were quite "ripe". In regard to the specimens fixed in formaldehyde, I wonder whether you sent me the wrong group of samples as they consist of a conglomeration of various tissues and not solely the specific thyroids requested.

In accordance with your request I have prepared a preliminary report which you will find enclosed. Quite frankly, the report is very premature because the age of the gross fission products has not been ascertained as yet and this is a parameter which must be established before any satisfactory interpretation can be made of the data. It is a time-consuming task which cannot be rushed. Also, I am working under extreme handicaps. Our laboratory has been dismantled for moving to the new building, our electronics specialist has resigned, and practically our entire staff, from whom assistance normally could be expected, except myself are on field trips for the entire summer.

I, too, will be out of town from June 25 to July 2 or 3 and thus shall be unable to start on the samples you recently sent me until the beginning of next month.

I hope the enclosed report will be of value to you. A more complete report will be forthcoming later in the summer.

Very truly yours,

Art Wolff

ARTHUR H. WOLFF, Acting Chief
Radiological Health Training Section

Respectfully forwarded:

V. G. MacKenzie

V. G. MACKENZIE
Officer-in-Charge
Environmental Health Center

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PRELIMINARY REPORT OF RADIOASSAYS OF SELECTED TISSUE SAMPLES FROM THE [redacted] SHEEP FROM THE CEDAR CITY, UTAH AREA

The preliminary phases of this study consisted of radioassaying select tissues of two ewes from the [redacted] herd. The tissues selected were the skin and wool, bone and thyroid from an old ewe (No. 7) and the thyroid from a two-year old ewe (No. 6).

Based on the decay characteristics of wool samples (assuming exponential decay occurring according to $T^{-1.2}$) it appears that as of June 15, 8:00 A.M. the age of the wool contaminants is approximately 526 hours (22 days). This would place the time of fission at May 24, 1953. It should be emphasized that there has not been sufficient time for accurate decay measurements to have been completed and that subsequent measurements may reveal older fission product components. Another fact which must be considered is shearing. If the wool being assayed represents new wool grown since shearing, then these data probably can be attributed to fall-out occurring since the shearing date.

This preliminary report is based on the supposition that all contamination and exposure is attributed to a single nuclear detonation occurring on or about May 24. This supposition may be erroneous but will be used as a working hypothesis.

Quantitative data on randomly selected wool and skin samples from dorsal and lateral surfaces of the No. 7 ewe indicate that as of June 11, 1953 there were approximately 1.7×10^{-2} microcuries of fission products per square inch of dorsal and lateral body surface. It is estimated that on the basis of only Beta radiation the dosage rate extrapolated back to one hour following detonation would have been 0.1 to 0.5 reps per hour and the total integrated dosage to the skin would have been less than 5 reps. This integrated dosage is not likely to have caused any appreciable pathology.

The thyroid tissues from No. 7 and No. 6 revealed 1.3 and 0.30 microcuries per gram of tissue respectively. Extrapolating back to the mid-point of the first week following the May 24 detonation the thyroid glands of these ewes received total integrated dosages of 900 and 200 reps, respectively. The 900 rep dose approaches the threshold for acute damage. Incidentally, the concentration of radioactivity in these thyroid glands as of June 9, 1953 exceeds by a factor of 250-1,000 the maximum permissible concentration of radioactive iodine for humans as stated in the National Bureau of Standards Handbook 52.

The radioassay on the bone specimen for No. 7 indicates that as of June 17 there was 3.2×10^{-4} microcuries per gram. This is approximately 50% greater than the maximum permissible concentration of strontium 89-90 for humans as stated in National Bureau of Standards Handbook 52.

If we assume that the above data is all associated with the May 24 shot then it appears that the exposure occurred in the Cedar City area rather than on the winter grazing ground. It further appears that the levels of radiation were not sufficient to produce any serious acute syndrome or pathology. Of greater significance, however, is that such surprisingly high concentrations of radioactive elements have become fixed in or on the aforementioned tissues in an area so far removed from the Nevada Proving Grounds.

It should be re-emphasized that this report is only preliminary and tentative.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ANIMAL INDUSTRY
LOCAL OFFICE

450 Federal Building
Salt Lake City 1, Utah
June 24, 1953

Dr. M. A. Holmes
c/o Utah State Department of Health
Capitol Building,
Salt Lake City, Utah

Dear Dr. Holmes:

In accordance with your request, there is enclosed a copy of my report to the Bureau on the condition in the sheep near Cedar City.

I have made no further reports on this to the Bureau, other than to submit the various newspaper items that have appeared in the local press.

Very truly yours,

F. H. Melvin
Veterinarian in Charge
Disease Control & Eradication

Encl.

106

AIR MAIL

450 Federal Building
Salt Lake City 1, Utah
June 8, 1953

Chief, Bureau of Animal Industry
Washington 25, D. C.

Dear ~~Sir~~ Dr. Simms

In reference to our telephone conversation of today regarding the losses in sheep in the vicinity of Cedar City (Iron County), Utah, there is enclosed a newspaper clipping from yesterday's Salt Lake Tribune describing the condition, as apparently given to the press by Dr. M. A. Holmes, veterinarian with the United States Public Health Service, stationed in Utah.

Dr. John I. Curtis, Utah State Veterinarian, and I visited these ranches two weeks ago, together with Dr. , the local practitioner. Following is the information given us by rancher

His flock of 3000 ewes were trailed from Cedar last fall to his winter range on the White River, Nevada, about 45 miles west of Caliente. No losses were experienced there. He trailed his flock home the last week in March and then during shearing he noticed first that the wool slipped off easily, that there appeared to be burns on the backs of the ewes. Deaths then occurred, and as lambing started the lambs were born dead. These were not abortions, but full-term, small dead lambs. Many ewes that died carried a full-term lamb. Most lambs that lived were small, and the ewes had very little milk. Nearly all deaths were in 2-year-old ewes, and the few dry ewes and bucks in the flock did not appear to be affected, although the bucks had been removed and returned home at an earlier date.

Dr. stated that there were many high temperatures, up to 106° and that he first noticed a peculiar blaze on the faces of the affected ewes, which started as a series of minute blisters and turned into a smooth scar. We noticed these scars on the recovered ewes, as well as the white, thick, powdery scabs or burns along their backs. There were no mucous membrane envolvement, no lameness, and no fever at the time of our visit and the condition had apparently about run its course by then, May 24. Post-mortems showed only a slight enteritis and some pulpiness of the liver. All else appeared normal. The ewes did not linger or struggle at death. They just went down and died, and the owner was trying to salvage many "bum" lambs. Mr. stated he had lost about 200 ewes and over 500 lambs.

west of Cedar, reported almost the identical condition and their ewes appeared the same as al- though the losses had stopped.

These two owners, together with all of Cedar City, trail their flocks to this same range in Nevada each winter and return home at the same time to shear and lamb. All have been doing this same operation for up to 20 years, and all report that this is their first such loss. The feed at home is native alfalfa hay with some cottonseed pellets, and in those ewes posted, the stomach contents appeared normal. Also the feces appeared normal in the corrals.

Neither Dr. Curtis nor I gave any diagnosis, but the owners were very convinced that their sheep were suffering from the effects of the atomic experiments, while they were in that area in Nevada. They referred to the condition on the ewes' backs as "radar burns." Upon my return to Salt Lake City I discussed the condition with Dr. W. T. Hurfman of the Pathological Division, but neither of us have arrived at any conclusions.

I have no information in regard to any Nevada sheep that may have ranged in this area, but there are rumors from Arizona about "ewes with no milk."

Dr. Curtis has informed me that he has discussed the condition with Dr. George Spendlove, M. D., Utah Health Director, which probably explains the presence of the Public Health veterinarians. Also the sheep owners informed us they intended to take some action with the Atomic Energy Commission.

Very truly yours,

F. H. Melvin
Veterinarian in Charge

Encl.

June 24, 1953.

Dr. W. T. Huffman,
U. S. Department of Agriculture,
446 Federal Building,
Salt Lake City 1, Utah.

Dear Doctor Huffman:-

I appreciate receiving copy of your official report. This will help tie in some of the loose ends which have been bothering us.

Pay no attention to the newspaper and radio reports. As usual, the information was garbled and the intent of Doctor Day's statement had been misinterpreted. We have not officially released any further information to the present time.

I would like, also, to thank you for your help at Cedar City. It has been a pleasure to work with someone of your capabilities.

One further request: Doctor Melvin promised that he would send me a copy of his original report. Would you mind asking if he has forgotten it?

Sincerely,

MONROE A. HOLMES,
Veterinarian.

MAH:uml

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UNITED STATES
ATOMIC ENERGY COMMISSION
SANTA FE OPERATIONS OFFICE
P. O. BOX 5400
ALBUQUERQUE, NEW MEXICO

IN REPLY REFER TO:
T-7

JUL 8 1953

Monroe A. Holmes, D.V.M.
Utah State Department of Health
Salt Lake City, Utah

Dear Dr. Holmes:

Reference is made to your letter of June 29, 1953, to Mr. Allaire of this office, relative to the sheep from the Nevada area.

We have just received today from Major Veenstra the information requested in your teletype of June 23, and are enclosing a copy, together with copy of memorandum of June 29 by Lt. Reed. A copy of Dr. Pearson's memorandum of June 21, 1953, which contains all the information we have available on numbers and types of animals involved, is also enclosed. Dr. Pearson, as you probably know, represents the AEC's Division of Biology and Medicine, which has been assigned the responsibility for correlating the investigations being conducted. A copy of our memorandum of June 26, which was issued to define areas of responsibility within the AEC, is attached for your information.

In the event further information is required, please do not hesitate to call on us.

Very truly yours,

James E. Reeves, Director
Office of Test Operations

Enclosures:
1. Veenstra's ltr 6/30
2. Reed's memo 6/29
3. Pearson's memo 6/21
4. Tyler's memo 6/26

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10-125

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 5400
ALBUQUERQUE, NEW MEXICO

JUL 3 1953

IN REPLY REFER TO:

T-7

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Utah State Department of Health
Salt Lake City, Utah

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Office of Test Operations

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U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

30 June 1953

P. D. Reeves
Santa Fe Operations Office
USAEC
Albuquerque, New Mexico

Dear Sir:

As Lt. J. S. Reed's Gamma Photon Counter was used to supply the data in question I discussed your dispatch with him. Enclosed is the report I have received.

Hope to have further data available by the end of the week.

Sincerely yours,

/s/ R. J. Veenstra

R. J. VEENSTRA, MAJ. V.C.

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COPY

COPY

Memorandum 29 June, 1953

From: Lt. J.S.REED, MC, USN.

To : Major R.J. VERNSTRA, VC, USA.

Subject: Answers to questions raised by dispatch discussed verbally.

The following answers might be given to the questions as mentioned in the dispatch described:

Question # 2; Tissues were prepared by placing in test tubes and counting activity present.

Question # 3; The counter has been calibrated with a standard of 0.00125 micro-curies of Cobalt 60(8340 d/min) and in a series of 5 three minute counts, gave a count above background of 4599± 0.5% S.E. per 3 minute count. This would indicate an efficiency of 55%. It must be remembered that the standard used emits 2 gammas. A single gamma emitter standard is in process of preparation at the present time. This could conceivably give a slightly different value for the efficiency.

Question # 3; This question can best be answered by giving further data on the previous samples and on the remainder of the samples presented. Thyroid samples from all of the animals presented considerable activity with the exception of the animals, #2. On this date (29 June, 1953) the thyroid samples gave the following Results:

Animal	Weight(gm.)	cts/3 min	cts/min	cts/min/gm
-1	0.550	37,400	12,490	22,709
-2	0.180	9,467	3,156	17,533
-3	0.120	25,080	8,360	69,667
-5	0.280	49,767	16,589	59,246
-2	0.100	14	5	50
-3	0.210	15,310	5,103	24,300
-4	0.020	2,018	673	33,650

It might be pointed out that these values as of this date are, with the exception of #5, an average of 43.5% of the values for the same samples when counted on 19 June, 1953; and that the samples when counted on 23 June, 1953 averaged approximately 68% of those on 19 June, 1953. The decay rate approximates that of I-126 fairly closely.

It has been determined that the tissue In #1 as lung is actually spleen and that the tissue referred to as liver is actually kidney. In the samples from #5, the tissue referred to as lung is actually spleen. All of the samples presented showed some activity originally with the exception of #2 and two of the tissues in #3.

/s/ J. S. Reed
J.S.REED, LT,
M.C., USN

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Dr. John C. Bugher

June 21, 1953

Paul B. Pearson

LIVESTOCK LOSSES AROUND TEST SITE

SYMBOL: EMB:PEP

On Monday morning, June 15, there was a meeting at the Las Vegas Field Office of the AEC to review the losses of livestock around the Test Site, or of animals that had been in the area during a part of the tests and subsequently moved to other areas, and to develop a plan for more intensive study of the etiology of the losses. The major objective of the group was to determine whether or not radiation could have been a factor contributing to the losses or injury of livestock, and secondly, to determine as far as feasible other causes that may have contributed to losses of livestock around the area.

The following group of people attended the meeting:

C. L. Comar, University of Tennessee-AEC Program
Lt. Col. John H. Rust, Veterinarian, University of Tennessee-AEC Program
Lt. Col. Bernard F. Trum, Veterinarian, University of Tennessee-AEC Program
Dr. Paul B. Pearson, AEC, Washington, D.C.
Dr. J. H. Shupe, Veterinarian, Utah State Agricultural College
Dr. D. A. Greenwood, Professor of Biochemistry, Utah State Agricultural College
Dr. Dee A. Broadbent, Asst. Director, Agricultural Experiment Station, Utah State Agricultural College
Dr. L. A. Stoddart, Professor of Range Management and Botany, Utah State Agricultural College
Dr. J. L. O'Harra, Veterinarian, University of Nevada
Dr. Robert H. Clark, Veterinarian, Las Vegas, Nevada
S. R. Woodruff, Jr., Field Manager, Las Vegas Field Office
J. B. Sanders, Deputy Field Manager, Las Vegas Field Office
T. A. Roehl, Engineer, Las Vegas Field Office
William S. Johnson, Los Alamos Scientific Laboratory
W. W. Allaire, Santa Fe Operations Office

This group represents competencies in the radiation effects on farm animals, veterinary medicine, range management and range botany, biochemistry and nutrition, fallout of radioactivity material, and the group from the Las Vegas Field Office who have a vast background of contacts with the livestock men and local situations.

LIVESTOCK LOSSES AROUND TEST SITE

Mr. , who is owning about 1000 head of cattle that are grazed in an area about 60 by 70 miles North of the Test Site, gave a very good account of their livestock operations, and losses of livestock since the beginning of the tests.

This memorandum is a report of the activities and observations, the material obtained for further study, the scope of the work that will be done, and also provides some background information. As reports of findings come in from the various laboratories they will be organized so as to provide a more complete picture of the situation. The report here is divided into a section each for horses, cattle and sheep. All of the men previously mentioned, except Johnson, were in the group examining the horses and cattle. Drs. Clark and O'Harra, Comar, Allaire, Roehl and Johnson did not go to the Cedar City range area to examine the sheep.

It is of significance that the say this is an extremely dry year, probably the dryest they have had in the past 20. It was apparent over all of the range area we travelled that it is very dry with extremely poor feed conditions.

Horses: The had 20 head of Quarter horses that were grazed in the vicinity of Papoose Lake about seven miles from the Test Site, and Mr. had one horse in the same band. These horses were moved out of the Papoose Lake area about June 1 and taken to the Groom Lake area which is where we saw them on June 16. Sixteen of these horses have lesions of varying degrees over the back. Four of the animals were caught and examined. The lesions on the backs appear to be typical beta-ray burns. In addition to the back lesions, two horses had lost one eye, and on two others examined minor lesions were beginning to appear on the eyes. It is believed that the eye lesions are caused by radiation, that they will progress and gradually involve more of the eye and that other animals may develop this condition. The eye condition could be caused by active particles lodging in the eye. A skin biopsy was taken from the back of one of the affected horses. Microscopic and laboratory studies will be made on the skin by Drs. Trum and Rust of the UT-AEC Project. If these studies confirm that the lesions are beta-ray burns, it would appear that the Commission should settle damages with the

There was low radioactivity in the hair on the backs of the horses. Values ranged from 0.5 to 1.0 mr/hr above background.

Paul B. Pearson

Cattle: The normally winter their cattle in the Papoose Lake area. They were moved from this area to Penoyer Valley between June 1 and 6. The feed conditions on the range were reported by Mr. to be poorer than any time during the last 20 years. The cattle that we saw were emaciated and in very poor condition.

On June 6 the , advised the Las Vegas Field Office that six cows which had not been moved from Papoose Lake had died between June 2 and 5 without apparent cause. The water hole at Papoose Lake was apparently very low at this time and by June 16 it was completely dry and hard as rock. Samples of the water were taken June 3 and 6. The radioactivity levels of the water were 1.77×10^{-3} and 5.9×10^{-3} mc/l. This level is not considered dangerous to cattle. It would also indicate that there had not been significant concentration of activity in the water.

Papoose Lake is in an area where the infinite or total accumulated dose could exceed 100 r. It is not likely that the cattle would have been in this area all of the time, since they graze over a very considerable area.

A post mortem examination was made on one cow by Dr. R. H. Clark of Las Vegas two or three days after the animal had died. Decomposition and autolysis had progressed so far that pathological studies were impossible. On June 16 the rumen contents of this animal showed 1.0 to 1.5 mr/hr. above background and similar levels occurred on the back. There was no evidence of external lesions or beta burns on the back of this animal.

Many readings were taken around the water hole and in general these averaged between 3 and 5 mr/hr., but occasionally there would be readings up to 20 mr/hr. The high readings were usually encountered on the windward side of plants or other obstacles.

About 100 pounds of dirt from the bottom of the water hole have been sent to Oak Ridge. The dirt will be fed to sheep and cattle to determine if it contains toxic materials. The dirt and rumen contents of the dead cow will be analyzed spectrographically to determine if there may be an excess of toxic elements or an indication of a deficiency of an essential element. Activation analysis will also be made on the dirt and rumen contents.

From Papoose Lake the group went to the Penyor Valley area where the summer range is for the cattle. The range here is extremely dry and there is practically no grass, consequently, the cattle are forced to subsist on low shrubs, some of which are poisonous. There is considerable greasewood in the area and a cow that was posted showed that it was eating amounts of this plant that could well be the cause of death.

Five or six animals have died since the cattle were brought from the Papoose Lake area. The cattle were very emaciated. The Stewarts recognize that malnutrition and the eating of poisonous plants could be the cause of the losses here. It was agreed by the group that unless the cattle receive supplemental feed or there is rain to bring the grass in the very near future, the mortality among the cattle is likely to be much higher. It is also likely that the cattle are suffering from a Vitamin A deficiency.

There were no signs of lesions on the back or head of any of the cattle that we saw. Radioactivity, if any, on the backs of the cattle examined did not exceed more than 1 or 2 mr/hr.

One cow was found which had died within probably 10 hours. A post mortem examination was made on this animal. Samples of various internal organs, bone and rumen contents were taken for analysis for radioactivity, pathological studies, chemical or spectrographic analysis for inorganic elements, and Vitamin A analysis. The radioactivity on the back and around the internal organs did not exceed background.

There was one two-year old heifer that had been affected a short distance from Papoose Lake when some of the remaining animals were being moved back to the Penoyer Valley area. According to Mr. this heifer fell over without warning while being driven. They decided that she would probably die so they left her and went on with the other cattle. Next morning they returned and found that she had recovered. The felt that she was typical of the other five that had died and were anxious to have a thorough examination of this heifer.

After several hours of traveling over the range both by cowmen on horses and by car, she was finally located about 5 p.m. Blood samples were collected for clotting time, differential cell count, hemoglobin, Vitamin A, and for cultures for studying possibility of an infectious organism. The cow was killed and samples of various tissues, organs and bone were taken for radioactivity measurements, pathological studies, Vitamin A and other studies that might be made. The studies on these tissues will be made at the UT-AEC Project, USPHS Disease Laboratory at Hamilton, Montana, and at the Utah State Agricultural College. The results of some of these studies should be available by June 30. This animal was in much better condition than most of the cattle. No gross lesions were found. The clotting time for the blood was 5 minutes, which is normal for this species. Had the heifer suffered from radiation, the clotting time of the blood would almost certainly have been several or many time longer than normal.

On the basis of observations made on the cattle, it was agreed by the group that there was no direct evidence that the deaths had been caused by radiation. More precise information will be available when the laboratory tests have been completed.

We also went to Wild Horse Spring which is used for watering of cattle by the and sheep by.

Sheep: The sheep in question are owned by several men around Cedar City, Utah. Three different visits have been made to Cedar City. Mr. Joe Sanders of the Las Vegas Field Office has done a remarkably good job and is to be commended for maintaining a very friendly spirit and the good will of the and of the sheepmen around Cedar City towards the AEC.

On June 5 Mr. Sanders, Major R. H. Veenstra, Dr. R. E. Thompsett, Dr. A. H. Wolff, USPHS, Cincinnati, Dr. W. G. Hadlow, USPHS, Hamilton, Montana, Dr. Monroe Holmes, USPHS, Salt Lake City, Dr. A. E. Johnson, Cedar City and Mr. Steve Brower, County Agent, Cedar City, inspected sheep belonging to the following men:

, Cedar City, Utah
Cedar City, Utah
Iron County Utah,
Cedar City, Utah
Cedar City, Utah
, Cedar City, Utah
Cedar City, Utah
, Cedar City, Utah

These men graze their sheep during the summer in the high mountains, East of Cedar City. They are wintered on the range around the area of Caliente, Alamo, and Penoyer Valley, Nevada. They are normally trailed from the winter range to Cedar City before lambing in the spring. They are then shorn, and after lambing are taken to the summer range. They may be held in the valley around Cedar City from 20 to 60 days.

This is a very dry year on the summer range. Mr. said they had not had such a dry year and so little feed since 1932. A very high death rate of ewes and lambs was reported by the sheepmen. Post morten examinations were performed on sheep showing typical lesions on the back and around the nose.

Various organs, tissues and bone samples were taken by Dr. Hadlow and Major Veenstra for pathological and radiological studies. The reports of these studies will be made available as soon as the work is completed. Major Veenstra has examined the tissues from four sheep for radioactivity. Two of the sheep showed no organ levels above background.

One sheep from the herd showed values as follows using a gamma photon scintillation counter:

Counted between June 13 and 20

No. 1	Background	1120	counts/5	mi/600	mg. tissue
	Liver	2376	"	"	"
	Thyroid	171,648	"	"	"
	Lungs	4175	"	"	"
	Bone	4523	"	"	"

No. 2 From

Background	12567	counts/5 ml./300 mg. tissue
Liver	2631	" " "
Thyroid	225,945	" " "
Lungs	1734	" " "
Bone #1	2988	" " "
Bone #2	3944	" " "

These would probably be all beta counts. While the calculated level of radiation that the animals could have received would be far below the amount required for physiological effects, it is the first indication that the animals have picked up significant amounts of radiation or radioactive material. It would be presumed the high thyroid levels represent iodine 131. However, decay rates will be determined to obtain more precise information on this. Information is being obtained from Dr. Kornberg on iodine 131 toxicity for sheep so as to more precisely evaluate the above data.

A total of nine sheep, most of them showing typical face and back lesions, were examined and blood and tissues taken for study by Major Veenstra, Dr. Hadlow and Dr. Wolff, who is with the USPHS Laboratory in Cincinnati. These animals were taken from herds of sheep owned by three different men. The external beta counts of these sheep on the back ranged from 1.7 mr/hr to 50 mr/hr. One of these animals showed internal hemorrhage and the others showed no gross internal symptoms characteristic of radiation injury.

The other seven sheep will be studied for radioactivity in tissues and organs.

Seven of the 9 sheep were obtained on June 13. Dr. Monroe Holmes, USPHS, Salt Lake City, Dr. W. T. Huffman, Bureau of Animal Industry, Salt Lake City and Dr. Robert Bey, University of Utah, met Mr. Sanders, and Mr. Allaire in Cedar City and accompanied them on visits to several ranchmen and the range area.

A summary of operating activities and losses of sheep arrived at by personal contact with the sheepmen June 12 and 13 follows:

Date of trailing from Nevada range - April 20
Trailing deaths - 6
Premature lambing during trailing - small
Date started lambing - April 20
Ewes lost during lambing (2 to 3 yr. olds) - 300 plus
Number normal lambs lost - ?

cont'd

Total number sheep - winter range - 3200
No. lambs lost at birth or immediately thereafter - 700
Shearing count - no answer
Time lamb died after birth - few hours to several days
Period greatest loss occurred - last 30 days
Date of shearing - April 20
Skin lesion first noticed - April 20

Date trailing from Nevada range - 4/6 to 5/5
Trailing deaths - 35
Premature lambing on trail - 6 to 8
Date of lambing - May 9
Ewes lost during lambing (2 to 3 yr. olds) - 200
No. normal lambs lost - 600
Total number sheep - winter range - 1835
No. lambs lost at birth or immediately thereafter - 500 to 600
Length of time lambs died after birth - 2 hrs. to several days
Period greatest loss occurred - May 15-25
Date of shearing - May 4 and 5

Bullock reported 10 ewes died during the day of June 11, 1953

Date of trailing - 4/1 - 4/8
Trailing deaths - 12-15
Premature lambing on trail - 0
Date of lambing - May 2
Ewes lost during lambing (older ewes) -200
No. normal lambs - ?
Total sheep (winter range) - 1375
No. lambs lost at birth or immediately thereafter - 400
Length of time lambs died after birth - 1 hr. to 1 week
Period greatest loss occurred - 5/5 - 5/20
Date of shearing - 5/7 - 5/8

Date of Trailing - 3/23
Trailing deaths - 10
Premature lambs on trail - 10-12
Date of lambing - April 5 - 15
Ewes lost during lambing (2 to 6 yr. olds) - 12
No. normal lambs lost - ?
Total sheep (winter range) - 2100
No. lambs lost at birth or immediately thereafter - 470
Length of time lambs died after birth - 1 hr. to 5 days
Period greatest loss occurred - April 5-20
Date of shearing - May 2

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Date of trailing - 4/18 - 4/27
Trailing deaths - 12
Premature lambing on trail - 0
Date of lambing - May 2
Ewes lost during lambing - 300
No. normal lambs lost - 300
Total sheep - winter range - 1500
No. lambs lost at birth or immediately thereafter - 600
Length of time lambs died after birth - 2 hrs. to 7 days
Period greatest loss occurred - May 1 - 20
Date of shearing - May 2 - 11

General appearance of Sheep (as told by stockmen)

Scabby face, hair falling out - sores appeared on head and some on body - body sores probably covered with wool - sores on back not noticed until shearing began. Wool on some sheep could not be sheared because it would pull loose from body - blisters first noticed on face - skin red in areas not covered by wool - no particular part of body affected more than any other.

Other Remarks by Stockmen

Sheep eat well until death - black sheep affected same as light - animals do not seem normal, very wild, lose mother instrinct - some lambs die from malnutrition - ewes do not furnish normal milk - many dry ewes.

sheep continue to die. Has 600 lambs left expected 1500 from herd of 1735 sheep.

---

and grazed their sheep in Nevada on range land located west and north of Pioche close to grazing area of Louis Ence. They began trailing sheep from winter range April 15. They report better than normal conditions with sheep this season. was on the range with the sheep and saw some of the N.P.G. Shots while there. It is the opinion of that most of the trouble the stockmen are having is attributable to poor management, improper care, etc. The gave their sheep a supplemental diet of protein and salt from 2 to 3 ounces per day per head. Two of the post mortems performed June 14, 1953 were on sheep furnished from flock. The had heard of some sheep losses close to Alamo.

Had herd of approximately 1600 sheep on ranges close to Modena, Utah, and Panaca, Nevada. Moved sheep from Panaca area to Modena area on May 1, 1953. Had greater than normal loss, many dry, very little milk for lambs, but attributes trouble to drier than usual year. No beta burns on sheep - no loose wool. Mr. Cedar City.

---

ranged sheep in Ely Springs, Dry Lake Valley S. W. of Pioche and N.W. of Panaca. Lost 300 out of a herd of 1700 ewe yearlings - very poor lambing - ewes lost lambs instinct, vitality. Sheep have sores on mouth and face, slipping wool, etc. reports 150 head of sheep died during two-day cold snap.

Reports kind of rough year, but not too much trouble. Ranges sheep in White River Valley south of range. Saw atomic clouds go over. Had few premature lambs but trouble no worse than experienced in previous dry years.

- June 12, 1953

Had 1500 ewes - normal loss 50 ewes. This year 300 - marked 300 lambs expected to mark 1000 out of herd of 1500. Has possible 100 more lambs to mark. Unable to determine cause of sickness. They eat plenty but do not seem to recuperate. Hay and grain do not seem to help sheep.

X About May 26, Dr. F. H. Melvin, Veterinarian in Charge, Salt Lake City Office of BAI and Dr. John E. Curtis, Utah State Veterinarian, visited three or four herds of sheep in the Cedar City area. They made some post mortems, but found nothing specific. Dr. Melvin's report says that there were many high temperatures among the sheep. This is in contrast to sheepman, who said there were no high temperatures and that the affected sheep had normal temperatures.

While only the general locations and movements of the sheep during the test period are known, this would indicate that radiation could have been much higher for the cattle and horses, than for the sheep.

On June 18, Messrs. Sanders, Woodruff, Pearson, Drs. Trum and Rust, UT-AEC, and Drs. Broadbent, Stoddart, Greenwood and Shupe from the USAC, were joined by Donald Mathews and Max C. Robinson of the Branch Agricultural College at Cedar City, and Mr. and Mr. for a drive of over 100 miles to the high ranges and sheep herds. Several herds of sheep were viewed in an effort to find sheep showing typical lesions. While some animals with loose hair and lesions around the face were found, Mr. said that none of them had the typical symptoms shown by his sheep. He remarked that all of the affected ones have either died or recovered.

One animal that showed some face lesions and was very thin was posted, tissues, bone and blood were taken for further studies. Three sheep showing some lesions around the face, and in a rather poor state of nutrition, were taken to the Utah State Agricultural College for further studies.

Summary: It was generally agreed that the 16 head of horses showed beta-ray burns. There is very little evidence that the losses of sheep and cattle are due to radiation, however, no conclusions or statements should be released until the laboratory tests and studies have been made. There is evidence that some of the losses of cattle and sheep are due to malnutrition.

Recognizing that the studies on the etiology of the losses of the cattle and sheep may not be conclusive this year, it is planned to set up research projects at the University of Nevada and the Utah State Agricultural College. Faculty members working on the projects will include veterinarians, range management specialists, animal nutritionists and biochemists.

cc: Joe Sanders
W. W. Allaire

Office Memorandum • UNITED STATES GOVERNMENT

TO : Distribution

DATE: June 26, 1953

FROM : Carroll L. Tyler, Manager, SFO

SUBJECT: LIVESTOCK AND MINING MATTERS, NEVADA PROVING GROUNDS AREA

SYMBOL : T-7

In connection with the Nevada Proving Grounds, the following policy, approved by the General Manager, is quoted for your information and guidance:

> "It must be made clear to all concerned that in these immediate problems pertaining to sheep, cattle and horses I have directed the Division of Biology and Medicine to be responsible for monitoring and correlation of the procedures and steps for getting complete data on the condition of the animals and for establishing the criteria for determining extent of damage on which claims could be considered and paid. Under this arrangement the Division of Biology and Medicine will provide correlation of the fragmentary studies of various individuals who have been drawn into this - veterinarians, Public Health officials, etc.; that where necessary the Division of Biology and Medicine will seek Commission approval of the criteria, but that they will provide as much advice and criteria as possible, on the spot, to the Santa Fe Operations Office in order that such claims as are proper can be handled as expeditiously as possible. In the field, the Santa Fe Operations Office and the Las Vegas Field Office will continue to deal with the public locally on these problems and others that arise, in a responsible capacity, calling on the Division of Biology and Medicine for assistance as needed."

Within SFO, the Office of Test Operations will be responsible for coordinating the assembly of data on matters pertaining to current problems involving livestock and mining interests, but excluding claims of a routine nature which are normally handled by the Las Vegas Field Office. The Office of Test Operations is responsible for coordinating requests for information on such

matters emanating from Washington and for transmitting pertinent data and information to the Division of Military Application or the Division of Biology and Medicine as may be appropriate. SFO offices, contractors and other related agencies shall refer any information or requests received in connection with such matters to the Office of Test Operations for coordination.

The Field Manager, Las Vegas Field Office, will continue to obtain and develop such information as may be required relative to the livestock and mine problems, and will continue to maintain necessary relations with local individuals and agencies.

Distribution:
Assistant General Counsel
E&C Division
Information Division
P&O Division
S&FP Division
Test Operations
Eniwetok Field Office
Las Vegas Field Office
Los Alamos Field Office
Dr. Norris E. Bradbury, Director, LASL
Dr. R. H. Thompsett, Los Alamos, N.M.
AFSWP, Sandia Base - attn. DWET

Information copies furnished to:
Division of Military Application, AEC, Washington
Division of Biology & Medicine, AEC, Washington

Aid 7nac

July 9, 1953

Mr. Vernon Metcalf, Secretary,
Nevada State Sheep Commission,
P. O. Box 1129,
Reno, Nevada.

Dear Mr. Metcalf:-

Mr. Warren B. Earl, Director of the Division of Animal Industry, Nevada Department of Agriculture, has referred us to you regarding some information we need.

As you probably know, Utah had sheep in several herds, owned by Cedar City men, winter ranging in Southeastern Nevada near the Atomic Energy Proving Grounds. Deaths of adult sheep and new-born lambs occurred in these animals a short time after trailing to Cedar City for shearing and lambing. We have considerable information regarding these particular herds but we have been unable to obtain additional information concerning Nevada owned sheep. Would you be able to supply the following data?

Number of herds and size of herds of Nevada owned sheep in the Caliente, Hiko, Panaca and Pioche areas?

If Nevada sheep were in these areas, were they affected by loss of wool; blistering on face and forehead; loss of lambs at lambing time or shortly thereafter; deaths of older animals during lambing or shortly thereafter?

We would appreciate knowing also: Total number of animals lost; number of lambs lost; who owned the animals; etc.

I realize this is quite a lot of information to request but, if it is possible to obtain it would aid in correlating the data found on the Utah sheep and may give us insight into what protective measures and information should be given in the future to live-stock people. Your prompt reply is necessary as the evaluation conferences are now being held by State Live-stock people, Health personnel and A.E.C.

Thanking you in advance for your courtesy and consideration, I am

Sincerely,

MONROE A. HOLMES
Veterinarian

MAH:unl

126

12.6-131

UTAH STATE DEPARTMENT OF HEALTH

SALT LAKE CITY

July 16, 1953

Dear Sir:-

Your name was given to us by Mr. Vernon Metcalf, Secretary of the Nevada Board of Sheep Commissioners. As you know, several of the Utah sheep men who were grazing in and around your area suffered considerable loss of sheep this year. Factors which may be the predisposing causes are so numerous it has been difficult to determine which one may have been the actual cause. If you have suffered losses in your sheep this year, we would appreciate that information, as well as the following:

1 Did the adult sheep show any wool slipping (on body) or blistering on the head and face?
2 Did you suffer over normal loss of sheep at lambing (number of adults and number of lambs)?
3 Were your lambs stunted in size although full-term?
4 Did these lambs die prematurely or did they survive?
5 Have you had any of the above trouble in previous years? When?
6 Exact location of your range from November through March, in relation to the Nevada Proving Grounds?
7 Have you suffered any malnutrition losses in the past?
8 What poisonous plants have your sheep ever eaten where death or sickness has resulted?
9 If you suffered losses in adult sheep with wool slippage or deaths, were these young sheep (2 to 4 years) or older sheep?

Inclosed is stamped self-addressed envelope for your convenience in replying. Your prompt answer to the above questions will be greatly appreciated, and may aid in preventing future sheep losses in this area, in which you yourself are interested.

We thank you in advance for your courtesy and co-operation.

Sincerely,

Monroe A. Holmes By U. N. Lee

MONROE A. HOLMES
Veterinarian

MAH:uml
Encl.

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Dear Mr. Monroe:

In answer to your inquiry will say we haven't had any sheep on the range for about 20 years.

We do have 3 ewes 4 lambs and a weather which we keep in pasture or feed. So far there has been nothing wrong with any of them.

Sincerely

UTAH STATE DEPARTMENT OF HEALTH

SALT LAKE CITY

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We thank you in advance for your courtesy and co-operation.

Sincerely,

Monroe A. Holmes

MONROE A. HOLMES By W. N. Lee 12
Veterinarian

MAH:uml
Encl.

We have no information of value, as we sold our sheep 18 mos. ago. Think your investigation should turn up something on the wool slippage but did not think of the cause at the time. [illegible]

UTAH STATE DEPARTMENT OF HEALTH

SALT LAKE CITY

July 16, 1953

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Sincerely,

Monroe A. Holmes By Y. N. Lee

MONROE A. HOLMES
Veterinarian

MAH:YNL
Encls.