Summary of Reports . . .

1980 Sheep and Wool Days

Special Report 578

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Agricultural Experiment Station

Oregon State University, Corvallis

CONTENTS

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CONFINEMENT SHEEP MANAGEMENT AT FAIRVIEW COLLEGE

L. T. Jones

Fairview College is a small institution north of the Peace River in northwestern Alberta.

Our climate is described as sub-arctic, and though this description brings to mind lots of ice and snow, such is not the case. Situated at 56° N., we enjoy long summer daylight hours, and relatively stable, though cold, winters. The college is 15 miles north of Dunvegan on the Peace River, in the heart of the Peace Country. Agriculture has been a program since the college was established in 1951, and the farm and livestock are almost exclusively used for instruction of students entered in the two-year Diploma Agriculture program.

The design of the management programs for the college cattle and sheep has been my responsibility as animal science instructor since 1957. Management changes have been designed more to demonstrate management techniques to students, and to provide maximum animal numbers, than to provide research functions. The development of our sheep management has "evolved" over the years.

During the early 1960s, the college flock was managed in the traditional manner of other flocks on western Canadian farms. Lambing occurred during March and April; ewes and lambs were grazed on predominantly grass (fescue, brome) pastures, and during late summer or early fall, lambs were weaned and finished on hay and grain to 100 pounds slaughter weight. Ewes were flushed and bred during mid-October and were wintered in open front pole frame sheds with access to hay feeding corrals.

In 1964, the flock was increased to 150 ewes, and during the summer, severe limitations became apparent in the pastoral management of ewes and lambs. These problems were:

1. A severe shortage of properly fenced pastures, with no available land to increase grazing and still produce winter feed.
2. Total annual precipitation of 16 inches and continued use of grasses such as fescue provided frustratingly low pasture-carrying rates, particularly after the end of July.
3. Pasturing required that potentially high yielding, bloat inducing crops such as alfalfa and red clover be avoided.

4. Crossfencing to ensure pasture and crop rotations represented a costly investment, and required that extra cost and labor be expended in tillage, seeding, and harvesting operations.
5. Harrassment of grazing ewes and lambs by dogs from the adjacent town of Fairview.
6. Internal parasite loads were becoming a limiting factor in lamb performance.
7. The lack of any shelters on pasture and dugout water supply increased the cost of production. Moving portable pasture shelters and rotation of the flock around available water increased the management load.

With a further flock increase to 200 ewes, the decision to eliminate pasture was made in 1966. The change in flock management was accomplished in the following manner:

1. All cross-fencing of former pasture and hay land was removed, leaving only the perimeter fence intact.
2. Pastures and hayland were plowed down, and annual high yielding forages and grains were grown. Dry matter yields of 1.3 tons/acre from brome-alfalfa hay were routinely obtained; however, 2.5 to 3.5 tons of dry matter/acre were harvested from the same land using barley-oats-peas silage (harvested at 35 percent dry matter). Increased number of sheep/acre of cultivated land became possible. No difficulty was experienced feeding silage to the ewes provided proper storage (in this case, bunker silos) and high dry matter (30 to 35 percent) levels were maintained.
3. Grain silage crops at the college were harvested during late August. By including fall rye in the seed mixture, grazing was provided for ewes during September to late October, depending on snow and moisture conditions. Stubble aftermath from silage harvest also provided late summer pasture.
4. The pole-frame sheds and hay feeding corrals which provided winter quarters also became the summer quarters for the flock.

During the first season, problems managing nursing lambs in confinement developed. Of those problems, pasteurella infections and coccidia parasitism of lambs were the most difficult to overcome. The dramatic increase in harvested forage yields from former pastures provided incentive to continue the program and to solve the lamb management problems. Access to the same quarters as the

TABLE 1

AREAS/SHEEP FOR HOUSING & CORRALS

SHEEP	SITUATION	AREA
1. DRY EWES DURING SPRING, SUMMER FALL	SHED CORRAL	10 SQUARE FEET 100+ SQUARE FEET
2. BREEDING (SEPT.)	SHED CORRAL	10 SQUARE FEET 100 SQUARE FEET
3. MID PREGNANCY WINTER	SHED CORRAL	10 SQUARE FEET 100+ SQUARE FEET
4. 6 WEEKS PRE-LAMBING	SHED CORRAL	18 SQUARE FEET 100+ SQUARE FEET
5. EWES WITH LAMBS	SHED CORRAL	20 SQUARE FEET 100+ SQUARE FEET
6. WEANED LAMBS (30-40 Days)	SHED	4-6 SQUARE FEET
7. LAMBS ON	ELEVATED SLATTED FLOORS	2.5-3 SQUARE FEET

+ ABSOLUTE MINIMUM. MAY BE INCREASED FOUR TIMES.

ewes, and "picky" eating habits peculiar to lambs, required that the lambs be weaned and removed to separate sheds and corrals. The following routine lamb management was developed:

1. Lambs were provided with a highly palatable, barley-based, 16 percent crude protein creep ration within 10 days of birth. Consumption depends entirely on weather, temperature, and lactation.
2. All lambs were weaned about 30 days of age by removing the ewes and holding them in the hay feeding corrals. The lambs were locked in the wintering shed with ready access to self-feeders containing the 16 percent creep ration. Consumption of the creep ration up to 30-day weaning usually did not exceed 8 pounds per lamb. The 30-day age was finally chosen to wean lambs, because it coincides approximately with the peaking of ewe lactation, and provides the best age at which to change lambs to grain self feeders without experiencing acidosis problems. All grain feeding of ewes stopped two days pre-weaning.
3. Lambs were finished on barley-based diets and heat prostration bordering on hyperthermia was experienced. Lambs were difficult to maintain in sheds on "deep litter" without experiencing coccidia problems. After the first several years, hay feeding was discontinued.
4. The attempt to "cool" the lambs during summer feeding on concentrates and prevent coccidiosis eventually led to constructing a pole frame shed with a wood slotted floor. Floors were elevated 30 inches above grade, and lambs were penned at 2.8 square feet each. Auger-filled self feeders, automatic waterers, and barley based diets with no forage proved extremely successful. Whole barley and a supplement pellet providing a diet of 13 percent crude protein were gradually introduced to 50 pound lambs and continued until 105-pound slaughter weights were reached (see Finishing Ration attached). During a brief interval in 1971, urinary calculi among males proved troublesome. However, adjustment of the calcium:phosphorous ratio to approximately 3:1, and replacement of small automatic in-pen waterers, with longer trough waterers outside the pens, solved the problem.
5. Both male and female lambs are raised in identical situations up to weaning, but are separated into sexed groups on slotted floors. Males are "ringed" at birth by pushing testicles up before applying an elastrator ring on the scrotum at the teats. Tails are also docked with elastrators. Ewe lambs are selected from slotted floor pens at 105 pounds, based on

TABLE 2

FAIRVIEW CREEP RATION (16 % CP)

Coarse Rolled Barley	1620 lbs.	(10 % CP)
Soybean	340 lbs.	(48 % CP)
Cobalt and Iodized Salt	20 lbs.	
Ground Limestone	20 lbs.	
	2000 lbs.	

- add to each ton,
  1 lb. TM 10 (10 gms. Terramycin per lb.)
  10,000,000 IU Dry Vitamin A, (VITADE)

- provide free access to loose cobalt - iodized salt, and limestone.

TABLE 3

LAMB CREEP FEED CONSUMPTION
(While Nursing)

TYPE OF RATION	AVERAGE AGE OF LAMBS * (DAYS)			
	BIRTH-20	21-32	33-38	39-46
	LBS.	LBS.	LBS.	LBS.
1. WHEAT & BARLEY (17% CP)	NIL **	9	49	178
2. SOYBEAN MEAL (48% CP)	NIL	47	43	100
3. TOTAL FEED (1 + 2)	NIL	56	92	278
4. FEED INTAKE PER LAMB DURING EACH PERIOD	NIL	.9	1.5	4.5

* 62 Lambs, representing 8 breed crosses, and all birth types (Single-Triplet)

* * Some was eaten, but was not measurable.

TABLE 4

THE FEED CONVERSION EFFICIENCY OF CREEP RATIONS FED TO NURSING LAMBS

NO. OF LAMBS	AVE. BIRTH WT. (LBS.)	AVE. GAIN/ LAMB (LBS.)	AVE. CREEP RATION CONSUMED LBS.	* FEED CONVERSION EFFICIENCY
264	8	46	65	1.4:1

* The contribution of the milk to lamb gains is not included.

No hay was offered to the lambs.

TABLE 5

Ewe and Lamb Feed Intake

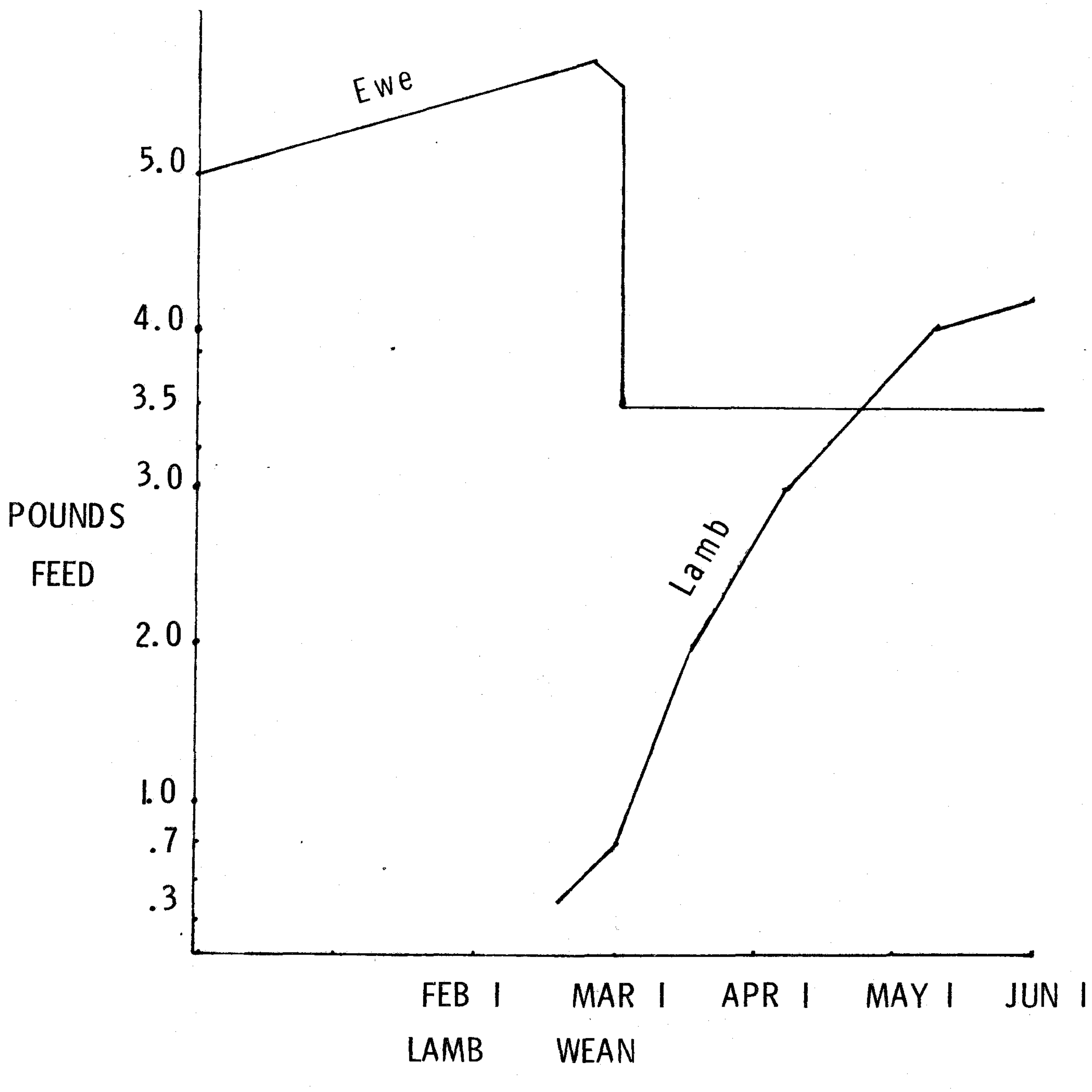


TABLE 6

FAIRVIEW FINISHING RATION (13 % CP)

Whole Barley	1860 lbs. (10% CP)
* Lamb Pellets	150 lbs. (50% CP)
	2000 lbs.

- Offer cobalt - iodized salt, and ground limestone free choice.

*LAMB FEEDLOT PELLETS

Meat Meal	330.0 lbs.
Canota Meal	55.0 lbs.
Soybean Meal	1095.0 lbs.
Urea	137.0 lbs.
Ground Limestone	385.0 lbs.
Cobalt - Iodized Salt	130.0 lbs.
Dried Molasses	27.2 lbs.
Beef Tallows	10.0 lbs.
TM 50	6.0 lbs.
Vitamins, Trace Minerals	3.8 lbs.
	2000.0 lbs.

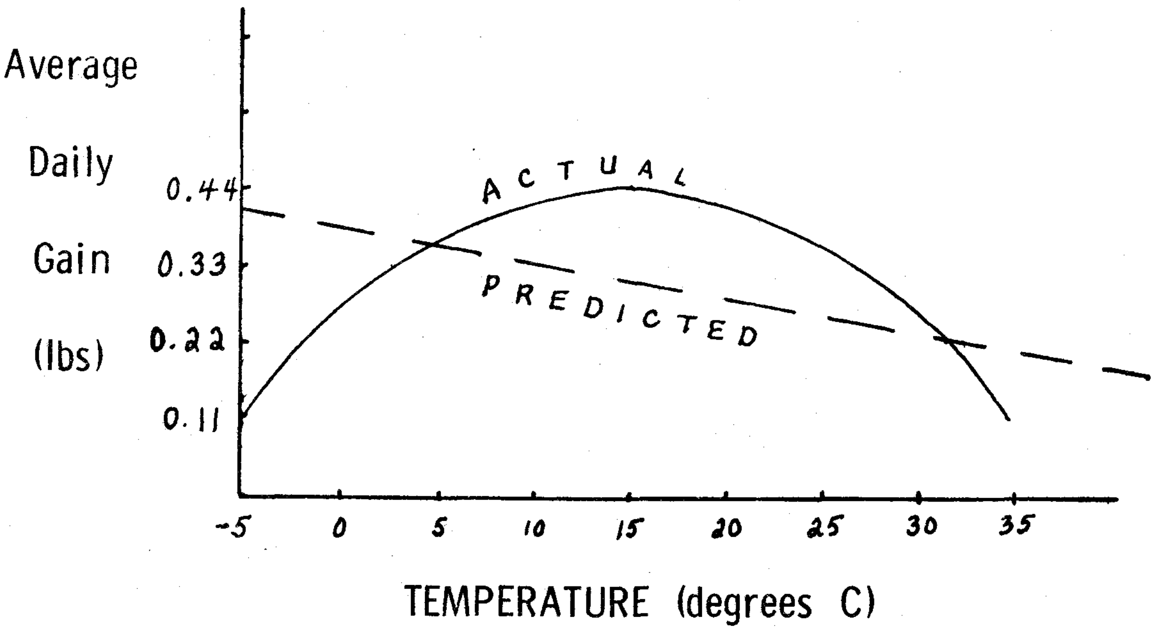
ECP from NPN = 18 %

Cost for Edmonton Alberta (March 1980) = $ 338 per ton

TABLE 7

*RELATIONSHIP OF ACTUAL AND PREDICTED GAIN
TO AMBIENT TEMPERATURE

(Ames, D. R.; Brink, D.r.; Journal Animal Sc. Jan 77)



*Shorn Lambs, Age Unknown

weaning index, 105 pound index, birth quarter, and birth type. It is interesting to note that the entire college ewe flock lambing in 1980 was raised under these conditions as lambs. Longevity and prolificacy have improved steadily.

The move toward raising lambs on slotted floors has proven extremely successful. Once lambs are grouped on floors, few management problems have been experienced. Grouping of lambs is done with care. Lambs of similar size, vigor, and sex will grow and finish together with few problems. However, "pecking orders" develop with mixed groupings, and wool picking may develop. Groups have not exceeded 30 head.

Summer management of the ewes, once lambs are weaned and in the slotted floor barn, becomes simplified. Various attempts to supply only maintenance diets, using oat straw and/or hay, proved successful. However, some producers attempted to imitate the maintenance straw feeding and neglected vitamin A, phosphorous, and protein nutrition, with resultant predictable problems.

To discourage "imitators," the college flock has been maintained during the summer on self fed (high fiber) hay. Ewes are maintained in thrifty, but slightly lean, condition, which would approximate the British Score of 2.5 on a 1 (thin) to 5 (fat) scoring system. Breeding and lambing body scores ranging from 3.5 to 4 are our goal. Annual fecal samples have shown it possible to eliminate internal parasites, with the exception of coccidia, in confinement. However, by constructing feeders which prevent feed (both hay and grain) contamination, and by moving lambs onto slotted floors early, coccidiosis need not be a problem.

Lambs are born from January to April. The first lambs go onto slotted floors about April 15, depending on weather conditions. Moving the ewes out of the shed corral system to clean up silage or crop aftermath fields saves labor and harvested feed. Ewes have been on these fields from mid-August to late November. Provided there are no special breeding plans such as synchronization, or specific matings, breeding on aftermath pasture has proven successful. Supplemental feeding with round hay bales is sometimes necessary late in the season.

Out of season lambing in October has been attempted, using artificial light. However, after Finnsheep rams became available in 1969, the 1/2 Finnsheep ewe, managed for production of more than 200 percent lamb crop, has proven to be most convenient for our needs. During the last five years, attempts to save all lambs at birth, and provide control of such diseases as EAE (Enzootic abortion of ewes)

TABLE 8

EARLY WEANED MALE LAMBS; PERFORMANCE DURING LATE GROWTH ON ELEVATED SLOTTED FLOORS

1. Type of Diet	Whole barley and pellets *
2. Weight on trial (lbs.)	76
3. Age on trial (days)	80
4. Weight off trial (lbs.)	109
5. Age off trial (days)	113
6. Feed Conversion Efficiency	4.1 : 1
7. Cost per lb. of gain (¢)	18

* 3.5 sq. ft. per lamb
** Lamb Feedlot Pellets (50% CP)

COMPARISON OF ALFALFA PELLETS vs BARLEY

	RATION	RATION
1. Type of Diet	Alfalfa pellets	½ Alfalfa pellets ½ Whole barley
2. Weight on trial (lbs.)	88	86
3. Age on trial (days)	98	95
4. Weight off trial (lbs.)	116	124
5. Age off trial (days)	141	139
6. Feed Conversion Efficiency	7.5 : 1	5.2 : 1
7. Cost per lb. of gain (¢)	23	19

* 16 % CP

TABLE 9

BODY WEIGHTS; CONFINED EWES

(60 Days of Gestation)

No. of Ewes	Age Years	Breeding Finn	Breeding Other	November weights This Year	November weights Last Year
		Percent			
38	Aged	0	*Mixed	168	166
17	3.5	50	"	176	160
31	3.5	0	"	171	160
7	2.5	25	"	144	119
22	2.5	50	"	168	136
32	2.5	0	"	161	139
3	1.5 **	25	"	122	116
16	1.5	25	"	134	124
11	1.5	50	"	133	118
36	1.5	0	"	130	125

* Mixed, predominately suffolk, also dorset, hampshire, and rambouillet, crosses.

** All 1.5 year olds lambed as yearlings.

TABLE 10

ECONOMICS OF CONFINEMENT

Annual Cost Per Ewe	Required Cultivated Acres/Ewe	
	Hay - Grain System	Barley - Silage Grain System
$ 88.00	.76	.58

Net Annual Revenue Per Ewe	Net Returns Per Cultivated Acre	
	Hay - Grain System	Barley - Silage Grain System
$ 20.00	$ 26.00	$ 35.00

* (1977) - Total feed, drugs, shearing, etc., shed corrals and other capital depreciated over 15 years to zero value.

** Fairview, Alberta (16 " precipitation annually)

-approximately 1.5 tons hay per acre. 40 bushels barley per acre

- 8 tons (35%) barley silage per acre

TABLE 11

EFFECT OF CHANGING

DIETARY ENERGY CONCENTRATIONS

	Diet A	B	C	D	E
ME Level of Ration, Mcal/kg	2.82	2.73	2.71	2.59	2.36
Daily Carcass Gain (g/day)	143	125	121	118	105
Dry Matter Content of Rumen (g)	503	816	818	1302	1287

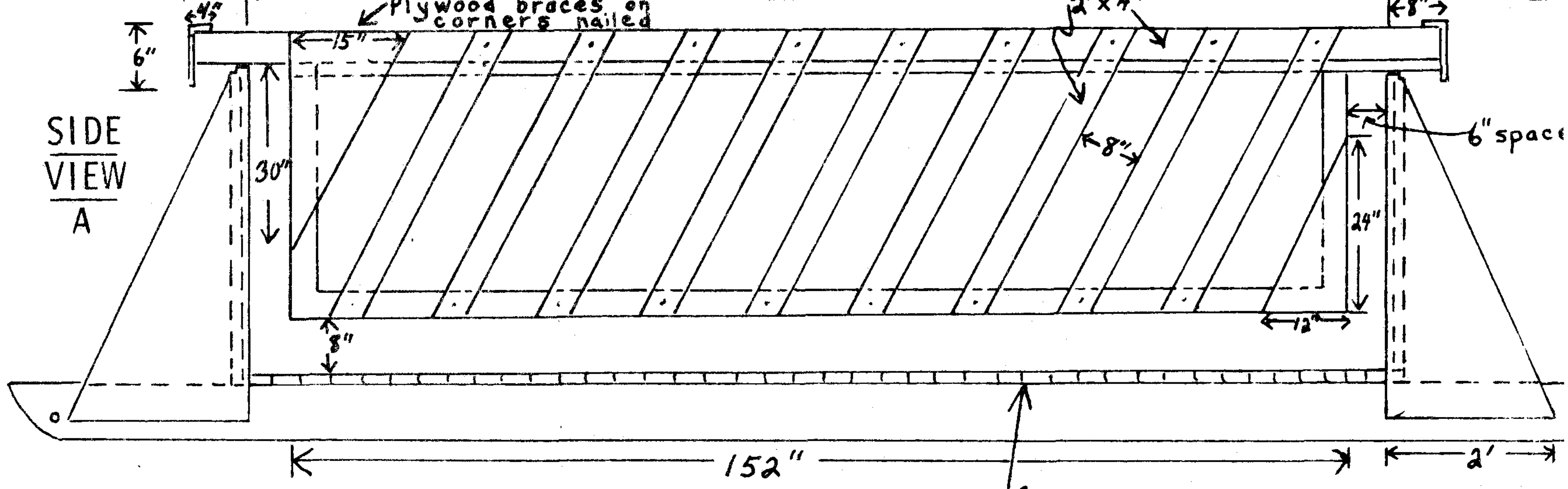
although the disease is not yet evident at Fairview, have led to efforts to isolate lambing ewes. The use of 3 foot X 5 foot stanchion stalls, in which ewes are placed at 140 days of gestation, has provided a survival rate (during the first 48 hours) of 99 percent of births. Ewes lamb while restrained in the stanchion, and have remained for as long as 30 days with no ill effects. However, 48 hours in the stanchion stall is sufficient to establish an extremely durable maternal bond. It is interesting to note that with 1/2 Finn ewes, mated to Suffolk rams, it has not been necessary to maintain a night lambing shift. Every year, a large group of college ewes lamb in the conventional arrangement (shedded at night, placed in the "jug" for 48 hours) with 24-hour lambing shift attendants. Our long-term lamb survival rate to 48 hours of age has been only 82 percent using inexperienced students at lambing time. When a stanchion lambing barn is completed, the entire flock will lamb in synchronized groups in stanchion stalls. The use of stanchion lambing stalls proves particularly valuable for yearlings.

In summary, the system is better described as "partial confinement" of ewes, since they graze silage harvest aftermath during late summer. The lambs, however, are closely confined and thrive under such circumstances. The system is particularly adaptable to areas of intensive cultivation, or where predators, fencing costs, or alternate land use prohibits grazing.

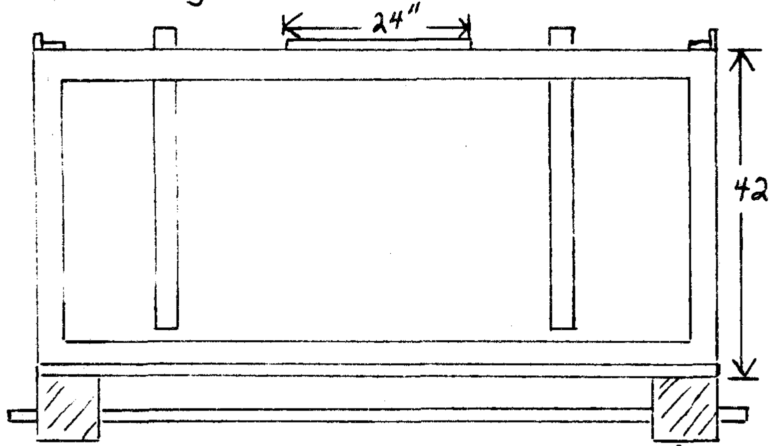
FAIRVIEW COLLEGE

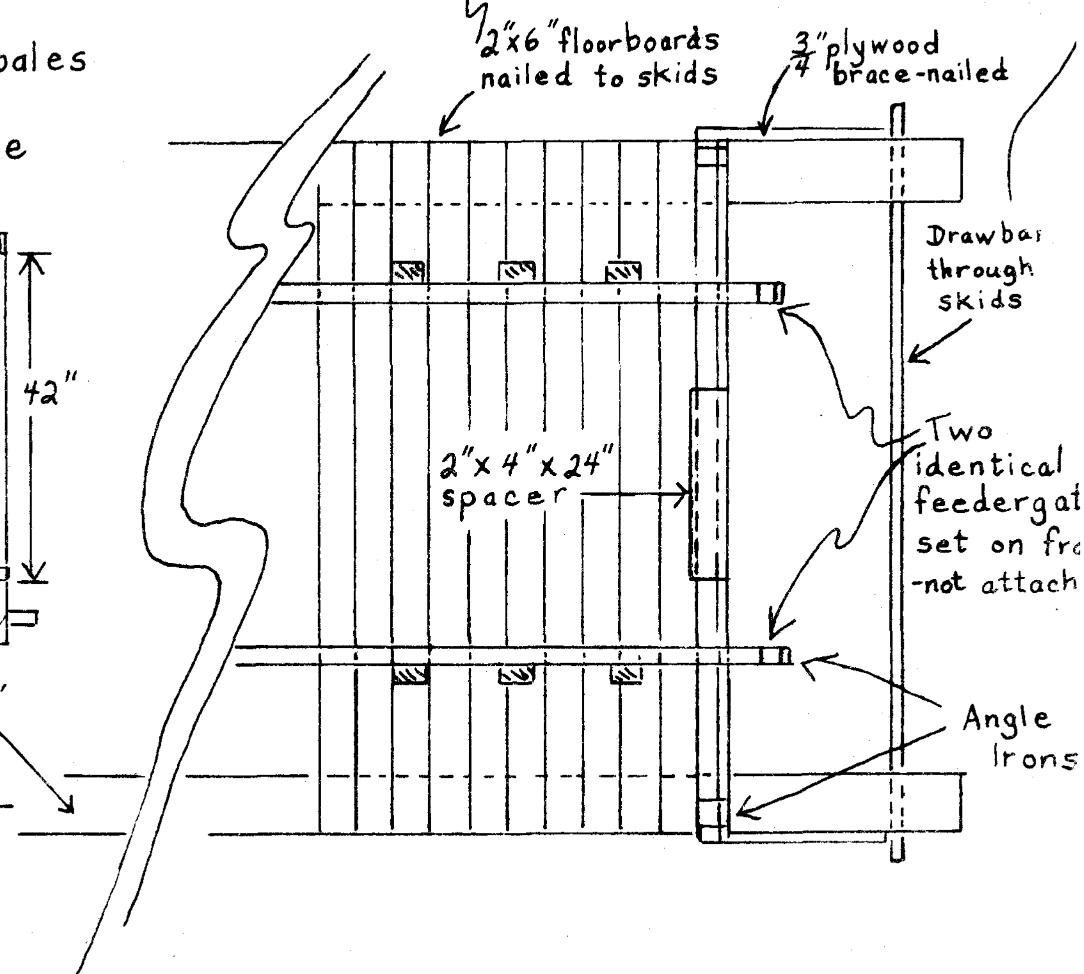
ROUND BALE (SHEEP) FEEDER

(2 Bale Capacity)



Lift off one feeder gate. Place 2 bales in feeder. Replace gate.
Sheep push gates toward centre as they eat.





ROUND BALE FEEDER - MATERIALS LIST

A. Plywood (1/2")

2 pcs. - 2' x 5' - Cut diagonally
2 pcs. - 41 3/4" x 90"
1 pc. - 3' x 2' Feeding gate
1 pc. - 2' x 1' corner gussets

B. Lumber

a) Feeding Gates and Ends

2 pcs. - 2" x 4" x 15'
2 pcs. - 2" x 4" x 12'8"
4 pcs. - 2" x 4" x 2' 6"
18 pcs. - 2" x 4" x 5'
2 pcs. - 2" x 4" x 2'
4 pcs. - 2" x 4" x 7' 6"
4 pcs. - 2" x 4" x 3' 6"

b) Flooring

28 pcs. - 2" x 6" x 7' 6"

c) Skids

2 pcs. - 8" x 8" x 9' 2"

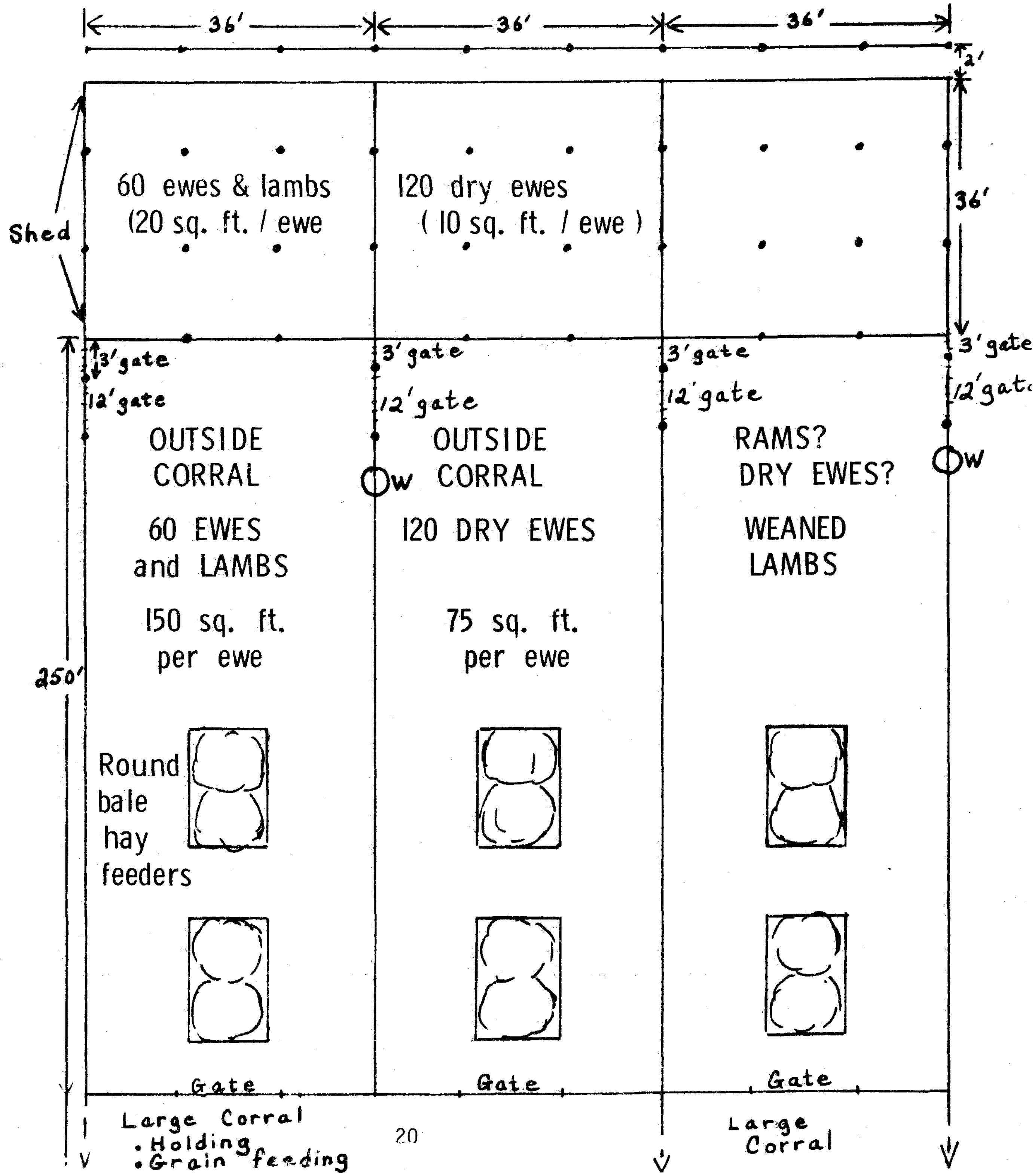
C. Hardware

2 pcs. - 1 1/2" metal bar x 96"
4 pcs. - 2" x 4" x 6" angle iron
4 pcs. - 2" x 4" x 4" angle iron
36 - 3/8" x 3 1/2" carriage bolts
Assorted nails

FAIRVIEW COLLEGE

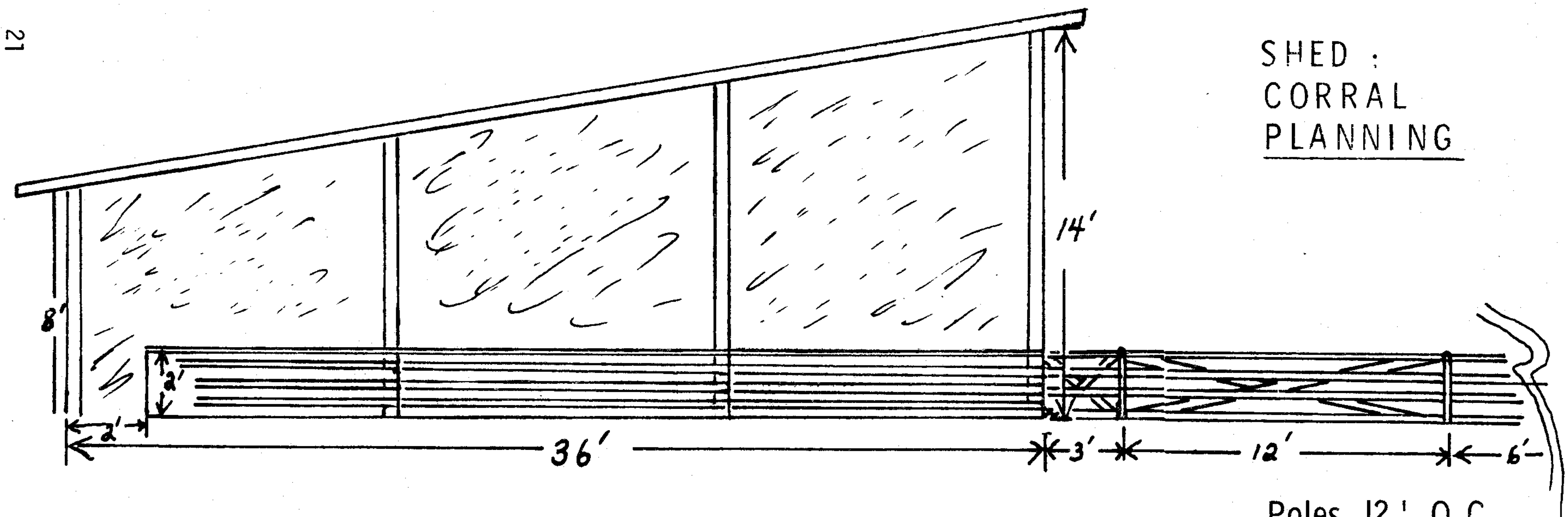
CONFINEMENT SHED AND CORRAL PLAN

*Pole and frame sheds (Poles 12' O.C.)
*One slope roof
*Plank and woven wire corral divisions
*Moveable interior shed divisions



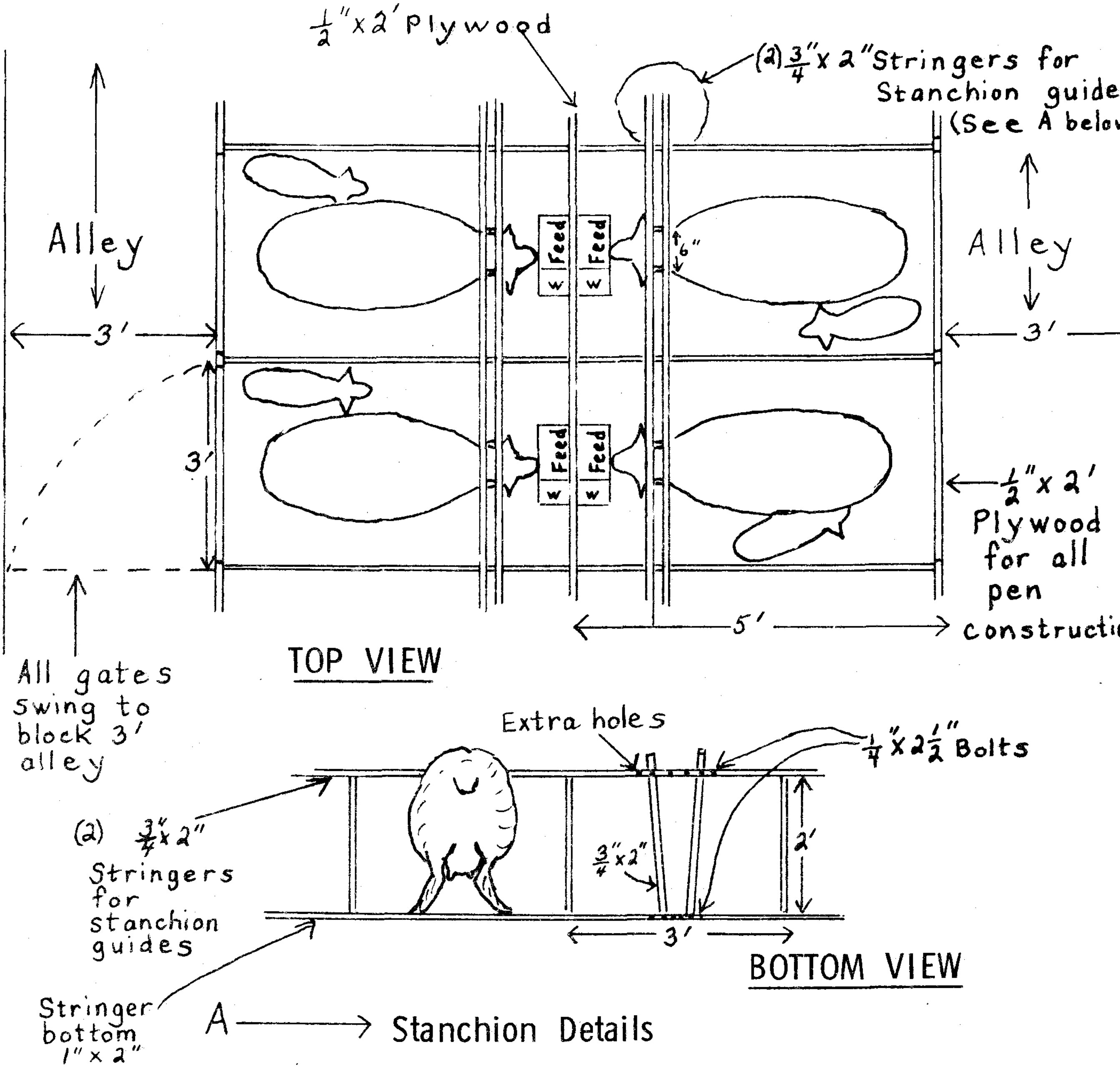
FAIRVIEW COLLEGE

SHED : CORRAL PLANNING



Poles 12' O.C.
Roof Pitch 2' in 12'

STANCHION LAMBING PENS



A → Stanchion Details

SLATTED FLOORS FOR SHEEP IN WESTERN OREGON

John A. Leffel

Interest in using slatted floors started in the early 1970s in western Oregon as the need for intensified sheep management became apparent. Various types of sheep management systems using partial or total confinement are still relatively new and not widely accepted, although swine and beef producers have been successfully using this type of confinement for many years.

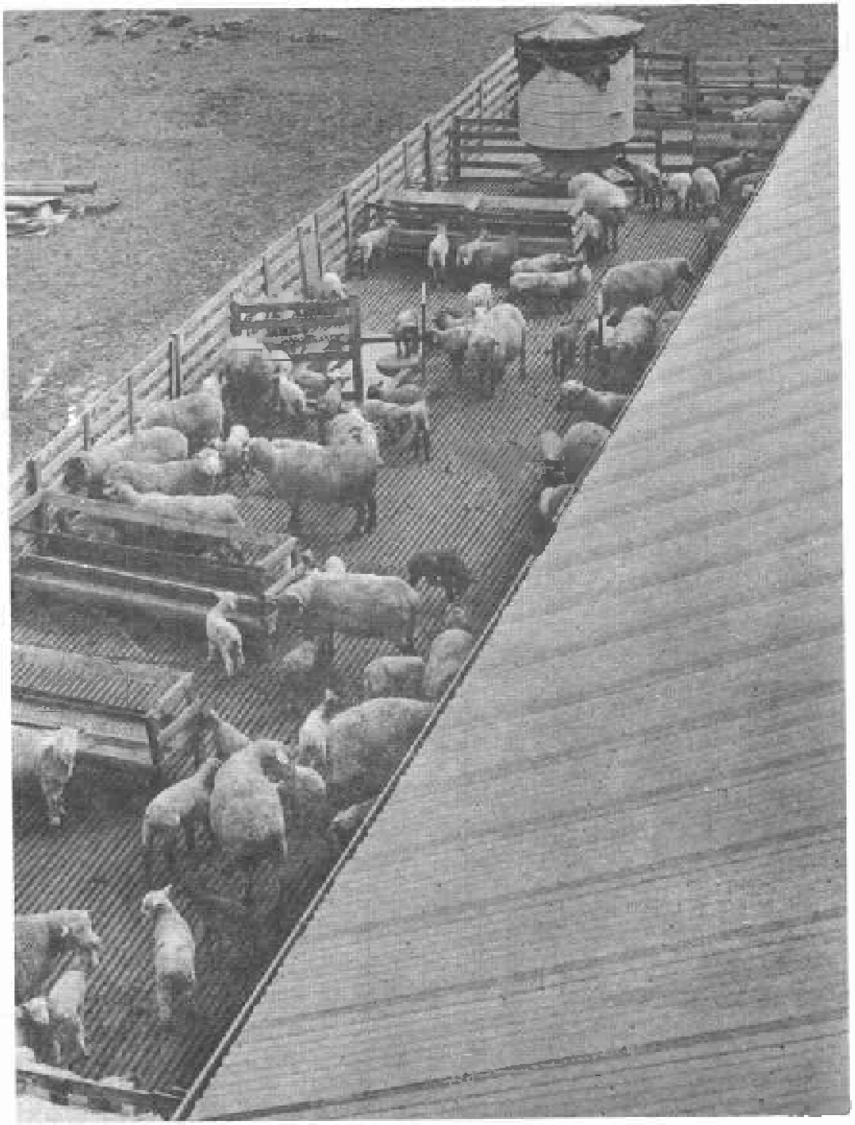
Slatted floors are gaining popularity in sheep production units because they help producers manage ewes and lambs. The floor can alleviate the continual mud problem in winter, require no bedding, less labor, and less space than traditional methods of housing. They also appear to provide practical control of internal parasites, aid in foot rot control, better summer comfort for feeder lambs, better predator control, and the opportunity for multi-lambing.

Research at Midwest universities showed that many materials can be used successfully for slatted floors, and that confinement of lambs from birth to marketing worked well and lambs gained equally well on all types of floors.

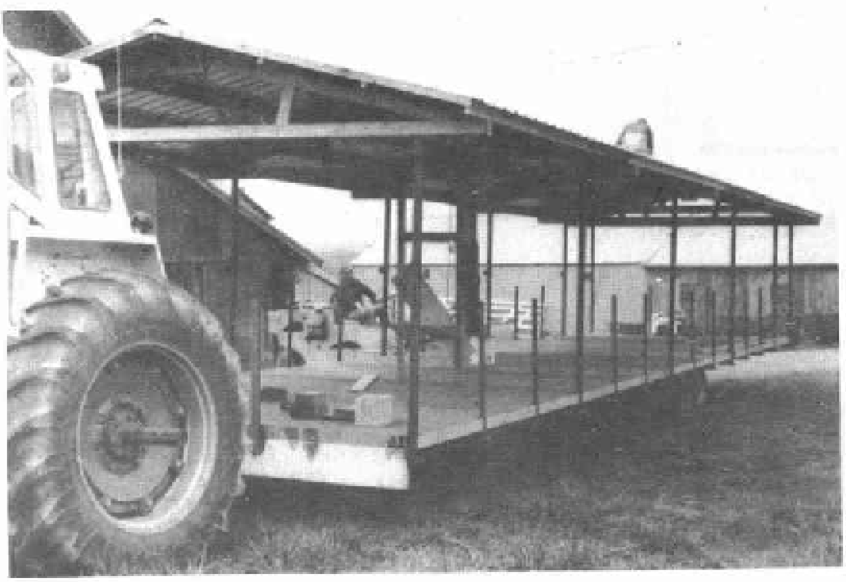
The first slatted floor operation in western Oregon was constructed in the Aurora-Wilsonville area by Ed and Judy Stritzke. They obtained old 2 x 2 bean stakes and constructed their unit from pictures obtained from Scotland. The unit was 90 percent open and still is.

It was designed with feeders hanging over the outside edge as well as one through the middle. This design is desirable because it allows more feeder space per ewe. On slats, less square footage per ewe and lamb is necessary than under conventional housing. The slatted floors were constructed in 6 foot x 7 foot panels with 2 inch x 4 inch support and nailers. The panels were placed on 2 inch x 12 inch stringers supported by 8 inch x 8 inch treated posts, which worked satisfactorily. The only problem observed was the shifting of the panels as the ewes and lambs walked on the flooring. This caused the stringers, which were nailed to the treated posts, to loosen. Consequently, construction design had to be changed, and the stringers had to be bolted to the posts.

It was at this operation that some of our initial work on feeding, space requirements, feed conversion, rate of gain, and management practices were



Ed and Judy Stritzke's operation near Aurora. First slatted unit in Oregon, built in early 1970s.



Slatted floor sheep trailer of the Pfennig's of Salem. Built on 12 x 60 mobile home frame in 1979.

observed and conducted. Results with the initial unit were positive and in 1977, the Stritzkes redesigned and rebuilt the unit. The original slats are still in use and in good condition. In rebuilding of the unit, the 8 inch x 8 inch support posts were removed and concrete stringers were put in to support the slatted floor panels.

Because this unit was so successful and has been widely publicized, it has led the way to the construction of several wood and steel units in the north and mid-Willamette Valley area.

SPACE REQUIREMENTS

To determine the size of a facility, figure approximately 12 square feet of space per ewe with lambs will be needed during the first 45 to 50 days after lambing, and this area includes the lamb creep. Feeders and waterers should be placed outside the pen if possible.

In research with feeder lambs on slatted floors, spacings of 4,6, 8, and 10 square feet per lamb were compared at Dixon Springs Agricultural Center in Illinois. Early weaned lambs made acceptable daily gains of .65, .64, .68, and .69 pounds, and no major difference was observed in health conditions. Work locally shows that 5 to 6 square feet per lamb is adequate. Last summer, a Salem area producer built a new slatted floor trailer house and used approximately 5 square feet. His results will be discussed later.

One of the real problems of slatted floors is adequate feeder space. An answer to this may be some type of self-fed ration, and work needs to be done on this.

It has been found that ewes kept in confinement performed very well at about 75 to 80 percent of the NRC nutrition requirements compared to ewes under usual management.

The following table provides information from Dixon Springs, Illinois, showing the space requirements under various types of housing arrangements. It compares space for gestating ewes, ewes and lambs, and feeder lambs.

(See table next page)

Space Requirement for Intensified Sheep Housing for Meat Production (Fleece Incidental) a/

Facility	Ewe b/	Ewe and Lambs	Lambs - Weaning to Market
Shelter space c/			
Open-front building	10-14 sq. ft.	12-18 sq. ft.	5-8 sq. ft.
Outside yard	20-30 sq. ft.	20-30 sq. ft.	6-12 sq. ft.
Open-front, solid-floor confinement (all under roof)	15-20 sq. ft.	18-24 sq. ft.	8-10 sq. ft.
Slatted-floor confinement	8-10 sq. ft.	10-12 sq. ft.	4-5 sq. ft.
Feeder space			
Group feeding	15-20 inch		10-12 inch
Self feeding	4-6 inch		2 inch

Other planning information

Lambing pens: 4' x 4' to 4' x 6', depending on size and production per ewe

Waterers (float-type and tank-type): one for each 50 to 80 ewes or lambs; one for each 40 or 50 ewes and lambs together

Creep panel adjustable opening: 6 to 10 inches

Panels and gates: 36 to 42 inches high.

a/ Note: size of animals can affect any of these dimensions

b/ Allow 1 sq. ft. more for rams

c/ Net space, allow extra for feeder space

SLATTED FLOOR MATERIALS

Many materials being tested have been found to do an adequate job and stay relatively clean. Research experiments have been done with the following materials:

1. 3/4 inch #9 flattened expanded metal
2. 3/4 inch #9 "Safe-T-Mesh" metal
3. Flattened expanded metal (Ex-plate) 2.8 pounds per square foot
4. Wood slats
5. Concrete slats
6. Steel slat bar section, and
7. Recently research has started with a product called "Tender Foot" which is plastic over the #9 diamond steel.

Elevated slatted floors can be built in several ways depending on how permanent an installation is needed. Floors can be constructed in sections of 4' x 8', 5' x 8', 4' x 10', or 4' x 12'.

The floor platforms should be a size that can be lifted or moved to simplify cleaning and manure removal. This would be the only limiting criteria on size.

All platforms should be elevated at least three feet off the ground to give adequate manure storage and air circulation. This, of course, will depend on the concentration of animals on the floor, which governs the rate of manure accumulation. Commercial operations probably will consider greater floor heights for longer periods of storage. Additional heights also may make it possible to use various types of cleaning equipment such as garden tractors and other mechanical means.

The #9 flattened expanded metal and the 3/4 #9 "Safe-T-Mesh" usually are cheaper than the Ex-Plate. Number 9 gauge steel has lasted more than eight years in trials at Dixon Springs.

In construction, each of the sheets of steel should be supported by 2 inch x 6 inch lumber frames around the outside with wooden cross supports of 2 inch x 4 inch material placed at least every two feet on centers. Recent findings indicated they may be better if placed every 18 inches, and 12 inches near feeders where back legs do considerable pushing. Scrap iron also can be used in cross bracing. The cross supports are only stabilizers.

If wooden slats are used, spacings between the slats should be about three-quarter inch. These openings often vary because of rough cut lumber.

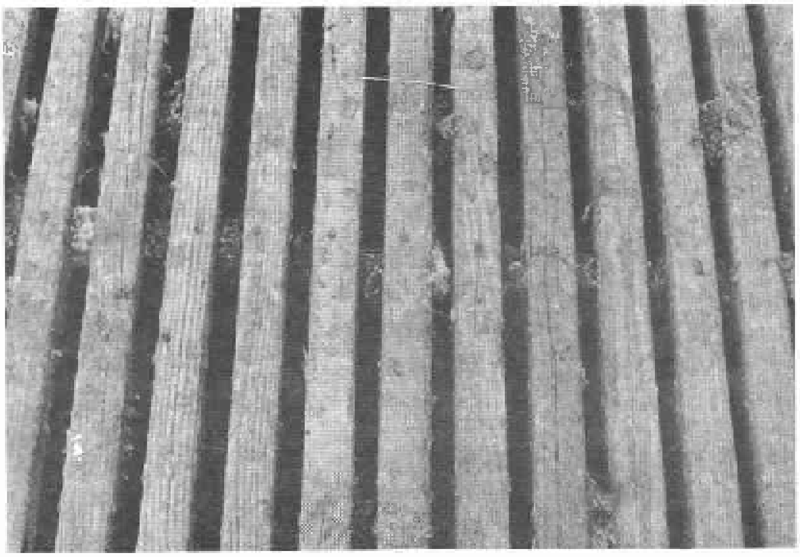
Most floors in western Oregon have been built of #9 guage three-quarter inch metal or wood.

Reports on Canadian aluminum slats with grooves in the top to improve footing indicated the grooves collected urine and dung and were difficult to keep clean. I observed aluminum slats of this type in DuBois, Idaho. During the winter, they were frozen closed because of an accumulation of urine and dung.

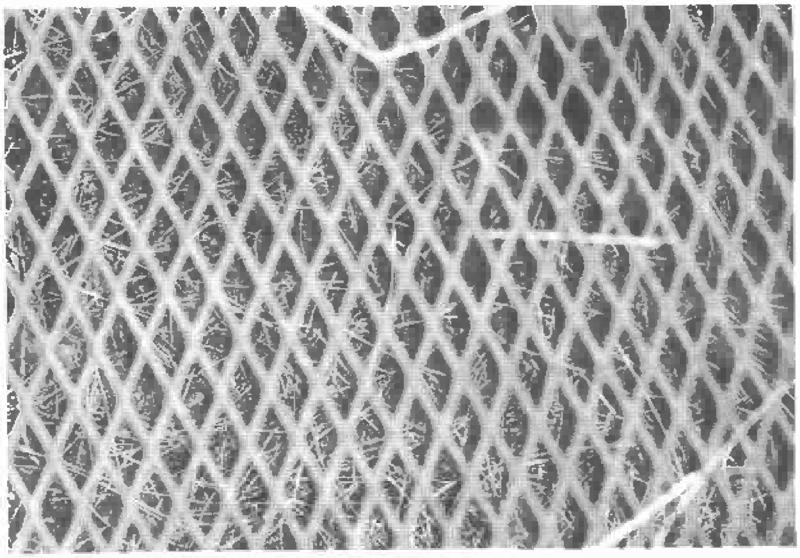
Most floors tested in research have given good results. The choice of materials depend on the producer, the design of the facility to be remodeled, and the type of economical materials available to the producer.

Three words of caution:

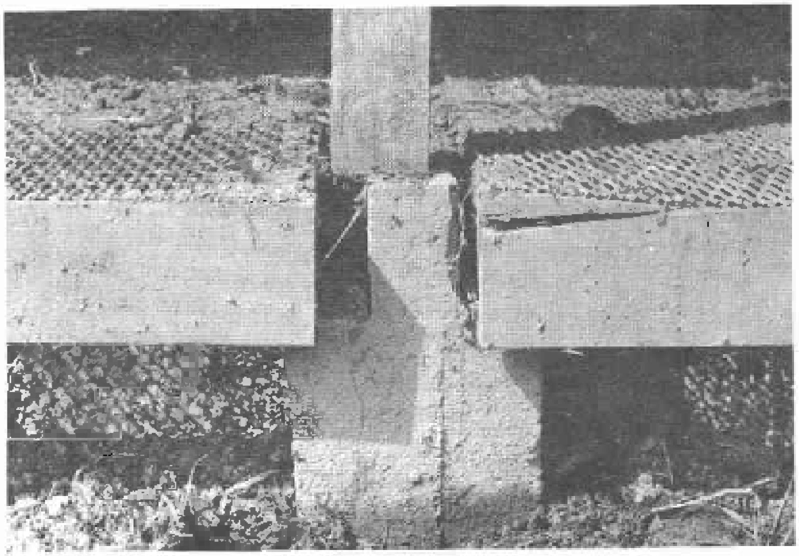
1. Research has found that Ex-Plate has injured feet where lambs can run with the opening. Because of this problem, we recommend that if Ex-Plate is used, the steel should be set so the long opening is along the short dimension of the pen, then the animals do not run with the opening.
2. If steel is used, it would be best to run feeder lambs, or buff the



Wooden slatted floors are very successful for sheep. Material 2 in. x 2 in., spaced 3/4 in. apart and supported by 2 in. x 6 in. and 2 in. x 4 in. supports, works well. These slats have had 8 years of usage.



3/4 inch #9 "Safe-T-Mesh" steel flooring has proven very satisfactory in Western Oregon. A 2 in. x 6 in. frame with 2 in. x 4 in. cross braces every 18 inches should be used. Near feeders, cross braces should be spaced every 12 inches.



Concrete pillars with these types of offsets work well to support wood or steel floor panels. They can easily be framed and poured by the producer. The pillars should be at least 3 feet from the ground to allow adequate manure storage and to reduce ammonia odors.

steel first so slivers are removed. Some problems on ewes' legs and udders developed when steel was first used.

3. When purchasing, make sure to order the #9 gauge steel. Other lighter weights will not stand up.

OTHER UNITS

Slatted floors, since our first unit, have been used for lambing pens, lambing creep areas, and, more recently, additional complete confined or semi-confined units.

At the 1978 OSU Sheep Days, Frank Hinds, University of Illinois, Urbana, talked about the success of slatted floors in Illinois. He showed slides of a trailer house built for sheep.

This sparked the construction of two units in the Salem area, built by Hank and Larry Pfennig. They obtained the frame after a fire destroyed a 24 x 60 foot trailer house and constructed two 12 x 56 foot units. To support the expanded metal floor, they used treated 2 inch x 4 inch lumber, 12 feet in length running perpendicular to the main steel trailer beams. The 2 inch x 4 inch braces are spaced two feet apart and additional 2 inch x 4 inch cross pieces are placed between the longer 2 x 4's at two foot intervals. They used the #9 gauge 3/4 inch flattened steel for the floor and have had few cleaning problems.

Steel expanded floors should never be welded but should be mounted on wooden frames and staples used to attach the flooring to the support braces. Welding crystallizes the steel, causing it to break at or near the weld. When attaching flooring to 2 x 4's, overlap the sheets of steel slightly and use 1½-inch fence staples every 12 inches.

When designing their unit, the Pfennigs purchased a large self feeder and put it in the center of the trailer so it can be split into two sections. Waterers are located at the end of each unit and a roof was constructed for shade, which proved very effective during last summer's heat. The perimeter is enclosed with heavy gauge hog wire and designed so that in severe weather, plywood sheeting, salvaged from burnt-out houses, can be used to break the wind.

If there are high heights under the slats, some type of a windbreak must be provided during the winter to prevent drafts coming up from under the floor. Normally, winds circulating under young lambs cause uncomfortable conditions during extremely cold weather, and either burlap, plastic, plywood, straw or other forms of blocking should be considered.

It may be desirable to support the trailer with stacks of cement blocks spaced every 12 to 15 feet on the sides under the main beams to prevent shifting.

The Pfennigs now use the trailers to lamb out their ewes and run ewes and lambs. They recently have early weaned these lambs at 45 days of age, averaging 46 pounds.

Lynn Trupp, Sauvies Island producer, built a new unit in 1978 and has gone through two winters with outstanding success. He has reduced lamb losses by more than 20 percent. His 4 x 8 foot panels of "Safe-T-Mesh" are supported by concrete curbs with 3 x 6 inch notches at the top. This design prevents shifting and slipping and is one that should be used.

Other units are also available for producers to view.

LAMB GAINS ON SLATTED FLOORS IN WESTERN OREGON

During the first summer with their unit, the Pfennigs cooperated with OSU Extension specialists on a number of trials.

They ran their own early weaned lambs to market weight plus buying additional feeder lambs that they finished. The owners compared lambs being fed in this unit versus a conventional dry lot. It appeared that lambs on the slatted floors were more comfortable and performed better than those in a conventional feedlot. Because of air movement, lambs on slats remained cooler and more comfortable, allowing better performance.

In trials with OSU, rate of gain and feed conversion data were obtained (see results next page).

Feeder Lamb Performance On Slatted Floors - 1979

Period		Totals	Per Lamb	Per Day	Lbs. Feed/Lbs. Gain
6/28 - 7/13 13 days 5 head	FEED	273 lbs.	54.6 lbs.	4.2 lbs.	3.38 lbs.
	GAIN	81 lbs.	16.2 lbs.	1.24 lbs.	
6/28 - 7/25 27 days 22 head	FEED	2,370 lbs.	107.7 lbs.	3.99 lbs.	2.73 lbs.
	GAIN	867 lbs.	39.4 lbs.	1.46 lbs.	
6/28 - 8/8 40 days 13 head	FEED	2,017 lbs.	155.2 lbs.	3.88 lbs.	2.85 lbs.
	GAIN	707 lbs.	54.4 lbs.	1.36 lbs.	

TOTAL FEED - 4,660 lbs. 2.82 lbs. feed/lbs. gain
TOTAL GAIN - 1,655 lbs.

COSTS GAIN - 1,655 lbs. @ .60¢ = $993.00
COSTS FEED - 4,660 lbs. @ .6¢ = -279.60
$713.40

CONCLUSION

The initial experience with slats by Willamette Valley producers has proven them to be effective.

They have improved flock management, lamb survival and health, rate of gain, and feed conversion on feeder lambs.

Units of this type allow producers to do a better job of feeding, pay closer attention to the ewes' condition, keep animals out of the mud, and they have less space requirements than conventional types of housing. They also help eliminate internal parasites, add easier and better handling of early weaned lambs, and enable the producer to leave lambs on the slats until market weight. They reduce labor by eliminating bedding and give ewes and lambs a dry, clean place to lie in winter, and can be used in multi-year lambing.

Slatted floors may not always result in fast gains like our preliminary work. Their use cannot assure profit or success in the sheep business. This type of housing will not be satisfactory for all producers, but should at least be considered if building new facilities or intensifying the operation. Slatted floors are just one more tool available to producers.

You must decide if this tool is an advantage to you. ARE THEY WORTH THE INVESTMENT? THIS IS A QUESTION YOU MUST ANSWER.

THE IMPORTANCE OF ONIONS AND OTHER BY-PRODUCT FEEDS IN A DRY LOT SHEEP OPERATION

Mike Howell

The number of farm flock breeding ewes has increased dramatically in Malheur County and the surrounding Treasure Valley area during the last two years. High interest rates, high energy costs, and inflating land prices have prompted many people to look at alternative income enterprises. The opportunity to have an intensified livestock enterprise on a small amount of land and other related resources has created an interest in dry lot and semi-dry lotting of breeding ewes. We are seeing sheep producers dry lotting between 100 to 600 breeding ewes.

An important factor in the success of such operations is the availability and use of by-product feed. In our area, the feeding of cull onions has played a major role in dry lots and other types of sheep operations. The Treasure Valley area raises approximately 10,000 to 12,000 acres of onions yearly, producing an average of 950 sacks per acre (50 pound sacks). Depending on the year, the cull rate runs between 15 and 40 percent. It is not hard to see that we are dealing with several thousands of tons of cull onions which must be either fed or buried. Detrimental effects have been reported from feeding cull onions to beef cattle. Therefore, sheep seemed to be a natural means of disposal.

Several years ago, research was conducted at the University of Idaho's Caldwell Veterinary Teaching Center on "The Effects of Feeding Cull Onions To Sheep." In 1979 and 1980, a small research demonstration project was conducted at a sheep operation in the Vale area, using personnel from the Caldwell Teaching Center.

In the Vale study, three groups of ewes, 30 ewes in each group, were used. Each group was kept separate and fed a different ration (Figure 1).

Figure 1.	Rations - Vale Onion Study
Group 5	5 pounds hay, 1/2 - 3/4 pounds grain
Group 7	free choice onions, 1 pound hay
Group 9	free choice onions, pasture, 2 pounds hay

All ewes were weighed and blood samples drawn every 10 to 20 days from August 28, 1979, to January 23, 1980. Table 1 shows the results on body weight.

Table 1. Vale Project: Onion Sheep Body Weights (Pounds)

Group	Days					Weight
	0	10	40	69	105	1-23-80
5	149.5	154.5	160.5	183.5	194	220.5
7	160	175	172.5	190	208	254.5
9	149.5	151.2	162.0	181.5	198.5	

Samples also were drawn from the onion piles and analyzed. Table 2 shows the results of these analyses.

Table 2. Vale Project - Onion Analysis

Sample date	8/27	9/21	10/9
Dry matter	10.51	12.54	10.68
100% DM basis			
Crude protein %	4.93	10.01	11.13
Acid detergent fiber %	13.80	15.99	15.01
Ash %	4.33	7.27	7.38
Calcium %	0.47	0.577	0.437
Phosphorus %	3.07	3.72	3.71

As shown, the onion is mostly water (90 to 95 percent). Generally, onions are scattered on the gound in piles and the sheep eat free choice. Once accustomed to eating them, sheep relish the onion and preferentially eat it instead of available high quality hay or concentrates. The decomposition that takes place in the onion pile does not diminish their appetite for the onions.

Toxic effects have been reported in cattle, horses, and dogs, but seldom in sheep. The basic toxic principle of onions is an alkaloid which allows the denaturization of hemoglobin resulting in precipitation and formation of Heinz bodies. Hemolytic anemia will then develop. Sheep seem to be fairly resistant to development of the blood anemia.

In the Vale study, the results of blood samples appear to be much the same as in the Caldwell study.

In the early stages of onion feeding, blood samples showed an anemia situation but later the ewes seemed to compensate for the anemia, and blood levels came back to the low levels of normal. The Caldwell study states "onion feeding will cause hemolytic anemia in sheep, the severity of the anemia probably relates to the proportion of the diet that onion comprises. Under dry lot free choice feeding of cull onions similar to the type in this study, the anemia may approach lower limits of normalcy. At this point, additional stress on the erythocytes system such as repeated bleedings from bacterialogical or serological parasite infestations should be avoided. The anemia is reversible, therefore, if clinical signs and toxicity appear, feeding of cull onions should be discontinued, at least temporarily."

How many onions will a ewe eat per day? In the Vale study it was determined that 53 pounds per ewe per day was required to keep an adequate supply available to them. It was estimated that each ewe probably was consuming 25 to 30 pounds per day.

It also was found that the method of feeding would have an effect on the amount of onions needed per ewe. If the onions were spread on the field instead of being dumped in piles, there was less waste and better utilization. Bunk feeding, the most efficient method, is seldom used.

Since most onions are spread or piled, some vital concerns begin to surface. No doubt this type of feeding creates more parasite problems, coccidia, and the spread of other types of diseases. Much work needs to be done in the area of methods of feeding onions to sheep.

Economically, onion feeding looks favorable. In the Vale study, the onions were free for the hauling; the producer estimated his trucking costs at $5 per ton. In other situations, onions are hauled to the producer for $1 or 2 per ton depending on the distance.

Most producers who feed cull onions indicate they can cut the amount of hay fed by one-half the amount normally fed without any detrimental effect to the ewes. During hard times, some producers have been known to winter ewes on a straight onion diet.

By now one may have the feeling that cull onions are God's gift to the sheep producer. There are still many unanswered questions concerning the effects of feeding cull onions. I believe that age and condition of the ewe before they go on an onion diet should be considered. Older ewes who are possibly anemic or carrying a heavy parasite problem could be getting you into a lot of trouble. Onion feeding in a dry lot situation also contributes to a lack of exercise because ewes have a tendency to camp on the onion piles all day. There is also some concern that cull onions may contribute to a tieup of vitamin E. These are some of the things that should be researched as we look towards the future.

OTHER BY-PRODUCT FEEDS

In addition to onions, Malheur County and the surrounding Treasure Valley area have an abundance of other by-product feeds. Seed screenings seem to be a good feed by-product for the dry lot sheep producer. Alfalfa, lettuce, onion, and turnip seed screenings are the most acceptable. Analysis indicate that seed screenings will run between 18 to 25 percent crude protein and 75 to 80 percent TDN. Alfalfa seed screenings are the most expensive at $40 per ton, compared to lettuce and turnip screenings at $25 to $30 per ton. Methods of feeding vary depending on the operation. Some producers simply dump the screenings on the ground like cull onions, others use self feeders and still others feed screenings like a grain supplement. Availability is good for our area with the major problem being a dry storage facility. Some producers are mixing screenings with alfalfa hay, cull beans, and molasses to make a range pellet or cube to be fed as a supplement.

Other by-product feeds such as sugar beet tailings, corn cannery tailings, wet beet pulp, potato waste, and others are available. The major problem with these by-products is that there is more competition from cattle feeders and unless the sheep producer is set up to haul and feed these products, they usually go to the beef cattle operations.

CONCLUSION

Seventy-five percent of the cost of running the ewe on a dry lot situation is related to feed costs. Cull onions and other feed by-products appear to be an economical and viable feed source. Onions and other by-products are not fail-safe even though lamb crops between onion fed and non-onion fed groups appear to be comparable. Some important concerns continue to surface so additional research and information need to be collected.

Table 3. Final Results Vale Onion Project, 1978-1980 March 3, 1980

Group	5	7	9
Ration	Hay, grain	onions, hay	onion, hay, pasture
Number of Ewes	10	10	10
Number of Ewes Lambing	10	9	10
Number of Ewes w/dead lambs	1	0	0
Total Lambs Born	19	14	18
Stillborn lambs	2	0	0
Pounds live lambs	200	184	204
Average wt. lambs/ewe	20.0	18.4	20.4
Average wt. live lambs	11.76	13.14	11.33
Twin lambs	11.75	12.6	10.81
Single lambs	12.0	13.5	15.5
Average live lambs/ewe	1.7	1.4	1.8

INTENSIVE GRAZING, THE KEY TO PROFIT

Wayne Mosher

Sheep farming in western Oregon generally is based on the use of forage produced on pasture lands, and much of that forage is grazed in place. The skill with which this resource is used and the percentage of forage actually eaten by the sheep probably are the major keys to the farm's profit. Using most of the forage by grazing the sheep can benefit the pasture, increase the profit on each unit of meat sold, and improve the environment at the same time. It sounds too good to be true, doesn't it? But the facts support it.

The sheep industry is a forage-based industry and all of us are really grass farmers. Our major crop is grass and clover. Sheep just happen to be the most efficient way for us to market that forage.

Because we are forage farmers, producing the most forage of the highest quality for the least cost has to be a goal. In much of western Oregon, the most efficient system seems to be the use of sub clover and rye grass: fertilizing the clover, letting the clover fertilize the grass, and grazing off most of the forage with sheep. In other areas, crop residues or other grasses and legumes are used. Each crop has different requirements and the manager must know and meet the requirements of the crop being grazed. I am going to restrict most of my remarks to the grazing system used on the hill lands of western Oregon but many of the principles apply to other situations.

Much work has been done on producing sub clover and grass, and the fertilizer programs have been in use in some areas of the state for a number of years. It has been well demonstrated that legumes respond to phosphorus, sulfur, potash, and molybdenum. The use of soil tests and, more recently, the use of plant tissue tests have proved helpful in designing a good fertilizer program. Although practices need to be demonstrated and sold more successfully to farmers in many areas, the information is available and can be put into practice.

Legumes are plants that have the ability to take nitrogen from the air and convert it to the plant's use. This is done by a symbiotic bacteria which invade roots of the plants and form a nodule where nitrogen is converted to the plant's use. If the correct strain of bacteria is not present, the rate of nitrogen conversion may be less than optimum or may not occur. If the correct strain is present and the plant and bacteria are properly fertilized, there is reason to believe that no nitrogen need be added to the system. In some cases, it could even be detrimental to the system by making the legume lazy and causing it to leave the stand.

If the legume plants do their job, they will supply a higher protein, more digestible plant to feed grazing animals. These plants also will maintain a high protein level later into the season and will provide some nitrogen for associated grasses.

The forage is consumed by the animal. Some of the nutrients are used to produce meat and the remainder is deposited back on the soil in the form of dung and urine. This helps to fertilize the soil so more grass and legumes can be grown. Nitrogen cycling through this system is one of the major sources of the nitrogen needed to grow grasses. The urine patch from a ewe on good grass legume pasture probably contains about 100 pounds of N per acre.

If most of the pasture grown is cycled through an animal, the resulting fertilization of the pasture can be quite significant. Nitrogen from the urine is readily available back to the plants. The N deposited on the soil in dung must be broken down by bacterial action and is delayed in its return to the system. Plant material not consumed by animals but left on the soil to rot is in the organic form and may be delayed for quite a long period in getting back into the plant production cycle. Grazing and getting the plant material into an animal are very important in keeping the plant food elements cycling.

Another problem created by forage that is not consumed in a sub clover grass system can be the temporary elimination of sub clover from the stand. The dead forage allowed to remain on the soil as the new crop is germinating in the fall can greatly reduce the sub clover content in the pasture which then lowers forage quality and animal gains. The total amount of forage also would be reduced for the year. Fortunately, if most of the forage is removed before the next germinating season, usually there is enough hard seed of sub clover in the soil for the stand to regenerate effectively.

With the fertilizer programs developed by Dr. T.L. Jackson of Oregon State University, we know it is possible to make most hill soils in western Oregon produce 4 to 7 thousand pounds of dry weight sub clover and grass per acre annually. Applying the correct fertilizer in adequate amounts will result in good forage growth.

Table 1. The effect of phosphorus and potassium fertilizers on yield of sub clover.

	K0	K1	K2
P0	1178	1014	1218
P1	3045	3807	3645
P2	3230	4136	4686

Table 1 shows that the correct materials need to be supplied. In this particular trial, phosphorus was the first limiting element. When it was supplied, production increased dramatically. When a level of about 3,000 pounds of forage was reached, phosphorus alone could not raise the level higher because another element, in this case potassium, became limiting. When potassium was applied, yields increased to the 4,000 to 5,000-pound level. This demonstrates that to achieve maximum growth we need to supply the limiting element.

Soil tests can help and current work of Dr. Jackson shows that plant tissue analysis can provide helpful information on those elements not included in the soil test.

Because of our climate, on hill soils we generally produce about 80 percent of the total forage for the year in three to four months. This creates a major problem, that of trying to feed a flock of sheep who have to eat all twelve months of the year. Fitting the sheep needs to the pasture production curve is one of the keys to a successful grazing program (Figure 1).

How can we modify the sheep needs to fit pasture production? The primary thing we control is the date of lambing. This is a crucial time in the sheep year and also signals the time that more mouths are produced to eat the forage. With dry sheep, there is little variation in the nutritional needs during the year but ewes bearing lambs have a great change in the nutritional curve through the year. If we could get all the ewes to bear and raise twins, certainly it would make it much easier to fit the pasture production curve. This should be one of our major goals, because in addition to helping us utilize the forage efficiently, it has a decided beneficial effect on net income (Table 2).

The other way we can influence the sheep nutritional needs curve is to know the minimum nutritional needs of the ewe. There are times when the ewe can be

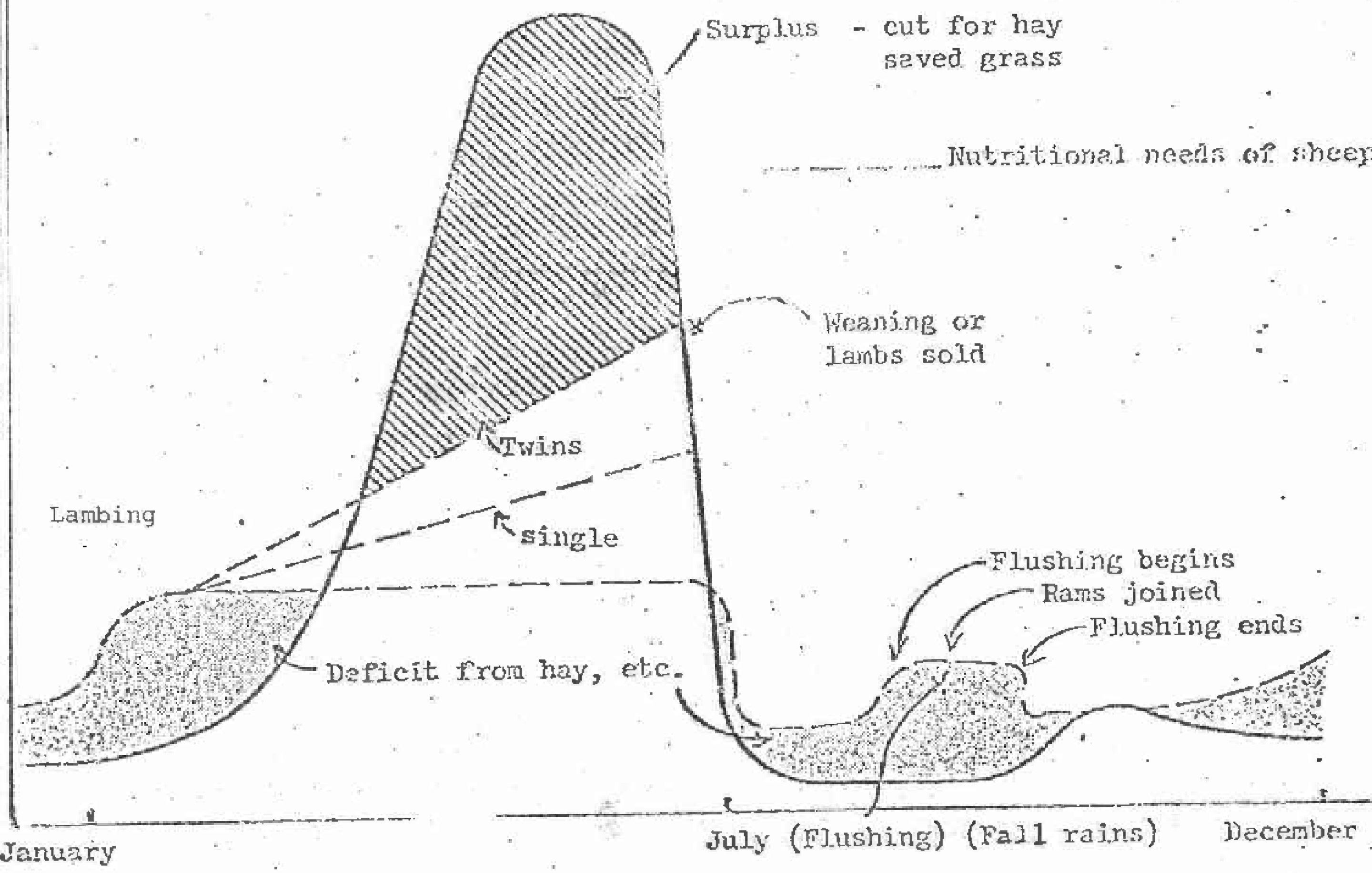


Figure 1. Nutritional needs of sheep vs. pasture production curve.

Table 2. Return to Operator's Labor and Management
with Varying Lambing Percentages and Stocking Rates*
1000 Ewes Enterprise Data Sheet 1970

Stocking Rate / ...ng ...ntage (ewes)	1 ewe/acre		2 ewes/acre		3 ewes/acre		Your Figures ____ewes/A	
	$Total	$/Ewe	$Total	$/Ewe	$Total	$/Ewe	$Total	$/Ewe
90%	-3,930	-3.93	2,570	2.57	4,740	4.74	____	____
110%	750	.75	7,250	7.25	9,420	9.42	____	____
130%	5,430	5.43	11,930	11.93	14,100	14.10	____	____
150%	10,110	10.11	16,610	16.61	18,780	18.78	____	____

This assumes constant costs except for interest on investment in land and taxes on land.

fed less than a maintenance diet and still maintain production during critical times, like lactation. There are even times when less than maintenance may benefit production. Feeding less than a maintenance level ahead of flushing may benefit the ewes if they are extremely fleshy. This may increase the response to flushing and result in more twins. However, the minimum nutritional level should be approached with caution because feeding less than that level can have a disastrous effect on production. Ewes in poor condition at lambing often have a poor milk supply which is disastrous for lamb survival and growth. Ewes with little milk also tend to have poor mothering instincts.

Most sheep farmers in western Oregon lamb ewes during December, January, and February. Usually pasture growth becomes adequate for sheep in early March in the Douglas County area and about two weeks later in the Willamette Valley and on the Oregon coast. As the pasture matures in late June and early July, the lambs cease to put on weight. During the last half of the lambs' growth period, the ewes have an abundance of feed and continue to put on fat after the lambs have ceased to grow. The pasture has an abundance of energy which will put fat on the ewes but is not adequate in protein to put growth on the lambs. Therefore, ewes raising twins will be fat even though the lambs do not have good enough feed to grow well. These ewes will continue to add weight through the early part of the summer and, unless stocked high enough to clean the pasture of rough material, will continue to gain or at least maintain weight through summer.

Extremely fat ewes brought to breeding season are difficult to flush. To flush them (get them in a gaining condition) takes a lot more feed and may make them so fat they will not breed well (it takes more energy to maintain fat than muscle).

Fat ewes going into winter take more feed to maintain than medium fleshed ewes. During the period just ahead of lambing, medium-fleshed ewes gain properly on a level of feed that would be less than a maintenance diet for a fat ewe. The condition of ewes during the winter certainly can influence the ability of a quantity of pasture to supply the nutritional needs of the sheep.

Ewe lambs raised for replacements require special care in the pasture program during their first year. Work in Scotland (Table 3) shows the level of nutrition during the first year of replacement ewe lambs may significantly influence their lifetime production. Table 4 shows the influence of nutrition during the first year on production of ewe lamb replacements in work done in New Zealand. The level of nutrition of growing ewe lambs does influence lifetime production.

Table 3. Effects of two nutritional levels from 6 weeks to 12 months of age on percent multiple births in two adult environments. (R.G. Gunn)

[Lifetime Production]

Year born	No. Lamb crops	Treatment LL	HL	LH	HH
1965	5	34	42	47	68
1966	4	30	48	55	62

Table 4. Effects of different growth paths from 4 to 11 months of age on subsequent production, (Romney ewes). (R.W. Moore)

Two Tooth Reproduction

	High Nutrition	Low Nutrition
Ewes lambing/ewes present	73%	79%
Ewes lambing multiple/ewes lambing	21	11
No lambs weaned/ewe	.80	.70

Now we have looked at the production of the pasture and the production of the sheep and now comes the most difficult part. The actual mechanics of fitting sheep needs to the pasture production curve.

Producing 5,000 pounds of forage per acre is not hard to do. But getting most of that into a sheep may be rather difficult and takes a lot of planning and effort. The simple program would be to "buy in" feeder lambs or calves when the grass starts to grow in the spring and sell them when the pasture is all consumed. Making use of the forage in a 12-month grazing program is a bit more complicated. As mentioned earlier, having each ewe with twins does help to simplify the problem but most of us are not getting that good a lamb crop. So, what are some of the things we can do to utilize that forage efficiently?

Fencing to subdivide pastures into smaller manageable units can help. According to some New Zealand work, pastures should be small enough so you can achieve a stocking rate of at least 20 ewes per acre in any pasture at any time. With 200 ewes, the largest pasture should be 10 acres. Smaller pastures are easier to manage. This means a lot of fencing which is expensive but subdivision of pastures is essential to achieve good utilization. Recent advances in electric fencing may be a cheaper but effective way to do the job. Without proper fencing some pasture areas will be undergrazed and some overgrazed and utilization will be uneven. It also is more difficult if not impossible to control the nutritional level of sheep at critical times without fencing. Fencing should be done to separate flat land from hill land, shady faces from sunny faces, and to provide water to sheep at all times. They also should provide for easy management of sheep. Fencing so that most or all of a pasture can be seen from one point is helpful.

With 5,000 pounds of high quality forage produced per acre and with the minimum nutritional needs of a ewe and her lambs at 1,500 pounds of forage annually, theoretically we should be able to run 3 1/3 ewes per acre on a year-round basis. The New Zealand work indicates we probably will be able to achieve only about 80 to 85 percent utilization of forage. This would leave us in the range of 2 1/2 to 3 ewes per acre. If we could run 3 ewes per acre and save a 125 percent lamb crop, that would mean the production of 3 and 3/4 lambs per acre. If we save 3/4 of a lamb per acre for replacements, we still would have 3 lambs per acre to sell, or between 250 and 300 pounds of lamb per acre. That would pay for a lot of fertilizer and fencing.

Most of us are already spending money on land and fertilizer. The additional sheep we run cost us only the amount invested in the ewe plus medicine, shearing, and purchased feed which should be rather insignificant. Taxes on the land and investment in land would not be higher. Income from sheep to use the excess forage most of us let go to waste would be pure profit. Table 2 demonstrates the effect of using the extra forage available on the net profit to the farm. It is substantial.

I might point out again that forage that is not used is detrimental to the system. It interferes with regeneration of the pasture and slows down cycling of nutrients in the system.

Highly productive, fertile pasture has a beneficial effect on winter production in our area. Not only does it produce more pasture in the winter but also it does not appear to be as susceptible to freezing damage. The high fertility pastures probably improve winter production percentagewise more than their improvement on spring growth. This helps to alleviate winter feeding which is probably the most difficult problem. As you grow more pasture and get it grazed by an animal, the dung and urine going back on the pasture tend to really increase the forage produced in winter.

I am convinced the major barriers to higher stocking rates to utilize the forage produced are mostly mental. A farmer going to a higher stocking rate has to think in different terms. Our farmers, like everyone else, resist change. Traditionally, farmers have been known as "good" because their stock was fat. At higher stocking rates, one thing you will not have is "fat" stock during some periods of the year.

One reaction I get from most farmers is, "If I carry enough stock to utilize the grass I'm growing in the spring, what am I going to do during the short seasons of the year?" Also, "What am I going to do in a bad year?"

The answers are: 1. Balance your feed with the stock by conserving surplus forage for short feed periods and, 2. We have a lot more good years than bad years so you can't afford to stock for the bad years. If you stock for the good years, then occasionally you may have to sell off some stock, even at a loss, to cut your stocking rate during a bad year. But in the meantime, you're taking advantage of all that extra production during the good years. (We seldom have a bad year.)

Psychologically, having extra feed on hand feels good. While a little of this may be good, overdoing it seems ridiculous when costs are rising and we need to become more efficient. It is much easier to make a system work if you believe it will work. We need to make use of our resources to the greatest advantage and in this system almost everything works better as we approach the higher stocking levels.

Perhaps the most exciting things in intensive grazing management to me are the increased income, the lowering of costs, and the development of a better environment all at the same time. Yes, I did say lowering the cost. As I mentioned earlier, utilizing most of the forage produced with sheep and the resulting cycling of nutrients can result in a highly fertile pasture which will have a decreasing need for fertilizer while maintaining a maximum output. On my own hill farm, under a fairly intensive grazing program, the need for continued applications of phosphorus has been greatly reduced compared to many neighboring ranches. Utilizing most of the forage produced through sheep seems to return most of the nutrient materials to the system and, phosphorus, the element we most often apply, seems to stay high in the soil and plants. Soil tests when the land was first cleared were low in the 6 to 8 ppm range. After 10 years of using 40 pounds of P_2O_5 per acre annually, the soil test levels reached the 40 to 50 ppm range. Six years without applying phosphorus have not brought a decline in the soil test levels. The plant levels also have remained high.

When you stop to think about it, there is a good reason for these results. Most of the plant material is eaten each year and kept in the system. Much of it goes back on to the soil as dung and urine. That sold in the form of lamb or cull ewe does not contain much phosphorus. Only about 4 percent of the animal body is mineral and only about 1 percent is phosphorus. Most of the body is composed of protein, carbohydrates, fats and water. The carbon, hydrogen, oxygen, and nitrogen--which are the major components of what is sold--are free. We get them from the air and water through the plants. They are abundant and cycle in the system very well in a good fertile pasture.

Lowering the cost of fertilizing, along with the increased income from more lambs and wool to sell, makes intensive grazing the real key to high profit in the sheep business. You must learn to manage the sheep near the minimum nutritional level without going below the critical level to use most of the pasture you grow. If you can do these things, you can make selling the forage you produce through sheep an environmentally sound and highly profitable business.

CONTROL OF TANSY RAGWORT BY GRAZING SHEEP

S. H. Sharrow and W. D. Mosher

Tansy ragwort (Senecio jocobaea) is a biennial or weak perennial weed widely distributed in the maritime climatic regions of northern California, western Oregon, and western Washington. It grows on approximately three million acres of forest and rangelands in western Oregon alone. A recent survey of dryland pastures in western Oregon (Issacson and Schrumpf, 1979) indicates that 43 percent of these pastures are infested. The average level of infestation is quite high, approximately 1,800 flowering stems per hectare. Not surprisingly, the economic impact of this infestation also is quite high. Annual economic losses in western Oregon are estimated to be $600,000 because of forage displacement alone (Issacson and Schrumpf, 1979). Perhaps more important than reduced forage production are potential losses of livestock which may be poisoned when they consume tansy ragwort. Tansy, like several other Senecio species, contains PYRROLIZIDINE ALKALOIDS. When consumed, the alkaloids are metabolized by the liver into active pyrrol derivatives, causing liver damage. These alkaloids have been demonstrated to be toxic to monogastrics such as humans and rats, cecae digesters such as horses and rabbits, and to ruminants such as cattle and goats. Cattle losses in Oregon attributed to tansy ragwort poisoning in 1971 were valued at $1.2 million (Snyder, 1972). This figure undoubtedly would have been much higher if it were not for the relatively low palatability of tansy ragwort to most livestock. Sheep, on the other hand, readily consume tansy ragwort and seem immune to its toxic properties. It is not clear if sheep possess the ability to destroy pyrrolizidine alkaloids in the rumen or if the alkaloids are not activated in the liver. In any event, there is little evidence to suggest that sheep are poisoned even when large amounts of tansy ragwort are consumed (Craig, 1978).

Because of the widespread distribution of tansy ragwort and because of public concern over the use of herbicides on both public and private lands, recent efforts to control this plant have centered on biological control. Two insect agents -- the flea beetle which feeds on roots and stems and the cinnebar moth whose caterpillars feed principally on leaves -- have been introduced for this purpose. Unfortunately, they have not proved successful in reducing tansy ragwort to acceptable levels. The purpose of this paper is to discuss sheep grazing as an alternative biological control agent.

To investigate the effects of sheep grazing on individual tansy ragwort plants, a study was established on the Mont Alto Ranch near Glide, Oregon, in May 1977. The site is a moist valley bottom with steep hillsides which once supported a Douglas fir forest. The entire area was grazed by cattle each spring. Two plots, one grazed by cattle and the other grazed by cattle in the spring followed by sheep in the early summer, were sampled during 1977 and 1978. On each plot, steel posts were driven into the ground 100 feet apart. The posts were reference points to permanently locate the positions of 100 tansy ragwort plants on each plot. Plants were subsequently relocated and identified by triangulation from the posts.

In 1977, forage utilization on the cattle grazed plot was only about 20 percent. Total utilization on the cattle - sheep plot was quite high (about 80 percent). Although no animal data were taken, the sheep seemed to gain weight despite the heavy utilization. This is not surprising because during the summer tansy ragwort is generally considered to be good feed for sheep. Chemical analysis of flowering tansy ragwort plants collected in early summer 1979 (Table 1) support this contention.

Leaves and flowers, the most readily consumed portions of the plant, exceeded Nutrient Research Council (NRC) dietary requirements for ewes both in crude protein and percent digestibility. Both of these plant parts also appear to meet the requirements for growing lambs. Stems, however, are quite fiberous and woody at this growth stage. Their low protein content and digestibility reflect this. In addition, it should be recognized that the protein contribution made by a plant such as tansy ragwort to sheep diets may be especially important as it tends to occur during the summer when other green feed is scarce.

The condition of tansy ragwort plants on August 8, 1977, immediately after sheep were removed is shown in Table 2. Sheep appear to be efficient defoliators of tansy ragwort. On the cattle-grazed plot, 43 plants were defoliated compared to 100 plants on the cattle - sheep grazed plot.

The intense defoliation achieved by sheep grazing was effective in preventing tansy ragwort from flowering and producing seed as evidenced by only

TABLE 1. Percent Protein and Invitro Digestibility of Tansy Ragwort Plants Collected June 28, 1979

	% Protein	% Digestible
Leaves	10.4	75
Stems	2.6	46
Flowers	14.5	71
NRC (maintenance - ewes)	8.9	55
NRC (growing lambs)	11.0	67

TABLE 2. Number of Tansy Ragwort Plants Per Class on August 8, 1977

Class	Cattle Grazed	Sheep - Cattle Grazed
Vegetative	15	0
Reproductive	40	2
Dry plants	2	0
Stripped leaf petioles	7	0
Stripped flower stalks	0	3
Stubs	9	30
Not observed	27	65
Total Plants Studied	100	100

2 percent of the plants flowering in 1977 on the sheep - cattle plot compared to 40 percent on the cattle-grazed plot. Furthermore, the two plants which were able to bloom on the sheep - cattle plot produced only one or two flowers each while blooming plants on the cattle-grazed plot produced dozens of flowers per plant.

A concern frequently expressed by producers and researchers is that tansy ragwort plants may be converted from a biennial (flowers in second year, then dies) to perennial growth as a result of defoliation by livestock. The practical effect of such a shift in growth habit would be to allow individual plants to persist in a pasture until either a year of particularly favorable climatic conditions or a reduction in livestock grazing pressure allowed them to bloom and to mature seed. If this occurred, effective control of tansy ragwort could not be achieved through defoliation of the plants by livestock. Fortunately, this does not appear to be the case.

Re-examination of our tansy ragwort plants in 1978 (Table 3), a year in which no sheep grazing occurred, revealed that a considerable number of 1977 plants were not present in 1978. Of special interest are the reproductive plants on the cattle-grazed plot. While 80 percent of these died after flowering in 1977, the remaining 20 percent were true perennials (they remained alive after producing seed). In fact, many of these plants not only grew vigorously the next year (1978), but also flowered for a second time. If this occurrence of perenniality is shared by other tansy ragwort populations, their seed-producing ability may be much higher than generally recognized.

If we look at the causes of the observed first year mortality of tansy ragwort plants (Table 4), a pattern becomes clear. Although the total amount of mortality was similar on both cattle - sheep and cattle-grazed plots, the cause of mortality was quite different. Mortality on the cattle-grazed plot was predominately from completion of the life cycle including both flowering and seed production. On the sheep - cattle plot, however, mortality largely was the result of grazing. This is more evident when one realizes that unless a stub or other grazed plant part was observed, mortality was attributed to "unknown causes." Many plants were so consumed by sheep that the location of any plant remains was extremely difficult to find. Thus, much of the "unknown" mortality class is likely caused by sheep grazing.

TABLE 3. Number of Tansy Ragwort Plants Observed in Each Class on August 8, 1977, Subsequently Observed Alive in May or December 1978

Class	Cattle Grazed	Sheep - Cattle Grazed
Vegetative	8/15 (53%)	0/0
Reproductive	8/40 (20%)	0/2
Dry plants	2/2 (100%)	0/0
Stripped leaf petioles	7/7 (100%)	0/0
Stripped flower stalks	0/0	0/3
Stubs	7/9 (78%)	19/30 (63%)
Not observed	10/27 (37%)	13/65 (20%)

TABLE 4. First Year Mortality of Tansy Ragwort Plants

Source of Mortality	Type of Grazing	
	Cattle	Sheep & Cattle
Bloomed	32	2
Grazing	2	14
Unknown	24	52
Total Mortality	58	68

It appears, therefore, that intensive grazing by sheep can effectively reduce the ability of tansy ragwort plants to flower and produce seed. Reduced seed production, together with the death of established plants resulting from the frequent intensive and defoliation which occurs under close grazing, may allow reduction of tansy ragwort populations to acceptable levels. Furthermore, tansy ragwort appears to be a relatively high quality feed for sheep, providing protein to their diet in the summer when other herbage is dry.

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INTENSIFICATION IN THE WILLAMETTE VALLEY:

SHEEP FOR PROFIT

Cleve Dumdi

Our goal is to run as many sheep per acre as we possibly can. We are doing it for one purpose and that is, hopefully, to realize an economic return on our investment. Sheep today have to compete with other agricultural enterprises on land that is high in value and therefore, have to show an economic return in order to justify the enterprise. We think that sheep have this opportunity, while some other agriculture enterprises are having economic problems. We certainly feel that sheep are in a challenging position. My involvement in the sheep industry goes back many, many years. We started our own enterprise ten years ago. We originally started strictly as a feeder lamb program, and then found that we needed to tie in a ewe operation in order to utilize our investment in equipment and labor the year around. Therefore, we now run a ewe operation, feeder operation, and summer feedlot program and we also have a buying and selling station.

Our program in the last couple of years has been developed around irrigation. At one point we thought that maybe we didn't have the greatest potential or possibility with sheep, but now we feel that we have. We are looking at land that is not number one, but it is land that can do many different things, if handled properly. It's best potential is growing forage.

We have developed our irrigation with movable wheel line, as labor has to be kept in mind at all times. Also, we do have one place that we recently purchased that is flood irrigated. Not all places lend themselves to this, but this place is very economical, as 100 acres can be irrigated in four days.

Let me explain our ewe operation. We try to maintain about 1,500 ewes in the operation. First let me start with our feeding and handling of these ewes. We start about the middle of July, after the lambs are weaned. At that time, we have an opportunity to get cull beans from the local cannery and these ewes are maintained on these cull beans from July through September. We usually have our flocks split into two bunches, utilizing the combined ryegrass field where there is adequate water. Their source of feed then becomes beans and straw. These beans bring these ewes into a very high condition, which lends itself to a very effective flushing program. Usually the ewes get too fat, but this doesn't bother me, as I like my ewes in a high condition. Following the bean season, we go to a ryegrass pasture, usually fescue or perenial ryegrass, where the ewes are maintained until close to lambing, at which time they are sorted and brought to the lambing barn to be handled through the lambing period. Following lambing, the ewes are returned to a ryegrass field where they are grazed until the first of April. At that time our ewes, with their lambs, are returned to our irrigated fields where we rotate the sheep by using a cross fence. (Mainly electric fences, now that they are available.) We want the sheep to eat where we want them to, rather than where they want to and we think this control grazing is a must.

The other part of our intensified program is our summer feedlot where we feed lambs on a combination of clover and self-fed pellets. Last summer we maintained approximately 1,300 head of feeder lambs on 40 acres in combination with the self-fed pellets. You might think that the lambs had the 40 acres looking like a dry lot, but this is not the case. It was irrigated and there was fresh feed before the sheep at all times.

Our winter feeding program is pretty much like any typical ryegrass program, as we buy these lambs in the fall and run them through the winter on the ryegrass pastures. We have the opportunity to collect our lambs earlier, since we have the irrigated pastures, where we can hold the lambs waiting for the fall rains to bring on the first pastures. As I mentioned, we do have a buying and selling station, which we maintain for the convenience of our neighbors and ourselves, and which we think blends very nicely with our overall sheep enterprise.

So far I have not mentioned predators. We do have predator problems - both coyotes and dogs, but not necessarily on the irrigated pasture program. This is one of the things under a highly intensified program which we have more of an opportunity to control.

Probably two of our biggest problems in the irrigated program are footrot and internal parasites, which can be controlled.

It has been a pleasure to visit with you about our operation. We invite you to come and visit us anytime, as we enjoy talking about sheep.

BOB AND ESTHER HIATT SHEEP OPERATION

Intensified sheep operations mean different things to people. To me, an intensified sheep operation means using total resources of land, buildings, feed, and time for the maximum net profit.

As many of you know, Esther and I moved to Douglas County in 1978 from Washington County near Hillsboro. There we ran approximately 300 ewes on 42 improved acres divided into 16 pastures. Fifteen to 20 acres were irrigated and most of our hay was cut from the pastures.

We used a rotational grazing system, flushed ewes on irrigated pasture, and several years saved more than 150 percent of the lamb crop. During inclement weather in January, February, and March, our sheep were mostly confined to the barn because the lanes and pastures became too muddy to get them out. When the sheep were in the barn, we fed our own hay and purchased grain or pelleted feeds.

In the 1973-74 winter, our pastures were severely damaged by a freeze. They were slow to recover that spring. We looked for additional feed and rented the dike around the Wapato Lake onion ground at Gaston. This amounted to about 60 to 70 acres of long, narrow, unimproved pasture.

That fall, we started feeding cull onions with a little hay and grain. We found onions a challenge to feed and had health problems from feeding them on the ground.

The next year we built an onion feeder which was quite successful. Ewes maintain good body conditions and milk well on onions. With the dike and the onions, we cut our feed costs and were able to run more sheep.

But I wanted to retire from Tektronix so we looked for a larger ranch. After years of searching, we found it in Douglas County in 1978. We moved 300 mature ewes and 250 ewe lambs to a rundown cattle ranch. Now we have a whole new set of challenges for intensification. On the 715 acres there were some modern barns and about 160 acres of established pastures that had not been fertilized for years. There were three pastures that were sort of fenced. The fourth pasture (the great outback!) was not fenced.

In the fall of 1978 and 1979, we fertilized the pastures with 0-36-0-20. Last summer, cleared, seeded, and fertilized another 100 acres. Our pastures are vastly improved.

A year ago, we lambed on a 70-acre pasture adjacent to the barn. There were no corrals at the barn, there were rose bushes in the pasture, and there was no electricity. Now we have electricity, the rose bushes have been mowed so we can find the lambs, and the 70-acre pasture is divided into five pastures and we are planning at least two more divisions plus additional pastures away from the barns.

All our sheep equipment is portable so we were able to move our lambing pens, mothering pens, working chute, and portable corral, which was a big help in lambing the first year..

Crossfencing is vital to an intensified sheep and pasture management program. I am fencing with electric fence, using Fiberglass posts, three smooth wires, and one grounded barbwire near the ground. The electric fence costs about one fourth the cost of woven wire fence. We used electric fence on our Washington County ranch for years. I am using a New Zealand Speedrite fence charger. We are extended a mile from the barn and have several fences on the same charger. And it is working great.

We had a few problems moving sheep to a different ranch. The ewe lambs had an outbreak of stomach worms three weeks after moving. It was amazing how fast healthy ewe lambs can go downhill on clean pasture. We had wormed about four weeks before the move. We then wormed them twice to get them straightened out.

That fall, the ewes had good pasture for breeding because of August rains and because there had been no livestock on the ranch since spring. But at last fall's breeding time, feed was short because of the logging, clearing, and seeding, and no fences. We soon learned that in summer sheep graze through wooded areas and, in our case, almost to Sutherlin. So we spent time bringing sheep home from neighbors when we should have been building fence.

Some of our ewes were too thin for best production at lambing this spring.

We plan to finish clearing about 40 more acres this summer, making a total of about 300 acres of improved dryland pasture. The remainder of the acreage is in timber reproduction, roads, and creeks.

We still believe we can run about three ewes to the acre on our mixture of bottom and hill land and cut our own hay. We have purchased a round baler and plan to self feed hay at breeding time and just before and during lambing. There are some well-drained and sheltered areas in the pastures where we will feed hay in self feeders in winter.

We plan to be flexible in marketing lambs. We have barn facilities now to feed out some lambs in the summer. As our sub-clover becomes more productive, we hope to get the bulk of our lambs finished for market off the clover by June. In the past, because we have no foot rot, we have sold crossbred flock replacement ewe lambs and when we get our flock built up, we will be looking at this market again. Last year, we held the lambs until fall and sold them as feeders when there was demand for them.

We are amazed at how much more pasture grows during the winter in Douglas County than in Washington County. Sunny days without east wind are wonderful.

My challenge yet is, first, to be a farmer growing the best forage, and, second, to be a sheep rancher, harvesting the forage with sheep for maximum profit.

SHEEP: RESISTANCE TO PYRROLIZIDINE ALKALOID FROM TANSY RAGWORT

A. Morrie Craig

During the last 10 years, there have been a number of experiments in Australia, New Zealand, and the United States which have indicated that tansy is toxic to sheep; other experiments have indicated that tansy is not toxic to sheep. These conflicting views and this conflicting data brought forth studies at Oregon State University to determine:

(1) if sheep are susceptible to pyrrolizidine alkaloids from tansy,

(2) the quantity of tansy sheep can eat and not be affected,

(3) why sheep are resistant to tansy toxicosis,

(4) whether toxic residues exist in the meat from sheep used as a biological control for tansy.

From 1968-70, Lannigan *et al.* in Australia published a series of reports showing that sheep were resistant in fact to tansy. These sheep consumed enough tansy to equal their body weight. In New Zealand from 1970-72, Mortimer *et al.* published a series of papers which showed that sheep were susceptible to the pyrrolizidine alkaloids from tansy *(Senecio jacobaea)*. They fed sheep on the average a quantity of tansy equal to 20 percent of the animal's body weight and reported consumption of the plant at this percentage resulted in hepatic damage. Mortimer *et al.* described the liver damage as being similar to that found in cows or horses consuming tansy. Later in 1978, Hooper in Australia showed that feeding tansy to sheep at 100 percent of their body weight produced liver damage. In 1978-79, we fed sheep 200 percent of their body weight in tansy over a four-month period and found no lesions or liver damage. Moreover, in Oregon there have been no confirmed cases of tansy toxicosis in sheep; even though some areas of the state used sheep as a control for tansy. Thus, it appears that sheep can consume moderate to large amounts of tansy in their diet and not be affected by the toxins.

How much tansy can sheep eat and not be affected? To answer this question we extracted pure pyrrolizidine alkaloids from the tansy plant and administered by ruminal bolus these alkaloids to sheep. Figure 1 compares sheep to cattle. As noted in our studies of bovine vs. ovine, with bovine, 0.15 g alkaloids per kgm body weight is equivalent to consumption of approximately 10 percent of the tansy plant, or 100 pounds of tansy for a large cow weighing 1,000 pounds. We administered at least 20 times that ratio of tansy to a sheep and have not seen any effect. We now are in the process of purifying more alkaloid to dose sheep with even higher amounts.

Since sheep seem to be so resistant to tansy, what protects them from the alkaloid? To answer the question one must first describe the metabolic pathway pyrrolizidine alkaloids follow. A brief explanation and Figure 2 describe this metabolic pathway.

The 6 to 8 alkaloid species in tansy plant enter the rumen. In the rumen, the pyrrolizidine alkaloids are released from the tansy plant and pass through the ruminal wall to the blood stream. The blood stream carries the alkaloid molecules to the liver parenchyma. The alkaloid molecules, at this point, are relatively non-toxic but the liver cell metabolizes these alkaloids to toxic, reactive metabolites called pyrroles. These pyrroles bind to vital liver tissue components and cause irreversible liver damage. In a cow or horse, this liver damage progresses from six months up to a year before any clinical signs can be detected.

However, the irreversible liver damage can be detected much earlier by an enzyme test developed at OSU measuring two enzymes, gamma glutamyl transpeptidase and alkaline phosphatase. To recapitulate, there are four aspects of this disease to consider, particularly regarding sheep:

(1) What happens to the alkaloid in the rumen?

(2) Does the alkaloid cross the rumen-blood barrier?

(3) Can the liver metabolize the pyrrolizidine alkaloids to activated pyrroles?

(4) Can the activated pyrroles bind to liver tissue, thus causing liver cell damage?

A number of investigators have indirectly addressed these steps. Dr. Culvenor in Australia has incubated ruminal contents of sheep with a plant monocrotaline. This plant contains pyrrolizidine alkaloids similar to but not the same as those in tansy ragwort. He found that alkaloids from monocrotaline were not altered by sheep's ruminal bacteria. More recently, Dr. Peter Cheeke, here at OSU, incubated tansy ragwort in a sheep's ruminal fluid. The incubated ruminal fluid was fed to rats and the rats died of liver toxicosis, thus implying that a sheep's rumen does not alter the Pyrrolizidine alkaloids to a less toxic substance.

In contrast to this conclusion, Dr. Lannigan published several papers reporting that pyrrolizidine alkaloids are altered by the ruminal microflora to a less toxic substance. Ruminal conversion of alkaloid to less toxic molecules is the pathway Dr. Lannigan feels protects sheep from pyrrolizidine alkaloids. Obviously, questions still remain.

A more direct approach would be to separate the rumen from the liver by cannulating the blood supply to the liver (Figure 3). We now are infusing through a cannula several sheep with pure pyrrolizidine alkaloids from tansy. Morever, we are observing liver damage and fibrosis. Although our results are not final, it appears that pyrrolizidine alkaloids from tansy can damage a sheep's liver.

In a second experiment, we have removed part of the liver of a sheep, cow, and horse. Each respective liver sample is mixed with pure tansy pyrrolizidine alkaloids in a test tube. In the test tube, these alkaloids are changed to pyrroles. We find that the sheep liver samples appear to be almost as effective at metabolizing pyrrolizidine alkaloids to pyrroles as the cow and horse liver samples. Therefore, if tansy alkaloids reach a sheep's liver, the liver can be damaged.

Why are sheep resistant? Some mysteries still remain. We can conjecture what is happening but science has yet to answer the question.

The final question of whether toxic residues are present in the meat of sheep grazing tansy also remains unanswered. Indirect evidence indicates that if toxic alkaloids reached the liver these alkaloids would cause liver damage. Since we have observed no liver damage in sheep, the toxins must bypass the liver and also probably do not reach the meat.

Presently, at our laboratory, further work is in progress examining these two questions. When scientists discover why sheep are resistant to tansy toxicosis they also will be able to determine if toxic residues are contained by meat in quantities harmful to man.

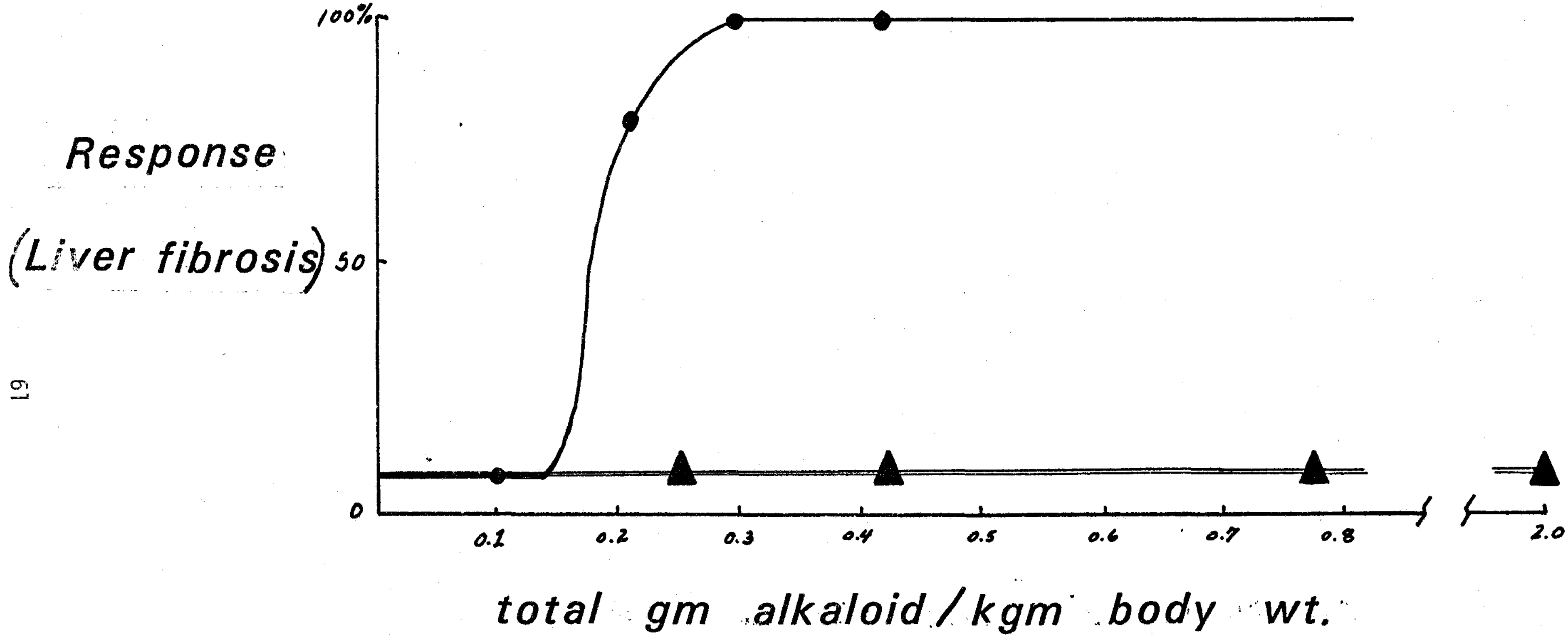

Figure 1: Pyrrolizidine Alkaloid Administered in Sheep and Cows

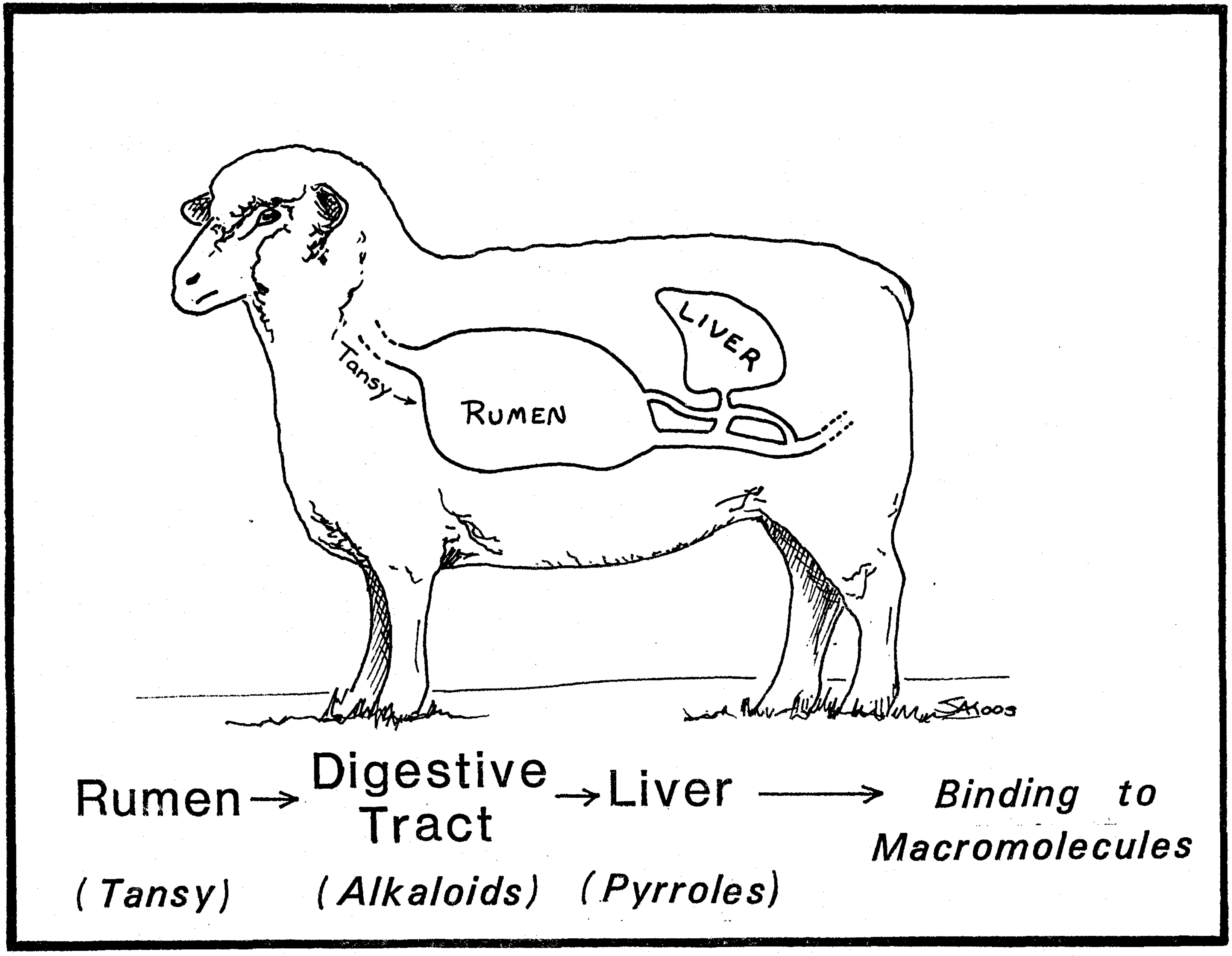

Figure 2: Possible Metabolic of Alkaloids in Sheep

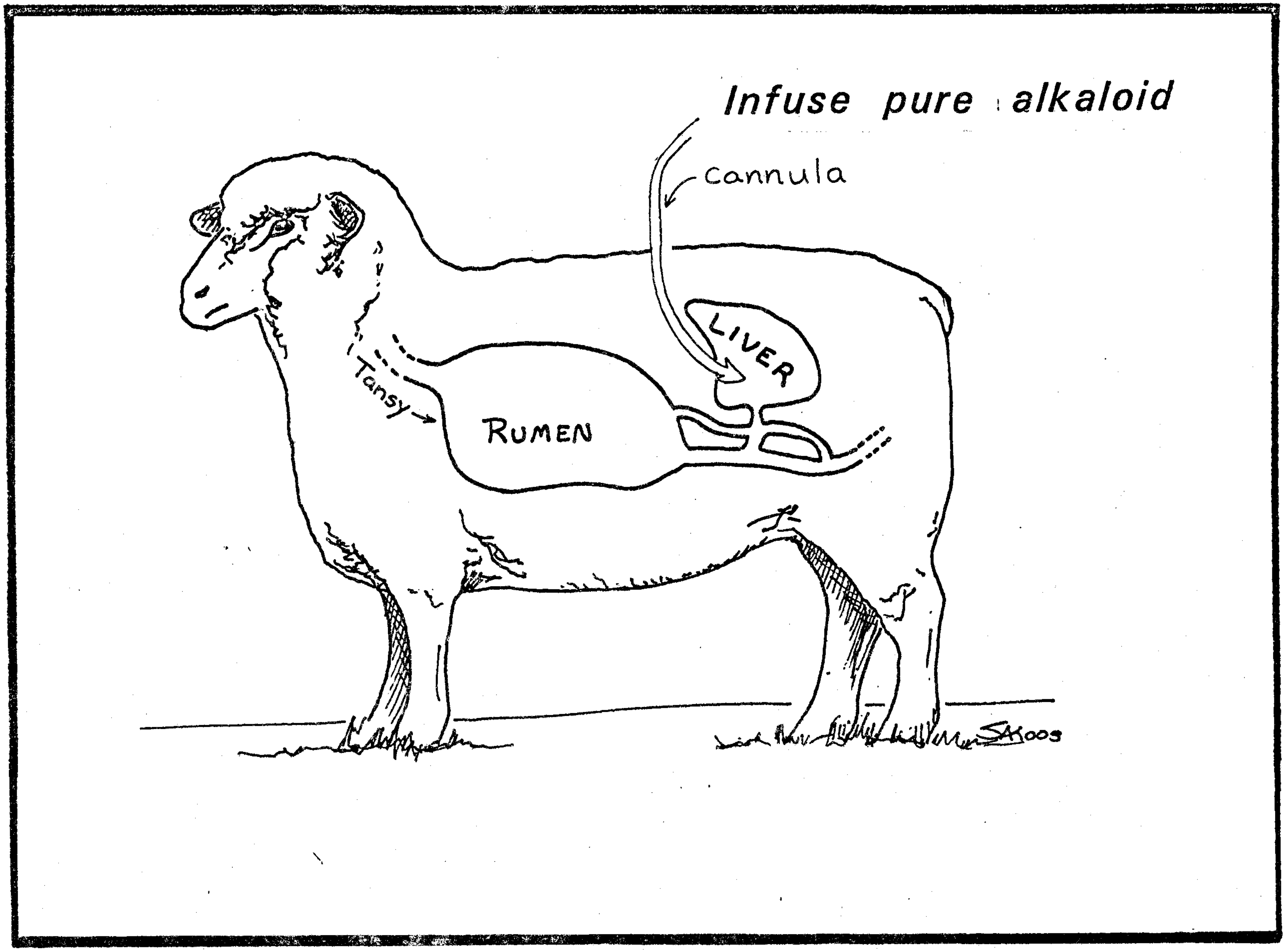

Figure 3: Infusion of Alkaloids into Sheep