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by
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Loss and Damage in Handling and Transporting Hogs

FARMER COOPERATIVE SERVICE

U. S. DEPARTMENT OF AGRICULTURE

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The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising, product quality, costs, efficiency, financing, and membership.

The Service publishes the results of such studies, confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

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Summary

Loss and damage to hogs associated with handling and transportation in marketing and processing are estimated at $22.6 million a year, based on average prices prevailing over the years 1957-59.

This national figure includes losses due to death in transit, condemnations of carcasses and primal cuts, and carcass bruise damage. On a per-head basis, this total loss reflects bruise damage amounting to 11.39 cents and death and condemnation losses of 8.02 cents and 6.16 cents, respectively.

A series of four handling and transportation tests were conducted by Farmer Cooperative Service beginning in April 1959. These determined the extent of such losses and explored the relationship they might have to handling conditions and practices ordinarily prevailing in the movement of hogs from concentration points to slaughter.

The four periods of research were on a seasonal basis and conducted in the midwestern and western sections of the United States in cooperation with Livestock Conservation, Inc., transportation and marketing agencies, and the packing industry.

A total of 211 test shipments of hogs moving by rail and truck from midwestern origins to slaughter plants located in the Rocky Mountain and Pacific Coast States were included in the study. These shipments involved some 29,000 head of swine observed during assembly, loading, at stops en route, unloading, and yarding. Post-slaughter examinations of the carcasses gave data on injuries or other conditions resulting in loss.

The value of tissue trimmed from carcasses because of bruise injuries accounted for 40 percent of the total bruise loss. Devaluation of primal cuts caused by severe or critical trim-out of damaged tissue, or both, made up the other 60 percent. By far the largest loss due to bruising was found in hams; this was figured at 7.38 cents a head. Bellies and shoulders, in that order, were the next most critical carcass parts affected but the total loss on these cuts was less than half that sustained on hams.

These tests confirmed results of previous studies of FCS and other agencies which had showed a positive relationship between increasing lengths-of-haul and rising losses. Total losses rose 47 percent on shipments moving an average of 1,900 miles over those transported 1,000 miles less. Increases in loss from condemnation and death were largely responsible for this increase in total loss since bruise losses declined on the long distance shipments after showing a rise on shipments moving about 1,400 miles.

This somewhat negative relationship of bruise loss to longer lengths-of-haul indicated that most injuries resulting in bruise damage must have occurred during earlier handling rather than during the

over-the-road haul. A number of control test shipments--moving an average of 125 miles, and conducted as a subsidiary of the major research--supported this conclusion. Although certain other factors were involved, bruise loss on these shipments was highest of all.

Seasonal variations in weather and climate were associated with changes in the level of losses. The two seasons of weather extremes (summer and winter) showed the highest losses. Death loss rose dramatically during these times of the year. Although pneumonia was a cause of condemnation in all seasons, it was three times more prevalent in winter. From another standpoint, adverse weather was closely related to bruise damage. This was determined by the identification of carcass damage with handling mishaps from icy or rain-slickened surfaces of facilities, and hazardous driving conditions in the case of truck shipments.

Average weight of hogs in the test shipments was 223 pounds. Transit shrink averaged 5.89 percent. Shrink was 0.6 percent greater on rail shipments than on those moving by truck. Hot yield (before carcass was put in cooler) on test hogs was 70.72 percent--only a 0.08 percent higher yield being realized on truck shipments. Shrink increased and yield decreased as shipping distances grew longer and time in transit increased.

Truck losses exceeded rail losses by $8.07 per hundred head. Death loss in truck shipments was the major factor in the overall higher loss on motor carrier loads. This loss was over three times higher than on rail shipments. This offset the somewhat higher bruise and condemnation losses on rail shipments.

Since the volume of truck shipments was concentrated in movements averaging about 900 miles in length-of-haul, we compared the two types of transport in the 900 mile distance group for more valid results. This comparison indicated a higher truck loss of $5.79 per hundred head with death loss still the dominant factor as it was slightly under four times as great as rail death loss.

Detailed records of observations of handling conditions and practices made during assembly, loading, unloading, yarding, and the like, revealed that the most frequent forms of mishandling were abusive use of persuaders, rushing and hurrying animals during loading causing pile-ups and overcrowding in chutes, slips accompanied by severe body impact with facilities, and careless handling resulting in hogs falling from elevated ramps.

About 18 percent of the shipments were subjected to hazardous conditions in transportation equipment and about 14 percent to unsafe conditions at loading facilities at origin points. Comparing losses on those loads where these abuses or hazardous conditions were observed with losses on loads not subjected to mishandling or unsafe conditions showed a positive relationship between handling conditions and practices and losses. Losses on the shipments mishandled were 27.5 percent higher than on properly handled loads.

If the loss rates found to prevail in those shipments associated with mishandling or hazardous equipment, or both, were applied to total annual slaughter of hogs in the United States, an increase in loss of more than $6 million a year would be reflected. Obviously, control and reduction of losses and the conditions

related to them are of paramount importance to the livestock and meat industry.

This study shows that control is not an insurmountable problem but it applies industrywide because every segment of the industry is affected by the loss and damage. Most of the loss-associated conditions can be corrected or controlled without the expenditure of large sums of money, although some time will be required to effect significant improvement in some cases.

Convincing those who actually handle hogs that their role is important in loss reduction should be of first consideration. Education in safe handling can accomplish much, but creating a desire to accord livestock friendly, careful handling may well be the best answer.

Loss and Damage in Handling and Transporting Hogs

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Loss and damage to livestock associated with handling and transportation in marketing and processing have long been matters of grave concern to the livestock industry. The total annual loss to the industry has been estimated in excess of $50 million each year.

These losses are of several classes: Death and crippling in transit, carcass damage from bruising, condemnation of entire carcasses or parts due to injury or disease, and the loss in weight occasioned by handling and transportation usually referred to as transit shrink.

Farmers and their livestock marketing agencies constitute an important segment of the total livestock industry and, as such, are vitally concerned with these losses. Because of the interest and concern of these groups, Farmer Cooperative Service has conducted a series of studies in the general field of handling and transportation losses to livestock over the last several years.

The first of these studies dealt with the problem of death and crippling only and was based on a survey of stockyard records at 10 major public markets. This study indicated that in 1955 and 1956, the national loss from death and crippling was about $8 million a year.

Since losses were higher in loads moved to market by motortruck than in shipments moving by rail, a second study surveyed conditions and practices in trucking livestock to market. This study, conducted at 8 major public markets, involved the observation of some 6,400 loads of livestock during unloading. Obvious overcrowding, improper bedding, inadequate or improper ventilation, excessive use of persuaders, and failure to use partitions where needed were established as definite loss associated conditions, which occurred in those trucks containing dead or crippled animals, or both.

More recently a study was completed dealing with the problem of carcass bruise injury in cattle. This study indicated that the loss from such damage was about $12 million a year, based on 1958 prices. Animal characteristics, facilities involved in transporting and handling animals, handling techniques, actions and

attitudes of personnel actually moving or handling the cattle, and miscellaneous factors such as weather, length of haul, and the like, were found to have a positive relationship to bruise injury.

While the largest number of bruises occurred after the animals were in the hands of packing concerns, the tests clearly indicated that carcass injury occurred in every handling phase beginning with sorting and loading at the feedlot, in transit, through receiving facilities, and until actual slaughter.[1]

Handling and transportation losses are particularly important in the case of hogs. The principal reason for this is that "deficit" and "surplus" production areas of hogs are scattered throughout the country. At the same time, major slaughter areas are also widely scattered and, in many instances, far removed from surplus production areas. Slaughter facilities are usually located in areas of greatest population, and consequently of larger consumption, while production has been centered in those areas where feed, especially grain, is abundant.

Millions of hogs are moved each year from these surplus production areas to slaughter facilities located elsewhere. This movement often involves distances up to 2,000 miles. Such movements, of course, subject the animals to considerably more handling--hence, the likelihood of losses associated with handling and transportation is greatly increased.

While it is true that this pattern of production and slaughter has changed somewhat recently, the basic pattern still remains. There is reason to believe it will continue to prevail for some time to come. The Nation's principal grain production area is not likely to be shifted. Latest population figures indicate the rate of growth of major consumption areas is far greater in sections of the country where hogs are in short supply. Material improvements in refrigeration, accompanied by expedited movement and a favorable freight rate differential for fresh meat over livestock, will be essential to any major or permanent change in the basic pattern of hog production and slaughter.

For these reasons, Farmer Cooperative Service initiated this study dealing with loss and damage to hogs during handling and transportation.

The study utilized approaches which provided information on several facets of the problem as well as a picture of general conditions prevailing in the problem area. Specifically, there were three objectives:

1. To accumulate data to determine the estimated economic loss occasioned by different types of injury, damage, or disease. Data were sought on loss and damage from death and crippling in transit, condemnation due to injury or disease, and carcass damage from bruising.

[1] Complete reports on the research done by Farmer Cooperative Service and referred to above are available in the following publications: Rickenbacker, Joseph E., Losses of Livestock in Transit in Midwestern and Western States, Mar. Res. Rpt. 247, Farmer Cooperative Service, U.S. Dept. of Agr., June 1958.

Rickenbacker, Joseph E., Causes of Losses in Trucking Livestock, Mar. Res. Rpt. 251, Farmer Cooperative Service, U.S. Dept. of Agr., June 1958.

Rickenbacker, Joseph E., Handling Conditions and Practices Causing Bruises in Cattle, Mar. Res. Rpt. 346, Farmer Cooperative Service, U.S. Dept. of Agr., August 1959.

This new and modern country buying station boasts excellent handling facilities including stairstep chutes and well-planned holding pens. The large dock has an adjustable ramp for loading double-deck trailers.

2. To collect information on handling conditions and practices prevailing in the movement of hogs from production areas or concentration points to slaughter. A positive association between these factors and the loss categories was established for cattle by the FCS study. Work done by other researchers indicated such an association existed for swine.

3. To use the data obtained to determine and measure the relationship of handling and transportation factors to the various categories of loss. If positive relationships were established, it might be possible for the study to point the way to changes and improvements in handling and transportation designed to help the industry reduce such losses.

We felt a study conducted along the lines named and pointed toward the outlined objectives would help the industry focus attention on the most critical loss areas.

Study Procedures

Before beginning the work, we held a series of conferences with those in the livestock industry most conversant with the problems incident to the study. We sought advice and counsel in order that procedures would be adapted to the ordinary day-to-day operations of the industry and would yield information which the industry would find useful in meeting the needs for developing loss curtailment programs.

A proposed program of procedure was developed during these conferences and then discussed in detail with each of the cooperators in the study. Final refinements were then made. The procedures eventually used represented a consensus of the best informed opinion available as to the most practical way to procure the information desired. These final techniques and procedures reflected modifications that limited the data obtained and resulted in less definitive results than might have been desired.

Cooperators were individually instructed as to procedures they should use. These procedures were pre-tested before the work began.

Scope of Study

We placed major emphasis on those shipments of hogs moving relatively long distances to slaughter. Eight packing plants, operated by four different concerns, were selected as test slaughter facilities. These plants were located in the Rocky Mountain and Pacific Coast States.

A number of origin points in the Midwest were selected to provide coverage of a widespread segment of the major production area, and to include public stockyards, auction markets, and country buying stations. Origins and destinations chosen were located to allow full consideration of diverse routes of movement and varying lengths-of-haul. It was also possible to obtain data on differences in terrain traversed and climate encountered.

Arrangements were made for test shipments to be moved by both of the principal means of transportation -- motortruck and railroad.

Although the study emphasized long distance movements, we arranged to conduct a limited number of special or control tests on shipments originating at distances up to 150 miles from slaughter facilities in the Midwest. This was necessary in order to establish controls and to serve as a basis for comparing short haul versus long haul shipments. Also, overall loss estimates would be more reliable since short haul shipments constituted the majority of shipments of hogs to slaughter within the major slaughter areas. Consequently, one Midwestern plant from each of three of the cooperating packing concerns participated in a series of these short haul tests.

Because of the generally accepted idea that the losses under consideration are directly related to varying climate, it was necessary to conduct the study over a period long enough for a variety of weather to prevail.

We decided that selected periods in each of the four seasons of the year would prove adequate. The test periods were determined on the basis of the cooperators' advice as to volume and source of anticipated purchases and after a general review of normal weather in the midwestern and western areas of the country over a period of years.

The first, or spring tests took place during April and the first 2 weeks of May 1959. The summer series was over a 5-week period in July and August of the same year. The fall series began late in September and ran through the middle of November. The winter test period was conducted during January and February 1960.

The test periods were quite adequate in that practically every type of weather prevailed at some time during the tests. There was rain, snow and fog, high and low humidity, and temperature extremes ranging from 10 below zero to 96 degrees above.

We tried to have two test loads slaughtered at each of the cooperating plants during each week of the study. Unfortunately, circumstances did not allow this schedule to be rigidly followed.

In view of the number of people and the distances involved in the study, it was fortunate that only 20 percent of the test shipments were not carried completely through the test procedures. In addition certain operational difficulties prevented the scheduling of tests at three of the cooperating plants during certain periods of the fall and winter series. Cooperators in the study have agreed that a sufficient number of tests were conducted on a satisfactory basis and under sufficiently varied conditions to provide data adequate both in quantity and quality.

Test Techniques

A company representative selected each of the test loads. He did this without actually observing the animals, but by simply designating a lot of hogs purchased at a given origin during a particular day. Company buyers were not informed which animals would be used until after purchase was made and the animals sorted for shipment. This procedure precluded the possibility of selecting test lots on a biased or prejudiced basis.

After the test load was designated, the FCS representative at the origin point witnessed all handling accorded the test animals from that moment until their departure. He recorded on a form the general condition of facilities and transportation equipment and noted handling conditions and practices exercised during the movement and loading of the animals into the truck or rail car.

Hazardous conditions in facilities and equipment included such things as broken rails or floor boards, protruding nails and bolts, improper bedding, and any other defects which might have a bearing on the safe handling of the hogs. The observer noted whether or not persuaders were used; if so, what type, to what extent and to what degree. All slipping, falling, jumping of animals from upper decks or ramps, hurrying, rushing, crowding and piling were noted. He recorded the loading time for each deck, the live weight of the animals, and the temperature, relative humidity, and general weather conditions.

He completed the form by inserting information about routing to be followed, time of departure, and an estimate of what should be the total time in transit.

Another FCS representative observed certain of the test loads at intermediate stops where the shipment was unloaded for feed, water, and rest. In these cases, he witnessed the unloading of the animals and their reloading for the journey to destination. He supplied information similar to that obtained at the origin point. In the event the animals "changed cars," he checked equipment on the outbound car, in addition to reporting the condition of the car which arrived from origin.

While it would have been desirable to have all shipments unloaded enroute kept under observation, diversity of routes and number of feed, water, and rest stops involved precluded such an arrangement. However, a sufficient number of loads were observed under these conditions to provide adequate consideration of the effects such transit stops might have on losses.

When the test animals arrived at their destination, an observer witnessed their unloading and their movement into packer holding pens. He recorded condition of equipment on arrival; off car weight; presence of dead or crippled animals, or both, in the test load; observations as to handling accorded; prevailing weather; a value judgment as to the physical appearance of the animals after the journey; and any observations which would contribute to an overall evaluation of handling during unloading.

A final form dealt with observations made during and after slaughter. The carcass location of any trim made as a result of bruise damage was recorded and the weight of the trim tissue obtained. In addition, a tabulation was made of body marks appearing on the carcass. If any carcasses or parts were condemned, this information was listed. A post-slaughter examination of carcasses supplied data pertaining to devaluation of cuts because of excessive bruise injury. The hot dressed weight (before the carcass was put in the cooler) was also obtained in order that yield figures could be derived.

Description of the techniques and procedures shows that a rather complete record was maintained of the movement and handling of the test loads from the time they were designated as tests until after slaughter. We made every effort to insure uniformity of reporting. Instruction manuals accompanied each form and, in addition, communication was maintained with the various observers in order to clarify any problems which might have resulted in distortion of data. For the most part the same personnel was used throughout the entire study. Where changes occurred, the new personnel received firsthand instruction.

General Appraisal of Losses

In utilizing the material obtained during these tests, we considered three classes of losses -- death, condemnation, and bruise injury. Perhaps it would be well at this point to clearly define each of the classes of losses under consideration.

Categories of Loss

By dead loss, we mean the value of those animals which arrived at destination already dead or those which died immediately after unloading at the packing plant, before time of movement to slaughter. Also included were one or two instances in which carcasses were removed from the shipment at the feed, water, and rest point because the animals had already died before arrival. It would have been more meaningful if it had been possible to perform an autopsy on each of the dead animals in order to determine the cause of death. This was not feasible.

Discussions with plant personnel and with veterinarians justified the conclusion that, in most cases, death could be attributed to the same causes which resulted in subsequent condemnation of animals arriving alive but found unfit after slaughter. If this conclusion is correct, the major causes of death in transit were pneumonia, icterus (jaundice), and some form of blood poisoning. In many cases where deads and condemnations occurred in the same shipment, cause of condemnation was one of these three conditions.

Entire carcasses, or parts thereof, are condemned when the meat is judged "unfit for human consumption." All fresh meat products moving in interstate commerce are inspected by the Federal Meat Inspection Service. Its inspectors condemn the unfit carcass or parts.

In general, they condemn the meat because of disease or conditions resulting from injury, but some other conditions may also result in condemnation. For example, parasites in organs such as the liver may result in their being condemned. Where only some portion is affected, it is not necessary to condemn the entire carcass but rather only to remove the affected part. Thus, all bruised tissue is trimmed from the carcass and condemned.

A major area of condemnation loss in hogs is the ham since many are affected by arthritis. This disease renders this most valuable portion unfit for human consumption.

Condemnation loss in this report includes all condemnations of entire carcasses and condemnations of primal cuts. We have not included loss which may have accrued due to condemnation of organs, such as livers, sets, and hearts; condemned heads; or arthritis. While these latter losses are meaningful, the general feeling within the industry is that these condemnations are not too closely related to handling and transportation incident to marketing.

As with other species of livestock, two factors determine loss from bruise injury: (1) loss from trimming away injured tissue, and (2) a so-called "devaluation loss" which results when the trimout has been of sufficient severity to lower the value of the primal cut in excess of the loss occasioned by the value of the trim itself.

For example, a belly may have a considerable amount of tissue trimmed away as a result of bruising and still be fit for use as a No. 1 side of bacon. In this case, the loss would involve only the weight of the trimmed tissue. In other cases, the location of the damage on the belly might be such that this particular cut could not be used for No. 1 bacon but might have to be processed into the company's B or C grade bacon. In such cases, there is not only the loss of tissue but the entire belly drops in value. This drop of the overall cut is the devaluation loss.

Calculating Economic Loss

Significance of loss and damage can best be indicated by the use of dollar and cents figures. We have, therefore, put price tags on the loss estimates established by this study. The dollar and cents figures used were derived as follows:

1. Dead loss - A simple average of prices paid for hogs by packers over a 3-year period (1957 through

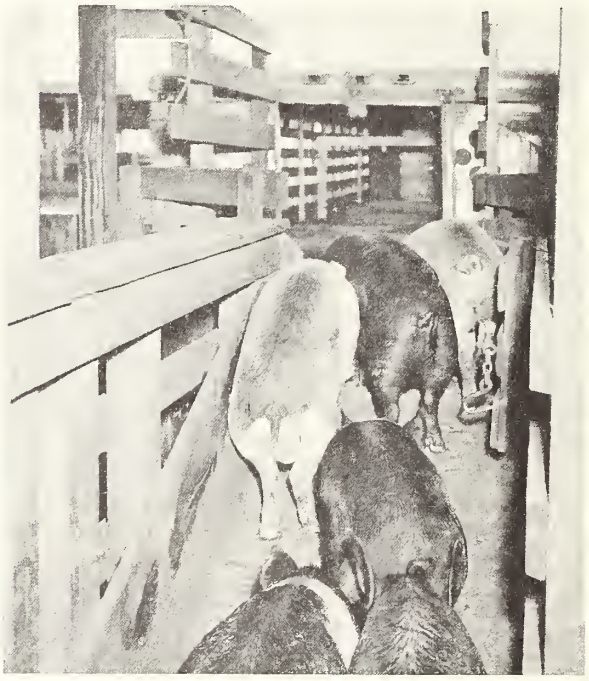
1959) was derived from U.S. Department of Agriculture market news service reports. The average live value was determined to be $18.38 per hundred pounds during this period. The dead loss was established by multiplying the average price per hundred weight by the average weight of the hogs in the shipment, of which the dead animal was a part. Thus, if the dead animal was in a shipment with an average weight of 220 pounds, the loss was calculated to be $40.44.

2. Condemnation loss - When an entire carcass was condemned, the same method of computing the dollar and cents loss was used as that for deads. Where only parts of the carcass were condemned, the loss was computed on the basis of the actual weight of the condemned part times the average price of the cut based on a simple average of wholesale prices at Chicago during the same 3-year period (1957 through 1959), derived from reports of the National Provisioner. The prices derived for this purpose were as follows: Hams - 43 cents a pound; shoulders - 25 cents a pound; bellies - 32 cents a pound; loins - 46 cents; fat-backs - 8 cents a pound.

3. Bruise loss - Trim loss due to bruise injury was determined by multiplying the weight of trimmed tissue times the average price of the primal cut from which the tissue was trimmed. Thus, if 3 pounds of tissue was trimmed from a ham, the trim loss was $1.29. This loss was computed for each cut on the carcass where bruise trimout was observed, and the total of the losses on the affected cuts became the total trim loss on the carcass.

The other factor in bruise loss was obtained from the post-slaughter inspection of the carcass and was added to the trim loss to obtain overall bruise loss on a given animal. In general, this devaluation loss was computed on a cents-per-pound basis so that the figure would remain constant regardless of changes in prices of the cut. For example, in the case of a severely damaged ham, it might be necessary to devalue the ham 3 cents a pound. If the ham weighed 14 pounds, the devaluation loss would then be 42 cents, whether hams were selling for 45 cents a pound or 35 cents a pound.

Using average prices for the 3-year period, 1957 through 1959,



Loading hogs into the upper deck of a truck or trailer calls for good facilities and "extra careful" handling. This loading chute is well constructed, but note the divider gate ajar in the chute and the heavy steel hook left free to strike against a handy ham or shoulder. Hurried loading in a situation like this could cause overcrowding and pileups resulting in injury and loss.

should enable the industry to better evaluate the loss figures contained in this study. This 3-year period covered a year in which prices were considerably higher than usual, a year in which prices were at virtual rock bottom, and a third year in which prices were what might be termed average. A review of prices prevailing since 1950 supports the argument that the average prices used in the study were representative and as meaningful as any figures which could be used.

Using loss figures derived on this basis and correlating them to the results obtained in this study, we projected what the 1959 loss would have been if applied to a total U.S. slaughter of about 88.5 million head of hogs. By this method, we estimated that the bruise loss would have been slightly over $10 million, losses due to condemnations about $5.5 million, and the dead loss approximately $7 million, or a total loss from these three causes of approximately $22.6 million.

Losses on Test Shipments

Actual loss figures of test shipments in this study showed that the average total loss per head on the basis of the three specified categories of loss was 25.56 cents based on the 3-year average prices indicated above. The 211 test shipments completed were made up of just under 30,000 head of hogs. The average weight of the test animals was 223 pounds. There were 58 hogs dead on arrival, 24 arrived at destination crippled, and 40 entire carcasses were condemned for 10 different reasons. In addition, a number of primal cuts were condemned for various reasons. A total of 3,800 pounds of tissue was trimmed from the carcasses because of bruise injury, and approximately 6,000 primal cuts were devalued.

A matter of particular interest to the livestock industry concerns the carcass location of bruise damage and the relative amount of economic loss it occasions. Table 1 lists the carcass location on the basis of the five primal cuts and gives the dollar and cents loss per hundred head due to trimout and devaluation caused by bruising. Prevalence of bruise injury to the various cuts is further indicated by showing for each cut the percent of total bruise loss associated with the particular cut.

Just under two-thirds of the total bruise loss was accounted for by injury to the ham. Of course, the ham is one of the highest priced of the primal cuts which would tend to make the loss run somewhat higher, but it was found that 60 percent of the total tissue trimmed from carcasses was also related to the hams and that 60 percent of all trim bruises were on hams. This contrasted with the loss on loins, also a higher priced primal cut, which accounted for only a little over 6 percent of total bruise loss. But in the case of loins, the total trim

TABLE 1.--Bruise loss per 100 head by carcass location

Carcass location	Loss	Percent of total bruise loss
Ham	$7.38	64.8
Shoulder	1.15	10.1
Belly	2.03	17.8
Loin	.73	6.4
Fat back	.10	.9
Total	11.39	100.0

weight represented only about 1 percent of the aggregate bruise trim.

Certainly, the figures given in table 1 point clearly to the critical areas of the carcass and suggest where the greatest emphasis on improved handling should be directed. Later on, we will discuss some of the apparent reasons for the relative rates of bruise damage assigned to the various primal cuts.

Factors Affecting Losses

Principal factors affecting losses were length-of-haul, weather, type of carrier, and shrink and yield. This section of the report discusses in detail their effect on losses.

Length-of-Haul

The livestock industry has generally assumed that handling and transportation losses increase as length-of-haul increases. This is based on the belief that the longer the haul the greater the likelihood of injury due to the accompanying increase in the amount of handling accorded the animal, and the greater time the animal is under stress conditions. The FCS survey of dead and crippled animals unloaded at public markets gave validity to this assumption.

That study showed these losses increased for all species of animals. However, the general pattern varied with "mid-distance" hauls (between 750 and 1,750 miles). Losses either slightly declined or remained on a plateau before spurting to new highs at distances beyond 1,750 miles. While some comparisons can be drawn from this earlier study, for the most part, the shipments received at these public markets traveled short distances moving under 150 miles by motortruck.

In the current study, the majority of shipments moved at considerably longer distances, almost half of them covering between 1,800 and 2,000 miles, mostly by rail. However, results from a number of short haul control tests conducted in the Midwestern area broadened the basis for comparison.

Because of the number of origins and destinations involved in the 211 test shipments in this study, we decided to group the tests into a limited number of combinations which would reflect the average length-of-haul of all those shipments included in the particular group. This was done by weighting the length-of-haul of a particular shipment by the number of animals included and then combining those shipments in the most feasible and logical groups.

Shipments fell almost automatically into the three average length-of-haul groupings shown in table 2--925 miles, 1,425 miles, and 1,925 miles. A fourth group could be included if the control shipments slaughtered in the Midwest were added.

The total loss column in table 2 shows that the expected pattern prevailed. Losses tended to increase as length-of-haul increased. Losses in

TABLE 2.--Loss per 100 head and average length-of-haul by major mileage groupings

Average length-of-haul in group	Number of head	Method of transport		Bruise loss	Condemnation loss	Death loss	Total loss
		Rail	Truck				
Miles		*Percent*					
925	7,554	62	32	$11.45	$2.11	$6.11	$19.67
1,425	6,656	94	6	13.55	5.61	5.23	24.39
1,925	15,280	96	4	10.42	8.40	10.17	28.99
All tests	29,490	88	12	11.39	6.16	8.02	25.57

the 1,425 mile group were about 24 percent higher than in the 925 group, and the long distance group shows about 19 percent higher losses than in the middle group.

The same positive relationship between increased losses and greater lengths-of-haul was illustrated clearly in condemnation loss and, to a somewhat lesser degree, in death losses. Bruise loss, however, did not vary much among the three mileage groups. Actually, the loss rose slightly between the first two groups and then declined for the longer movements.

In the control movements (those averaging 125 miles), bruise loss was $19.04 per hundred head, higher than any of the figures shown in table 2. This could probably be explained by the fact that the local shipments often contained animals of a less desirable type and, frequently, of considerably greater weight. This was understandable since their inclusion in long distance shipments would be more or less asking for trouble.

On the basis of the bruise loss figures shown in table 2, it would

A 12-inch gap between the bottom of this gate and the floor is an invitation to disaster where small animals are concerned--especially when there is a steep, inclined rampway on one side as there is just beyond this gate. In the excitement of handling, the smaller animals often manage to get caught or wedged in the opening. Two hogs in one test slipped on the incline and were trapped under the gate. Both carcasses showed up in the cooler with severely bruised hams.

appear that most bruise injury occurred during the early stages of handling and was not influenced to any great extent by the over-the-road movement. For if it were, we should have had considerably higher bruise damage on those shipments which fell into the 1,925 mile group.

Significant differences occurred in the loss per hundred head on total shipments originating at the various shipping points. The same situation was true when the shipments were considered on the basis of point of slaughter.

Each of the slaughter plants received test shipments from only certain of the origin points. No plant received shipments during any one of the test periods from more than six different origins. Likewise, none of the shipping points supplied hogs to more than four of the slaughter plants during any one test period.

Table 3 shows the total loss per hundred head on all shipments originating at the various shipping points and indicates the average length-of-haul applying to those shipments. Here again the loss rate was somewhat lower for the shorter distances than for the longer with slight deviations at origins G and H.

TABLE 3.--Loss per 100 head and average length-of-haul on test lots by origin point

Origin	Average length-of-haul	Loss
	Miles	
A	982	$10.86
B	1,102	22.49
C	1,197	21.81
D	1,241	27.88
E	1,482	30.21
F	1,575	26.64
G	1,646	22.11
H	1,798	22.32
K	1,884	28.01
L	1,886	24.72
M	1,976	37.61
All origins	1,555	25.57

TABLE 4.--Loss per 100 head and average length-of-haul of test lots received at slaughtering plants

Plant	Average length-of-haul	Loss
	Miles	
A	644	$4.11
B	929	24.92
C	968	16.93
D	1,197	21.83
E	1,571	22.20
F	1,745	37.71
G	1,925	25.80
H	1,986	32.38
All plants	1,555	25.57

The same pattern prevailed except for plant "B" when length-of-haul and loss rates at slaughter plants were analyzed, as in table 4. This exception to the pattern may be partially explained in that this plant received most of its shipments from shipping points where observers noted a higher instance of mishandling than prevailed at most of the origins.

This same was true of plant "F" which also broke the pattern somewhat. While the average length-of-haul for shipments to plant "F" was not the greatest, this plant had much the highest loss rate per hundred head.

This analysis of the relationship of length-of-haul to losses had its limitations since it did not consider other factors which might have been equally significant. We sought to minimize these limitations by introducing the length-of-haul factor in considering other loss relationships

further along in the report, but it seems valid to conclude that, limitations notwithstanding, length-of-haul bore a positive relationship to loss and damage.

Weather

The relationship between weather and losses to livestock has long been recognized. Perhaps more consideration has been given to the possible adverse effects of unfavorable weather on hogs than on other species of livestock. This has been prompted by the fact that in many instances large numbers of hogs have died in transit during periods of extreme heat. A number of similar disaster shipments have occurred during periods of bitter cold.

For many years, campaigns have been conducted during the spring by such organizations as Livestock Conservation, Inc., designed to alert farmers and shippers to the susceptibility of hogs to the effects of heat and humidity. A great deal of research has also been done on ways and means to prevent higher losses during the summer season. Not nearly so much effort has been directed toward the reduction of losses during the winter or extreme conditions of cold.

Since the various tests run as a part of this study were handled on a seasonal basis, we considered the possible relationship of climate to the various categories of loss which accrued to test shipments.

Table 5 shows the loss per hundred head of each of the loss categories on a seasonal basis. The loss from death in transit was much greater in the two extreme seasons--summer and winter--than for the intermediate seasons--spring and fall. In the case of condemnation loss, there was not too much variation between the seasons except for the fall of the year during which the loss rate fell rather dramatically. Bruise loss was higher during the summer months, but the level of loss from bruising remained rather constant over the year.

Summer and winter stood out clearly as the more critical loss seasons, with total loss in summer about 87 percent higher than the low season (fall) loss. Winter losses were 64 percent higher than those in the fall. Losses in the spring were about 23 percent higher than fall loss. This latter was largely because condemnation loss was at its highest point during spring.

The somewhat tenuous relationship between bruise loss and seasonal factors was not surprising since these losses would be expected to have a closer relationship with handling and facilities. Of course, weather could influence handling and facilities in such a way that bruise loss could be affected. For example, loading chutes and ramps could become hazardous because of ice or snow or even become slick from rain. Basically, these are handling problems and can be successfully met by exercising care and using

TABLE 5.--Losses per 100 head by seasons

Class of loss	Spring	Summer	Fall	Winter	Annual
Bruise	$10.70	$13.84	$11.15	$10.01	$11.39
Condemnation	8.32	6.07	1.87	7.84	6.16
Death	3.37	14.17	5.21	12.05	8.02
Total	22.39	34.08	18.23	29.90	25.57

materials to alleviate the hazardous condition.

The somewhat higher bruise rate occurring during the summer months could be more closely associated with seasonal factors. Effect of excessive heat or humidity, or both, resulted in an unfavorable physical reaction in animals, making them more difficult to handle.

Observations of test shipments indicated that the closest relationship between seasonal factors and bruise loss came about because of the effect of unfavorable or unpleasant weather on the personnel handling the animals. Tempers became short, care and caution were often forgotten, and impatience reared its costly head when the handler was loading hogs in the broiling sun or in the driving rain or snow.

Table 6 shows a number of carcass condemnations for various causes on a seasonal basis. Pneumonia was a cause in each of the seasons, but it was much more prevalent during the winter than during other seasons of the year. Icterus, which was the second most important reason for condemnation, was of greater importance during the spring but also occurred in summer and winter.

These two conditions are generally regarded as being the more closely connected with transportation and handling. In the case of pneumonia, its relation to adverse weather, particularly extreme cold, has been generally accepted. The data indicated that pneumonia must be considered a definite hazard, regardless of length-of-haul, but that particular care must be taken during winter months where long hauls are involved. While there have not been any major studies positively relating icterus to weather, the results of one important study in this field rather closely parallel the icterus pattern indicated in table 6. These

TABLE 6.--Causes of condemnations by seasons and average length-of-haul

Average length-of-haul	Spring	Summer	Fall	Winter	Total
Miles					
900	1 Pneumonia	2 Pneumonia			3 Pneumonia
1,400	1 Asphyxia 2 Icterus 1 Pneumonia 1 Pyemia	1 Pyemia	1 Pneumonia	1 Icterus	1 Asphyxia 3 Icterus 2 Pneumonia 2 Pyemia
1,900	4 Icterus 1 Nephritis 1 Pericarditis 1 Pneumonia 2 Sex Odor 1 Uremia	2 Contamination 2 Icterus 1 Pneumonia 1 Pyemia 1 Septicemia	1 Nephritis 1 Pneumonia	1 Icterus 9 Pneumonia	2 Contamination 7 Icterus 2 Nephritis 1 Pericarditis 12 Pneumonia 1 Pyemia 1 Septicemia 2 Sex Odor 1 Uremia

data buttressed the findings in the study of icterus: Elapsed time in movement or distance traveled, or both, may be more closely related to losses due to condemnation for icterus than climate is.

If it had been possible to obtain autopsies on those animals which arrived dead, the death loss figures would be more meaningful. However, it is reasonable to assume that the majority of the deaths in transit could be attributed to the same condition which resulted in condemnation of animals slaughtered. That is, the majority of animals dying in transit during the winter months probably died of pneumonia, and the majority arriving as deads in the spring shipment may well have died as a result of an icterus condition.

If these assumptions are correct, the relationship between death loss and seasonal factors can be explained in much the same way as for condemnation. The major difference is that, in many condemnation cases, the animal will not expire because of icterus in the time which elapses between the farm and the slaughter plant.

Whether or not weather factors, length-of-haul, or the two combined were positively related to the causes of condemnation or death in instances other than icterus or pneumonia cannot be determined from the work done in this study. Certainly adverse weather and the long periods spent in stress conditions cannot be ruled out as possible factors in both condemnation and death loss.

Type of Carrier

It is always difficult to compare loss rates for shipments moving by highway versus those moving by railroad. Truck shipments normally move considerably shorter distances than do rail shipments of livestock. Comparison is even more difficult in the case at hand since such a preponderant majority--about three-fourths--of the test shipments moved by rail. However, sufficient lots moved by truck to permit some general observations on the relationship of loss and damage to mode of transport.

We can make the best comparison in the case of those shipments which had average lengths-of-haul of around 925 miles, or our block I mileage group (table 7). In this case, rail accounted for about 60 percent and truck, about 40. Truck shipments accounted for only a very small percentage of the total volume in blocks II and III. On the other hand 100 percent of the local control shipments slaughtered in the Midwest moved by truck. In this latter case, no comparison with rail could be made.

Table 7 gives the total loss per hundred head of shipments moving by rail and by truck on a seasonal basis for each of the three mileage groupings. On an annual basis, truck losses were greater than rail losses, regardless of distance, but considerably greater for the longer lengths-of-haul.

On a seasonal basis, truck losses were considerably higher than rail losses in the two extreme seasons of summer and winter. Rail losses exceeded truck losses in the more temperate seasons of spring and fall. The seasonal comparison was impaired somewhat, however, since during the fall and winter months no truck shipments moved over the longer distances. A closer examination of records of the test shipments

TABLE 7.--Loss per 100 head of hogs by rail and truck by major mileage groupings

Mileage group	Season				Annual
	Spring	Summer	Fall	Winter	
I. 925 miles					
Rail	$17.97	$26.81	$12.85	$8.92	$17.28
Truck	12.13	19.85	7.89	42.81	23.07
All loads	15.96	23.37	11.90	35.66	19.67
II. 1,425 miles					
Rail	27.40	21.16	18.30	14.61	20.54
Truck	No shipments	94.26	No shipments	No shipments	94.26
All loads	27.40	33.25	18.30	14.61	24.39
III. 1,925 miles					
Rail	24.29	37.81	20.95	32.98	28.37
Truck	61.70	54.84	No shipments	No shipments	57.98
All loads	25.42	38.70	20.95	32.98	28.99
All groups					
Rail	23.14	31.31	18.69	27.27	24.52
Truck	17.64	47.44	7.89	42.81	32.59
All loads	22.39	34.08	18.23	29.90	25.57

disclosed the most important factor in the higher truck loss rate was that, regardless of distance, death loss in truck shipments was higher than rail loss--not just higher, but much higher.

Bruise loss was greater on rail shipments except for the really long haul movements but on an all-shipment or distance basis, total bruise losses for each type of transport were only about 15 percent apart (rail higher than truck.)

Rail losses from condemnations were higher on all shipments except those in the number I (925 mile) block.

In block I where the volume of shipment by each of the modes of transport was more nearly equal, a closer examination of the various categories of loss indicated that bruise loss was somewhat over 25 percent higher on rail shipments. Truck losses for condemnations were 28 percent higher than rail losses and 277 percent higher than rail losses from death in transit.

On a seasonal basis, bruise loss for block I was higher on rail shipments in all seasons except for winter, and it was 30 to 45 percent higher in each instance. In the winter, however, truck losses in this category exceeded rail losses by 50 percent. Detailed records of the "high loss" shipments during the winter showed that in several cases drivers reported extremely poor driving conditions--icy roads, heavy snowfall, and buffeting winds. These shipments may have been subjected to unusual hazards during the actual over-the-road transit.

In block I no deaths were reported in shipments moved by rail during the fall or winter, and none in shipments moved by truck during summer and fall. Death loss was

relatively low during the spring, but truck losses were nearly double rail losses. Summer death loss was moderately high and confined entirely to rail shipments, while winter losses were quite high and confined to truck shipments.

There was a moderate condemnation loss on rail shipments in the spring series of tests in block I, and a more substantial condemnation loss in truck shipments moving in the summer. Other than these two instances, no condemnations were reported.

Based on the data obtained during the tests, the following conclusions, relative to rail and truck shipments, seem justified:

1. Bruise loss was a rather significant problem in the case of both modes of transport, but should be of somewhat greater concern to railroads than to trucks, except that during winter months where road conditions are extremely hazardous potential bruise damage should be of vital concern to motor transporters.

2. Possibility of death in transit was far greater by truck than by rail. This was true, regardless of distance shipped, but was especially true where shipments moved really long distances. Death loss was a much more significant factor during the extreme seasons of summer and winter

As pneumonia condemnations were quite high for long distance rail shipments during the winter, protection against extreme cold during rail movement should be a matter of concern for railway livestock departments.

3. Since condemnation loss on rail shipments were higher than on truck shipments, such losses would appear to be a more significant problem for rail shipments. Many of the conditions which resulted in condemnations apparently required the extra time involved in transporting animals long distances. Again, protection against extreme cold to reduce condemnation loss from pneumonia was the paramount problem in winter shipments by rail. Some method for combating the incidence of icterus during spring and summer should also be developed if these losses occurring in rail shipments are to be curtailed significantly.

4. In the case of truck shipments moving short distances--such as the local control loads slaughtered in the Midwest--careful attention should be directed toward the assembly and handling of hogs to reduce high incidence of carcass damage from the bruising apparent in these shipments.

Overall, there was not too much difference between the two modes of transport, yet the data indicate that length-of-haul and seasonality should be considered in deciding whether to ship hogs by rail or truck since particular hazards became more important in the one case than the other. These hazards may be of such significance as to clearly indicate the type of transportation best suited.

The most critical factors involving each of the two types of transport should be the subject of close investigation by the respective managements. There is every reason to believe that changes and improvements in procedures can result in the elimination or substantial lessening of these critical areas.

Shrink and Yield

Loss of weight sustained by livestock during the time involved in movement from farm to final destination is a problem of some economic significance. It is perhaps more significant in those instances where the livestock is slaughtered upon arrival at final destination since there is no opportunity for the animal to regain lost weight. The loss of weight involves two factors: (1) A loss from the natural excretions of the animals, and (2) loss in body weight usually referred to as "tissue shrink." Since the loss in weight is associated with handling and transportation, the term "transit shrink" is generally used.

In this study we obtained figures relating to shrink by listing the total live weight of the shipment at origin point and the weight of the animals upon unloading at destination. Actually, the weight at origin constituted the purchase weight rather than the weight at the moment the animals were loaded. However, the amount of handling animals received from the time of purchase until loading operations began was not excessive. It only involved moving the animals from the scales to holding pens adjacent to loading facilities.

In all cases animals were put across company scales at destination plants immediately following unloading from the vehicles. This weight represented the true weight of the test lots upon completion of the transportation period. The shrink represented a difference in the two weights and was stated as a percentage of loss in weight from the weight at time of purchase.

After hogs are slaughtered and dressed, the carcasses are weighed before going into the cooler. The percent this weight represents of the live weight at origin or time of purchase constitutes the hot yield. After carcasses are cooled or chilled, there is usually a slight additional shrink and corresponding reduction in weight of the carcass. The difference between the hot weight and the weight after chilling would represent "cooler shrink." The percent the weight of the chilled carcass represents of the original weight at origin or time of purchase would be the ultimate yield. Because of conditions prevailing during these tests, we have not dealt with cooler shrink or ultimate yield.

Average shrink for all test loads in this study was 5.89 percent and the hot yield was 70.72 percent.

"Putting them across the scales" is often a critical handling operation. While these scales are in excellent repair and have easy access, hogs must be turned on the scales and leave through the same gateway they entered. Making hogs do "an about-face" isn't always easy and handlers must be alert to avoid trouble from the animals as well as from their own dispositions.

Average live weight of the test animals was 223 pounds a head. In table 8, the percent of shrink and hot yield and the average live weight a head are shown on the basis of rail and truck shipments related to the length-of-haul.

As might have been expected, total transit shrink gradually increased as length-of-haul increased. This was accompanied by a somewhat less significant decline in hot yield. Rail shipments showed higher rates of shrink in the first two mileage groups, but shrink was much higher on truck shipments in the case of the longest length-of-haul.

In all instances, except for truck shipments moving an average of 1,425 miles, the lowest shrink was consistent with higher hot yield. In the exception noted, the average weight of the hogs in the truck shipments was a low 209 pounds, which probably explained the somewhat lower yield.

If distance were disregarded and all shipments were examined only on the mode of transport, truck shipments would show 0.6 percent less shrink than rail shipments do, but only 0.08 percent greater hot yield. A review of data obtained on the control shipments slaughtered in the Midwest revealed that the percent of shrink on these shipments, all moved by truck, was 1.95 percent, and a hot yield of 71.44 percent was obtained. These shipments had an average length-of-haul of approximately 125 miles, so the lower shrink and higher yield fit into the general pattern suggested in table 8.

A review of shrink and yield figures on a seasonal basis, without regard to length-of-haul, showed that shrink on rail shipments remained

TABLE 8.--Shrink and hot yield on rail and truck shipments of test hogs by major mileage grouping

Mileage group and mode of transport	Average weight per head	Shrink	Hot yield
I. 925 miles	*Pounds*	*Percent*	*Percent*
Rail	227	5.50	71.19
Truck	229	5.00	71.52
II. 1,425 miles			
Rail	223	5.65	70.69
Truck	209	4.61	68.09
III. 1,925 miles			
Rail	222	6.24	70.59
Truck	216	7.92	68.55
All distances			
Rail	223	5.96	70.71
Truck	225	5.36	70.79
All loads	223	5.89	70.72

fairly constant for all seasons of the year, with a very slight rise in summer and fall and a moderate decline in the winter (the overall range being confined to 0.78 percent). On the other hand, climate appeared to have influenced shrink in truck shipments for shrink was 7.05 percent in the summer months, 5.77 percent in the winter, and only 4.22 percent in the spring, with the fall rate 0.3 percent greater than the spring rate.

Likewise, hot weight obtained on rail shipments differed little regardless of season, ranging from 70.51 percent in the fall to 70.97 percent in the spring. As for trucks, where shrink rates were low, yields were high and where shrink was high, yields fell correspondingly. Thus, in the summer the yield dropped to 68.74 percent, while the low shrink rate in the spring was accompanied by a high yield of 72.22 percent.

Animals shipped by rail are subject to the so-called "Twenty-Eight

Hour Law," which requires that they be unloaded at a point enroute after 28 hours in transit, unless the consignor signs a release. Then the animals may remain on the cars a total of 36 hours. In almost all instances, the release is obtained, so for all practical purposes, 36 rather than 28 hours is the usual maximum time in transit without unloading.

All of the rail shipments involved in this study that moved distances greater than 1,000 miles were unloaded at least once and sometimes twice. During such stopovers, the animals were given feed and water. In addition, feed was usually spread over the floors of the rail cars, both at point of origin and at the stop enroute.

Only one truck shipment moving a long distance was unloaded for rest enroute. In only a limited number of cases was feed placed in the truck before loading. Truck shipments are not subject to the legislation mentioned above, and stops enroute for feed, water and rest are discretionary. In general, the average haul is within the 36 hour limit usually applied on rail shipments and where longer, the shipper often requests they be omitted, in the belief that the consequent lessening of total time in transit compensates for any adverse factors.

Whether or not feed, water, and rest enroute help to control shrink and contribute to higher yield cannot be positively proved. The results obtained in this study would seem to indicate that at least some salutary effect was had because rail shrink losses and hot yields obtained were considerably more favorable than those obtained on truck shipments not stopped enroute.

In a few incidents rail shipments were unloaded at a point some 8 to 10 hours travel time from final destination and held at that point from 2 to 4 days before continuing to the slaughter plant. These animals were on feed and water during this period. In the case of these shipments, shrink loss was about 1 percent less and yields about 0.5 percent higher than on shipments moving to the same destination from the same origin which did not enjoy the long stopover at the last unloading point prior to destination.

These few shipments did not provide justification for concluding that animals can quickly convert feed to effective body gains. Other conditions may have prevailed which could not be isolated by the procedures used in this study. Nonetheless, we regarded this as at least an interesting development.

Whether or not shrink constitutes an actual loss from the conditions revealed in the study, or whether it is a real loss under any conditions in hog marketing probably depends on several factors. If transportation charges are based on the purchase or loading weight, a real transportation loss is involved, for freight is paid on the meat that isn't there at the end of the journey. Generally, however, these charges are based on delivered weight.

Then, of course, there is the amount of money paid for the hog at the time of purchase for a given weight versus the value of the animal at destination, if determined in the same way (live weight times price a pound). This represents a significant economic loss to the purchaser provided the price paid has

not been "adjusted" to allow for such shrink. Whether or not such an adjustment is made probably depends on market conditions prevailing at the time, or more specifically, on just how bad the packer needs the hogs. Suffice it to say, shrink represents a disappearance in value (meat) and, as such, should be controlled insofar as possible.

Handling Conditions and Practices

A major objective of this study was to observe handling conditions and practices affecting the test shipments during as many of the various handling phases as might be practical. By maintaining a record of such observations and comparing them with post-slaughter observations of test animal carcasses, the possible relationship between various handling conditions and practices and loss and damage might well be established.

The degree of accuracy obtained in the previous study of cattle by FCS could not be realized in this particular study since it was not feasible to identify individual animals. Identification had to be on the basis of test lots. The limitation left some of the conclusions reached on the relationship existing between handling and losses somewhat less than proven fact, but it by no means reduced them to conjecture. The various records maintained were in detail and the identification of the test animals was preserved. Where test lots were mixed or otherwise "lost," these shipments were omitted from the test data and from the analysis.

Further strength was given to the conclusions reached in this study pertaining to these loss relationships through close and thorough observation of the control shipments slaughtered in the Midwest, and extensive observation of operations at country buying stations and assembly points, buttressed in many instances by loss data on animals handled through the facilities during the period of observation.

While a major objective of the study was to establish relationships as cited above, no attempt could be made to assess blame or fix responsibility for losses on any particular segment of the industry, since it was impossible to include every handling operation and phase within the scope of the study. In addition, the only techniques practical under "field conditions" were such that any such positive assessment of responsibility would be open to challenge. Insofar as bruise injury was concerned, however, severe application of persuaders, kicking, falling and so forth were proved to be a cause of carcass bruise injury in laboratory research conducted by the Ohio State University, under contract with FCS, the results of which have been previously published.[2]

The methods used in establishing the relationship of mishandling to bruise injury were the same in this study as in the work done on cattle. The results obtained in the case of

[2] Rickenbacker, Joseph E., Biochemical Problems in Determining the Age of Bruised Animal Tissue, Service Report 42, Farmer Cooperative Service, U.S. Dept. of Agr., Feb. 1959.

cattle strongly supported the Ohio laboratory research for the record of mishandling was compatible with the record of carcass condition in 70 percent of the cases. Severe impact whether from the abusive use of persuaders or as a result of other forms of mishandling almost invariably resulted in bruising to some degree.

Two-thirds of the total financial loss due to bruising was positively identified with a "potential injury" observation. Laboratory research revealed that the various species of livestock are about equally susceptible to bruise injury from various traumas. Those associated with mishandling were positively related to carcass damage in the work on cattle. Thus we assumed that these same traumas would produce bruises on hogs.

Classifying Shipments

We maintained a detailed record of handling and the condition of equipment and facilities on each of the test shipments. In all cases, the record included the results of observations during assembly and loading at origin and unloading and yarding at destination. In some cases, this was supplemented by observations made during unloading and reloading at feed, water, and rest stops enroute. On the basis of this record, the test shipments were analyzed and divided into two general classes.

One class comprised all shipments observers had noted as being handled without any untoward incidents and which moved in equipment free from observable hazardous conditions and through facilities likewise deemed adequate and "safe." In other words, this class contained those shipments which, on the basis of observation, should have shown little or no loss or damage as a result of handling conditions and practices during the tests.

The other class of test shipments comprised those which, in the opinion of the observers, had received handling potentially able to produce loss and damage, or handled through or in defective facilities and equipment that could result in potential injury.

We decided which handling conditions and practices should be regarded as likely to result in potential injury and what facilities or equipment should be termed "hazardous" by applying standards developed in a previous study, by recognizing the significance of the laboratory findings resulting from the Ohio State research, and by carefully considering informed opinions of industry leaders. By using standards thus established, the decisions reached become much more than mere value judgments.

Using these standards in classifying the test shipments on the basis of the two categories indicated, we found that approximately 50 percent of all test loads fell into class 2--that is, roughly half of the total shipments were deemed to have been subjected to handling conditions and practices likely to result in injury or subjected to hazardous facilities and equipment. A comparison of rail and truck shipments showed that 46 percent of the former and 80 percent of the latter were classified in the "potential loss" category.

Some idea of the relationship between handling conditions and

practices and loss and damage can be obtained by comparing the dollar and cents loss on the potential loss loads (classification 2) with the total loss on loads deemed to have been handled safely. Using this technique, we found that the total loss per hundred head on the class 2 shipments was $28.61, as against $22.43 on class 1 loads. This higher loss rate (27.5 percent) may not at firsthand appear overly significant, but projected on a total annual slaughter basis it would represent an increase in loss in excess of $6 million a year. While some may regard such a projection as an over-dramatization, at least it serves to emphasize the importance of safe handling and the elimination of hazardous conditions from facilities and equipment.

Handling Abuse

Table 9 lists the frequency of various handling abuses as well as the frequency of hazardous facilities and transportation equipment in the 211 test shipments. In a good many cases more than one abuse was noted. In some instances, there was handling abuse--plus hazardous equipment or facilities, or both. In other instances, only one condition of a potential loss-related nature was observed, but in these cases this one condition was judged

TABLE 9.--Frequency and economic significance of handling abuses, hazardous facilities, and transportation equipment defects in 211 test loads

Type of abuse of mishandling	Incidence	Percent increase in total loss above properly handled loads [1]
Abusive use of persuaders	100	23
Forcing animals to jump from decks or ramps	3	23
Animals falling from decks, ramps, or chutes due to rough or careless handling	18	29
Abusive kicking by handlers	9	92
Forcing animals to pile-up or crowd in chutes by rough or abusive handling	57	77
Rushed or hurried handling resulting in slips, catching legs in openings, or severe impact of body with part of facility or vehicle	24	69
Bedding of vehicle: Inadequate, improper, or absent	14	52
Defective vehicle (harzardous)	39	21
Hazardous stationary facilities at loading, rest stops, or destination	30	31

[1] The total loss per 100 head on loads "properly handled" (no abusive handling practices or conditions observed) was used as the base for computing the percentage increase where the indicated types of mishandling were noted. Some duplication resulted since loads receiving more than one type of mishandling were included in the calculations for each type.

flagrant enough to classify the shipment as subject to potential loss and damage.

In the first series of tests, a good many shipments were handled before personnel at the various points knew exactly what was happening, and a greater frequency of handling abuse was noted. But once the word got around, it became almost impossible to say that the test shipment did not receive at least some measure of preferential handling. This resulted in some bias which ought to be considered in evaluating the findings presented here.

On the basis of observations made from overhead walkways and ramps at public stockyards and auction markets and observations made at country buying stations and concentration points, the bias accruing from preferential handling should probably be regarded as moderately significant. Perhaps an additional 15 to 20 percent of the test shipments would have been classified as potential loss shipments if ideal conditions for observations could have prevailed. If this were true, dollar and cents loss per hundred head on class 2 shipments would have increased about 10 percent.

Under the circumstances, relationship between the incidence of mishandling and hazardous equipment and facilities to loss and damage should probably be regarded as more positive and significant than indicated by this study. Loss figures pertaining to those loads in class 2 might well be considered conservative.

Table 9 shows that the abusive use of persuaders was the most common and frequent form of mishandling. This abuse occurred primarily during the loading of animals into vehicles for transportation, either at origin point or when reloaded after a stop enroute. Although persuaders were frequently used in unloading at destination, only a few cases of their use in an abusive manner were reported.

Actually, there would be considerably less reason for using persuaders during unloading since animals will generally leave the vehicle voluntarily after a journey, provided the door is open, the way is clear, and the unloading facilities uncomplicated in that ramps and chutes are straight and the animal is not required to jump. For descent from upper decks of trucks or rail cars, stair-stepped chutes seem preferable to cleated rampways.

There may possibly be some justification for using persuaders during loading operations because hogs are wary about entering the confines of a vehicle, particularly if they must do so by devious routes and by mounting steep inclines. But many hours spent in observing livestock movements lead us to assert that loading can be accomplished, in many instances, without use of persuaders and, in the remainder of instances, by their occasional judicious use.

Electric prods (hot shots), canes, sorting poles, canvas slappers and whips were all observed during this study, but the electric prod and the slappers were used most frequently. By abusive use, we mean application of the persuader to the animal with extreme force or in such a way as to cause the animal, as a result, to sustain strong impact against some part of the facility or equipment, particularly rough corners, door jams, or partially opened gates.

Where the application of the persuader was less severe, but was of a virtually continuous nature, so animals became overly excited, use of the persuader was also considered abusive. This latter use of persuaders was classified as abusive on the basis of the Ohio State research, which clearly indicated that highly excited animals were not only more susceptible to carcass damage due to bruising, but also that bruises incurred were likely to be of greater severity.

The excessive and abusive use of persuaders witnessed during this study and the extent to which such conditions occurred emphasize the importance of leaders in the livestock industry instituting training programs to properly instruct handlers in the significance of this particular problem. Much of the other mishandling was in some way related to the improper and abusive use of persuaders. Unfortunately, many handlers of livestock believe that severe applications of persuaders to animals result only in body marks and do little or no material damage. While this is true in some cases, it is not universally so. Serious and costly damage can result because attendant excitement causes a lowering of the animal's natural resistance to bruising and, at the same time, can result in other damaging mishaps.

Programs to curtail losses from improper use of persuaders should not only be directed toward those handling animals on farms, at buying stations and concentration points during shipment, but also to those who drive the animals from holding pens to slaughter. Severe blows sustained, even seconds before slaughter, can result in carcass bruise injury with the same effect as those administered hours or even days before the animal is processed into meat.

Since one does not normally think of the human foot as a persuader, kicking animals by handlers was listed separately. In nine test loads observers noted handlers engaged in this practice. The same standards in determining abusiveness were used as in the case of bona fide persuaders. In several cases, kicking was accompanied by other intemperate actions on the part of the handler. Kicking can have the same damaging effect as the injudicious use of a sorting pole or cane. It can be especially damaging if the handler is wearing safety shoes which have steel toes. These were not uncommon, particularly in packing houses.

Hogs forced to jump from upper decks or elevated ramps or chutes, or those falling from such heights due to rough or careless handling, are especially vulnerable to severe injury. If they happen to land in a certain way, they may "spread" which results in a most severe form of carcass damage. If this occurs at the beginning of a journey, they may well die enroute, or may have to be destroyed at the outset. If they escape this fate, the impact sustained from the fall can result in severe bruising.

Forcing animals to jump was often associated with the use of stub-decks in livestock trailers where portable unloading facilities were not supplied, or the partition placed at the end of the deck could not be used as a descending ramp. The remedy for this is obvious.

In some situations height of permanent facilities used in loading or

unloading was such, that the animal had to jump rather than step from the vehicle onto the facility. This situation was more prevalent when motortrucks were used because of the lack of uniformity and positioning of the decks on the trucks. The remedy here is to use a portable chute of the proper height, to install adjustable chutes, or perhaps use specially constructed extensions which can be attached to permanent fixtures when necessary.

When animals fell from elevated ramps, the chutes or upper decks, there were usually two causes: (1) The sides of the loading facility were not properly protected, or there was a gap or open space between the facility and the vehicle; and (2) handling accorded the animals was rough, careless, and usually hurried as well. A little simple carpentry, patience, and common sense can alleviate this loss associated condition.

Rushing or hurrying animals during loading or unloading (frequently accompanied by the abusive use of persuaders) often resulted in animals slipping and falling and in severe impacts of the body with a part of the facility or the vehicle. In the case of hogs, there appeared a tendency for the ham to sustain severe bruise damage. The hind legs always seemed to catch in the smallest opening, thus causing the animal to lose its balance and fall. Extricating the leg usually entailed a good deal of threshing about, and could result in sufficient strain being placed on the leg as to bring on internal hemorrhage.

Rushing and hurrying the hogs were also major causes of overcrowding and piling up in chutes and passageways. While it may be that the animals did not suffer severe injury, there can be little doubt that they were injured by the abusive tactics often employed by handlers in attempting to break the bottleneck or unscramble the pile. On occasions such as these the foot was apt to become a persuader and bona fide persuaders were apt to be used in an intemperate manner.

Certainly much of the loss related to the conditions just described can be eliminated by exercising patience. If the handling is careful, orderly, and unhurried, slips and falls are unlikely and pileups and overcrowding can be avoided.

Hazardous Facilities and Equipment

Importance of facilities and equipment cannot be overestimated. We have already discussed certain hazardous conditions which can contribute to loss and damage--stub-decks, poorly constructed ramps, and facilities which failed to meet the requirements for which they were intended.

In general, most of the stationary facilities at the origins observed in this study were properly constructed and in good repair. However, at times shipments were loaded from a particular area at an assembly point where the facilities had been allowed to depreciate, or from an area not normally used in the handling of hogs. In these cases, an attempt was made to "make the facility do," or some procedure was improvised to overcome the obvious difficulties. Unfortunately, both of these approaches usually failed.

Occasionally weather made normally satisfactory facilities unsafe

Dilapidated facilities can exact a toll in losses many times the cost of replacing them or bringing them to a good state of repair. This loading chute with its broken and worn cleats, split and splintered sides, protruding nails and bolts, and a weak sagging dock demands that the handler use care almost "beyond the call of duty" to move hogs safely through. The hazards could be materially lessened with a hammer, saw, a few nails, and a little lumber but a major overhaul or complete replacement will be necessary to effect really lasting and satisfactory improvement.

and hazardous. This was particularly true during the winter when ice and snow were present, and during other seasons when rain slickened the surfaces. Obviously, applying material designed to provide better footing and exercising additional care in handling could overcome much of the potential danger.

Modifying facilities to conform with prevailing equipment specifications (particularly ramps and chutes used in loading and unloading) and using protective materials during inclement weather should minimize or eliminate the majority of hazardous conditions in stationary facilities at most hog concentration centers.

Selecting and applying proper bedding are particularly important in the safe movement of hogs. In all species of livestock, proper bedding is somewhat a safety factor because it can be used to provide good footing. This is important not only during loading and unloading but during the over-the-road trip as well since swaying and lurching of the vehicle can result in animals slipping and falling. They can sustain impacts of sufficient strength to cause bruise injury.

The physiology of swine is such that bedding may have considerable influence on body temperature or other physical factors which, in turn, could be related to losses. Thus, during the summer, using damp sand may have a cooling effect, which would be beneficial. During the winter, a bedding of straw on top of dry sand would promote warmth. These were the only two materials used as bedding in vehicles transporting the test shipments. Observations made at stockyards and country buying stations during the study, however, showed that sawdust, wood shavings, and a mixture containing a considerable amount of ground corncobs were also frequently used in bedding motortrucks.

In all but two instances rail cars were supplied with bedding of some sort--generally sand. A few cars had inadequate bedding. If the hogs

"changed cars" at a rest stop, the new car was, in every instance, freshly bedded. Where the same car was used to destination, additional bedding was added where needed, in most instances.

While most truck shipments were also properly bedded, on several occasions the top deck was left bare. The excuse for this was that "the sand sifts through anyway so there isn't any use to put it up there." Because swaying and lurching are somewhat worse in the top deck and because this portion of the vehicle is more difficult to load, livestock haulers should feel it incumbent to make whatever changes are necessary to bed upper decks properly and eliminate the loss of the bedding during the over-the-road trip.

The vehicle itself can also have some relationship to loss and damage if conditions present could cause injury in and of themselves, or if the condition could help create a hazard. The most frequent safety defects encountered during the tests, on rail shipments, were broken side slats with sharp points left hanging inside the car; floors that were buckled and worn, or in which there were holes; badly leaking roofs which would allow rain to come into the car in such quantities as to cause sloppy bedding; and rough or splintered bulkheads and sides. In one or two cases the upper deck was supported by wooden posts set out in the car where animals could be thrown against them during movement.

Major defects, insofar as trucks were concerned, were rickety upper decks, improperly fitted, so legs slipped between the boards of the flooring or between the deck and the side of the vehicle and end gates framed by open channel irons.

As in the case of facilities, the majority of hazardous conditions in transportation equipment were such that minimum cost and effort could eliminate most of them. The shipper can control this situation either by his selection of the carrier or by insisting that only equipment in good condition be offered for the movement of his animals.

Conclusion

All of the loss figures developed in this study indicated that loss and damage associated with transportation and handling was higher than it had generally been assumed by most of the industry. Controlling these losses is not an insurmountable problem. Not one of the abuses or hazards listed requires the expenditure of large sums of money to correct, although many will take time. The most difficult job is convincing livestock handlers of their importance in loss control and in not only educating them, but creating in them a genuine desire to accord their livestock charges friendly, careful handling.

This is not just a job for packers, or for transportation agents, or for marketing agencies, or for farmers. It is a job for the entire industry because loss and damage is an industrywide problem. Finding an effective solution to the problem will benefit every segment of the industry.

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