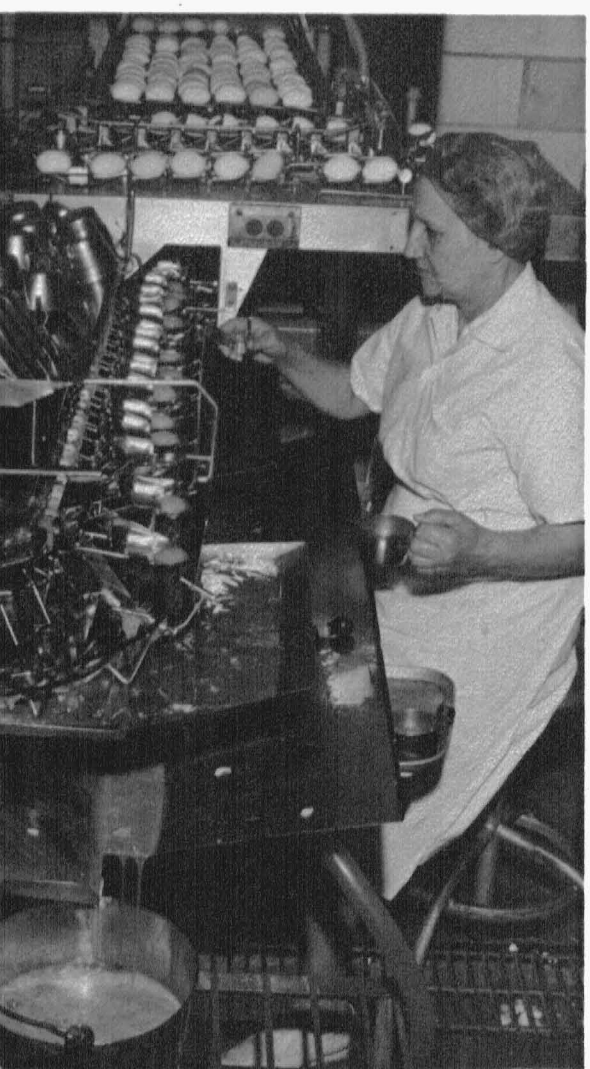
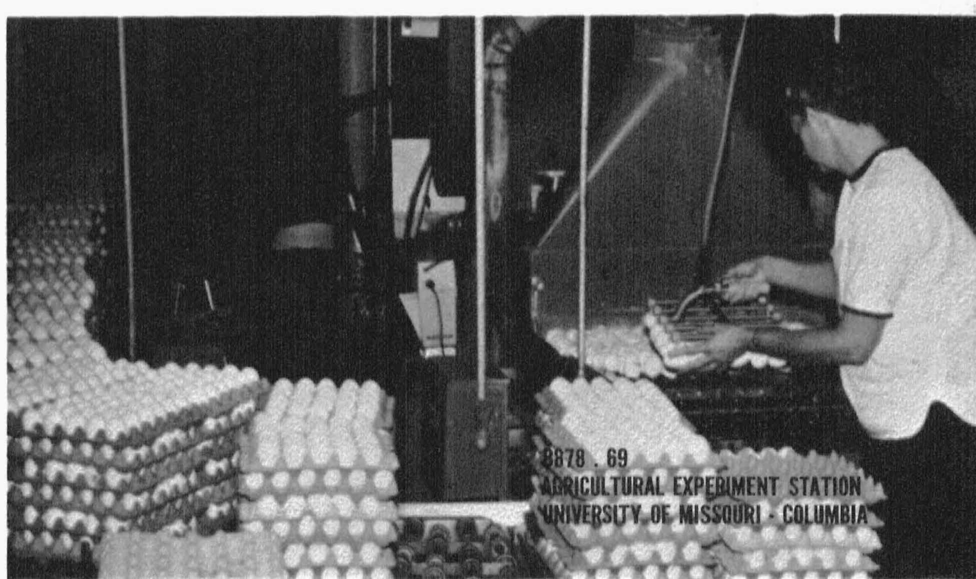


POULTRY INDUSTRY OF MISSOURI

E.M. FUNK



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Contents

POULTRY INDUSTRY OF MISSOURI

The poultry industry of Missouri, which returns 80 to 100 million dollars to producers annually and generates $300 million of business, is important in the economy of the state.

Though most consumers in the United States eat eggs and poultry, the total amount used per capita is not as much as for red meats (see Fig. 1). However, since 1950, the per capita consumption of turkey and chicken has been increasing at a faster rate than that of the red meats (Fig. 2). If the present rate of increase in the consumption of chicken continues, the per capita consumption of chicken by 1975-80 will equal or exceed that of pork.

The number and farm value of poultry products produced in Missouri in 1966, and 1967, are given below.

As the industry becomes larger and more specialized, the agribusiness features of the industry become increasingly important. The feed industry not only prepares most of the feed used, but supplies many of the services needed, such as financing, technical services, production and supervision of marketing.

	1966		1967	
	Number	Value	Number	Value
Chickens	7,341,000	2,533,000	7,660,000	2,602,000
Broilers	21,965,000	11,202,000	20,867,000	9,933,000
Turkeys	9,976,000	44,073,000	11,459,000	44,492,000
Eggs	1,340,000,000	34,728,000	1,419,000,000	27,198,000
Totals		$92,536,000		$84,225,000

(The lower farm value of poultry products in 1967 was due to extremely low prices for all these products.)

Table 1 TEN HIGH STATES IN TURKEY PRODUCTION IN 1967
(From USDA PES-248, September, 1967)

State	Number of turkeys raised					Rank		
	1955	1965	1967	Change in number between 1955-67	Change in number between 1960-67	1955	1965	1967
	Thousand	Thousand	Thousand	Thousand	Thousand	No.	No.	No.
California	10,196	15,667	19,088	8,892	4,552	1	1	1
Minnesota	8,034	15,567	16,937	8,903	2,662	2	2	2
Missouri	2,442	7,588	11,724	9,282	7,439	8	4	3
Arkansas	1,557	4,802	8,720	7,163	6,588	13	8	4
Texas	3,032	5,281	8,005	4,973	4,065	5	7	5
Iowa	4,453	8,139	7,515	3,062	- 160	4	3	6
North Carolina	1,053	4,699	6,855	5,802	5,055	16	9	7
Virginia	5,529	5,660	5,721	192	1,067	3	5	8
Wisconsin	2,211	5,381	5,076	2,865	997	10	6	9
Ohio	2,958	3,508	4,322	1,364	1,174	6	11	10

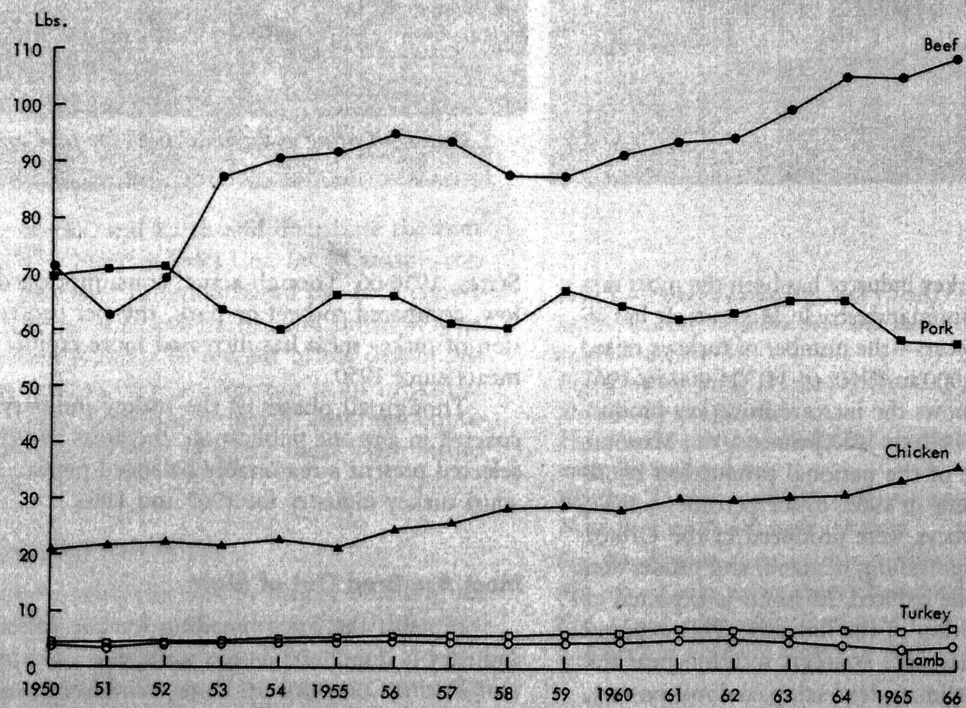


Fig. 1—Per capita consumption (lbs) of meat in U.S., 1950-66.

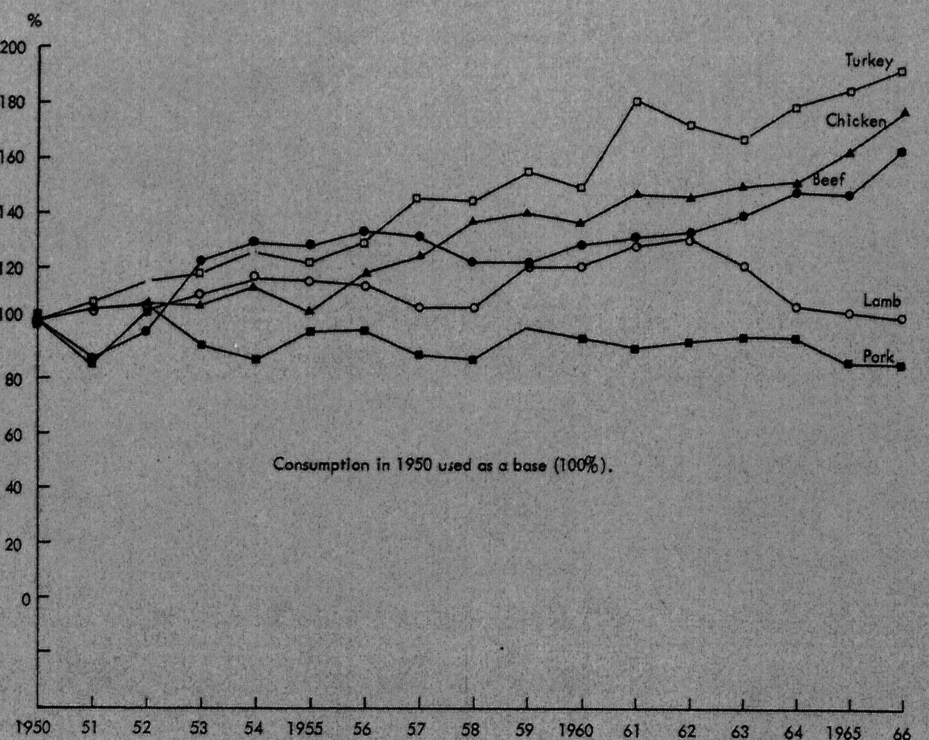


Fig. 2—Trends in per capita consumption of meat in the U.S. 1950-66.

The Turkey Industry of Missouri

Fig. 4—Testing individual toms for feed conversion.

Since 1960, the turkey industry has been the most rapidly expanding agricultural industry in Missouri. It has almost tripled in seven years—the number of turkeys raised increased from 4,285,000 in 1960, to 11,724,000 in 1967 (Table 1). (Figure 1 shows the increase in turkey production in Missouri from 1930 to 1967.) Since 1960, Missouri has increased its share of the national production by 78 percent; from 5.1 percent in 1960, to 9.1 percent in 1967. Though too many turkeys were produced in the United States in 1967 for the prevailing demand, and production in 1968 will probably be reduced, Missouri is expected to increase its future position in the industry. This expectation is based upon Missouri's strategic location near the resources needed(feed, climate, leadership, and manpower), its central location for national distribution, and a commitment by strong firms to expand the industry.

Figures 2 and 3 show the actual and relative increase in per capita consumption of different meats in the United States, 1950-66. Though actual consumption of turkey is low, compared to beef or pork, the per capita consumption of turkey meat has increased more rapidly than other meats since 1950.

Though all phases of the turkey industry cannot be covered in any one publication, the areas and photographs selected present a reasonably balanced picture of the Missouri turkey industry for 1967 and 1968.

Most Are Bred Out of State

Most of the basic breeding for the Missouri turkey industry is done outside the state. For example, the Ralston Purina Company, St. Louis, conducts its turkey breeding in California and Texas. Rose-A-Linda Turkey Farm and Hatchery, Concordia, operates its turkey breeding farm at Rio Linda, Calif. The primary stock is imported as poults or hatching eggs. Missouri turkey hatcheries

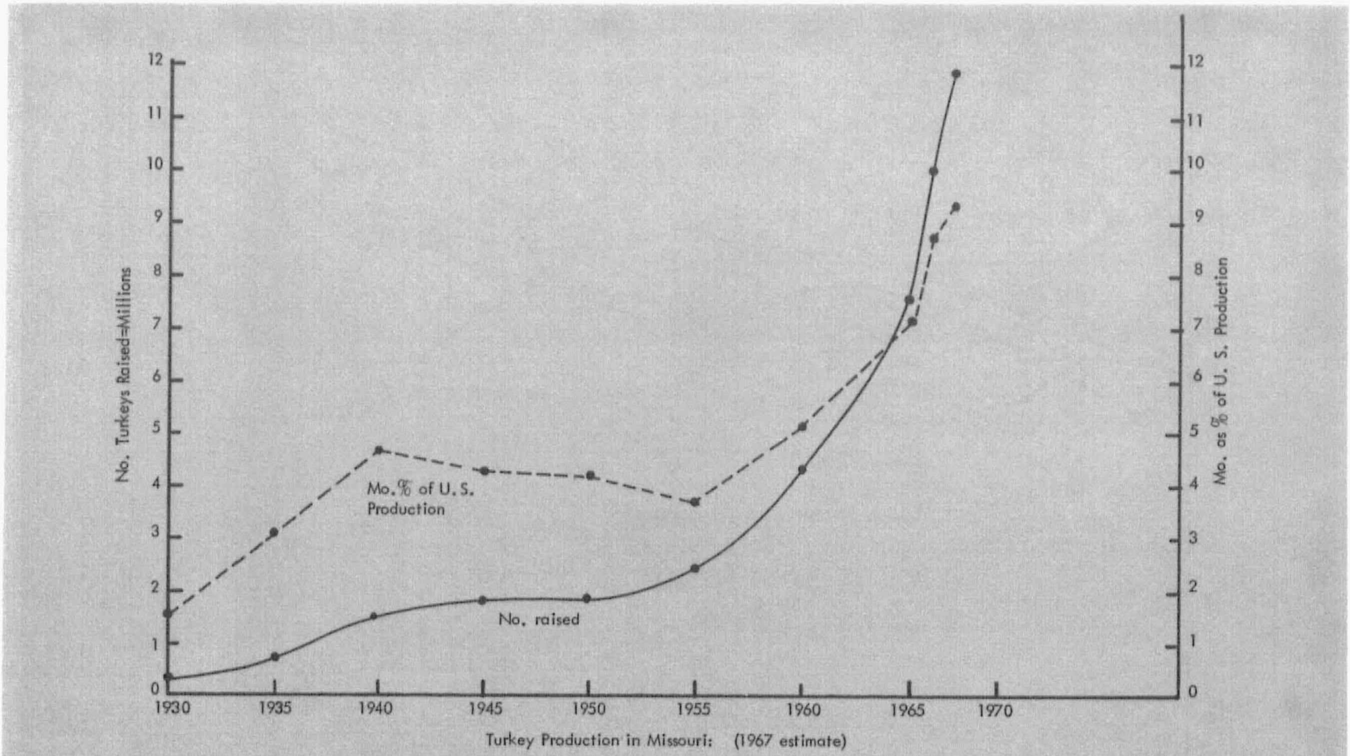
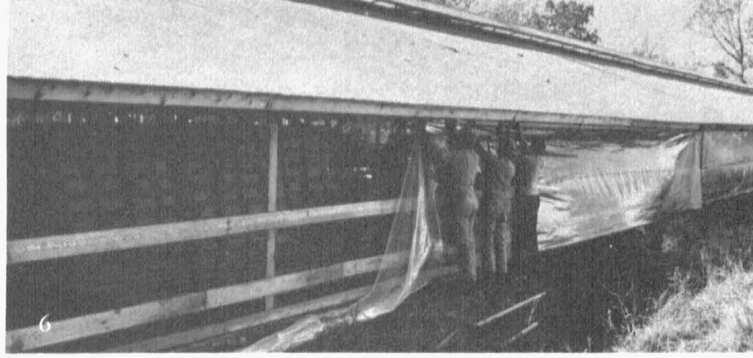


Fig. 3—Turkey production in Missouri, 1930-67.



multiply these stocks, and hatch and distribute the commercial poults. The Morrow Sales Co., Inc., Cathage, conducts a turkey breeding program based on feed conversion, with both Broad Breasted Bronze and Broad Whites. (Fig. 4.) Since feed is about 70 percent of the cost of producing market turkeys, feed conversion is an important factor in any turkey breeding program. Another important consideration is the yield of edible meat when further processed. (Figs. 5-11.)

Shift to Artificial Insemination

One of the recent changes in turkey breeding has been the shift from natural matings to artificial insemination. This change became necessary when the industry developed a large, broad-breasted male turkey, incapable of mating properly and thereby unable to produce a high percentage of fertile eggs. By using artificial insemination the breeders have maintained higher fertility.

Fig. 5—Turkey breeding stock (hens) on Ozark range before mating. Timber provides shade and protection against storms.
Fig. 6—Preparing the turkey breeding pens for winter. Side walls are plastic.
Fig. 7—Texas type breeder house with double decked nests for turkey hens.
Fig. 8—Turkey roosts (1" x 6") for breeding stock (hens). Note that roosts are near the floor.
Fig. 9—Bronze toms used to produce semen.
Fig. 10—Large white turkey breeder hens.
Fig. 11—Large white toms used by a Missouri turkey hatchery to produce semen in 1968.

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Special crews are organized by the turkey hatcheries to inseminate their breeding flocks. (Fig. 13.) Most of these crews do their work late in the afternoon or at night after the hens have laid their eggs.

Those interested in this subject will find the process described in detail in Missouri Agricultural Extension Service Circular #882, "Artificial Insemination of Turkeys." Figure 14 shows the use of a syringe in inseminating a turkey hen. Most crews now use a plastic straw on the tip of the syringe which is discarded after each insemination to avoid the spread of infection from one turkey to others. (Fig. 15.)

Management of Breeding Stock

Those interested in the care and management of turkey breeding stock should consult Circular 742, "Missouri Plan of Turkey Breeder Management," University of Missouri Cooperative Extension Service (Figs. 16 and 17).

In recent years there has been a shift from independent turkey hatcheries to hatcheries which either are part of integrated firms or produce poults for the firms. (Figures 18-23 show some of Missouri's turkey hatcheries.)

The percentage of poults hatching depends upon the breeding stock, the fertility of the eggs, the nutrition of the stock, the care given the eggs, and the operation of the incubators. Turkey eggs should be gathered at least

Fig. 12—Crew collecting semen.
Fig. 13—Crew applying artificial insemination to turkey hen.
Fig. 14—Inseminating syringe is inserted about 2½ inches into the relaxed oviduct.
Fig. 15—A plastic straw is inserted in syringe to inseminate turkeys without touching the straw. Block contains 400 plastic straws.
Fig. 16—Saddles are used on turkey hens to prevent tears, though males do not mate with the hens.
Fig. 17—Turkey hen leaving nest. Metal front prevents more than one hen from entering nest.
Fig. 18—The Rose-A-Linda Turkey Hatchery, Concordia.
Fig. 19—Ralston Purina Turkey Hatchery, Stover.
Fig. 20—Swift and Company Turkey Hatchery, Trenton. (Courtesy Swift and Company)
Fig. 21—Swift's Turkey Hatchery, Trenton, 350,000 egg capacity. (Courtesy Swift and Company)
Fig. 22—Hill Turkey Hatchery, LaPlata, 135,000 egg capacity.
Fig. 23—This stand-by generator provides electricity when regular current is interrupted.

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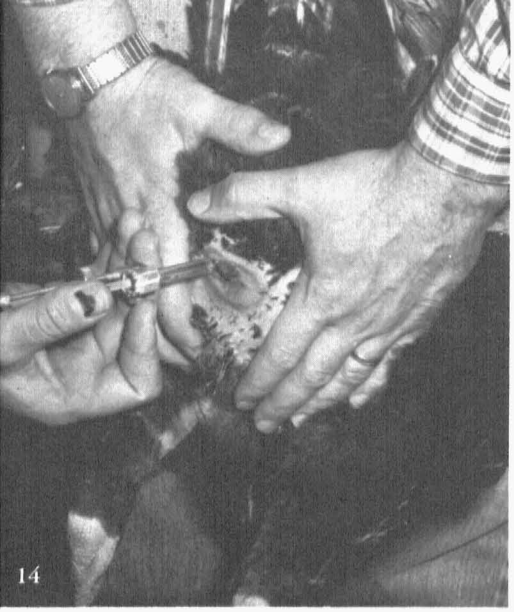
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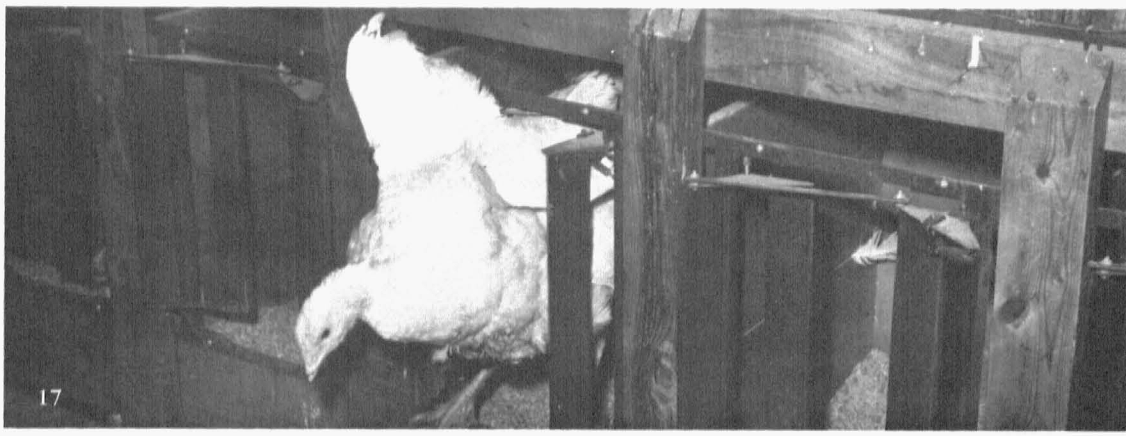
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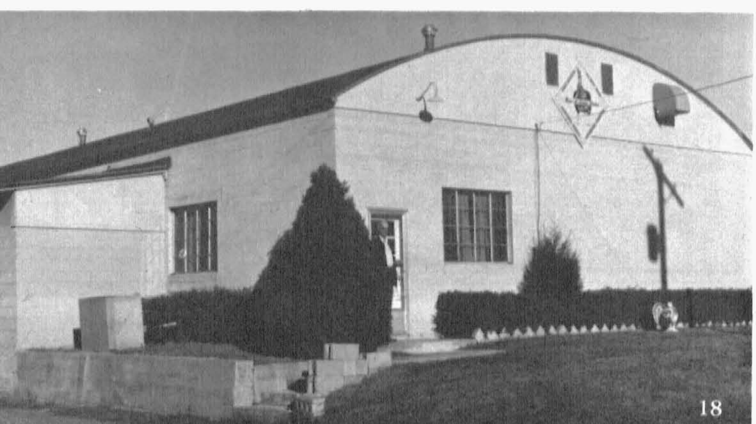
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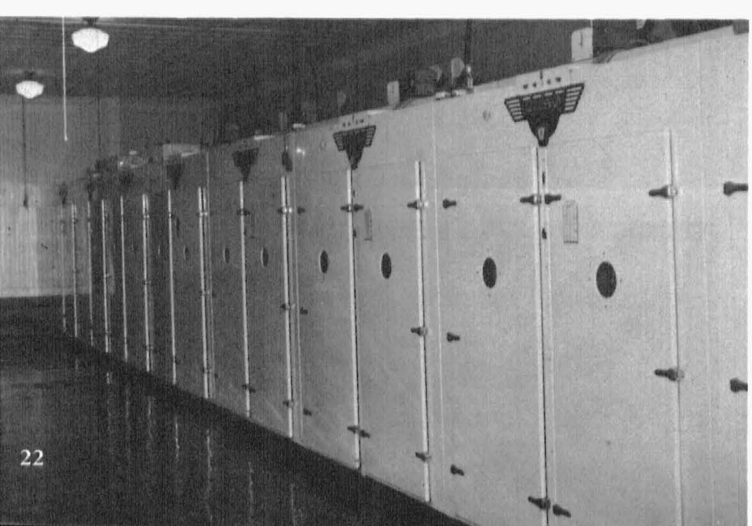
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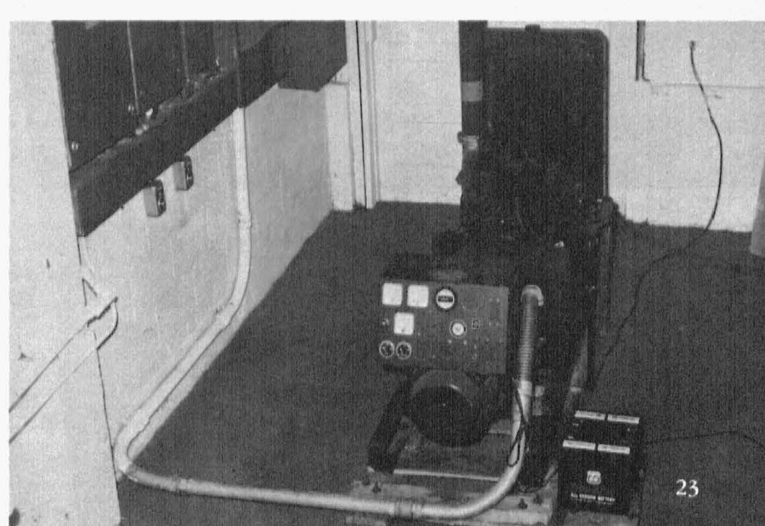
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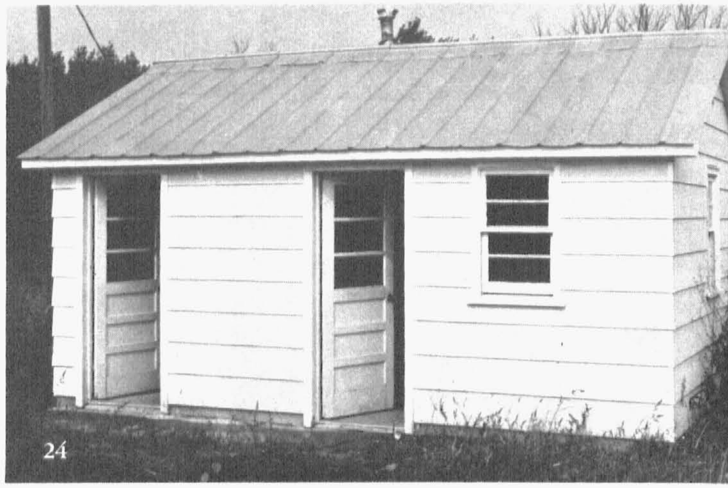
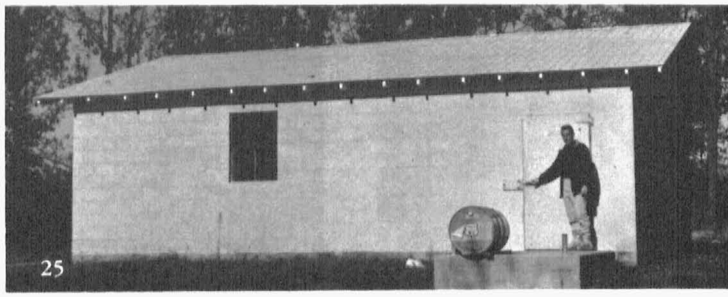
Fig. 24—Egg holding rooms where turkey eggs are cleaned, fumigated, and stored.
Fig. 25—Holding building for turkey hatching eggs.
Fig. 26—Cabinet for fumigating turkey hatching eggs with formaldehyde gas.
Fig. 27—Dry cleaning turkey hatching eggs.
Fig. 28—Hatching eggs are turned daily by tilting the cases held in a rack.
Fig. 29—Traying turkey hatching eggs with a vacuum lift.
Fig. 30—Males and females are identified at one day old for separate brooding and rearing.
Fig. 31—Desnooding poults to minimize outbreak of erysipelas.
Fig. 32—Poults are injected with antibiotics before they leave the hatchery to protect them against stress.
Fig. 33—Disposal of hatchery waste.
Fig. 34—A high pressure sprayer is used in cleaning and disinfecting hatching trays.
Fig. 35—Vans used for transporting poults. Hatchery located in remodeled Camp Crowder buildings.
Fig. 36—Moving day-old poults from hatchery to farm. (Courtesy Swift and Co.)
Fig. 37—Trucks specially designed for delivering day-old poults.
Fig. 38—Brooder house (40′ x 200′) for brooding turkeys (6000 to 8000, depending on weather).
Fig. 39—Brooder house for turkeys and broilers.



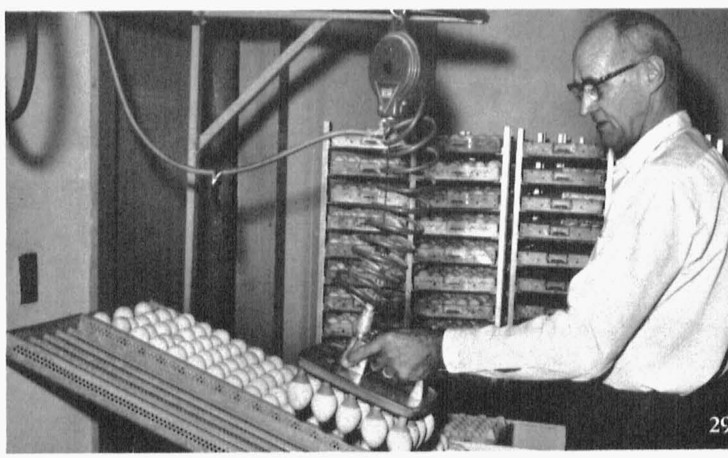


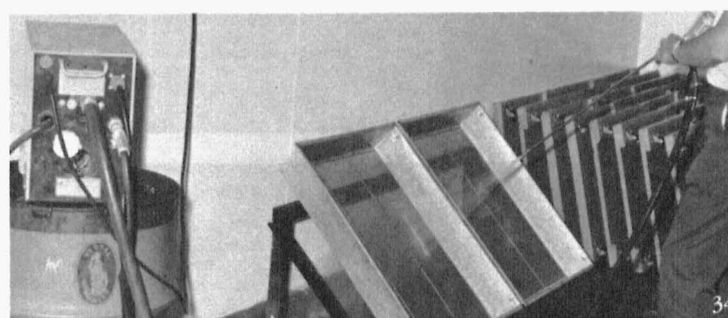
every two hours. Dirty eggs should be dry cleaned or washed soon after gathering and before the eggs are incubated. All eggs should be fumigated within eight hours after collecting. (Figs. 24-26.)

The modern turkey hatchery operates under sanitary conditions and some hatcheries allow no outside visitors. (Various hatchery operations are shown in Figures 27-37.)

Day old poults are delivered either by special vans or by air transport. Many poults are brooded for 8 to 10 weeks before being delivered to the grower of market turkeys.

Heat is necessary for turkey poults during the first six to eight weeks. One-story brooder houses, 30 to 40 feet wide, are generally used for brooding.



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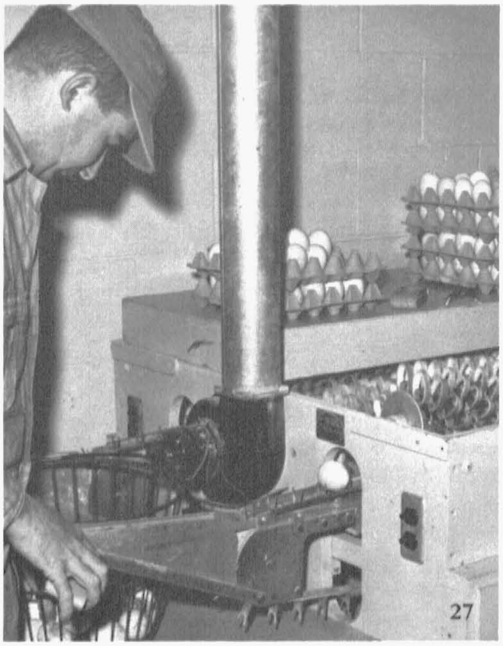
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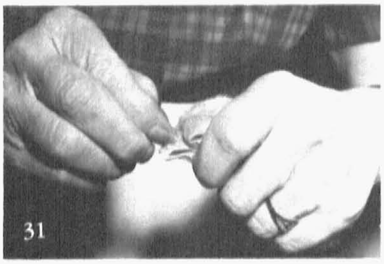
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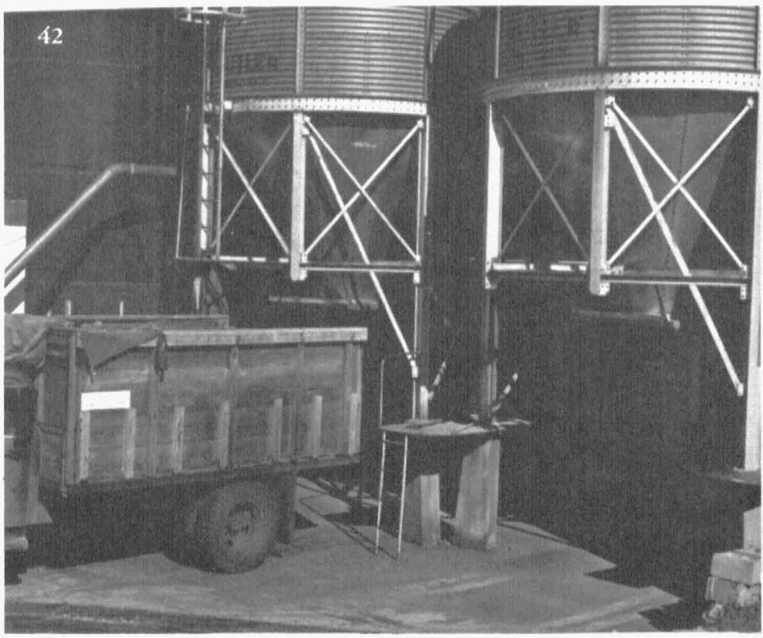
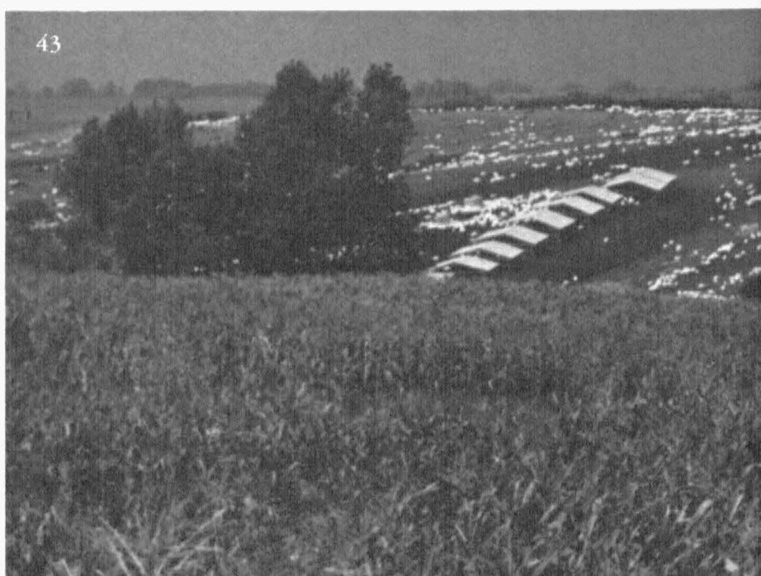
Fig. 40—Ten thousand poults (250 per gas brooder).
Fig. 41—Two-week old poults with automatic feeder.
Fig. 42—Truck being loaded with cedar shavings for turkey litter. This plant produces cedar lumber for closets.
Fig. 43—Thousands of white turkeys on rolling hills of north Missouri (Sullivan County).
Fig. 44—Bronze turkeys in south Missouri ready for market.
Fig. 45—Turkeys on range in north Missouri.
Fig. 46—Seven thousand large white tom turkeys ready for market.
Fig. 47—Commercial turkey production in the Ozarks.
Fig. 48—Market turkeys in the Ozarks where timber protects against heat and wind.
Fig. 49—Feed is augered from the bin into automatic feeders in the brood house.
Fig. 50—An electric fence used to confine turkeys to area and keep out predators.





Day-old poults must be taught to eat and drink by confining them near feed and water. "Starve outs" can be prevented by working with the newly hatched poults and teaching them to eat and drink. Some producers use grit, rolled oats, marbles, or bright-colored whey products to attract poults to the feed troughs. Placing feed on egg flats and keeping feeders full the first few days will help get them started. (Figs. 40-41.)

Some dry material, such as shavings, that is free from mold and is highly absorbent should be used as litter. It should cover the floor to a depth of two to four inches. Any caked or wet litter should be removed, as moldy litter could produce Aspergillosis in poults. (Fig. 42.)

Suggested temperatures about three inches above the litter at the edge of the brooder are: 90-95°F. to begin with, lowering the temperature 5 degrees each week until 70°F. is reached. This temperature is maintained as long as heat is needed. The most important guide is that the poults be comfortable; neither too hot nor too cold.

Many day-old poults are injected with antibiotics at the hatchery to overcome stresses encountered during their early life. They are also often desnooded at the hatchery to lessen the spread of erysipelas, a disease that may infect the turkey through cuts or tears in the skin, including the snood which may be torn by fighting. Debeaking is not advised until the poults are several days old or until they show evidence of feather picking or cannibalism.

It is essential that market turkey growers start with strong healthy poults from the US Pullorum-Typhoid Clean breeding stock that has been tested for S. typhimurium and M. gallisepticum. By starting with disease-free poults some hazards can be prevented.

The trend is to sexed poults, brooding and growing the sexes separately. Better growth has resulted and different rations can be used for males and females.

Market turkeys can be grown in Missouri either on range (Figs. 43-50) or in semi-or complete confinement.

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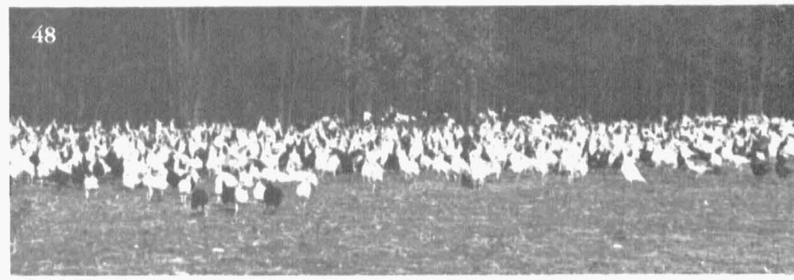

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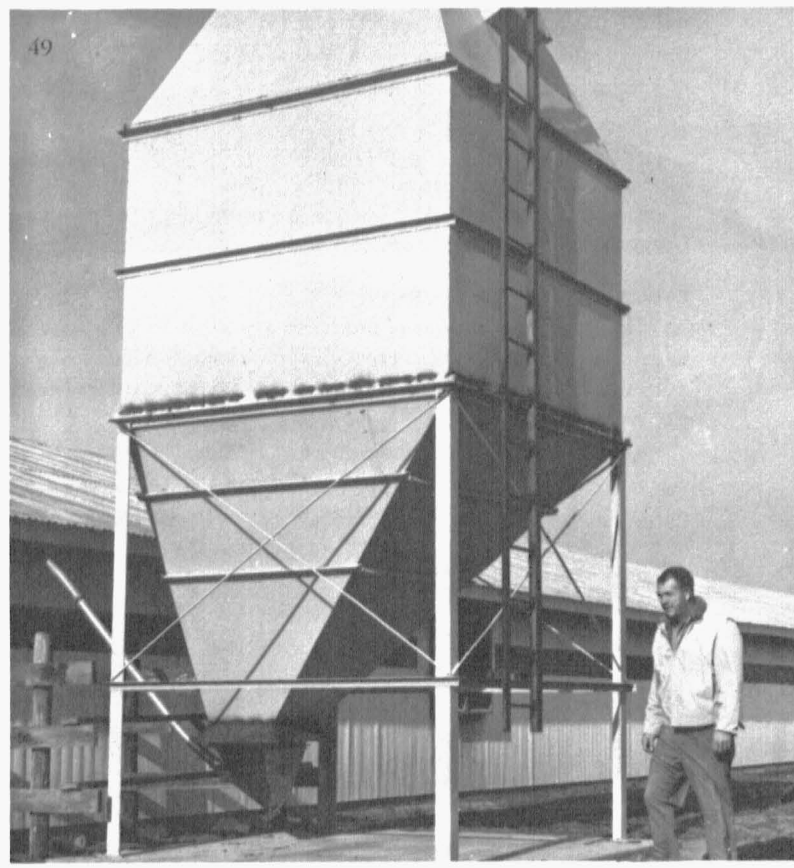

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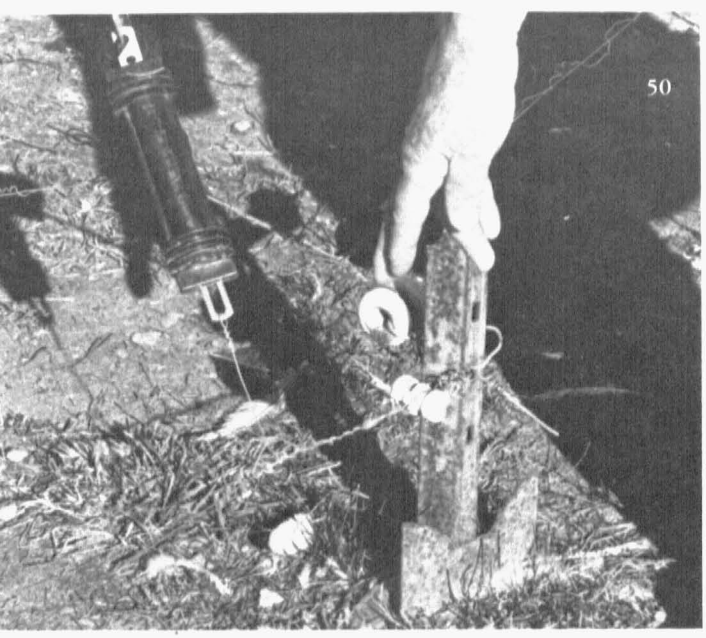

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(Figs. 51-52.) Under Missouri conditions, two broods can be grown on range with a minimum of shelter except during the first eight weeks or brooding period. If turkeys are brooded or finished during the winter months, confinement in buildings is necessary.

The Missouri region has a climate that the industry can capitalize on. Turkeys can be grown on range with a minimum of investment in buildings. Records compiled in 1967 by the Agricultural Extension Service show that savings of 20 cents or more per market turkey can be made by growing two broods of turkeys per year on range as compared to confinement rearing (see Table 2).

There are some advantages of growing turkeys in confinement for the integrated firms that wish to provide year-around employment and use of facilities. Higher costs during the winter season cannot be avoided in such operations.

Manufacturing Feed for Turkeys

One-hundred-million turkeys consume approximately 7.5 billion pounds or 3.75 million tons of feed annually in the U.S. Feed production for turkeys is a major industry, but it is now usually a part of an integrated turkey operation (Figs. 53-57).

Financing Turkey Enterprises

Twelve-million turkeys produced yearly in Missouri have a farm value as live turkeys of approximately $45-$50 million. At the retail level these turkeys have a value of $75 to $100 million.

Credit is necessary to keep the turkey industry in operation. It is important for those in the industry to maintain a sound financial position based on accurate records and sound management practices.

Production and Marketing Contracts

Most of the turkeys in the state are produced under contract with large integrated firms, independent producers, or processors.

Fig. 51—Semi-confinement rearing of turkeys in the Ozarks.
Fig. 52—Turkeys (8000) grown in 40' x 370' confinement house. Feed is conveyed by overhead pipe to self feeders.
Fig. 53—Modern feed mill, an essential part of an integrated turkey operation.
Fig. 54—This modern feed mill mixes 100 tons of feed daily.
Fig. 55—Feed storage and mixing on a Missouri turkey farm.
Fig. 56—Controls for a modern "push button" feed mill. Three men can pellet 20 tons of turkey feed per hour.
Fig. 57—Feeding turkeys on Missouri farm. Feed being augered from wagon feeders.

Table 2 ESTIMATED GROWER'S COST OF PRODUCING HEAVY TYPE TURKEYS UNDER CONTRACT 8 WEEKS TO MARKET; CONFINEMENT vs RANGE, 1967.

	Cost Per Turkey Marketed							
	Confinement				Range			
	Two Broods/Year		Three Broods/Year		Two Broods/Year		Your Cost	
Grower's Cost Item	Hens Cents	Toms Cents	Hens Cents	Toms Cents	Hens Cents	Toms Cents	Hens Cents	Toms Cents
Litter	3.42	5.73	3.42	5.73	--	--	______	______
*Depreciation (Bldg. 15 yrs.)	9.33	15.63	6.22	10.42	--	--	______	______
(Equip. 7 yrs.)	3.89	6.51	2.59	4.34	4.39	6.76	______	______
*Interest on Investment	5.01	8.40	3.34	5.60	2.55	3.37	______	______
*Insurance, Taxes, & Repairs (3% of bldg. & equip. cost)	5.01	8.40	3.34	5.60	2.86	1.69	______	______
Hired Labor	2.00	2.00	2.00	2.00	2.00	2.00	______	______
Miscellaneous Costs	.64	1.07	.64	1.07	1.52	3.10	______	______
**Avg. Total Cost/Turkey marketed	29.30	47.74	21.55	34.76	11.32	16.92		

* Annual Costs are divided by no. of broods raised per year.
** Does not include cost of family labor or return to management or other costs furnished by contractors.

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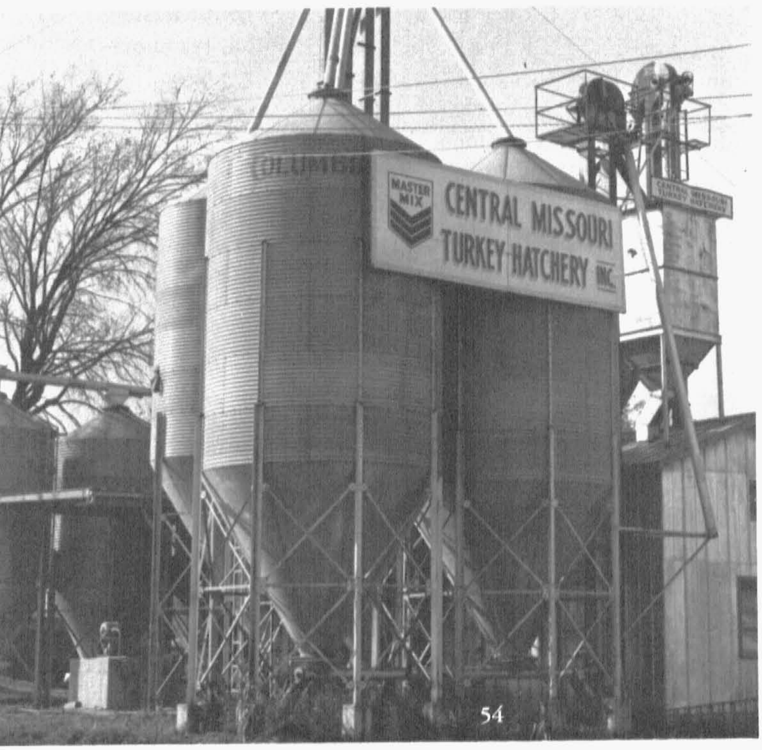

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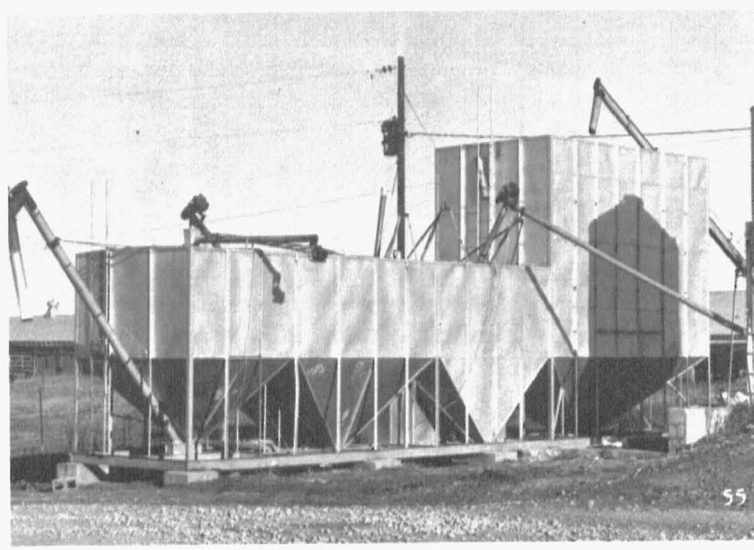

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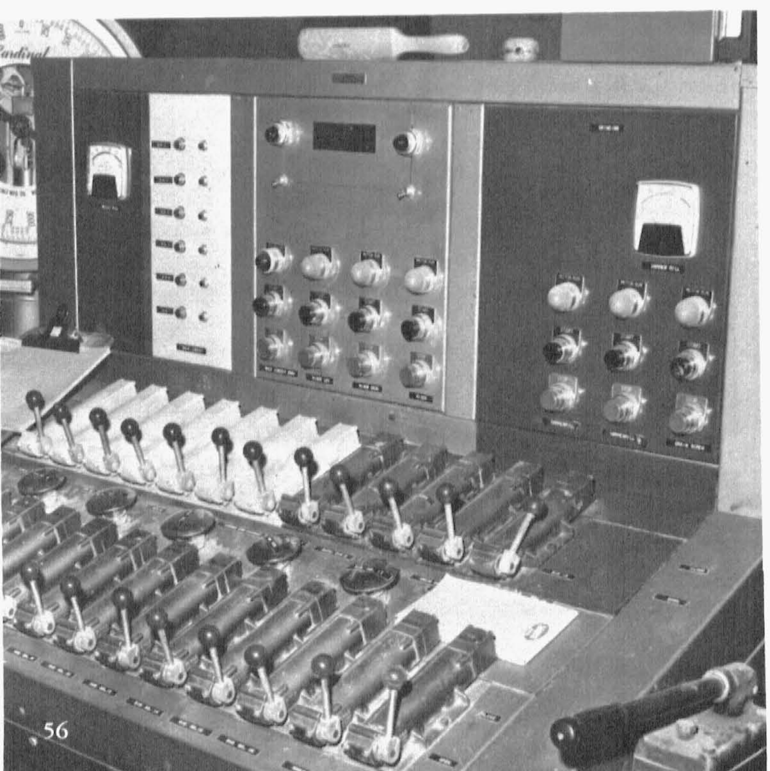

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Several types of contracts are available. The most popular contract with the young producer who has limited financial resources is the guaranteed wage. It agrees to pay the producer a specified amount per bird or per pound of live weight marketed. It usually provides for bonuses and/or penalties based upon feed efficiency or livability.

Many of the larger independent producers prefer the floor price contract which is more flexible and relates to the current market price. Under this contract the processor usually specifies a minimum floor price, grading policy, sex, and weight of birds marketed. Any returns above the floor price at marketing time is shared on a percentage basis.

The third type of contract is primarily a financing plan for feed, poults, and other expenses involved in producing turkeys. Under this contract the producer bears the risk of production and pays off the loans soon after the turkeys are marketed. Financing plans of this type are usually made available through feed companies to growers unable to get adequate financing through their local banks or other lending agencies.

Disease Control

Disease causes more losses and apprehension among turkey growers than any other factor. Though there has been much progress made against turkey diseases by control and vaccination programs, there are several serious diseases difficult to prevent and treat. Two of these are cholera and blue comb (Figs. 58 and 59).

Diagnostic Facilities

Since losses from disease in large commercial turkey flocks may run into thousands of dollars in a few days, it is imperative that competent diagnosis of disease outbreaks be readily available to the industry. Missouri has lagged behind most states in this important public service. The situation is now greatly improved with the following two diagnostic services available:

New (but only temporary) poultry diagnostic facilities have been constructed at the University of Missouri-Columbia School of Veterinary Medicine—staffed by highly competent poultry disease specialists. This facility serves all of Missouri but, by its location serves North and Central Missouri best.

The state veterinarian's office at Jefferson City maintains a diagnostic laboratory in Springfield, where turkey blood samples are tested for these diseases. This laboratory has also been equipped and staffed to diagnose other turkey diseases. This laboratory serves Southwest Missouri best (Fig. 60). The National Turkey Improvement Plan as operated in Missouri has been successful in controlling such egg-borne diseases as pullorum, typhiod, typhimurium, and mycoplasma gallisepticum.

Some of the industry laboratories diagnosing poultry diseases for their customers are:

Ralston Purina Company
Checkerboard Square
St. Louis, Missouri
and I. D. Russell Co. Laboratories
Kansas City, Missouri

Transport 11.5 Million Turkeys

The movement of 11.5 million live turkeys from Missouri farms to processing plants and the movement of the resulting products from the processing and further processing plants into the distribution channels requires the services of a major transportation industry. Specially designed coops and trucks are used in moving the live turkeys to market. One Missouri firm, Koechner Manufacturing Co., Tipton, builds such coops.

More than 6,000 truck-loads of live turkeys move to market each year in Missouri alone (Figs. 61-67).

Fig. 58—Trucks are cleaned and disinfected before they return to farms to load more turkeys.
Fig. 59—Beef cattle precede and follow turkeys on this range. A two or three year rotation helps prevent diseases. Turkey manure improves livestock pasture.
Fig. 60—Poultry disease testing laboratory operated by the State Veterinarian at Springfield. (Courtesy Dr. Munger, Springfield Laboratory)
Fig. 61—Turkey loader that is adjustable to the height of coops being loaded.
Fig. 62—Truck load (2000) of turkey hens on the way to a processing plant.
Fig. 63—Shade must be provided in hot weather when trucks stop or wait to unload. Fans help.
Fig. 64—Ralston Purina Turkey Processing Plant, California, Mo. Capacity: 1800 toms or 2700 hens per hour.
Fig. 65—Unloading live turkeys at a processing plant.
Fig. 66—Turkeys are hung on shackles on line moving into killing and dressing area.
Fig. 67—Live turkeys are stunned electrically, then killed by bleeding.


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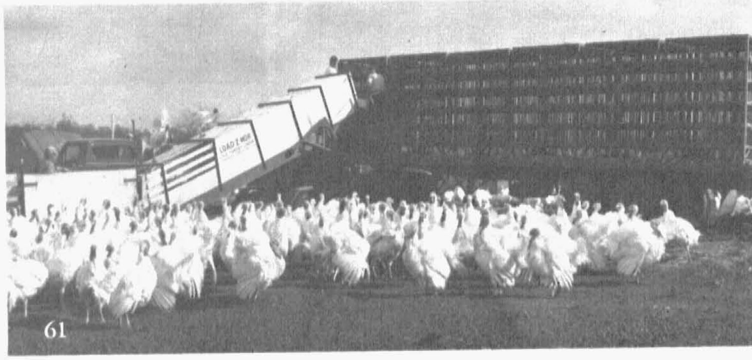
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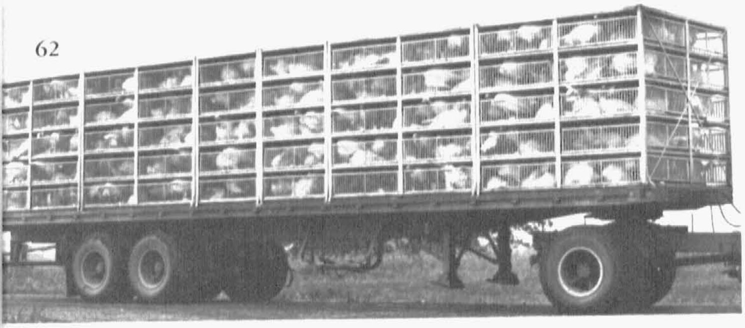
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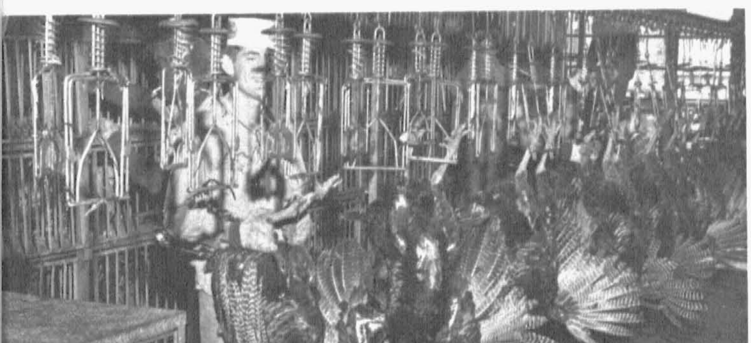
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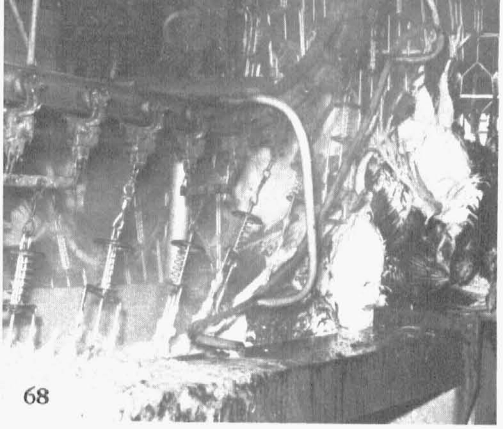

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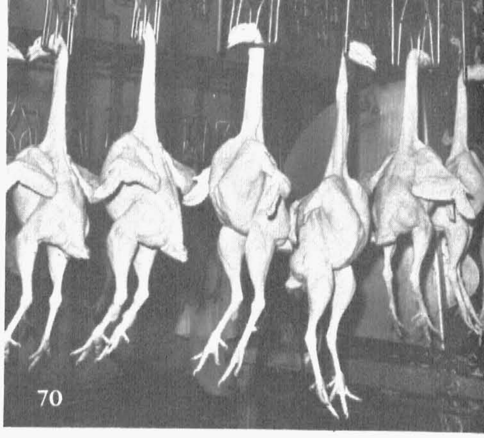

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Fig. 68—From the scalder they go to the roughing machine.
Fig. 69—Turkeys being conveyed from scalding tank to picking machines.
Fig. 70—Turkeys coming from feather picking machines.
Fig. 71—Turkeys are reversed on the shackles for further dressing.
Fig. 72—Hock cutter in use at the F. M. Stamper Co., Marshall.
Fig. 73—Removing shanks with a knife.
Fig. 74—Partially dressed turkeys pass through the gas singer and then through the washer (left).
Fig. 75—Slitting skin on necks before removing necks.
Fig. 76—Heads are removed as the birds are conveyed along the line. The neck separates at the junction with the head.
Fig. 77—Neck is removed with power shears.
Fig. 78—Dressing line. Several thousand Missouri women are employed in poultry processing plants.
Fig. 79—Removing the crops.
Fig. 80—Hanging turkeys for evisceration.
Fig. 81—Removing viscera for U.S.D.A. veterinary inspection (inspector with white helmet).

Improved Merchandising Needed

The turkey industry has solved its production problems fairly well, but the marketing problems appear to be more difficult. The industry's future economic welfare depends largely on how well it can increase per capita consumption of turkey in the U.S. by solving its merchandising problems and promoting the use of turkey meat.

It is estimated that three million Missouri consumers use turkey meat in some form during the year. By proper merchandising and displaying of turkey meat products the industry can improve the products' image and encourage housewives to purchase more.

Much work needs to be done in selling turkeys in retail stores. Too often whole turkeys are thrown into deep refrigerator cabinets with torn packages or in such a position that the customer must almost stand on his head to dig out a turkey.

Processing the Turkeys

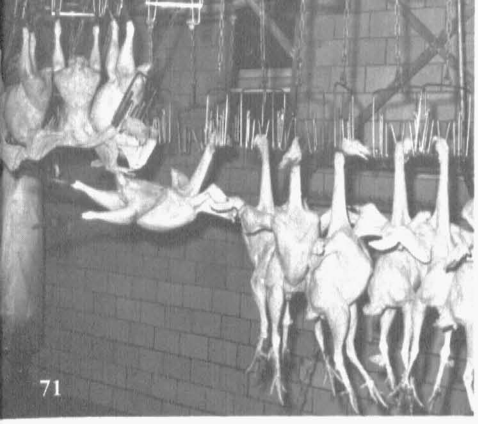
Turkeys ready for processing are picked up at the farm or point of production and transported by special trucks to plants where they are killed and dressed as "ready-to-cook" turkeys. Some of these plants also do further processing.

To maintain continuous operation during a workshift, truck deliveries to the processing plant must be scheduled to keep delay in unloading turkeys at a minimum. Delays can result in unnecessary shrinkage. During hot weather specially designed sheds that provide shade and fans for blowing air over the birds are desirable. As long as the trucks are moving, the birds are reasonably comfortable. However, when trucks loaded with live birds stop, the turkeys may die from the heat or become so dehydrated that they are downgraded or condemned.

The plant should be arranged for live turkeys to be readily hung on shackles on the dressing line (Figs. 64-66). Most plants are equipped with an electric stunning device (Fig. 67) which quiets the birds before they are killed by cutting their throats. If properly done the birds bleed well and do not show poor bleeding which results in low grading or condemnation.

After bleeding the turkeys enter the scalding tank for about 100 seconds where the temperature is 140°F. (Fig. 68). This loosens the feathers for removal by automatic machines. With modern automatic pickers very few pin feathers remain on the birds to be removed by hand. These machines have almost eliminated hand labor in picking poultry (Figs. 69 and 70).

After bleeding and removing the feathers, the birds continue on the line to where the heads are cut off and evisceration begins. (Figs. 71-85.) Inspection is made when the body cavity is opened and the viscera exposed for the veterinarian to examine the bird for any evidence of disease or unwholesomeness.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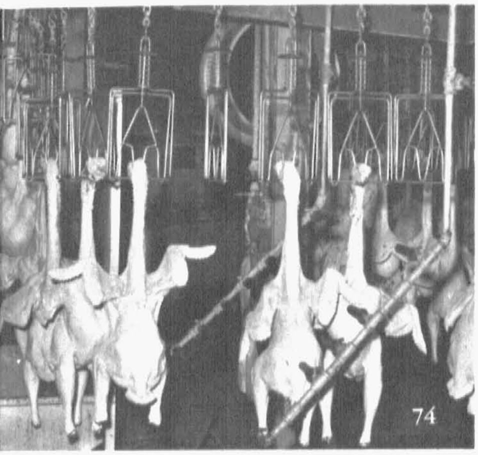
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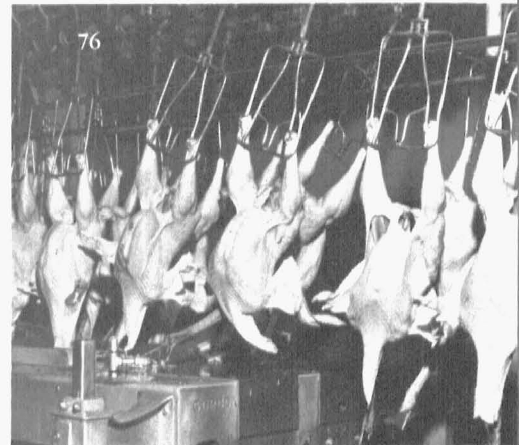
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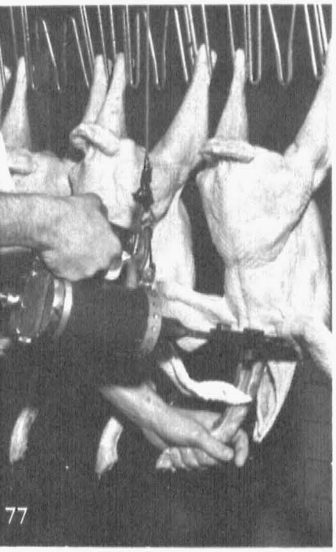
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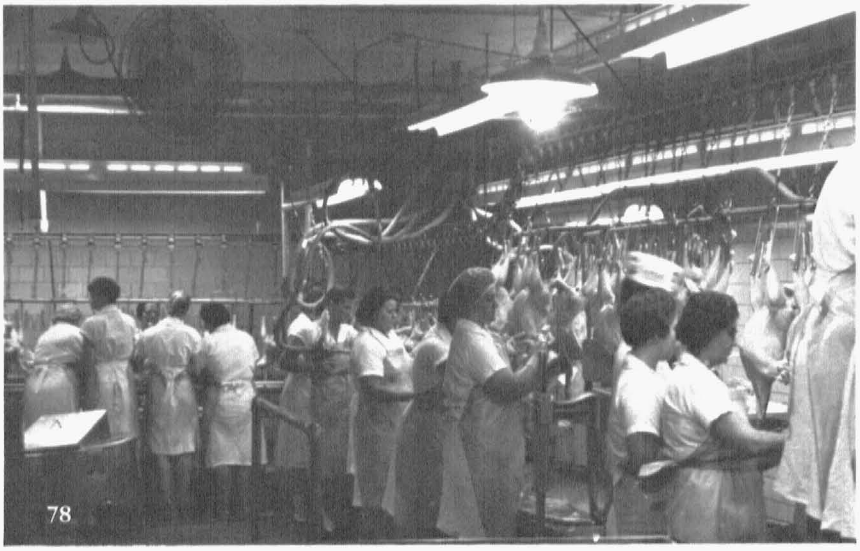
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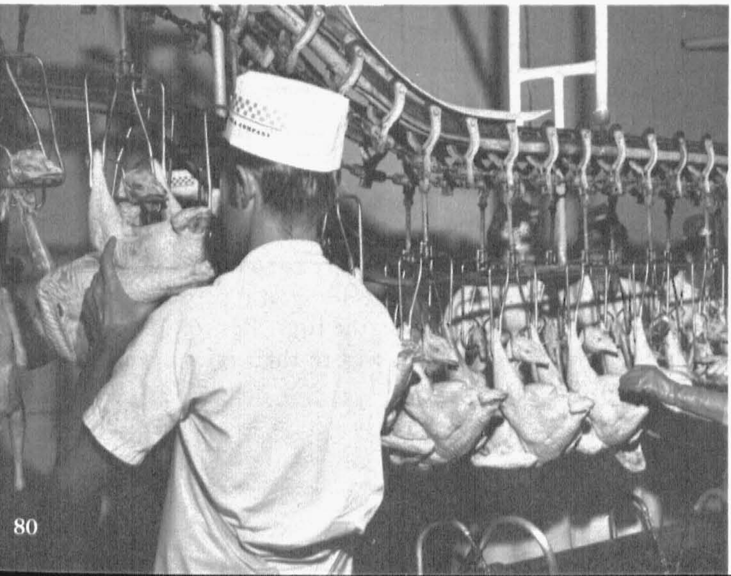
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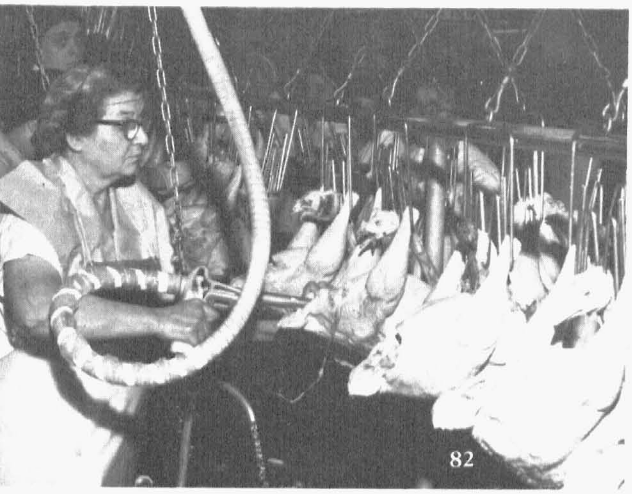

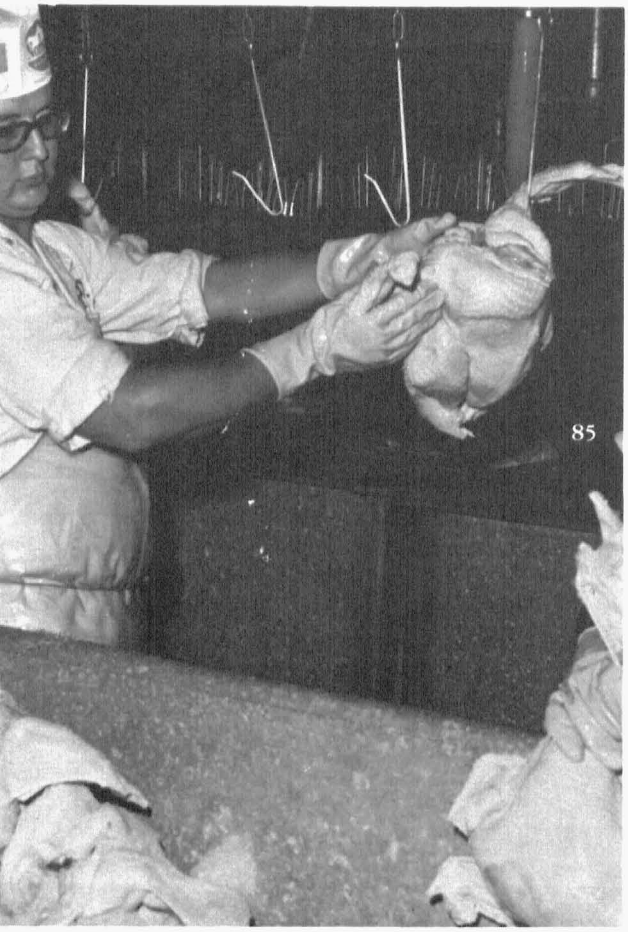

Fig. 82—Kidneys and lungs are removed by vacuum suction.
Fig. 83—Removing edible portions (livers, hearts, gizzards) of viscera.
Fig. 84—Rotating auger conveys the turkeys through ice slush in tank, chilling the turkeys in about 75 minutes.
Fig. 85—Moving dressed turkeys from line into chilling tank.
Fig. 86—Inspecting and grading turkeys.
Fig. 87—Bagging ready-to-cook turkeys.
Fig. 88—Inspecting vacuum-packed turkeys.
Fig. 89—Enclosing dressed turkeys in plastic bags.
Fig. 90—Plant superintendent (R. E. Fuhn) inspects finished product.
Fig. 91—Packing frozen turkeys in boxes for storage and distribution. Grade and weight are recorded with a computer.
Fig. 92—Placing packaged turkeys in tank for crust freezing in liquid Propylene glycol at 0 F. for 23 to 27 minutes.

Turkey processors use both USDA veterinary inspection and the services of the Grading Branch of the Consumer and Marketing Service, USDA. This latter service may be used for live or dressed turkeys and poultry food products. The grades are A, B, and C. There are also two procurement grades for ready-to-cook poultry—U.S. Procurement Grades I and II. The classes of turkeys are: young turkeys (fryer-roaster, hens, and toms), yearling (fully matured but usually under 15 months), hens and toms, and mature or old turkeys (usually in excess of 15 months of age). (Fig. 86.)

Birds that are to be sold as whole birds (ready-to-cook) are packaged in Cry-O-Vac or other moisture-proof bags, and then quick frozen. This gives a very attractive bird that does not discolor from the sub-scalding and subsequent dehydration. Colorful printing on the bags adds to the appearance of the dressed birds and to their sales appeal (Figs. 87-91).

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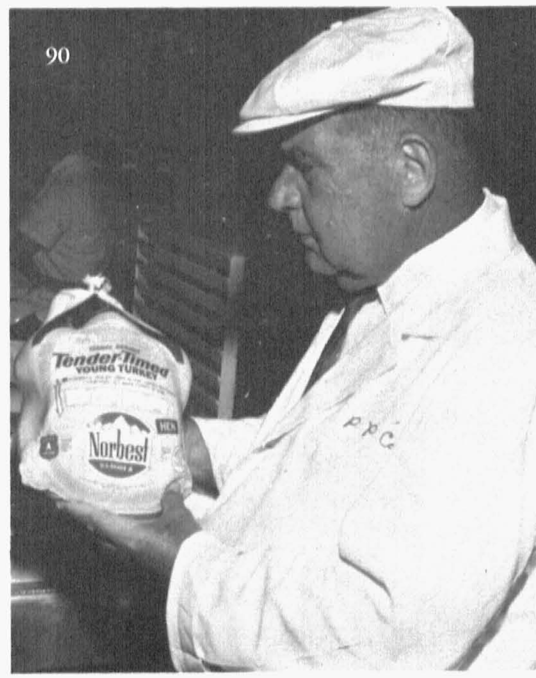

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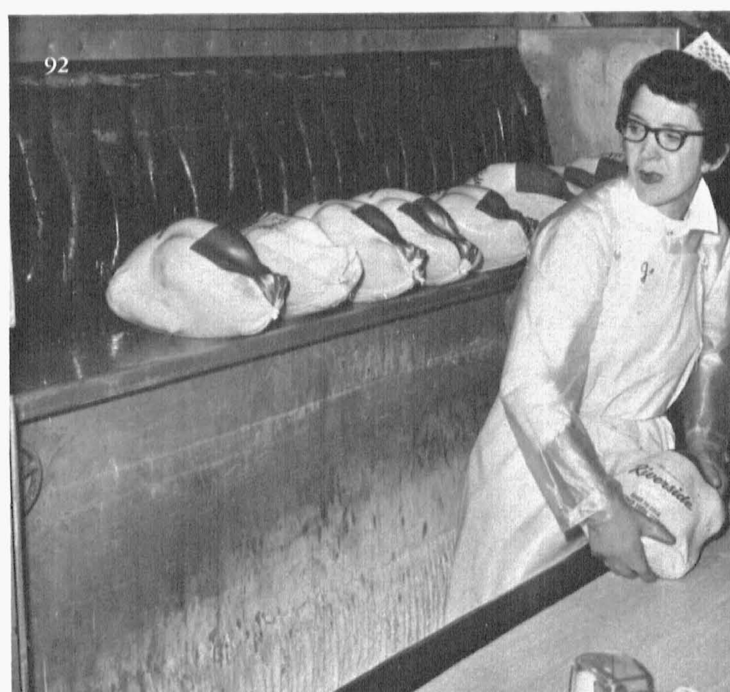

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Freezing for Storage

The packaged whole birds are frozen by passing them through a wind tunnel blast freezer or a Propylene Glycol solution (0°F.) which crust-freezes the birds in 23 to 27 minutes. The partially frozen birds are then placed in storage rooms where they are completely frozen (Figs. 92-93).

Modern sanitary methods of processing and freezing turkeys result in a ready-to-cook turkey that can be held for several months and remain in excellent edible condition. Storage rooms for poultry should be held at O°F. to -10°F (Figs. 94-97).


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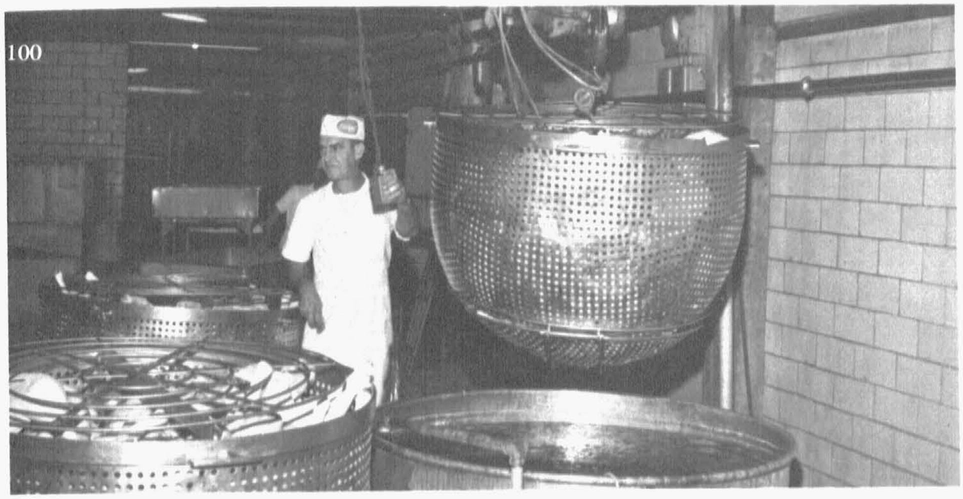
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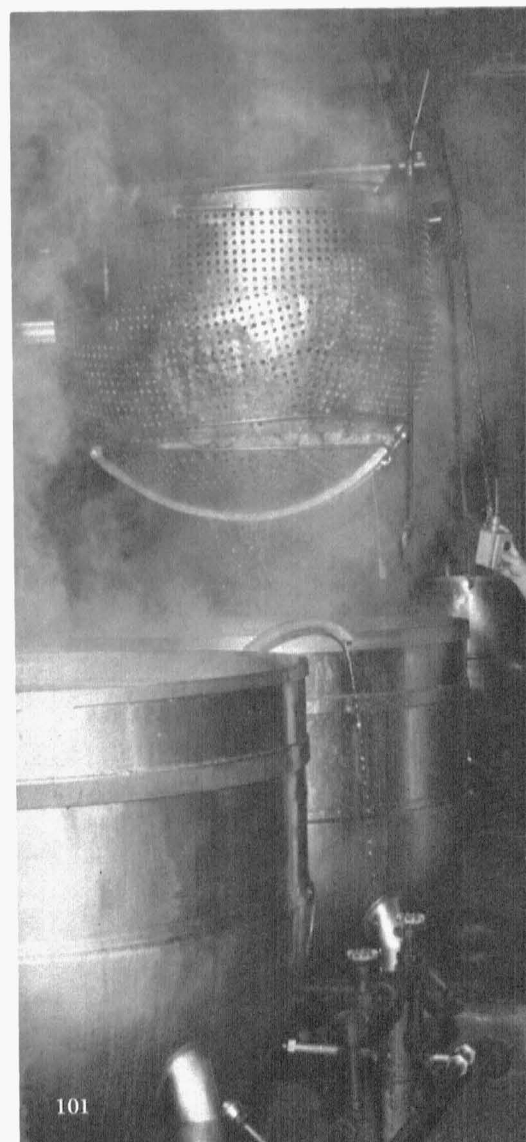
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Fig. 93—"Crust frozen" turkeys go to sub-zero storage room to complete the freezing process.
Fig. 94—Frozen turkeys in storage.
Fig. 95—Storage of further processed turkey products.
Fig. 96—Moving chicken dinners into storage.
Fig. 97—Frozen storage space is necessary in further processing plants.
Fig. 98—Removing turkey meat from the skeleton.
Fig. 99—Boning out turkey thighs and drum sticks.
Fig. 100—Moving dressed turkeys to cooking vats.
Fig. 101—Removing cooked turkey from the cooking vats.

In 1967 the turkey industry suffered for lack of storage facilities and many live turkeys were held too long on the farms before they could be processed and stored.

Turkey By-the-Piece Boosts Sales

The preparation and sale of further processed turkey parts and other items has increased consumption of turkey meat. This relatively new field offers a great potential for expanding consumer usage of turkey meat. Many new products will probably be developed and made available not only to housewives but also to institutions and commercial eating establishments.

Further processing of turkey products in 1967 is shown in Figures 98 to 110.


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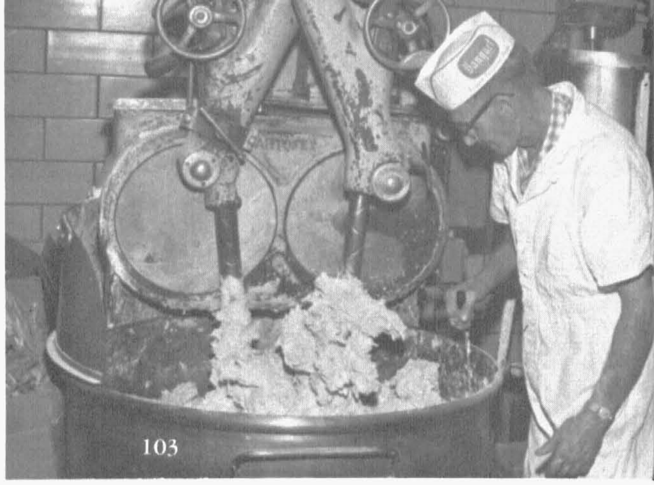
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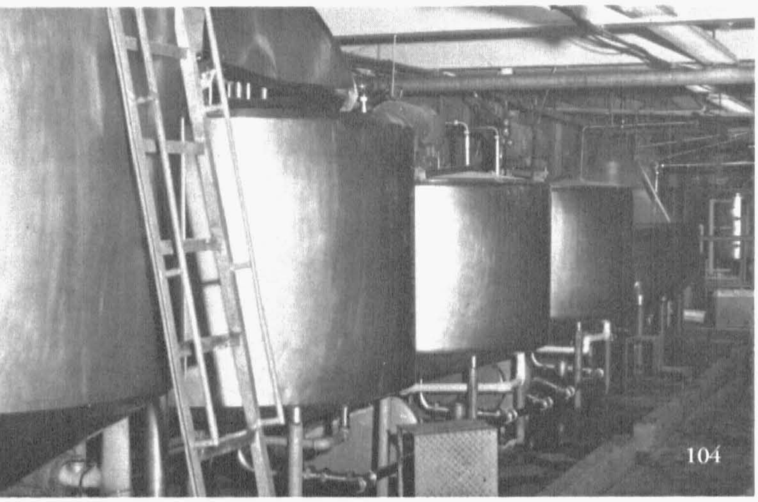
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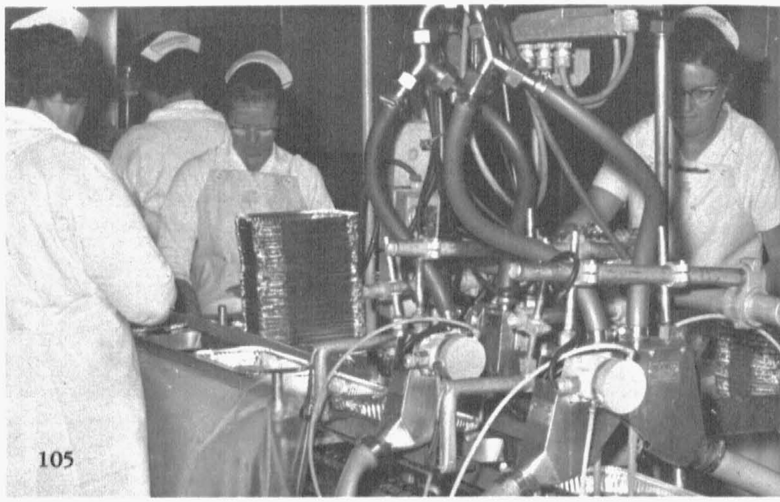
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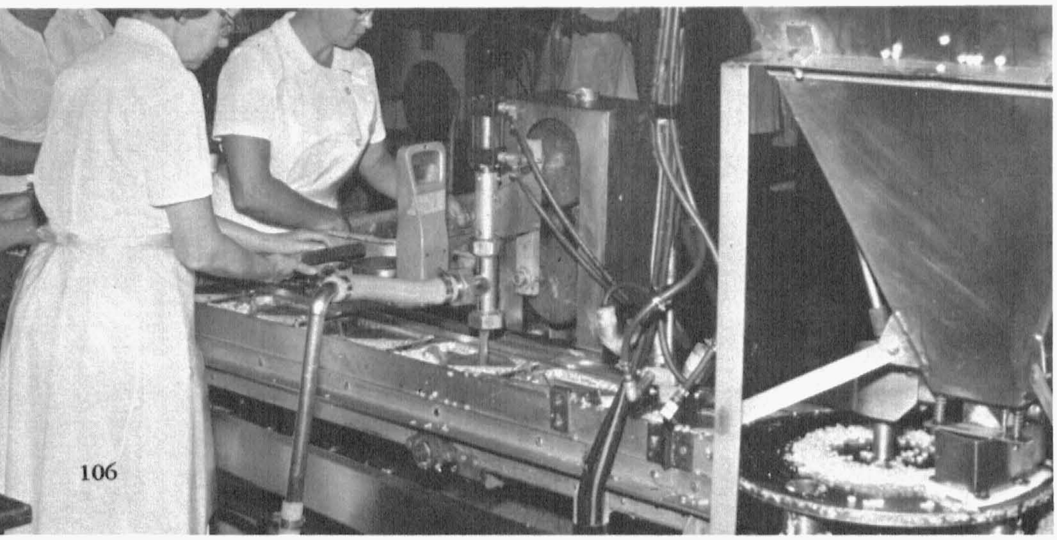
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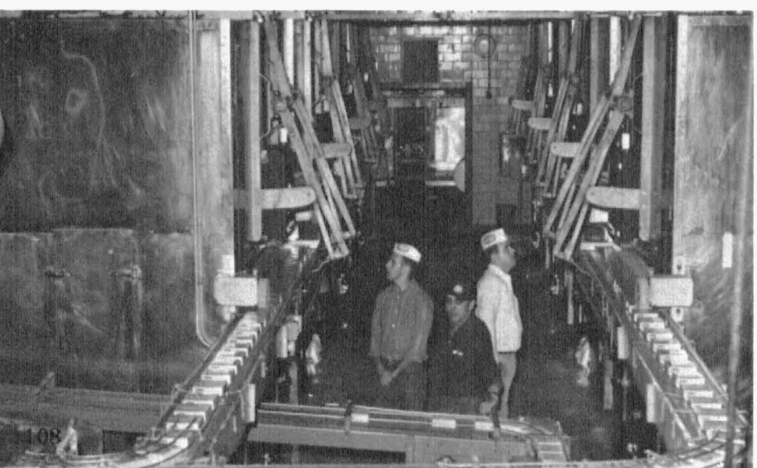
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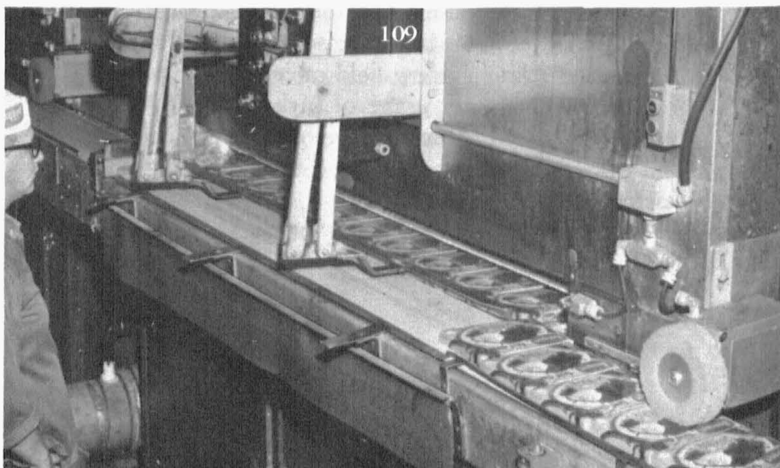
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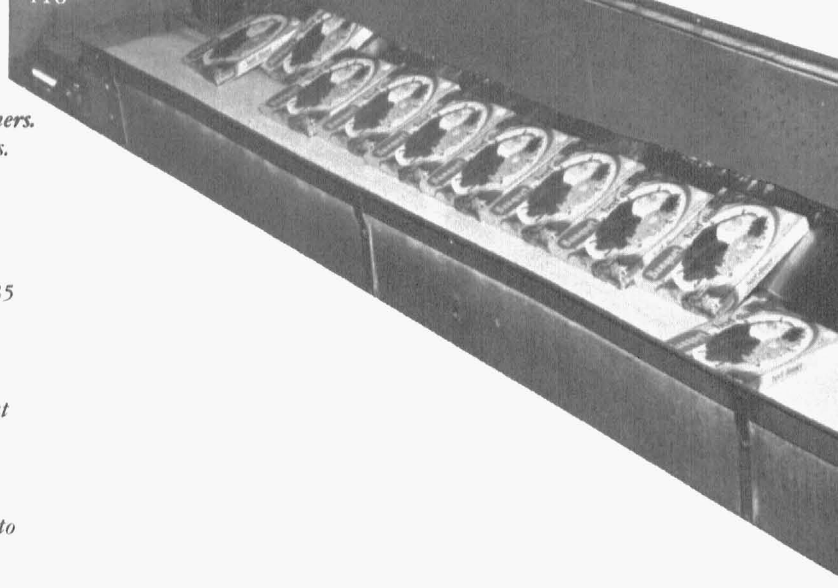

Fig. 102—Slicing turkey meat for turkey pies and dinners.
Fig. 103—Preparing dough for chicken and turkey pies.
Fig. 104—Vats used in preparing gravy for Banquet dinners.
Fig. 105—Adding gravy to sliced turkey to make Honeysuckle Turkey and Gravy.
Fig. 106—Preparing Banquet dinners at the rate of 135 per minute. The gravy dispensing machine in use.
Fig. 107—Placing sliced turkey in aluminum pans for Honeysuckle Turkey and Gravy.
Fig. 108—Turkey pies moving into the quick freezers at the rate of 600 per minute.
Fig. 109—Quick freezer freezes dinners in about 60 minutes.
Fig. 110—Frozen dinners being returned from freezer to the line for packaging and storage.

This industry suffered a relapse in 1967 because retail stores were stocked with these products in 1966 thereby creating a false notion of the demand for such products. The stores were filled faster than the consumers purchased these new products. There must be a normal flow of these products in all channels of trade to have a proper marketing situation.

The per capita consumption of turkey meat (7.8 lbs. in 1966) is relatively low when the quality and nutritional value is compared with pork. In the same year, pork had a per capita consumption of 58.0 lbs. For many years turkey was relatively high-priced and considered a luxury food to be used only at Thanksgiving and Christmas. The industry adjusted to such a demand and until recently, did little to develop new products and make all turkey products available throughout the year, whereas the meat packers developed and made available many different cuts and pork products year-round.

Some Missouri firms have developed new turkey products and have done a good job of merchandising them. The F. M. Stamper Company has promoted their Banquet brand turkey dinners, pies, and sliced turkey and gravy. These products are found in retail stores throughout the U.S., Canada, Mexico, Venezuela, Australia, and Great Britain.

The Stamper Company operates a large further processing plant at Marshall, where turkey, chicken, and beef dinners, pies, etc., are prepared. They also have a plant at Macon that specializes in fried chicken dinners.

The Producers Produce Company, Springfield, markets its turkeys through the Norbest Turkey Growers Association, Salt Lake City, under the brand name of Norbest (Fig. 41).

In 1962, the Ralston Purina Company built at California, Mo., possibly the largest turkey processing plant in the world. Further processing is also done at that plant. The company produces and merchandises the Honeysuckle brand of whole turkeys, turkey steaks, and sliced turkey and gravy.

Swift and Co. has leased a processing plant in Sedalia, where the Butterball Turkey will be produced for national distribution.

Banquet, Butterball, Norbest, and Honeysuckle brands produced in Missouri are nationally advertised and distributed.

The industry must become more consumer-oriented and develop new turkey products with the built-in services the present day housewife demands. She can purchase these ready-to-serve meats in other species—so why not in turkey?

Merchandising at the retail level is very important because this is the place where the consumer makes her choice of food products. All foods compete in the retail stores for their share of the consumer's dollar. In today's affluent society, the convenience of the product may have greater appeal than the nutritional value. Therefore, merchandisers of food products should study the shopping habits of housewives and make every effort to satisfy her demands. Attractive packages are necessary for turkey products to compete with the many other beautifully packaged food products Fig. 111-112).

The way that turkey products are displayed is important. No longer will customers stand on their heads and try to dig a turkey out of a freezer. Figure 116 shows an attractive display of turkey products in a Missouri retail store. The industry needs more such displays and should have sales and service people working with retailers in displaying turkey products.

The National Turkey Federation and the Poultry and Egg National Board have developed some excellent material for promoting turkey, but the weak link is in getting such material into the retail stores.

Loss in dressing live poultry may vary from 20 to 35 percent, depending upon the species, age, sex, and size. In turkeys it will be 20 to 25 percent. The total weight of such waste in the U.S. is estimated at 2.5 to 3.0 billion pounds annually. Much of this waste occurs in small plants where it is not economical to recover it. However, in larger

Fig. 111—Grades, weights and other data are put on computer for transmission to sales agency in Salt Lake City.
Fig. 112—Loading trailer truck with frozen turkeys.
Fig. 113—Carload of Banquet products ready for trip to retail outlets.
Fig. 114—Loading cars of chicken and turkey pies and dinners for distribution throughout the United States.
Fig. 115—Truck loads of Banquet dinners and pies move to retail chain stores.
Fig. 116—Well arranged display of turkey and chicken products.
Fig. 117—Pipe line conveys (in water) feathers and viscera to byproducts plant.
Fig. 118—Wet feathers arrive in the byproducts plant.
Fig. 119—Viscera arrives in the byproducts plant.
Fig. 120—Dehydrator dries feathers.
Fig. 121—Dried poultry meal before it is fully ground (note bones).
Fig. 122—Dried feather meal; meal from white feathers, lower left, and bronze feathers, upper right.
Fig. 123—Mill that grinds cooked and dried feathers into feather meal for poultry and livestock.
Fig. 124—Bulk tanks where feather and poultry meals are stored before being loaded into trucks or railroad cars.

plants there is sufficient material to justify rendering or for by-products plants to collect this material and process it into poultry by-products. There are a few large processing plants where poultry by-products facilities have been established to handle the waste products from a single plant. One such plant is the Ralston Purina Turkey Processing Plant, California, Mo. This plant has capacity for processing more than 200,000 pounds of live turkeys daily and therefore, has sufficient volume to justify a by-products plant. The by-products plant utilizes the feathers, inedible viscera, and blood, converting the feathers into feather meal and the blood and viscera into poultry meal. These products are used in poultry and pet animal feeds.

Turkey producers in Missouri may be members of two state organizations: the Missouri Turkey Federation and the Missouri Poultry Improvement Association. Those who produce hatching eggs or poults operate under the National Turkey Improvement plan which is supervised by the official state agency, a committee of the Missouri Poultry Improvement Association (Fig. 125). All other matters pertaining to the turkey industry are handled by


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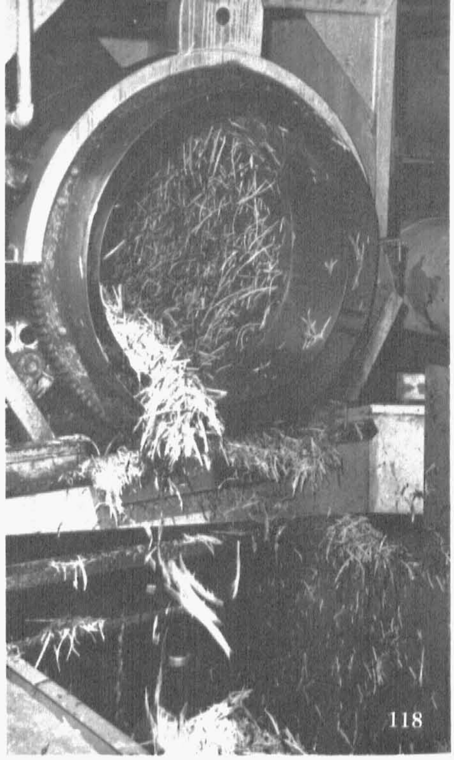
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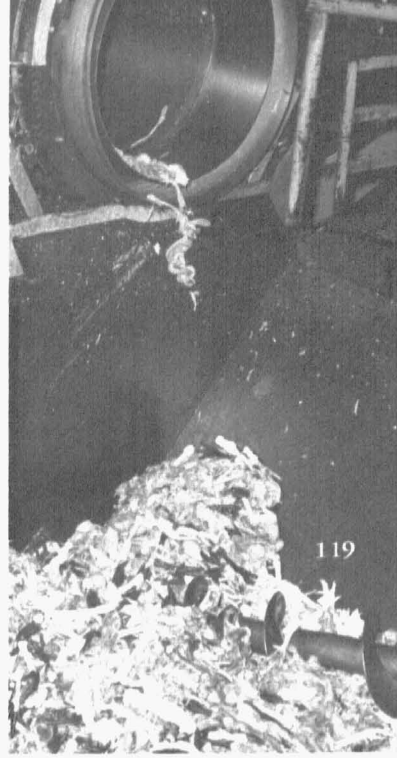
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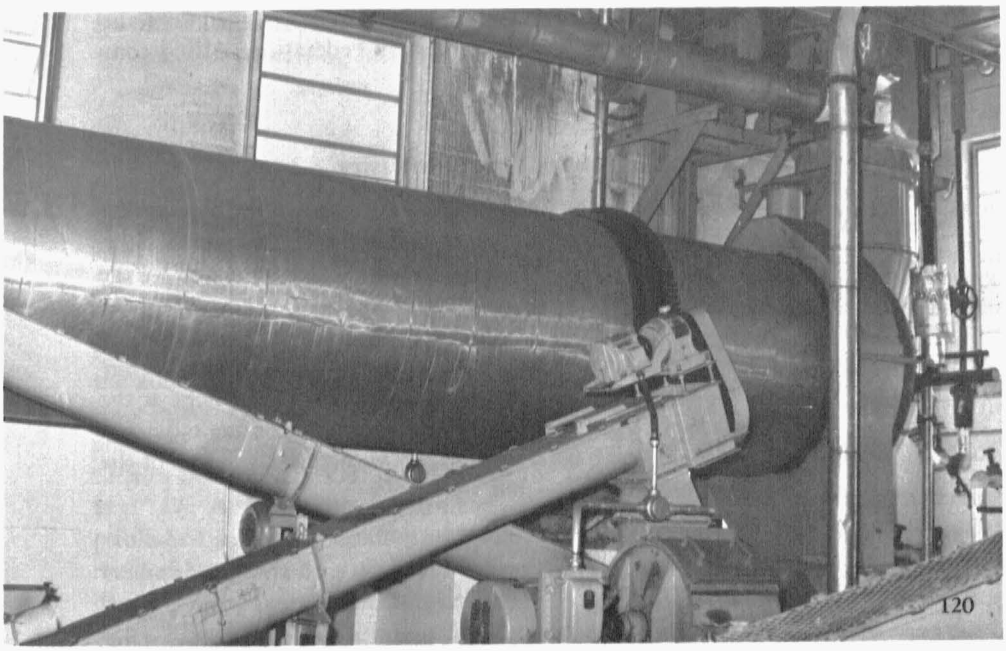
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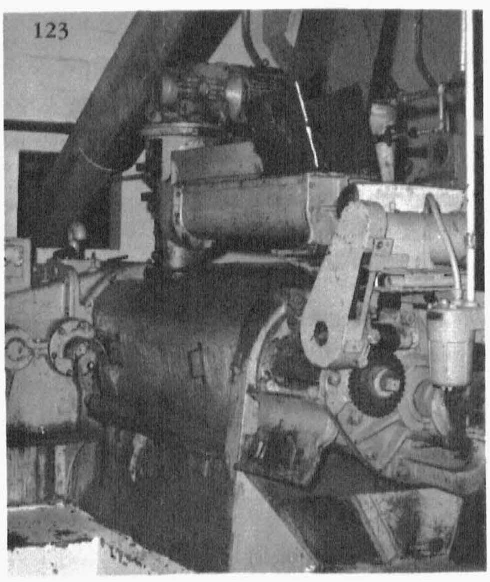
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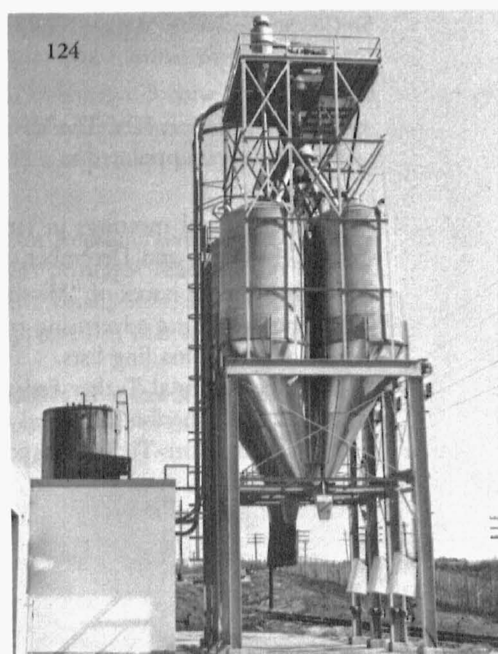
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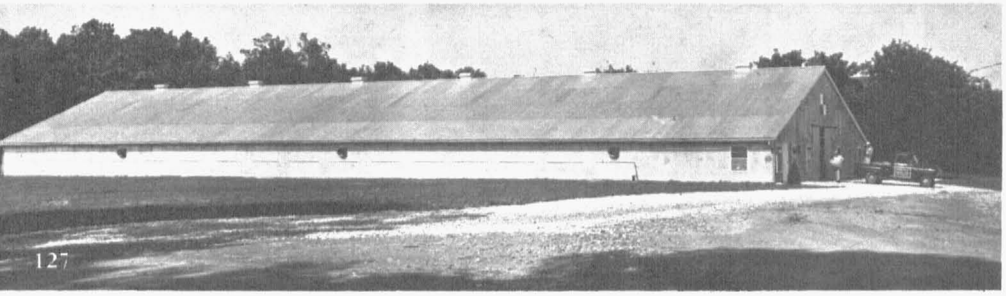

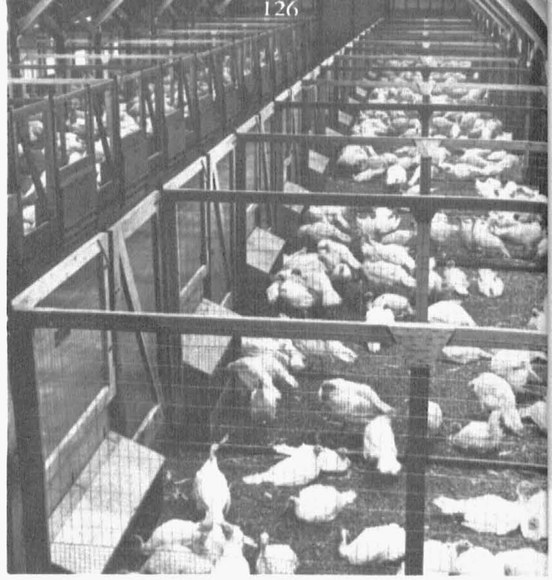

Fig. 125—Officers and directors of the Missouri Turkey Federation, 1968.
Fig. 126—Turkeys on experiment at the Ralston Purina Research Farm, Gray Summit.

Fig. 127—An environmentally controlled turkey research house at that Ralston Purina Research Farm, Gray Summit.

the Missouri Turkey Federation. The Missouri Turkey Federation in 1967 carried on the following program:

Missouri Turkey Federation Activities - 1967

1. Sponsored Missouri Turkey Day Program - University of Missouri, 1967 and 1968. Held annual meeting and election of officers.
2. Initiated new membership campaign to cover all segments of the industry, issued membership certificates to cooperators.
3. Sponsored National Turkey Federation Convention in St. Louis, January, 1968. Helped with registration, exhibits, turkey show, ladies luncheon, youth career program, largest turkey exhibit, etc.
4. Sponsored Junior Market Turkey Show at state convention. Contributed trophies, cash awards, and ribbons of approximately $1,000. Secured speakers for program.
5. Cooperated with Market News Service of State Department of Agriculture.
6. Cooperated with Governor's Conference in November, 1967, in Jefferson City. The Missouri Turkey Federation President was appointed to a 21-man committee by the Governor.
7. Held six board meetings in January, April, May, August, October, and December.
8. Published four issues of "Missouri Turkey News" magazine, obtaining advertising to support the magazine and maintain mailing lists.
9. Paid the National Turkey Federation research quota of $1,822 and contributed several thousand dollars to the N.T.F. Eat-More-Turkey campaign.

Most of the larger Missouri producers of turkeys also belong to the National Turkey Federation. Allied companies are also members.

Research for the Turkey Industry

The turkey industry, as all agricultural industries, must be undergirded by sound research programs. Such programs, to improve the industry, are conducted by the state and federal experiment stations.

The Ralston Purina Company has conducted research with turkeys for many years at its research farm, Gray Summit. Figure 126 shows turkeys on experiment at the research farm. Figure 127 shows an environmentally controlled house used for research with turkeys. Some of the problems investigated are:

1. Year-around egg production.
2. Trap nesting turkey breeders with the development of a high egg-producing strain.
3. Specialized rations for starting, growing, developing, and breeding turkeys.
4. Basic nutrition studies on leg problems.
5. Effects of forms of feed on growth and feed efficiency.
6. Studies on semen preservation.
7. Lighting programs for normal and out-of-season egg production.
8. Procedures for handling turkey hatching eggs.
9. Artificial insemination techniques.
10. Effect of antibiotics in preventing the infertility syndrome in turkey breeders.
11. Basic nutrient requirements of growing turkeys at different ages and by season of the year.

Fig. 128—Poultrymen visit Rocheford Turkey Research Farm, Columbia.

Fig. 129—Young Bronze toms harvesting milo at the Rocheford Turkey Research Farm.

12. Basic information on ingredient processing and the effect of processing methods on nutrient value of ingredients for turkeys.

The University of Missouri College of Agricuture, Department of poultry hubandry, and the School of Veterinary Medicine have a long history of research with turkeys, but until recently, with limited support.

Research with turkeys at the University of Missouri goes back to the 1920s when Dr. W. R. B. Robertson in the zoology department started a study of inheritance of color in turkeys and in 1925, published an Agricultural Experiment Station Bulletin #236, "Inheritance of Color in Crosses Between the Various Breeds of the Domestic Turkey." Dr. A. J. Durant, department of veterinary science published in 1930 the results of his investigations of a method for preventing blackhead in turkeys by cecal abligation—Agricultural Experiment Station Research Bulletin #133, "Blackhead in Turkeys—Surgical Control by Cecal Abligation."

The Agricultural Experiment Station was quite limited in facilities for research with turkeys until the Rocheford Turkey Research Farm was made available to the College of Agriculture in 1956 in the will of the late Miss Julia Rocheford, Extension specialist in home economics. This 160-acre farm has been developed into a facility for research with turkeys (Fig. 128).

The School of Veterinary Medicine has improved its research facilities and has some well-qualified personnel investigating such diseases as cholera, synovitis, and other common diseases of turkeys.

Research at the University of Missouri for the industry appears most promising and with proper support from the state and industry should provide the basic information needed to build an even greater turkey industry.

Results From Recent University Research

1. Whole milo, fed free-choice to turkeys with a 25 percent protein grower from 16 to 24 weeks, was equal to whole yellow corn. The concentrate contained an ample amount of vitamin A.
2. Range-grown standing (dwarf) milo was found to be a practical and economical source of grain during September, October, and November. Daily restriction of the concentrate fed to balance the ration was necessary to force the turkey to consume the maximum amount of milo.
3. The use of concentrates containing 5 percent and 8 percent of added salt were effective in limiting the consumption of concentrates fed free-choice.
4. The use of self-fed high protein (38 percent) concentrates were self limiting and may offer the most acceptable method of balancing a ration when turkeys are on milo pasture (Fig. 129).
5. Some crops found to be unsatisfactory for turkey grazing were soybeans, corn, and sudan—sorghum hybrids.

Current Studies

"Breeding Turkeys for Reproductive Efficiency" with Dr. A. B. Stephenson as principal leader, Dr. Harold Biellier, and Kendrick Holleman, M.S., as co-leaders, will provide a strong team approach in this selected area (Fig. 130).

The following objectives give research flexibility and permit a simultaneous attack on the problems in each generation of the experimental lines.

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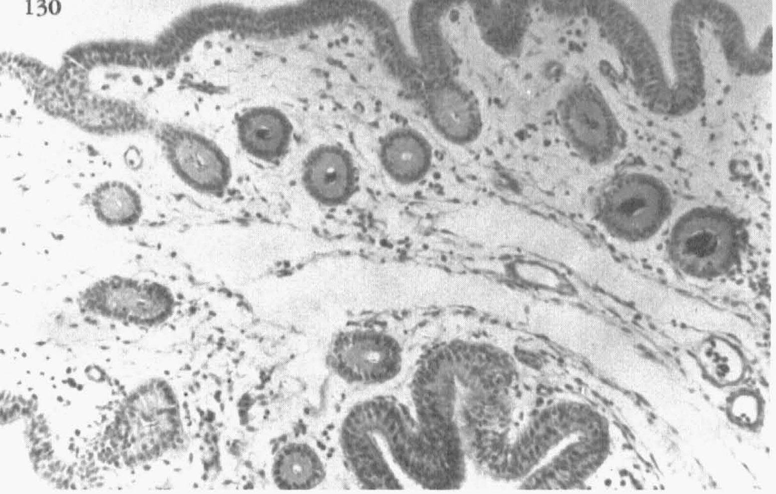

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Fig. 130—Enlarged photograph of semen storage region of a turkey hen's oviduct. Dark stained bodies within each tubule are the heads of sperm.

Fig. 131—Tamsy Reed presents Gov. Hearnes (left) with her grand champion, Missouri Junior Turkey Show, 1967. Others in photo are Tamsey's parents and Karl Stout (right), president, Missouri Turkey Federation.

Objectives were:

1. Develop and evaluate the use of tester lines as a method of identifying and reducing the frequency of specific types of embryonic mortality.
2. Develop high and low lines for reproductive performance from the Ohio control population. Estimate heritability and genetic correlations for traits of economic importance.
3. Compare the high and low reproductive lines for physiological difference. Finding real basic differences may provide a selection trait which is more independent of environmental influences than the number of poults hatched per hen.
4. Develop improved techniques of artificial insemination, storage, and semen evaluation in order to practice more rigorous selection of males.
5. The longer range objective is to evaluate specific selection techniques in pure strain, two-way crosses and three-way crosses as methods of breeding turkeys.

A cooperative project, "Studies on Fowl Cholera in Turkeys" with Dr. L. D. Olson as principal investigator, Dr. E. L. McCune, Dr. B. L. Moseley, and Dr. Harold Biellier as co-investigators has been initiated. The departments of veterinary pathology (Drs. Olson and Moseley), veterinary microbiology (Dr. McCune) and poultry husbandry (Dr. Biellier) contribute to the project's goal.

Objective was to study, through the use of the diagnostic facilities at the School of Veterinary Medicine, the epizoology of fowl cholera in turkeys in Missouri.

Missouri Still Holds Junior Show

The showing of live turkeys, once popular in Missouri and throughout the U.S., has almost disappeared. Dressed turkey shows for youth are popular in some states. In Missouri a Junior Turkey Show has been held for several years as a part of the Missouri Poultry Industry Convention. Figure 131 shows the 1967 winner of the show presenting her grand champion turkey to Governor Warren Hearnes of Missouri. This presentation has been an annual event for several years.

Outlook Good for State's Turkeys

Because of Missouri's favorable location this state has a bright future in the turkey industry. Missouri is strategically located with respect to feed supplies, climate, markets, competitive industry, efficient growers, integration, and allied industries.

Being in and near the corn and soybean belt, Missouri producers can, with proper planning and organization, compound rations at minimum cost. Some growers may not enjoy these lower costs, but the potential is here for those who take advantage of lower ingredient costs.

The climate in Missouri is conducive to low-cost production. Neither breeding stock nor market turkeys produced in season require the more expensive housing needed in the north or south to protect turkeys against extreme temperatures. This advantage does not pertain to those who produce turkeys the year around in Missouri.

A central location gives Missouri an advantage in distributing its surplus production. Since most turkeys are sold as frozen turkeys, Missouri can move its dressed and frozen turkeys by rail and trailer-truck at minimum transportation cost.

Turkey production, especially in southern Missouri, does not have to compete as strongly for competent growers as in areas where there are more rewarding alternative opportunities in industry or in grain farming.

Missouri turkey growers, in the main, are intelligent and efficient producers who can compete with any area of the U.S.

The Missouri turkey industry is rather highy integrated and therefore organized to produce most efficiently. Some Missouri farmers have developed their own integrated operation from breeding stock to market turkey. Some of the larger firms have developed integrated operations that extend to the dressed turkey and into further processed products such as turkey rolls, roasts, pies, and dinners. The more popular of the further processed turkey items are dinners, pies, rolls, steaks, and parts. Some housewives were at first disappointed in the quality of some of these early products. They were new and in some instances may not have been of the highest quality. The industry is continually improving the quality of these products and the demand is increasing.

The allied industries that service the turkey industry of Missouri are rendering efficient service so that Missouri remains competitive. The feed industry which accounts for about 70 percent of the cost of producing turkeys is efficient, giving essential services at minimum cost. This is very necessary if Missouri is to continue to expand in turkey production.

From the photos one must conclude that Missouri in 1968 has a modern turkey industry that is equal to that of any state. With proper support and leadership the turkey industry of this state should continue to expand and retain its position of third in the nation, surpassed in numbers raised only by California and Minnesota.

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Fig. 132—Poultry Reasearch Staff of Colonial Farms. L. to R.: Arthur Covell, research supervisor; Dick Irwin, president ;Dr. Fred Shultz, geneticist; and Raymond Houts, manager research farm.

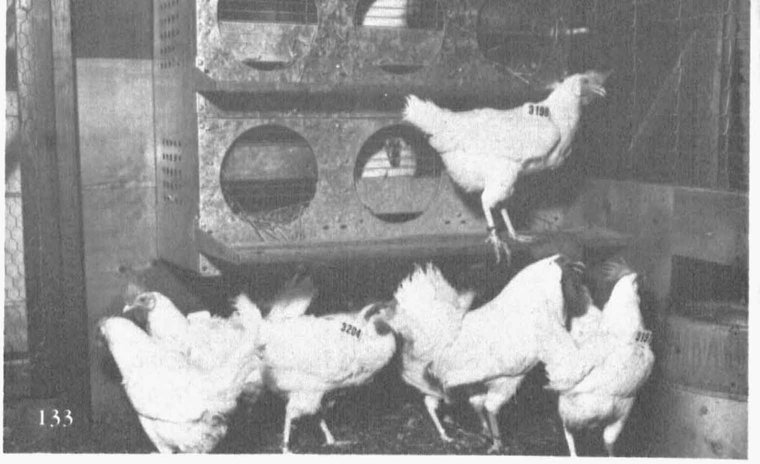

Fig. 133—Trapnested mating. Wing badges are used for identification.

Missouri Has Thriving Shell Egg Industry

The production of eggs in Missouri continues to be an important source of farm income. In 1967, Missouri produced 1,419,000,000 eggs valued at 27 million dollars. Though egg production in Missouri has been declining since 1944, 1967 production increased six per cent over 1966. Farm flocks as a source of commercial eggs have almost disappeared and large scale commercial egg production in Missouri is increasing. Though egg prices to producers during 1967 and early 1968 were below cost of production, the commercial producers in Missouri have continued their operations and may be expected to expand production as more favorable prices return.

Shift in Breeding Stock

In recent years there has been a decided shift in breeding for egg production, from many purebred varieties, to a relatively few strains, crosses and hybrids of egg-type chickens which carry predominately Leghorn blood lines. The different commercial lines are tested by the breeders and found to have superior egg production qualities before they are offered to the public.

Most of the breeding for egg production is done by a relatively few firms and individual breeders who have the facilities and "know how" to develop and maintain lines that satisfy the producers of market eggs.

These firms employ personnel trained in genetics and are capable of breeding superior egg production stocks. Some of the programs used involve large numbers of birds for long periods, which makes the breeding of these strains expensive.

Most of the primary breeding of egg stocks used by commercial producers in Missouri is done outside the state. Missouri does have one large poultry (chicken) breeding operation at the Colonial Poultry Farms, Pleasant Hill. The Colonial Poultry Farms breeding program was started in the late 1920's. Eden Booth, founder of Colonial Poultry Farms, developed and bred the "Booth Strain" of White Minorcas and sold and shipped breeding stock to many nations. This stock was very popular at that time because of its characteristic large, white egg.

In 1935, Colonial Poultry Farms entered U. S. Record of Performance breeding and had several breeds and varieties under official USROP trapnest and pedigree. USROP cockerels from these pedigree matings were used to mate breeding flocks of Colonial's Best Egg grade for commercial chick production. This practice of upgrading flocks through the use of pedigree males from high record hens was very effective in the early days.

In 1947, Colonial started a program of test-crossing of pure lines for the development of hybrid egg-type chickens. This program was carried on with some success for several years and in 1955 an entry of Colonial White Leghorns won the California Random Sample test with an average production of 277 eggs per hen.

In 1958, Colonial employed Dr. Fred Shultz as Director of Research and the Colonial breeding program has been continuously under his direction since that time (Fig. 132).

Dr. Shultz and research supervisors Arthur Covell and Raymond Houts plan each step of the breeding program which includes: 1) the lines to be hatched, 2) the number of chicks in each line and sub-line to be hatched and the dates, 3) the date the birds are to be housed and which facilities on the two breeding farms will be used to house each line, 4) the date that trapnesting will be started and the date to be completed, 5) dates for summary and analysis of records, and 6) the time for mating of pedigree pens to start the next cycle.

Much of the Colonial poultry breeding work is based on a program of cross-testing for combining ability and pure line improvement for the many key economic factors, such as egg numbers, egg size, livability, egg qual-

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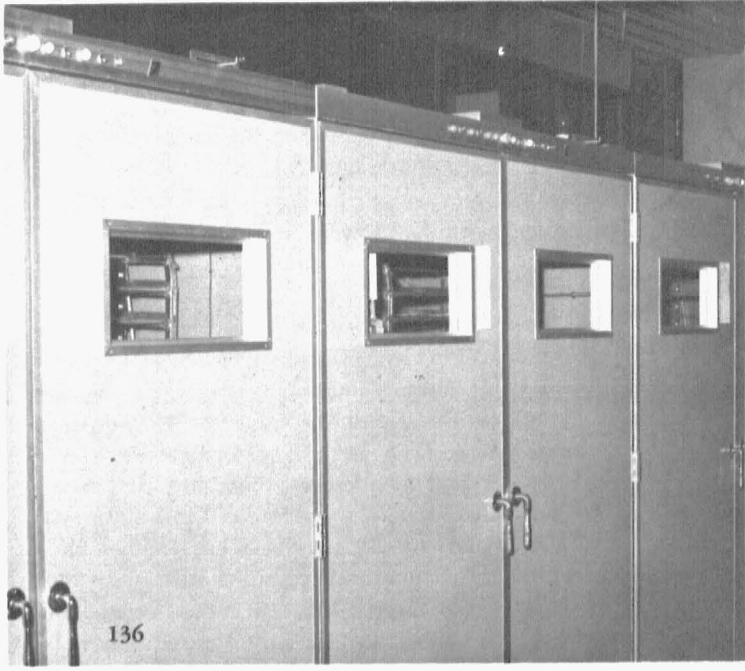
Fig. 134—Measuring the interior quality (I.Q.) of eggs in selecting breeding stock for quality egg production.
Fig. 135—Commercial hatchery of egg production stock.
Fig. 136—Incubators used for hatching egg production stock.
Fig. 137—Interior of incubator. Plastic egg tray slides into the incubator rack. Trays are filled by the primary breeder in another state and transported to the Missouri hatchery and set without rehandling.



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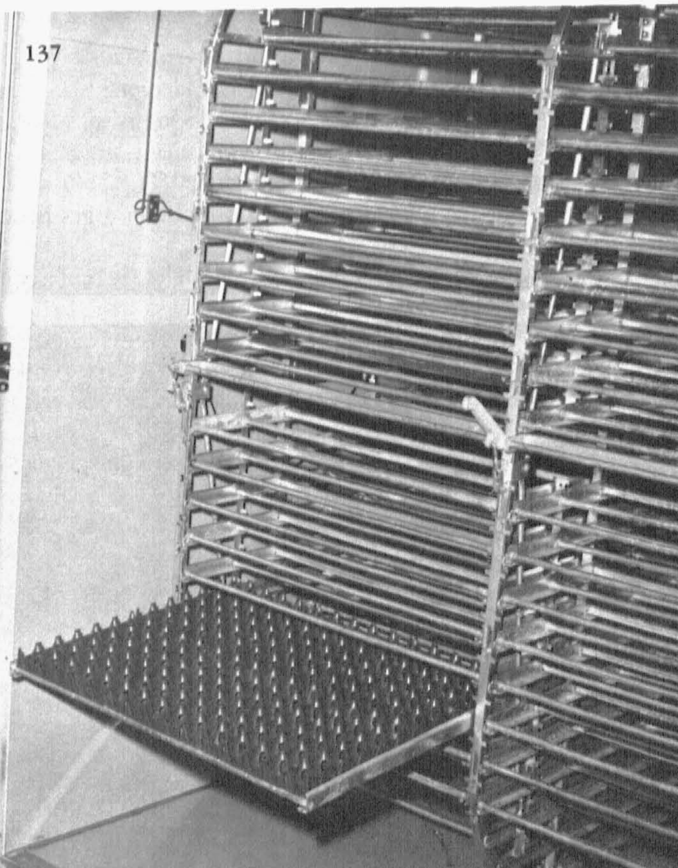

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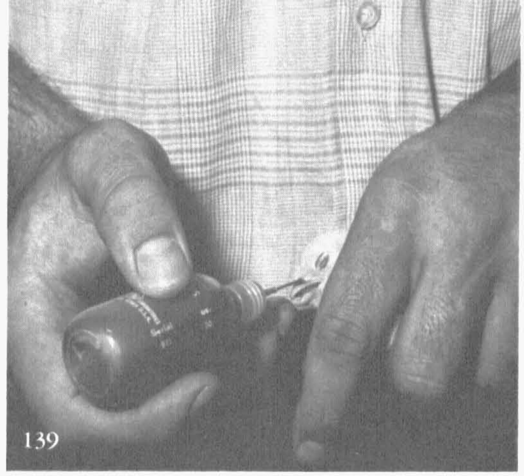
ity, shell thickness and early maturity as evidenced by date of first egg. This entails a large volume of records and these valuable data are kept in fireproof safes on each of the breeding farms. The breeding farm at Clinton, is used for the development of the female lines and the farm at Pleasant Hill, is used for the development of the male lines. In addition to separate farms to assure complete separation of key lines, further safeguards to maintain identity of lines include distinctive colored wingbands and the use of specific colored plastic egg flats for the gathering and holding of eggs from each line (Fig. 133).

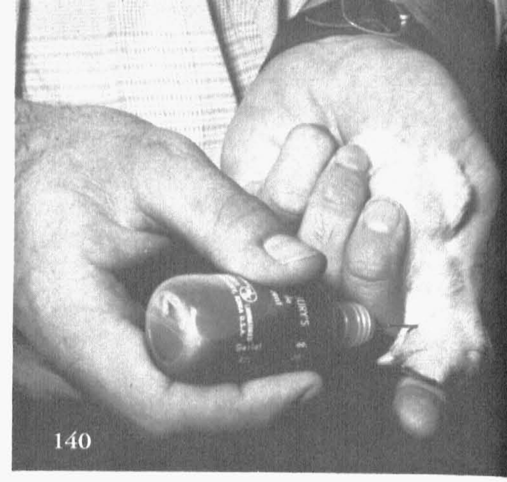
One phase of the Colonial research program that is unique and which has attracted world-wide attention is the program of measuring eggs for yolk volume and recording the results on a family pedigree basis. This is done to discover those lines and families within lines with the highest potential for yolk volume. The egg breaking industry in Missouri is large and the processor of liquid egg is interested in a high yield of yolk in relation to white because of the greater value of egg yolk (Fig. 134).

In addition to the testing of line and breed crosses for combining ability and the improvement of lines and sub-lines via trapnest and pedigree breeding, Colonial's present program includes planned exposure of pedigree families to test for resistance to Marek's disease and a program for the eradication of PPLO from foundation breeding stock.

Changing Hatchery Operations

The operation of a chick hatchery has undergone many changes in recent years (Figs. 135 and 136). The number of hatcheries in the U. S. has declined by 80 percent since 1934 (11,405 in 1934, to 2365 in 1965). But, the egg capacity per hatchery has increased from 24,000 to 200,000. The number of varieties or strains has been greatly reduced. The size of breeding flocks has increased.





In some cases the eggs are transported by truck from other states on plastic egg trays that are placed in the incubators soon after they arrive at the hatchery (Fig. 137). In other cases, the breeding stock is introduced as chicks or hatching eggs and the hatchery supply flocks are maintained near the hatchery. The breeding stock may be owned by the hatchery and the flocks housed in buildings owned by the hatchery or by a farm producer.

Before leaving the hatchery the day old chicks will usually be sexed (Fig. 138) and vaccinated (Figs. 139 and 140) for some diseases and may be debeaked (Fig. 141), de-winged (Fig. 142), dubbed (Fig. 143), and injected with antibiotics (Fig. 144). The cockerels of egg-type chickens are generally destroyed because they have no economic value.

The demand for day old chicks has declined and instead producers demand started pullets that are ready-to-lay (20-22 weeks of age). This demand has created a new business—the started pullet industry. Hatcheries have been forced to sell started pullets or discontinue their business.

Many Changes in Brooding

The brooding of chicks has undergone many changes and new methods are continually being tried. Most chicks are now raised in confinement and many are grown in environmentally controlled buildings (Figs. 145 and 146). Some are brooded and reared on wire in cages instead of on the floor (Fig. 147).

The gas burning brooder has almost replaced other types of brooders (Fig. 148).

It is important that chicks be given a good start in life by providing a clean environment where temperature is correct for the age of the chick and proper ventilation and humidity are maintained.

The success of market egg production depends largely on the quality of the pullets housed. The quality of the pullets depends on their breeding and how well they are grown out.

A new poultry business has developed recently in the U. S. and in Missouri—the raising of started or ready-to-lay pullets (20-22 weeks of age), for use in Commercial

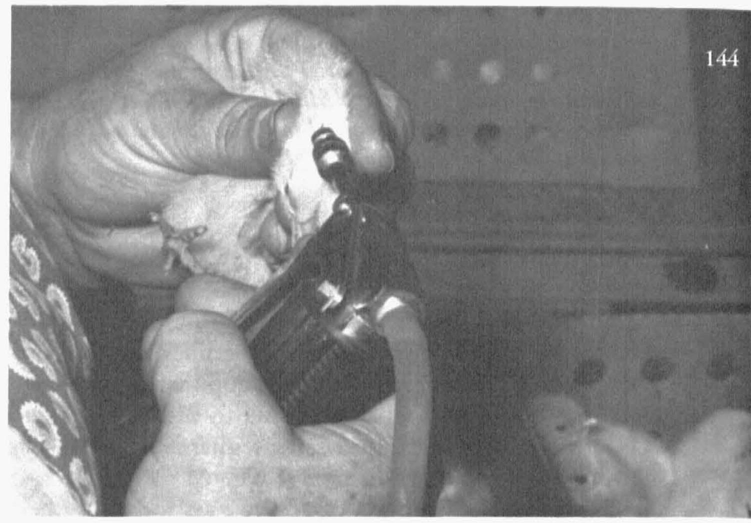
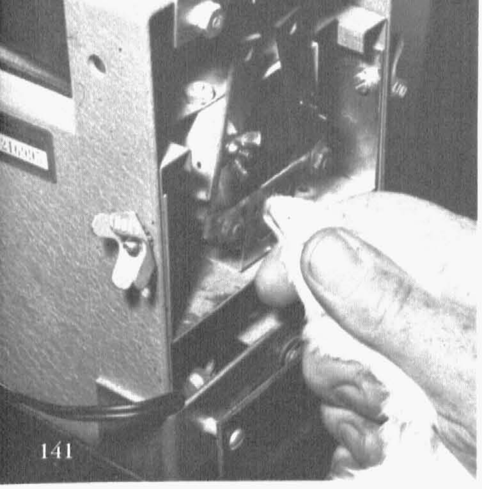


Fig. 138—Sexing newly hatched chicks. Only the pullets will be raised.
Fig. 139—Intranasal vaccination for Newcastle and Bronchitis.
Fig. 140—Intraocular vaccination for Newcastle and Bronchitis.
Fig. 141—Debeaking 5-week old chick to prevent cannibalism.
Fig. 142—Dewinging day-old chicks at the hatchery minimizes flying in the growing and laying house.
Fig. 143—Dubbing pullet chicks before they leave the hatchery, using manicuring scissors.
Fig. 144—Antibiotics injection reduces stress in pullet chicks and give them a good start.
Fig. 145—An environment controlled house used for growing egg-type pullets.
Fig. 146—Day-old started pullets in environmentally controlled brooder house. Wire chick guards confine chicks near the heat for a few days.
Fig. 147—Growing pullets in colony cages from 8 to 20 weeks of age.
Fig. 148—Started pullets being grown in open-type house with gas brooders, automatic feeders and sloping roosts.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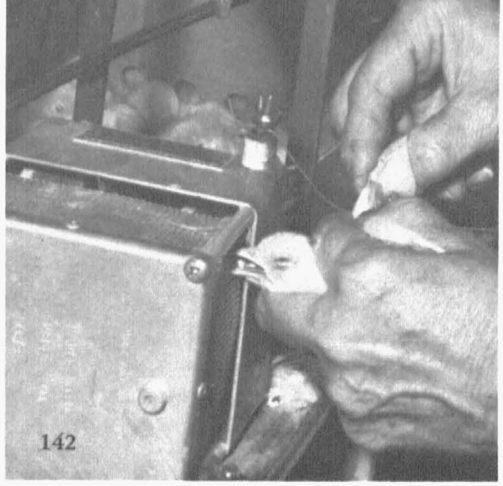
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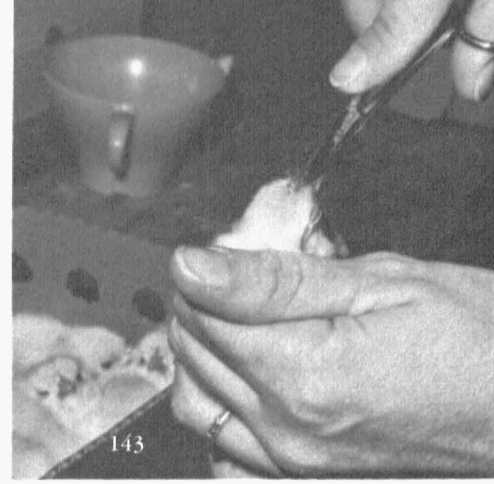
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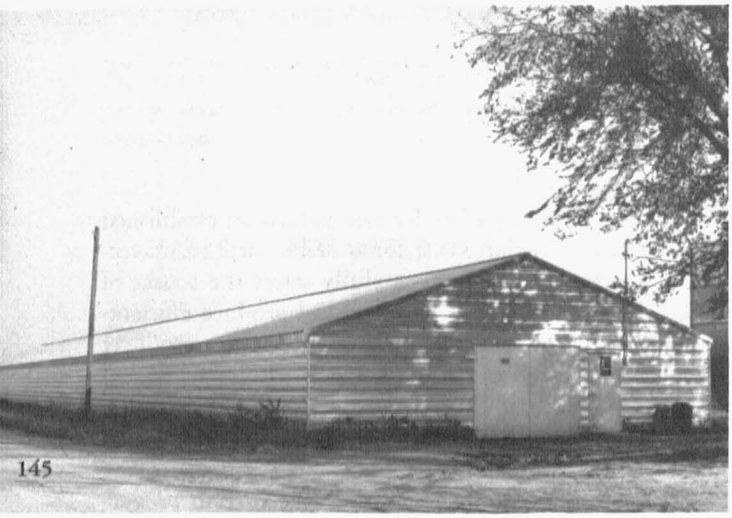
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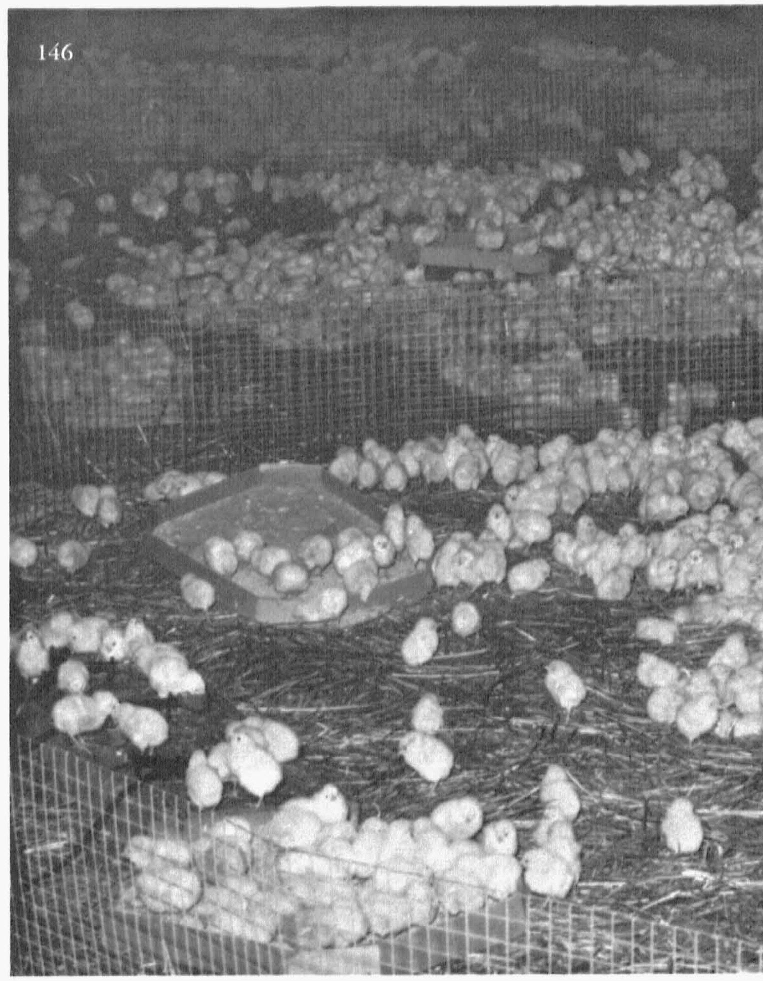
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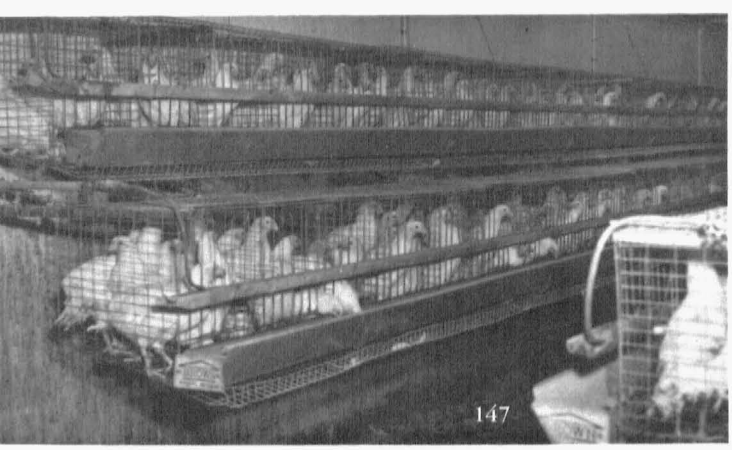
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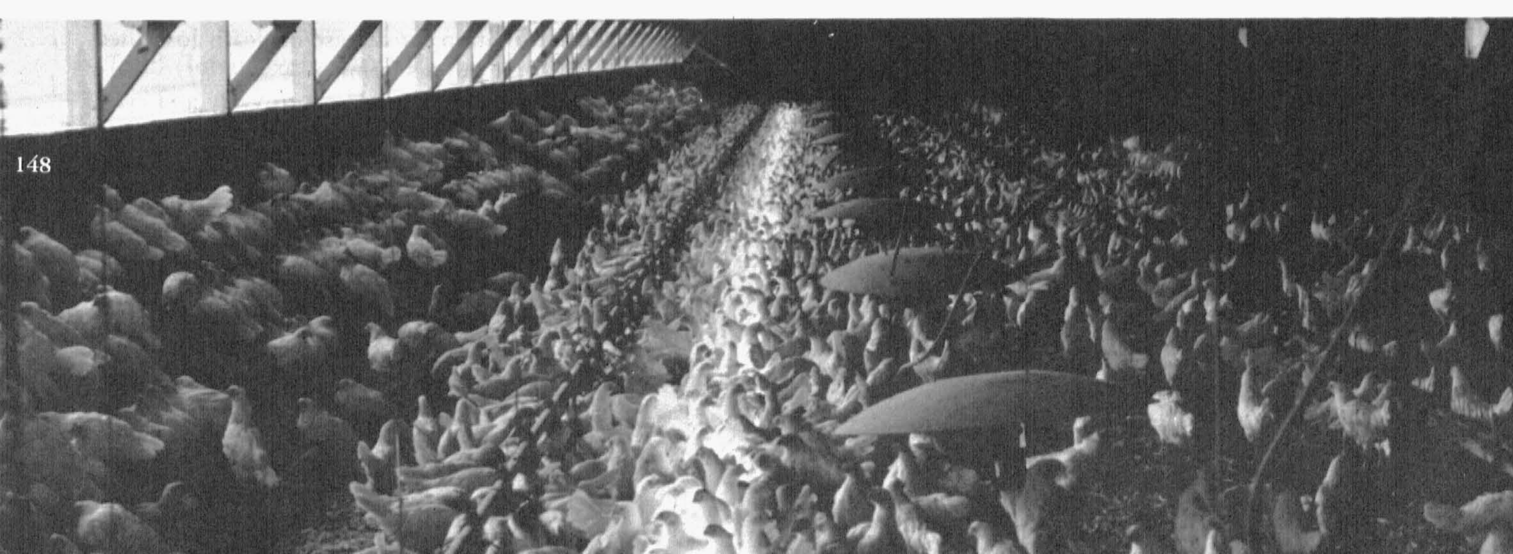
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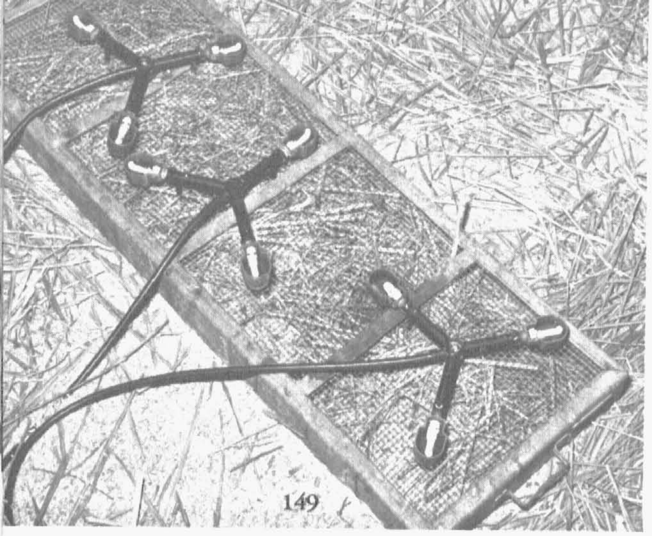

Fig. 149—Cup waterers used in growing started pullets on the floor.

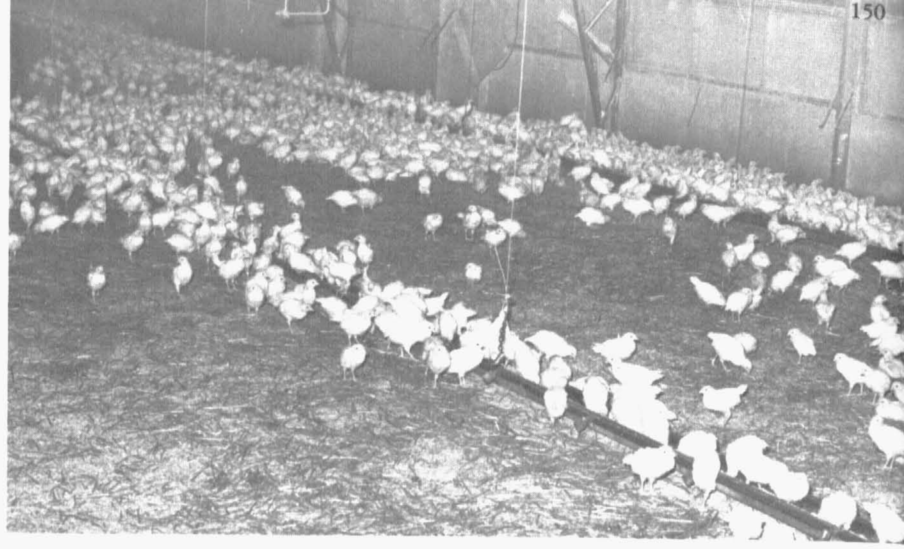

Fig. 150—Four-week old pullets being reared on the floor.

egg-producing units. Most large scale producers (10,000 or more layers), prefer to purchase pullets and utilize their time and resources in producing market eggs.

Hatcheries producing day-old chicks of the egg-laying strains have shifted a large portion of their business to producing ready-to-lay pullets. However, this has not been true of the heavy breed chicks purchased by farmers, nor of the producers of broilers strain hatching eggs. Farmers who purchase heavy breed chicks will accept day-old straight-run chicks. Many producers of broiler strain hatching eggs continue to raise pullets and cockerels from day-old chicks.

This business, like most new industries has had its growing pains. New problems have had to be solved in growing pullets, instead of selling them as day-old chicks. The transportation of ready-to-lay pullets is quite different than for day-old chicks. The increase in facilities (buildings and equipment) and the labor and feed required has multiplied the investment required (Figs. 149-152).

Purchasing vs. Raising Pullets

While most commercial egg producers purchase ready-to-lay pullets, some producers, usually those with smaller numbers of layers or very large operators, prefer to grow their own pullets. It may be profitable for egg producers to raise their own pullets when they have unemployed labor (children, and partially employed adults), brooding and rearing facilities standing idle, or when well developed pullets of the strain desired are not available. Those who grow their own pullets can control the management and vaccination of their pullets to suit their needs and avoid some problems in moving pullets long distances to laying quarters. Producers who have been successful in growing pullets that performed well under their own conditions, hesitate to turn this important job over to a stranger. However, it should be noted that young stock should be grown under sanitary conditions and away from older birds. This may not be possible on a commercial egg farm.

The growing of pullets for sale is now an established business and has lived down some of its earlier unfavorable reputation. One should carefully select the source of pullets, because their ability to live and produce efficiently determines the profit. The commercial egg producer must consider whether his labor and facilities can be employed more profitably in raising pullets or in caring for layers. The trend is toward more specialization with the commercial egg producer employing his resources in egg production and letting someone else specialize in producing and selling ready-to-lay pullets.

Buyer-Seller Agreement

Since misunderstandings sometimes arise between buyer and seller, it is desirable that a written agreement be entered into which specifies:

1. Strain of birds.
2. Age of birds at delivery.
3. Date of delivery.
4. Vaccinations given? At what ages?
5. Wormed? Debeaked? Dubbed? Treated for lice?
6. Any culls or retarded birds permitted?
7. Who pays for hauling?
8. Terms for payment.
9. What happens if contract is cancelled?
10. Any compensation for disease or death loss after birds reach the buyer's farm?

Such an agreement may avoid controversy and even law suits. The reputation of pullet grower or hatchery and its management history is the best guideline.

Cost of Producing Pullets

The buyer as well as the seller should understand the factors that enter into the cost of producing pullets. Both should understand that a sound business must realize a margin of profit sufficient to pay for management and encourage pullet production. Table 3, prepared by Walter

Fig. 151—Twelve-week old started pullets. Automatic feeders and cup waterers are on wire platforms for sanitation.

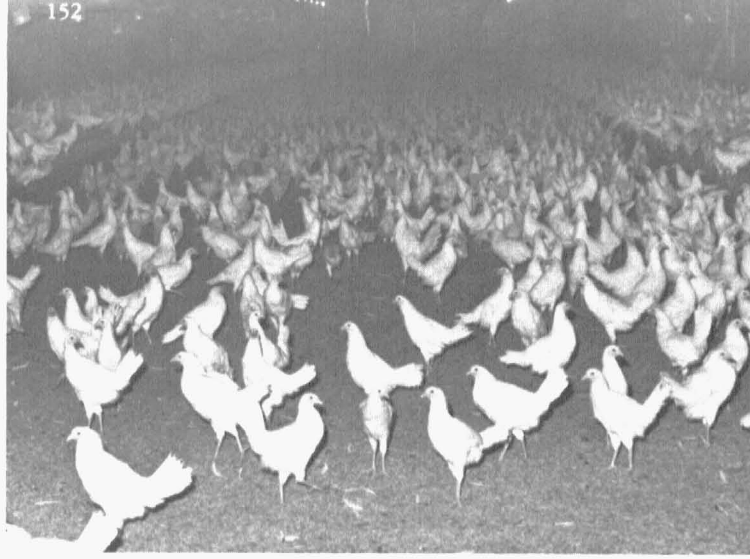

Fig. 152—Sixteen-week old started pullets in environmentally controlled house.

TABLE 3. ESTIMATED COST OF PRODUCING A STARTED PULLET TO 20 WEEKS OF AGE[1]. 1967

Item	Cost/Saleable Pullet Cents	Your Cost
Pullet chick @ 40¢ - allows for 5.5% mortality. Extra chicks = culls.	42.2	
Feed - 18# @ $72/ton	64.8	
Building (new) $1.60/sq. ft. - 5% depreciation. Allows 1 sq. ft. per bird	04.0	
Equipment[2] - $0.40/bird, 10% depreciation	02.0	
Interest on investment (buildings & equipment) 6%	06.0	
Vaccinations @ 3¢/bird	03.0	
Litter @ 1 1/2¢/bird	01.5	
Electricity @ 1¢/bird	01.0	
Fuel @ 1.5¢/bird	01.5	
Medication & Misc. @ 1¢/bird	01.0	
Insurance @ 1.5¢/bird	01.5	
Total (labor excluded)	128.5	

[1]Figures are based on the cost of producing 10,000 saleable pullets 20 weeks of age. Two flocks per year are produced. No labor costs are included. Besides daily chores, growers should consider such labor as getting ready for chicks, putting down chicks, vaccinating, debeaking, cooping and transporting ready-to-lay pullets plus a return for management.

[2]Equipment included - gas brooders, fuel tank, bulk feed tank and auger chick waterers, automatic waterers, starter feeders, automatic feeder and debeakers. Coops and other misc. equipment not included.

Fig. 153—Wing web vaccination for Chicken Pox.

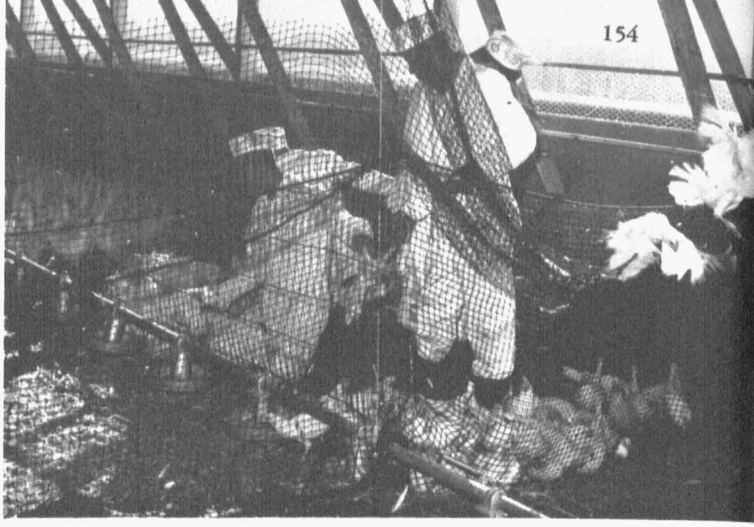

Fig. 154—Crew vaccinating pullets for pox. Note the use of a net for confining and catching birds to minimize injuries.

Russell and Glenn Geiger of the Missouri Agriculture Extension Service, presents cost estimates for producing egg strain pullets. (These figures do not include payment to management and delivery costs).

Order Early and Make Deposit

In order to be assured of delivery when pullets are needed, the purchaser should develop a schedule of deliveries with his supplier and make a deposit on his order. Such an arrangement is good business for both the buyer and seller. Proper pullet growing facilities are too expensive for use only 4 to 5 months out of 15, and it appears that pullets should not be grown on the same farm and cared for by the same people, with layers.

It takes better management to grow a good pullet than it does to get profitable production from a good pullet. Whether it is a raised or purchased ready-to-lay, it must be a good pullet to be a profitable egg machine.

Disease Preventives Helpful

Diseases and parasites are hazards all livestock and poultry producers must prevent or control if they are to maintain a productive and efficient operation. Many of these are preventable, but some are, as yet, uncontrollable (Figs. 153 and 154).

Many diseases and parasites can be prevented by proper management. Egg-type chicks started, should be U.S. pullorum-typhoid clean or of an equivalent status. The growing stock and layers should be kept under as near quarantine as is physically possible, with respect to visitors, wild birds, rats, mice, and insects.

The disposal of dead birds is a serious problem on commercial farms. Assuming a mortality of one percent per month, a 10,000 bird flock will average three dead birds per day, and a producer with 100,000 layers will average 30 birds per day. Birds should not be thrown out on the land to be eaten by dogs or varmints. The producer should provide a sanitary method of disposal (this is especially important if the producer is located near a town or neighbors). Incineration is a sanitary way of disposing of dead birds, but neighbors are very sensitive to any odors emanating from a poultry farm. Disposal pits have a place for smaller units located where the soil is well drained. Some larger producers have found the landfill method most satisfactory because it eliminates odors as well as the dead birds. If the birds are buried, they should be placed at least 18 inches underground to prevent animals from digging them up.

Following an all-in, all-out program with a period of two or three weeks, when no live poultry is on the premises, will help break the life cycle of many diseases and parasites. This period can correspond to the time when the houses and equipment undergo a thorough cleaning.

Vaccines are now available for the prevention of Newcastle disease, bronchitis, fowl pox, epidemic tremors and laryngotracheitis. The schedule of vaccinations used and found to be satisfactory by the Department of Poultry Husbandry, University of Missouri - Columbia, is as fol lows:

Intra-nasal vaccination at day-old for Newcastle and bronchitis, water vaccination at three weeks for Newcastle and bronchitis, wing web vaccination for fowl pox at eight weeks of age, wing web vaccination for Newcastle at 12 weeks and water vaccination for bronchitis at 16 weeks. The department has not found it necessary to vaccinate for Epidemic Tremors or Laryngotracheitis. The University Department of Veterinary Microbiology recommends that each commercial producer consult a competent poultry disease specialist and develop a vaccination program that fits his area and specific needs.

Preventing Cannibalism

Severe losses may result from picking or cannibalism among chicks, growing stock, and layers. Birds in multiple-bird cages are more of a problem. Light is a factor, as bright light increases cannibalism. Crowding also results in more cannibalism.

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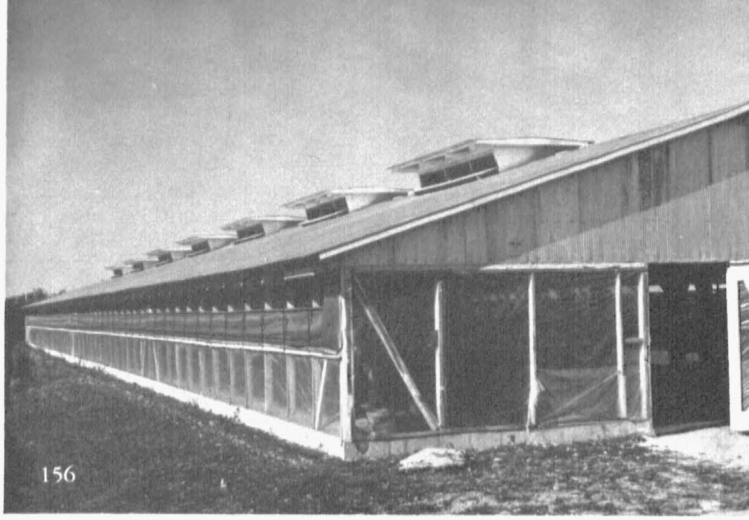

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Debeaking is the most acceptable method to prevent cannibalism. Some debeak at day-old, others at about 7 days, some at 13 to 16 weeks of age. Still others wait until cannibalism starts. However, all pullets going into multi-bird cages should be debeaked by the 16th week so that the pullets recover from the stress of debeaking before they start laying (Fig. 155).

Revolution in Methods and Housing

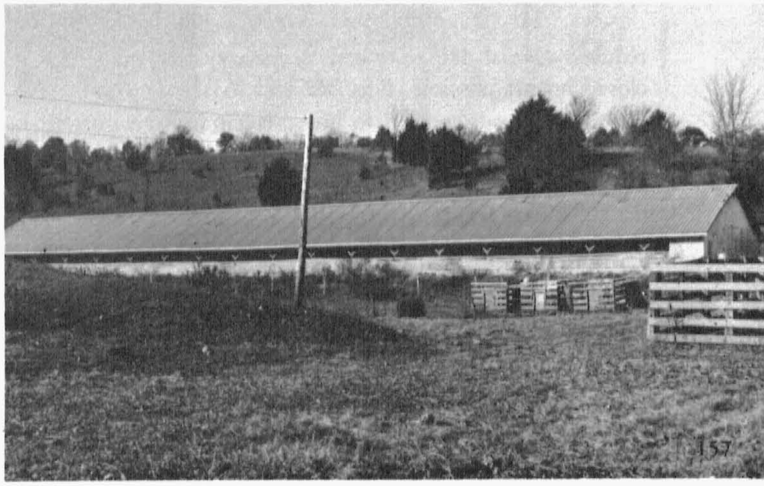
During the past 30 years there has been a revolution in the production of eggs in Missouri. The farm flock has been replaced with more efficient commercial production and marketing. However, 30 years from now, producers may look back on 1968 as a time when producers were using crude and inefficient methods in both egg production and marketing. Thus, it becomes desirable to establish a benchmark (1968) of practices in use at this time so that members of the industry in the future may compare their practices with the past.

Great strides have been made in breeding and today's egg producer is far superior to the stocks used for egg production by the general farmer of 30 years ago. However, poultry breeders appear to have reached a plateau from which they have been unable to increase production above flock averages (hen-house production) of 240 to 250 eggs per hen for 365 days of production. Thus, a challenge remains for poultry geneticists to breed layers capable of hen-housed production of 300 eggs or more.

There has been a revolution in poultry housing. The small farm flock required only small and inexpensive housing to satisfy production. Commercial production, at a time when labor is scarce and high priced, requires automation and large units for thousands of birds in each house (Figs. 156-161).

More recently, enclosed houses (environmentally controlled), where light, ventilation, temperature, and humidity are controlled, have gained wide acceptance. The use of pad cooling, whereby inside temperatures can be

Fig. 155—Debeaking laying hens to prevent cannibalism.
Fig. 156—Inexpensive cage layer house includes plastic curtains, metal roofing, and 4" of dead air space between roof and tri-ply vapor barrier under rafters.
Fig. 157—Laying flock of 6,500 on a general farm in the Ozarks. Direct sale of eggs to retailers is major source of farm's income.
Fig. 158—Modern egg plant for caged layers in north Missouri. Each 40' x 240' house holds 10,000 layers.



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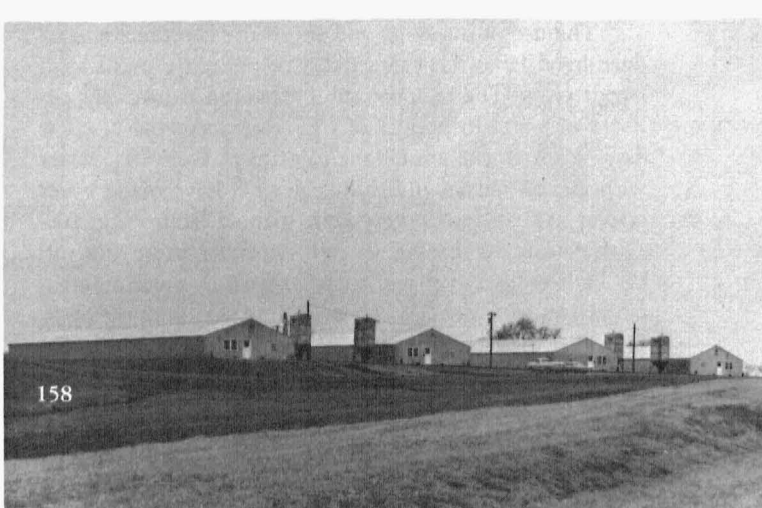

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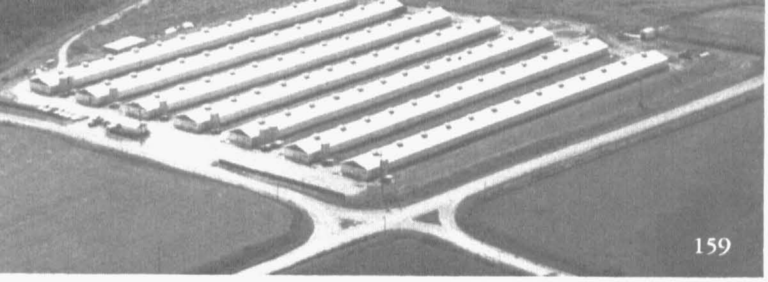


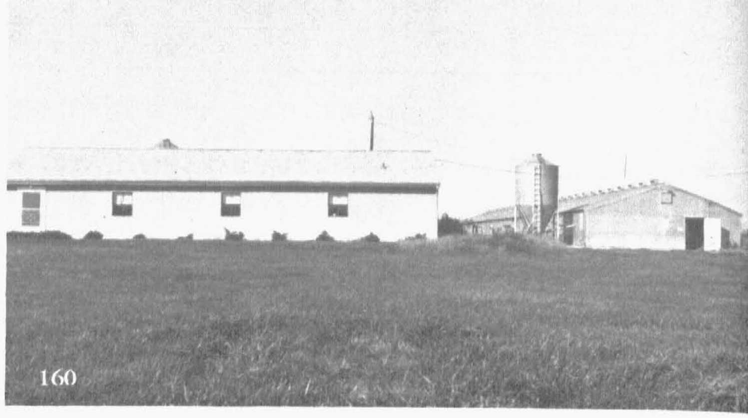
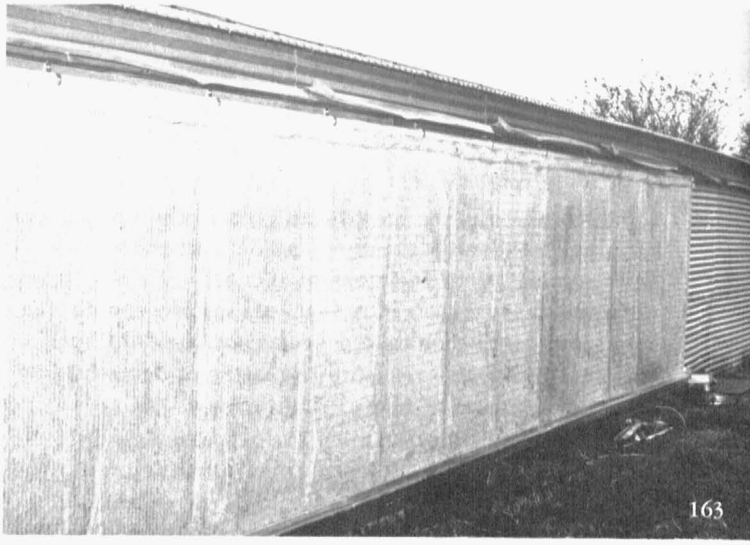


Fig. 159—Aerial view of a commercial egg farm; 107,000 laying hens. (Courtesy of Schuster Fans, Gower).
Fig. 160—Modern egg production (20,000 layers). Egg building on left houses refrigerated holding room, grading room, and sales room for retail sales.
Fig. 161—Caged laying house with outside bulk feed tank.
Fig. 162—Two of ten planned 30,000-layer houses on large commercial egg farm in southwest Missouri. One man cares for layers in each house.
Fig. 163—Pad cooling system used on houses where pullets are grown and caged layers are housed.
Fig. 164—Caged layers in double decked stair-step cages. Has concrete walk for power carts.
Fig. 165—Automated feed cart used in filling triple deck feeders.
Fig. 166—Single deck caged layer house with automatic feeders, waterers, and egg gathering.
Fig. 167—Single-deck colony cage laying house with all equipment suspended from ceiling.
Fig. 168—Closeup view of cup used for watering birds in two colony cages.
Fig. 169—Feed being augered from outside bulk tank into the feed troughs of double-decked cages.
Fig. 170—Electric cart augers feed into the feed troughs of double-decked cages.

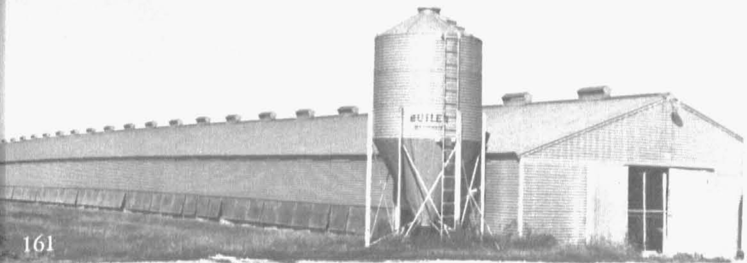


reduced several degrees when necessary, has made enclosed houses possible (Figs. 162 and 163).

The present trend is to house layers in cages instead of on the floor (Fig. 164-167), where most of the birds are kept in multiple bird (2-8 birds) cages, allowing only 0.5 sq. ft. per layer. Such concentrations lower the investment per bird, but produce satisfactory production. However, production per bird is reduced slightly and cannibalism is increased, but economically, the crowding of birds in cages is a sound practice.

Layers housed in cages simulate factory conditions where a less skilled poultryman can achieve more satisfactory results than with layers on the floor. A systematic schedule can be set up by the owner or manager that an inexperienced person can follow.

The use of machines and automatic equipment to reduce hand labor has characterized the poultry industry in recent years. The simplest thing to automate was the delivery of water to poultry of all ages (except the first few days when chicks are taught to drink). Running water with cut off valves and timing devices have made water readily available with very little manual labor (Fig. 168-170). Automatic feeding, though somewhat more difficult, has been solved so that those who wish may use automatic feeders to feed chicks or layers in cages or on the floor. However, some excellent poultrymen prefer to feed by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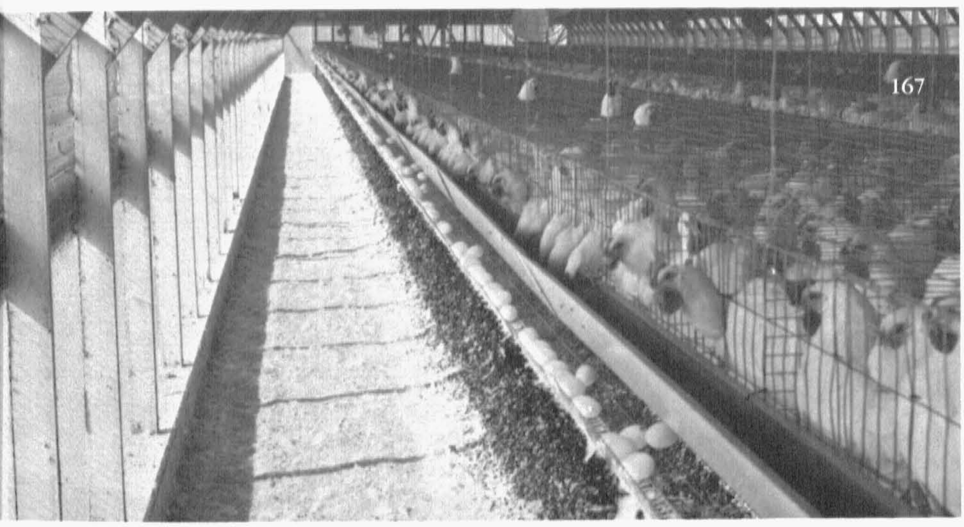
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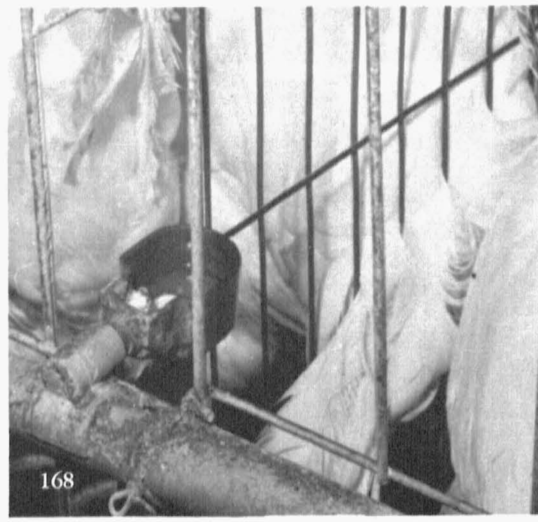
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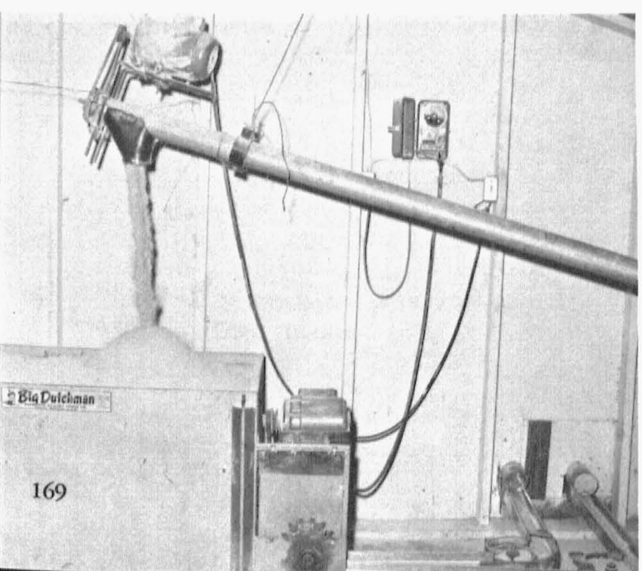

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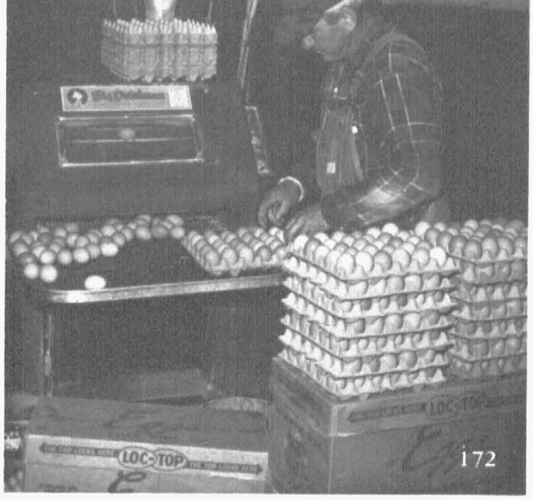
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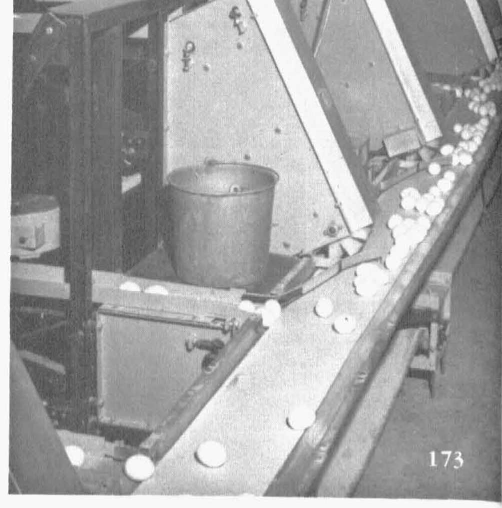
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Fig. 171—Traying eggs from an automatic egg collector in a cage layer house. Belt that collects eggs from all cages on a given line.
Fig. 172—Mechanical egg gathering machine in a cage layer house.
Fig. 173—Belts which collect eggs from cages. Second belt carries eggs to a third (far right) which elevates them to a work and storage room on second floor.
Fig. 174—Hand gathering eggs with an electric cart. Eggs can be gathered from both sides on one trip.
Fig. 175—Hand operated cart that travels on a concrete walk, guided by rollers on sides of cart.
Fig. 176—Tractor has extension blades for pushing manure from beneath cages to end of house where it is dumped in manure spreader.
Fig. 177—House extended so manure can be dumped into spreader.
Fig. 178—Transferring eggs from egg trays to an egg washing machine with vacuum lift.
Fig. 179—Attractive white eggs that were washed in a modern egg washing machine.
Fig. 180—These eggs are candled, cleaned, sized, graded, and cartoned for retail at the farm or in nearby stores.

hand from a cart so that the birds may be observed more often and mechanical problems may be avoided.

The gathering of eggs mechanically has challenged the designers and builders of equipment and some unique systems have been developed (Figs. 171-173).

The removal of manure and litter has been the most difficult chore to mechanize. Though some mechanical methods are in use, this problem is still unsolved. Handling manure in a liquid system is used by some poultrymen (Figs. 176-177).

The commercial poultry and egg producer has a major problem in disposing of manure, dead birds, litter and other waste. If each layer produces 100 pounds of manure annually, the producer with 20,000 layers must dispose of 85 tons monthly.

The ideal use of manure is as fertilizer. Manure is especially valuable for crops and pasture that utilize nitrogen. Poultry and beef cattle production make an excellent combination.

The term "processing" in economics refers to changing the form of a product, for example, wheat into flour, and therefore is more appropriately applied to the breaking, freezing, and drying of egg products. However, those who handle and prepare shell eggs for retail outlets also consider themselves egg processors.

Processing Shell Eggs

Methods for handling eggs have been mechanized. The use of plastic egg trays or filler flats has made possible the gathering and washing of eggs and setting them in incubators on the same tray. The vacuum egg lift makes it possible to handle 30 eggs in a single operation, (Fig. 178).

Dirty eggs should not be offered to the consumer. Shell eggs may be cleaned by washing or dry cleaning. Since very few shell eggs are stored, washing has been generally accepted as the most practical method for cleaning shell eggs. There are several machines on the market that do a good job of cleaning soiled eggs (Fig. 179).

It is important that shell eggs be washed in warm water (110°F to 130°F). The time should not exceed that required to get the eggs clean.

The commercial method of determining shell egg quality is by candling. This method is reasonably accurate with fresh eggs, but does not detect some spoilage ("green whites") in shell eggs that have been stored for several months. By candling the operator can view the size of the air cell, the quality of the shell, any germ (embryonic) development, the centering of the yolk, the condition of the white, and detect most blood and meat spots. By relating these quality factors to grade standards, eggs can be commercially graded as market eggs.

Eggs may be candled individually by hand or en mass by the operator viewing the eggs as they pass over a lighted area (flash candling). The latter method is used commercially for fresh eggs. It is fast and efficient (Fig. 180).


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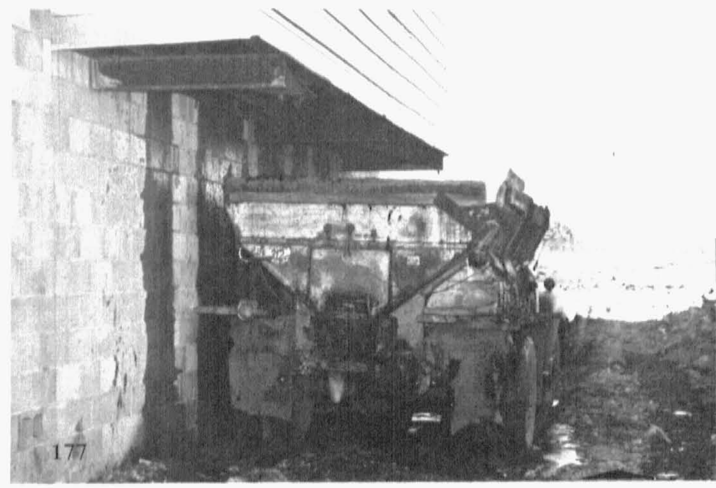
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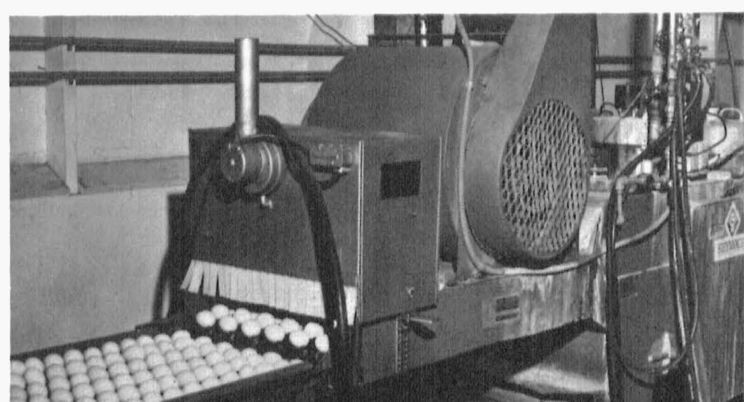
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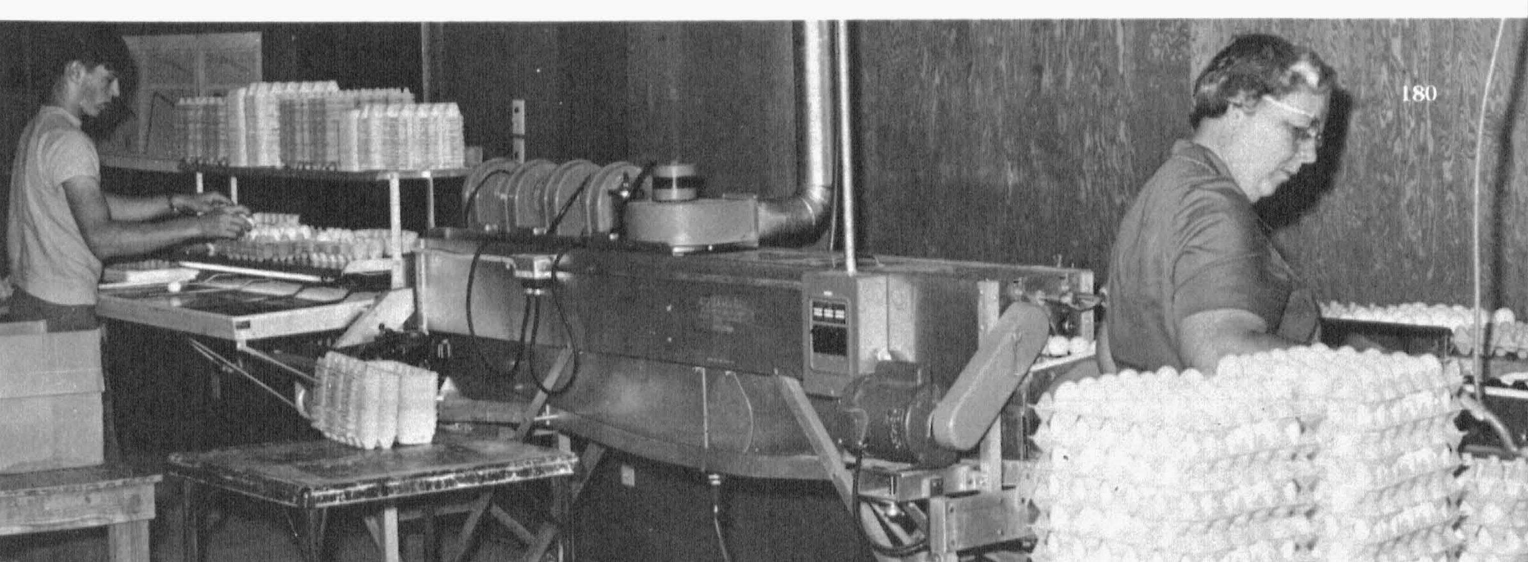
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Table 4.--Summary of United States Standards for Quality of Individual Shell Eggs.

Quality Factor	Specifications for Each Quality Factor: AA Quality	A Quality	B Quality	C Quality
Shell	Clean. Unbroken. Practically normal.	Clean. Unbroken. Practically normal.	Clean; to very slightly stained. Unbroken. May be slightly abnormal.	Clean; to moderately stained. Unbroken. May be abnormal.
Air cell	1/8 inch or less in depth. Practically regular.	3/16 inch or less in depth. Practically regular.	3/8 inch or less in depth. May be free or bubbly.	May be over 3/8 inch in depth. May be free or bubbly.
White	Clear. Firm. (72 Haugh units or higher.)	Clear. May be reasonably firm. (60 to 72 Haugh units.)	Clear. May be slightly weak. (31 to 60 Haugh units.)	May be weak and watery. Small blood clots or spots may be present.* (Less than 31 Haugh units.)
Yolk	Outline slightly defined. Practically free from defects.	Outline may be fairly well defined. Practically free from defects.	Outline may be well defined. May be slightly enlarged and flattened. May show definite but not serious defects.	Outline may be plainly visible. May be enlarged and flattened. May show clearly visible germ development but no blood. May show other serious defects.

For eggs with dirty or broken shells, the standards of quality provide three additional qualities:

Dirty	Check	Leaker
Unbroken May be dirty.	Checked or cracked but not leaking.	Broken so contents are leaking.

* If they are small (aggregating not more than 1/8 inch in diameter).

The consumer demands a graded product. The USDA, in cooperation with industry, has developed standards for shell eggs (see Table 4).

Grading involves classifying eggs according to their quality (both interior and exterior) and their size or weight. The U.S. weight classes are listed in Table 5.

Table 5 U.S. WEIGHT CLASSES FOR CONSUMER GRADES FOR SHELL EGGS

Size or weight class	Minimum net weight per dozen	Minimum net weight per 30 dozen	Minimum weight for individual eggs at rate per dozen
	Ounces	Pounds	Ounces
Jumbo	30	56	29
Extra Large . .	27	50½	26
Large	24	45	23
Medium	21	39½	20
Small.	18	34	17
Peewee	15	28	--

Missouri Egg Law

The Missouri Egg Law, passed by the legislature in 1955, and the regulations as promulgated by the Commissioner of Agriculture in 1964, and 1966, provide Missouri producers and consumers with a law that meets the US DA standards for shell eggs. This law has improved the quality and appearance of eggs sold to consumers through retail stores.

Regulation 9 (1966) provided that shell eggs, after being graded, must be held at temperatures not exceeding 60°F.

The law is administered by the Egg Division of the Department of Agriculture, Jefferson City, Mo.

As shell eggs are graded, they are packed in cases or cartons for delivery to other dealers or retailers. This operation has also been mechanized and automated to reduce labor (Figs. 181-182).

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Fig. 181—An insulated and refrigerated egg room on the farm.
Fig. 182—Modern shell egg processing plant.
Fig. 183—Eggs passing thru an Electronic Blood Rejector. Note eggs in single line at bottom of photo.
Fig. 184—Loading a 700-case truck with eggs for delivery in northern cities.
Fig. 185—A modern shell egg processing plant.

The dozen egg carton is the most popular container. These cartons are assembled (set up) by machine. Egg cartons, some very attracive, provide valuable space for advertising eggs.

The standard 30 dozen fiberboard case remains the most popular container for handling bulk and cartoned eggs in retail stores. However, wire baskets for handling egg cartons are becoming popular (Figs. 183-184).

Distribution and Retailing

With modern transportation, eggs can be cartoned several hundred miles from the retail stores within a matter of hours. Missouri does not supply all the shell eggs used in St. Louis and Kansas City. Eggs from Iowa, Minnesota, Arkansas, and several other states flow into these markets.

Missouri producers have good markets nearby and Missouri is centrally located with respect to national distribution. These two factors should favor the future expansion of commercial egg production in Missouri (Figs. 185-187).

The sale of shell eggs to the consumer may be made by the producer (direct marketing), the local grocery store, or the chain store. The producer may sell direct at the farm or deliver eggs to the consumer's door.

The selling of eggs in a store provides an opportunity to arrange attractive displays and encourage impulse buying. Some attractive displays are shown in Figure 188.

There are a number of Missouri producers who market their eggs directly to the consumers or to retail stores (Fig. 189). There are some definite advantages to direct marketing where conditions are conducive, especially when

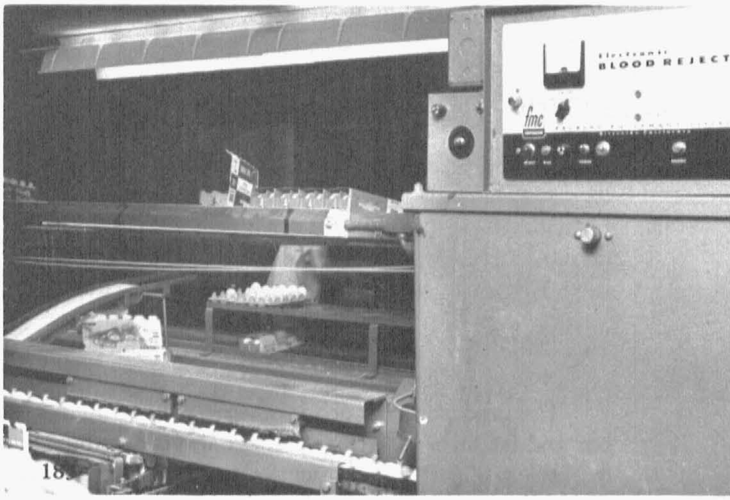

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Fig. 186—Modern shell egg processing plant where eggs are cleaned, candled, graded, and cartoned for distribution to retail stores.
Fig. 187—Trucks being loaded with graded shell eggs. Truck on left holds 700 thirty-dozen cases of shell eggs.
Fig. 188—Graded eggs cartoned and held in wire baskets for distribution to retail stores. This producer is also the egg processor (Bill Steinbrueck, Chesterfield).

Fig. 189—Van for delivering graded eggs from the farm to retail outlets in nearby towns.
Fig. 190—Eggs cartoned for sale under the producers own trade name.
Fig. 191—Cartoned eggs sold under a brand name (Ozark Daisies).
Fig. 192—Ozark home built by income from laying hens.

prices to the producers are depressed by an oversupply of eggs.

Those who sell directly to consumers often maintain the same price of eggs throughout the year. Consumers are willing to pay higher prices for eggs delivered to them by producers. They usually receive a high quality egg from an individual they know and trust. There is a personal relationship which is difficult, if not impossible, for a retail store to maintain with their customers (Figs. 190-191).

The producer must decide whether he can use his labor and facilities to better advanage in production or in marketing. The trend has been for fewer producers to engage in direct marketing. However, under some conditions, there are opportunities for producers to sell directly to consumers or to retail stores and realize a greater income than they could receive from production. Large producers, who can supply retail stores with graded and cartoned eggs throughout the year, find this a profitable way to market their eggs (Fig. 192-193).

The Use of Eggs

The egg of the domestic fowl, used throughout the world, is one of the most versatile of all human foods. It is also one of the most complete foods, providing all the nutrients needed for developing and sustaining perfect animal life (a newly hatched baby chick).

Essential Nutrients In Two Eggs
(without shell)
(108 grams*)

Protein, total	12.2 grams
Essential Amino Acids	
Arginine	.82 gram
Histidine	.33 gram
Isoleucine	.86 gram
Leucine	1.03 grams
Lysine	.84 gram
CALORIES	154 calories
Total carbohydrate	0.6 gram
MINERALS	
Calcium	52 milligrams*
Phosphorus	202 milligrams
Sodium	132 milligrams
Chlorine	148 milligrams
Potassium	152 milligrams
Sulfur	134 milligrams
Magnesium	54 milligrams
Iron	2.6 milligrams
Iodine	4-9 micrograms*
Manganese	4-18 micrograms*
Zinc	1 milligram
Molybdenum	present
Cobalt	present
Copper	0.3 milligram
Methionine	.41 gram
Phenylalanine	.66 gram
Threonine	.68 gram
Tryptophan	.24 gram
Valine	1.00 gram
FATS AND LIPIDS	11.0 grams
Unsaturated	
Fatty Acids	7.2 grams
Linoleic acid	2.4 grams
Linolenic acid	0.32 gram
Arachidonic acid	0.26 gram
VITAMINS	
Vitamin A	1100 I.U. **
Vitamin D	100 I.U. **
Vitamin E	2 milligrams
Vitamin K	present
B Vitamins	
Thiamine (Vitamin B_1)	0.1 milligram
Riboflavin (Vitamin B_2)	0.28 milligram

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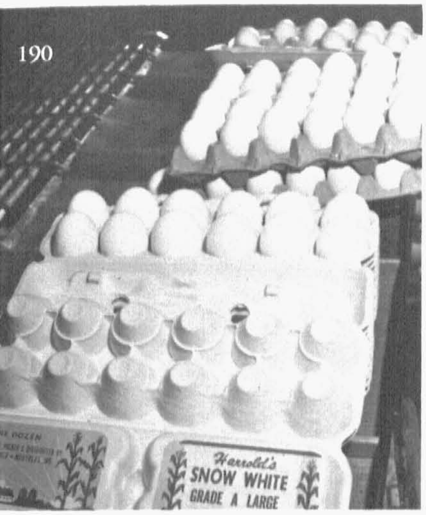

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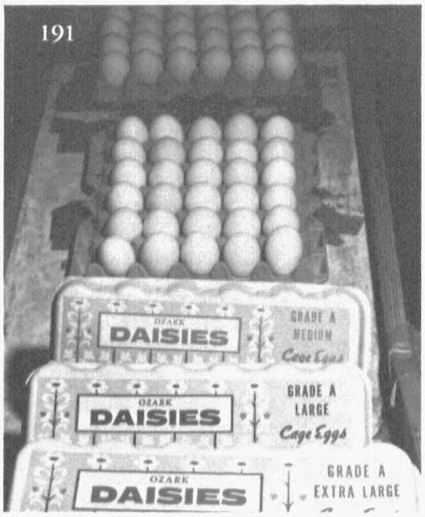

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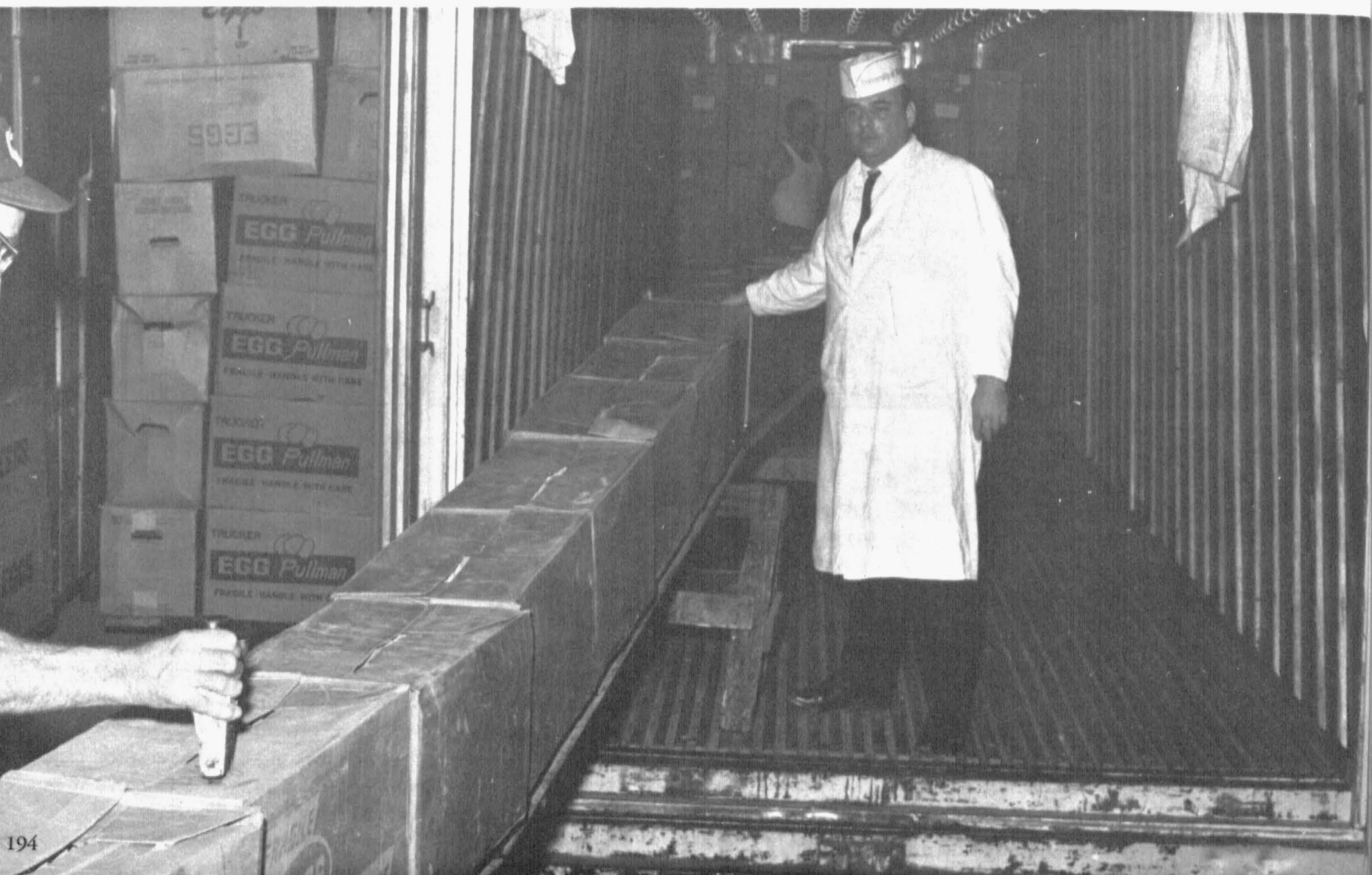
Pantothenic acid	1.6 milligrams
Choline	582 milligrams
Niacin	0.1 milligram
Vitamin B_6 (Pyridoxine)	120 micrograms
Folic acid	6 micrograms
Biotin	10 micrograms
Vitamin B_{12}	1 microgram
Inositol	22 milligrams
Unidentified growth factors	present
WATER	74 grams

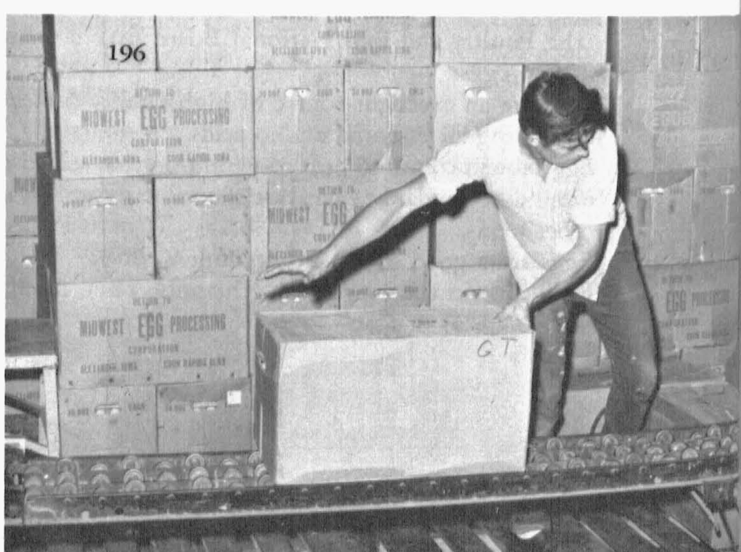
*There are 28.35 grams in 1 ounce, 1000 milligrams in 1 gram, and 1,000 micrograms in 1 milligram.
**International Units.

The Poultry and Egg National Board lists a dozen facts about eggs:

1. Eggs are an excellent source of high quality protein, containing all essential amino acids.
2. Egg protein comes so near to perfection that scientists use it as a standard to measure the value of protein in other foods.
3. Eggs are a good source of vitamin A.
4. Eggs contain the B vitamins, thiamine (B_1), riboflavin (B_2), and B_{12}.
5. Eggs are second only to fish liver oils as a natural source of vitamin D.
6. Eggs are one of the first solid foods recomended for infants (especially important because of the infant's need for iron not found in milk).
7. Eggs are easily and completely digested.
8. Eggs are excellent for children and teen-agers, providing stamina and helping to take care of body's food needs during periods of rapid growth.
9. Eggs are vital in daily meals of adults because of their food value, convenience, digestibility, and economy.
10. Eggs are important in reducing diets. They contain generous amount of protein and other essential nutrients with a modest number of calories (154 in the 2-egg serving).
11. Eggs are equally important for gaining weight. In addition to eggs as the main dish, they can also add a "plus" value to milk or fruit beverages; or they may be used hard-cooked as snacks and a "bonus food" with lunch and dinner.
12. In a nationwide survey conducted in 1958, eggs were ranked by homemakers as a "necessary food" by 94 percent, and as "high in protein" by 89 percent.

Fig. 193—Beautiful home in the Ozarks built by a market egg producer egg income.
Fig. 194—Unloading 30-dozen cases of shell eggs from a trailer-truck which transports about 20,000 dozen egg in each load.
Fig. 195—Moving 30-dozen cases of shell eggs on pallets by motor truck from truck into holding room.
Fig. 196—Moving eggs on roller-type conveyor into breaking plant.





The Egg Products Industry of Missouri

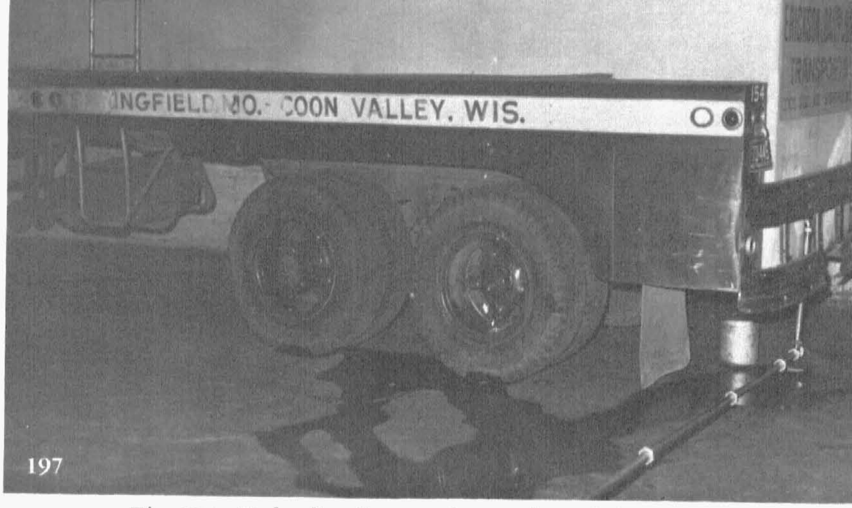


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Fig. 197—Unloading (by pumping) tank truck load of liquid egg into an egg drying plant.

This section describes the egg products industry of Missouri, as of 1966-67. Some reference is made to earlier practices for comparison with modern methods.

The value of egg products produced in Missouri in 1966, was approximately 40 million dollars. It is estimated that the plants located in Missouri produced 63,500,000 lbs. of liquid eggs valued at 20 million dollars and 14, 500,000 lbs of egg solids valued at 20 million dollars. There is some duplication in these figures since much of the liquid egg was dried. Missouri leads all other states by processing about 10 percent of the liquid eggs produced in the United States and about 30 percent of the egg solids. Egg processing has been an important part of the poultry industry of this state since the early 1900's. It expanded very greatly during World War II. After the war it declined to meet peace-time requirements, but has remained a relatively important part of the egg business.

Egg Solids Industry Started in St. Louis

The egg solids (dried egg) industry of the United States was started in St. Louis in 1878. Termohlen (1938) stated that the American Poultry Yard, Feb. 16, 1878, reported a St. Louis firm was transforming egg yolk and albumen, by a drying process, into a light brown, meal-like substance. W. O. Stoddard, an early inventor of machinery and processes for drying eggs, also operated an egg drying plant in St. Louis at about the same time. Koudele and Heinshohn (1964) reported that in 1961, there were 36 plants in the U.S. producing egg solids and nine of these were located in Missouri. The six top states were:

	No. plants
Missouri	9
Nebraska	6
Kansas	4
Iowa	3
Illinois	3
Texas	3

The egg solids industry of Missouri in 1967, was a multimillion dollar business employing several hundred people. The latest data available (1967) show that Missouri continues to be a leading producer of egg solids. Processors of egg solids, 1967 (from Who's Who in the Egg and Poultry Industries):

	No. plants
Missouri	7
Nebraska	4
Illinois	3
Kansas	3
Minnesota	2
Iowa	2
Washington	2

States with one plant each were Georgia, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, and Tennessee.

Historically the egg products industry was built on a surplus of eggs produced in the United States by farm flocks during the spring months (February through June) when eggs were relatively low in price. During this period, the yield was high and the quality good. Much of the industry still follows this pattern. However, new procurement programs based upon commercial production and year-around operation are developing. The industry has changed so that egg production and prices are less seasonal and the quality of eggs is consistently high.

Some processors have entered into contracts with commercial producers to take their entire output at a base price or on a contract price. Still others are starting their own egg production plants. How far egg processors will go into egg production remains to be seen, but the trend is in that direction. It may be many years before this will be the principal source of eggs for processing. Figures 194 to 196 show the movement of shell eggs into an egg breaking plant. Liquid egg is also moved by tank trucks, (35, 000 to 45,000 lbs.) from breaking plants to egg drying plants (Figs. 197 and 198).

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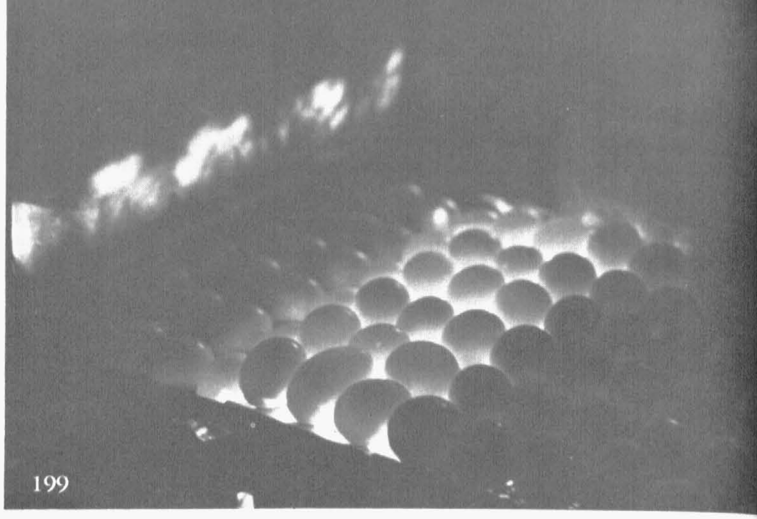

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Fig. 198—Pumping tank-truck load of liquid egg into holding tank.
Fig. 199—Candling to detect and remove eggs not satisfactory for processing.
Fig. 200—Eggs being conveyed to breaking machine after washing and sanitizing.

Egg processors are moving from seasonal to year-around operation. The shortage of seasonal labor and the regulations governing labor relationships, as well as overhead costs, have caused egg processors to change to year around production. This move to annual production has encouraged them to set up their own shell-egg production units so that they may have a more constant supply of high quality eggs.

Preparing Eggs for Breaking

USDA regulations (1967) require that only clean shell eggs may be broken for the production of liquid, frozen, or dried eggs in plants under USDA supervision. The public has become Salmonella conscious and the Food and Drug Administration have established strict regulations with respect to all food products including egg products. These programs are designed to give the consumer the most wholesome product industry can produce under government inspection and surveillance. It should be observed that this industry has, through the years, cooperated fully with regulatory agencies in programs for improving the quality of egg products.

Shell eggs, before being broken, are candled to remove undesirable eggs. The eggs are then cleaned by specially designed egg washing machines. The eggs are also treated with a sanitizer before being broken (Figs. 199 and 200). These eggs are then conveyed to an egg breaking machine where a stainless steel machine breaks and separates the egg into yolks and white without human hands touching the eggs. Such an operation produces egg products with a very low bacteria count.

Early egg breaking was a slow hand operation requiring much labor and time (Figs. 201 and 202). The quality of the shell eggs was poor and many eggs were discarded after breaking into cups by the breaker smelling the eggs for off-odors or by sight (blood or green whites, etc.).

Mechanical egg breaking machines came into commercial use about 1950. By 1962, 40 percent of the eggs processed were broken by machine. By 1967, most commercial egg processors were using machines almost exclusively. Before they were introduced, 100 or more women could be found breaking eggs in a single plant. Today one rarely finds more than 10 women operating 10 machines and breaking as many or more eggs than were broken by 100 women 15 years ago (Fig. 203-205).

Require Pasteurization

Effective July 1, 1966, the USDA required that all egg products produced under their supervision be pasteurized except dried whites which must be either pasteurized or heat treated and tested for Salmonella. This regulation required that liquid whole eggs be heated to not less than 140 degrees F. and held at that temperature for not less than 3½ minutes. All other egg products shall be heated to such temperatures and held for such times that will give equivalent effects and result in Salmonella negative egg products.

The necessity of producing only Salmonella negative products has not only resulted in pasteurization of these products, but it has upgraded all sanitary practices followed in producing egg products (Figs. 206-216). The Missouri Egg Products Industry compares favorably in sanitary practices with any other food industry in the United States.

An enormous amount of space is required to hold the shell eggs used for breaking, the liquid eggs produced,


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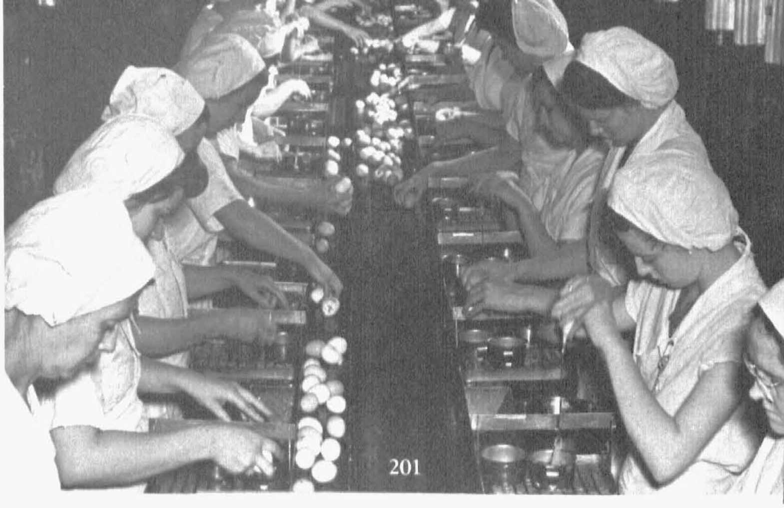
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Fig. 201—Breaking whole eggs by hand, 1946. (Courtesy G. Massie, State Department of Resources and Development)
Fig. 202—Hand breaking and separating eggs.
Fig. 203—Egg breaking machine. Note separation of yolks and whites.

Fig. 204—Battery (10) of egg breaking machines at Tranin Egg Products Co., Kansas City. Liquid goes in stainless steel pipes to holding vats.
Fig. 205—Egg breaking machines in operation at the Producers Produce Co., Springfield.


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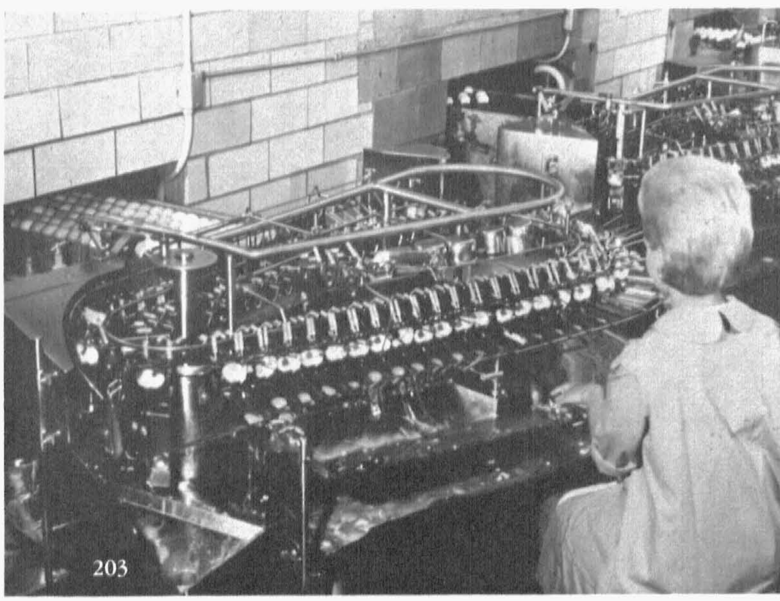
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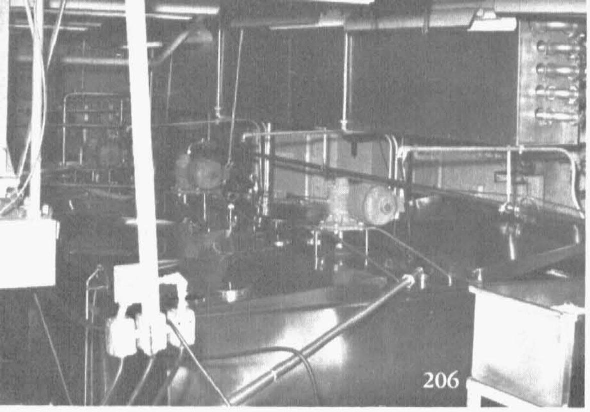
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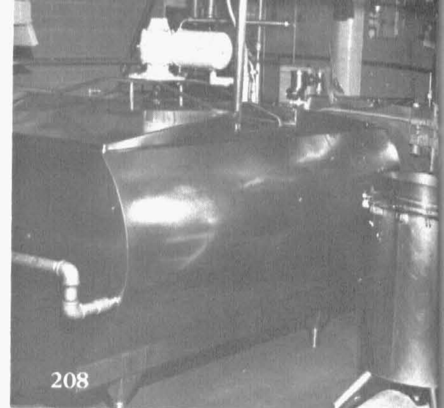
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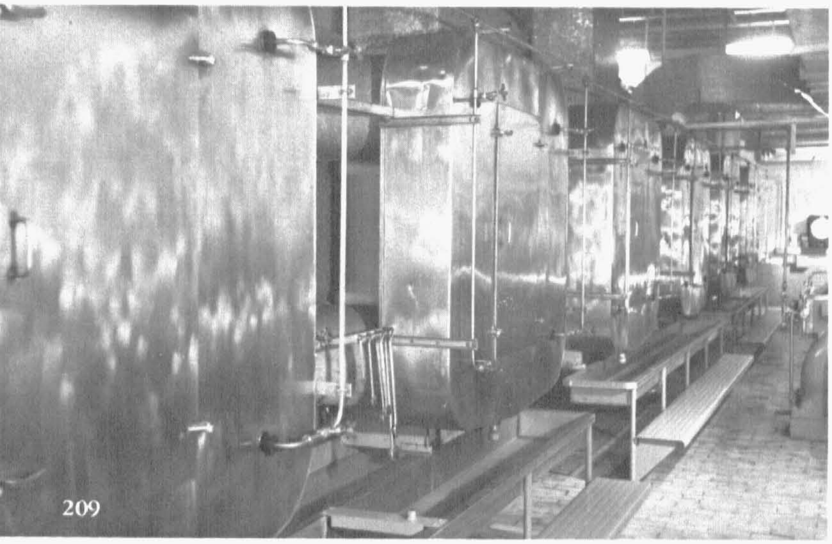
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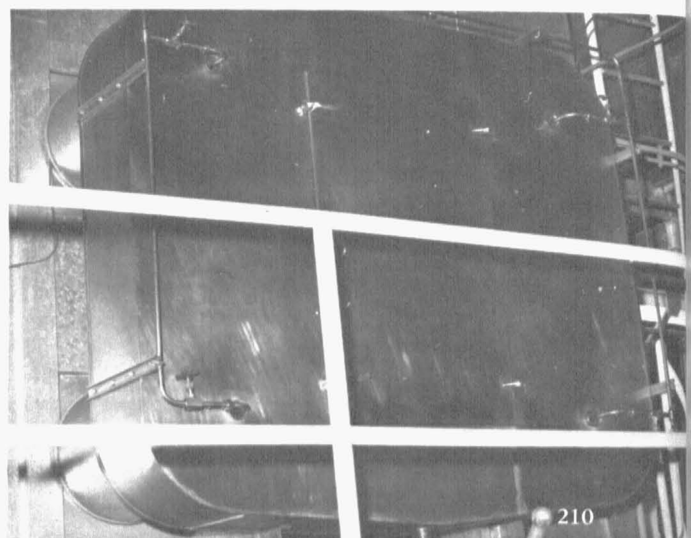
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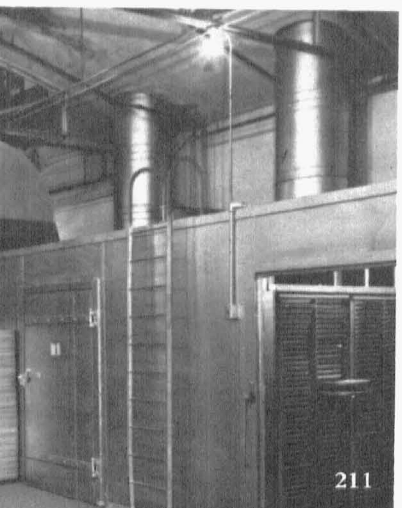
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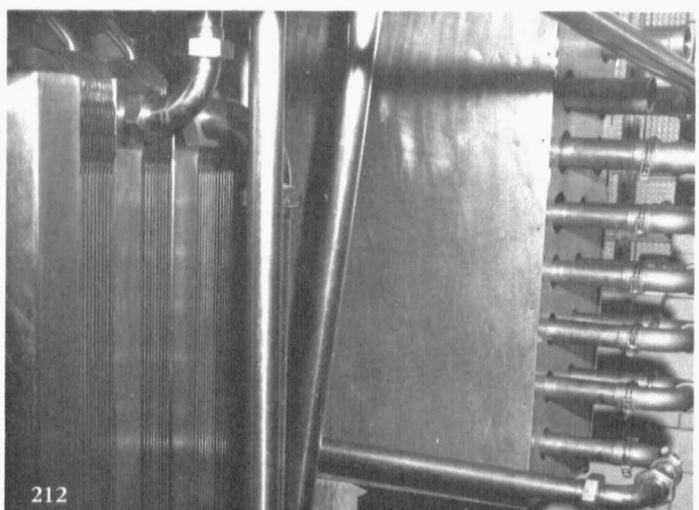
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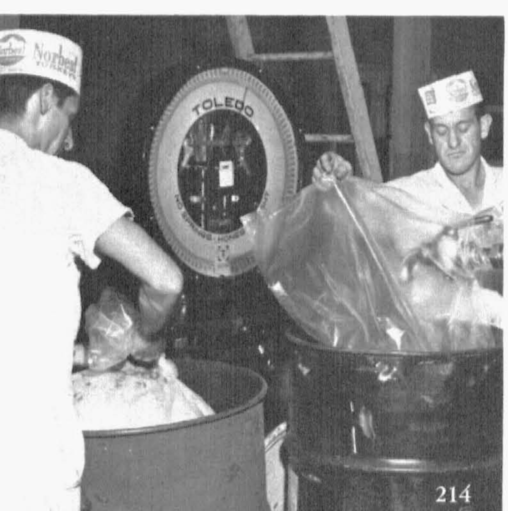

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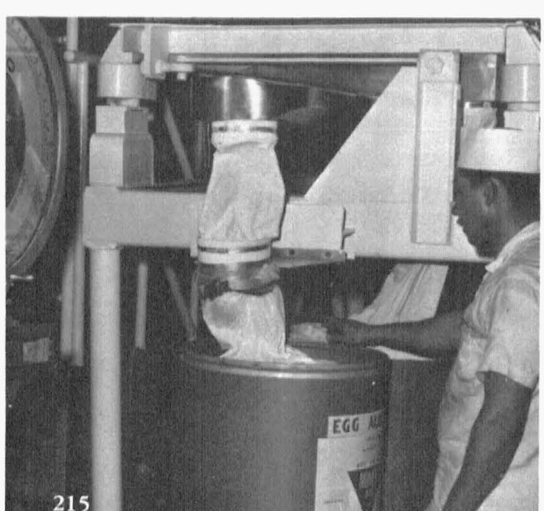
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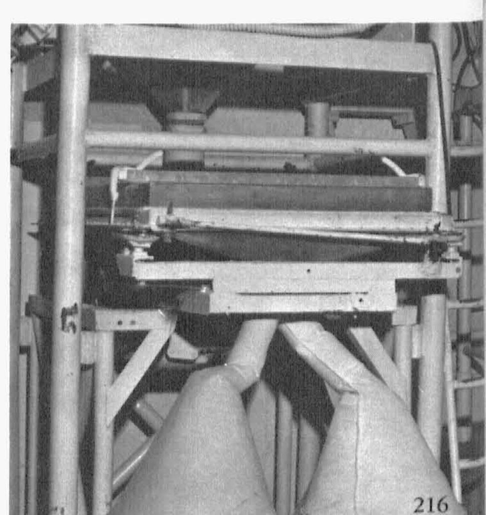
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Fig. 206—Stainless steel holding tanks for liquid egg and pasteurizer holding tubes in (upper right).
Fig. 207—Mixers and filters used for egg products before pumping holding tanks.
Fig. 208—Stainless steel holding tank, Producers Produce Co., Springfield.
Fig. 209—Rogers Spray Dryer used for drying egg whites.
Fig. 210—Air inlet plenum (top), ducts, and liquid feed lines to spray nozzles on Rogers Dryer.
Fig. 211—Pan drying of albumen. (Courtesy Tranin Egg Products Co., Kansas City).
Fig. 212—Plate pasteurizer (left) at Monarch Egg Corporation, Kansas City; holding tubes at right.
Fig. 213—Draining liquid egg from mixing tank into 30-pound can for freezing and distribution.
Fig. 214—Filling plastic lined barrels with liquid egg.
Fig. 215—Dehydrated egg albumen being packed in plastic lined fiberboard drums.
Fig. 216—Filling plastic lined fiberboard drums with dried egg albumen.
Fig. 217—Frozen eggs in 30-pound cans stored at Producers Produce Company.
Fig. 218—Frozen eggs stored in both metal and fiberboard containers.
Fig. 219—Dried eggs (yolks and whole eggs) stored in 50-pound cartons and 200-pound drums.
Fig. 220—Weighing albumen foam to determine specific gravity.


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and the frozen and dried eggs stored. It was estimated that Missouri, in 1966, produced 63,500,000 lbs. of liquid eggs which would be the equivalent of more than 2,000, 000 thirty-pound cans of eggs. Missouri's egg solids production for 1966 was estimated at 14,500,000 pounds or 72,500 drums (200 lbs.). One Missouri egg processing plant alone estimated their storage requirements for 1967 as follows: for shell eggs, 100,000 cu. ft., frozen eggs, 200, 000 cu. ft., and egg solids, 200,000 cu. ft. Frozen eggs are stored near -10 degrees F. Yolk and whole egg solids should be stored at 40 degrees F. Egg white solids should be stored at room temperature.

A 30-dozen case of eggs may weigh up to 60 pounds, a can of frozen eggs 30 pounds, and a drum of egg solids may weigh 200 pounds. Thus, the manual labor required in handling these products is difficult and expensive.

The introduction of pallets in industry and the use of power lift trucks for handling these pallets and their loads has greatly reduced the hard manual labor required and decreased labor costs accordingly (Figs. 217-219).

Most of the commercial producers of egg products maintain control laboratories in their plants with trained technicians to check the quality of the product they are continually producing. These technicians determine the solids content, the total bacteria count, freedom from Salmonella, and the functional properties (cake making properties, etc.) of the products offered for sale (Fig. 220-223).


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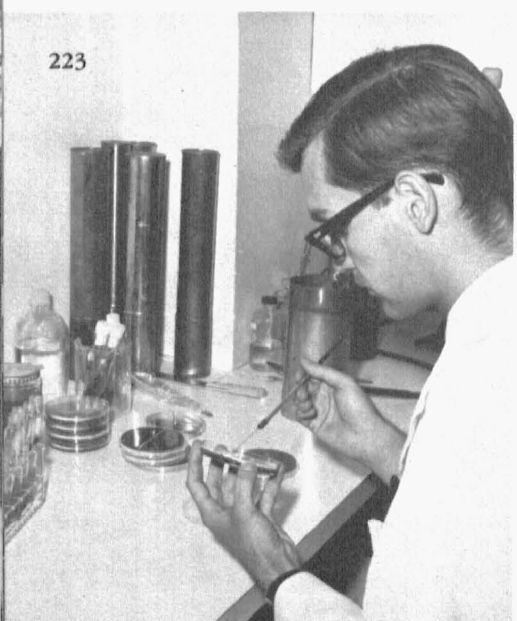
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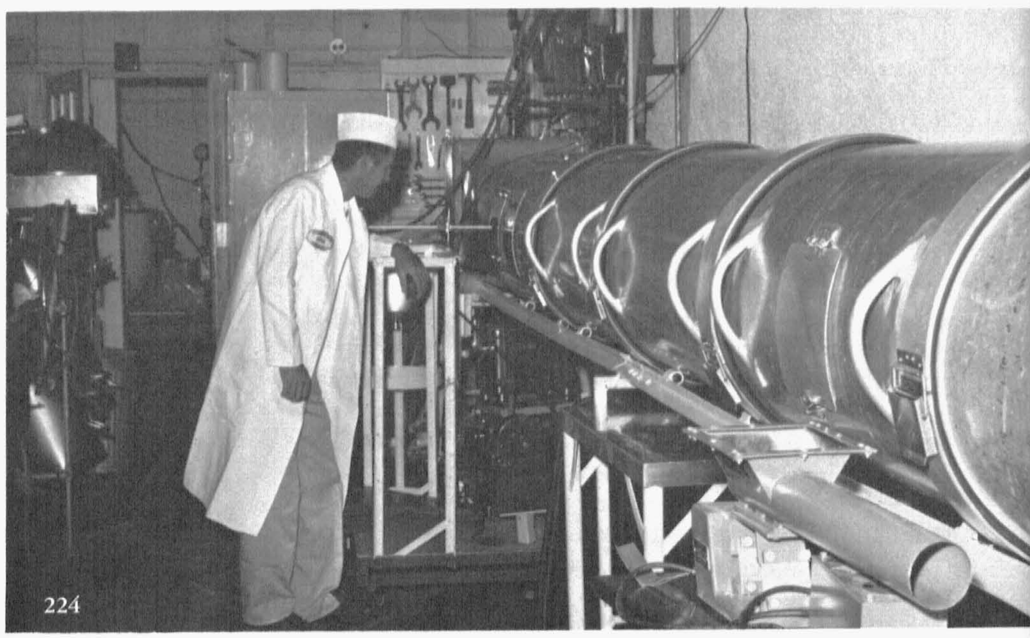
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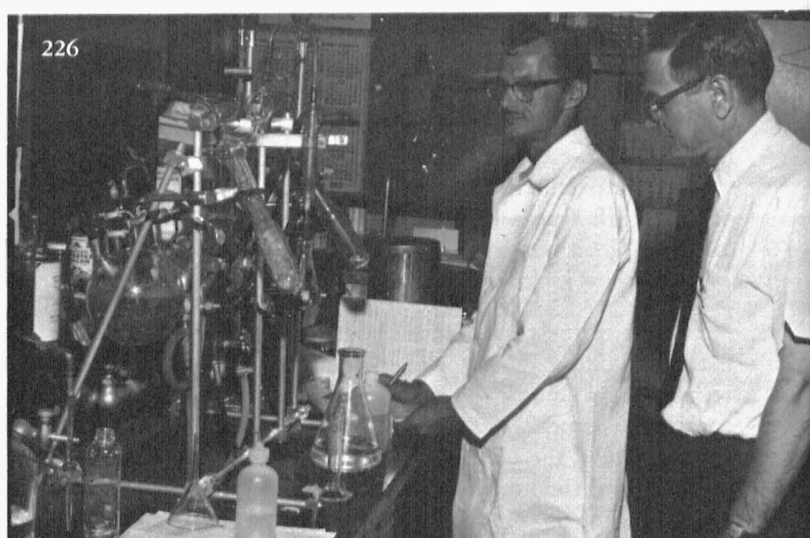
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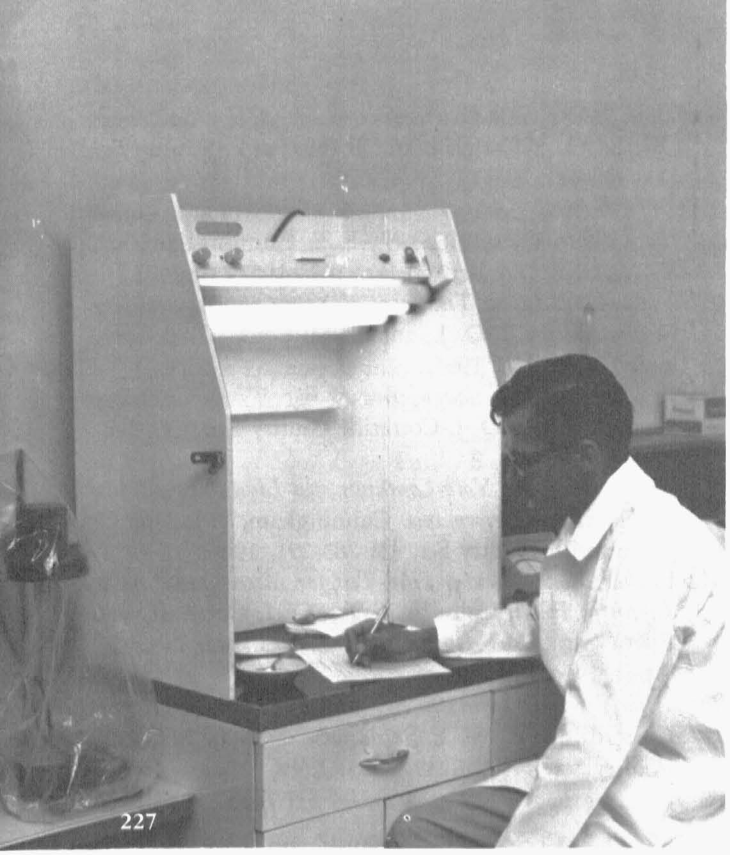
Fig. 221—Measuring volume of foam produced by egg albumen in a quality control laboratory.
Fig. 222—Preparing angel cake for evaluation in a quality control laboratory.
Fig. 223—Scene in quality control laboratory.
Fig. 224—Experimental egg drier, Henningsen Foods, Inc., Springfield.
Fig. 225—Bacteriology laboratory used in developing new products and new uses for egg products.
Fig. 226—Chemical laboratory used in developing new egg products.
Fig. 227—Specially lighted booth for taste panel evaluation of egg products.
Fig. 228—Instant dried egg albumen, right, developed by Henningsen Foods, Inc.
Fig. 229—USDA inspector drilling frozen eggs to examine for odor and other characteristics.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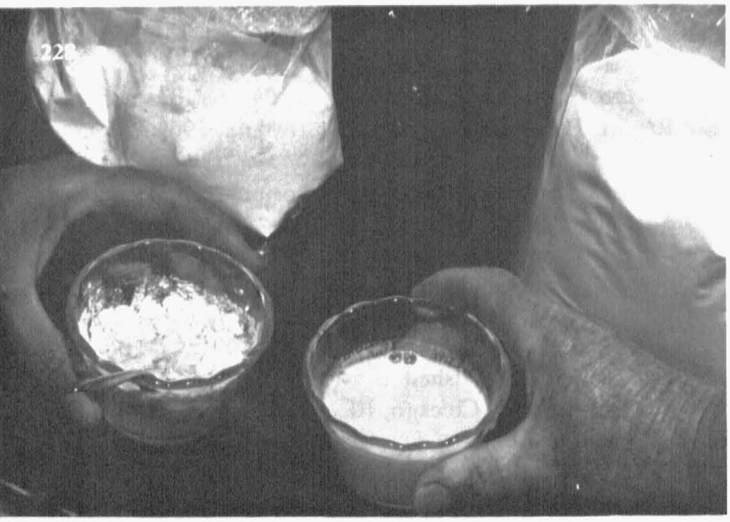
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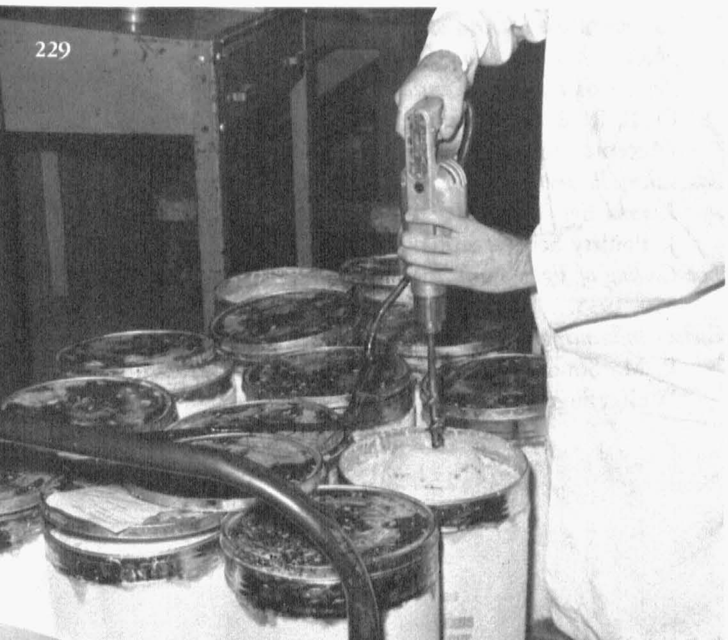
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The egg products produced in a plant under USDA supervision must meet not only the specifications of the purchaser, but they must also meet the standards of the U.S. Department of Agriculture and the Food and Drug Administration.

Commercial producers of egg products are interested in expanding their markets by developing new products and new uses for egg products (Figs. 224-229).

Develop Instant Albumen

A significant breakthrough in new egg products occured in the recent development of an instant egg albumen by a Missouri Laboratory (Central Laboratories, Henningsen Foods, Inc.). Such laboratories employ highly trained and experienced food scientists with basic training in chemistry, bacteriology, and engineering.

The egg processors who produce egg products under USDA supervision utilize the services of Federal-State Egg Products Inspectors. The Agricultural Marketing Act of 1946, provided for such service on a fee basis. Products produced in such plants carry the USDA shield stating "USDA Inspected Egg Products processed under supervision of a USDA licensed inspector."

The Federal-State inspector supervises the plant operations that pertain to the production of a sanitary and wholesome food product (Fig. 229).

Most of the basic research on egg products has been done in the state and federal laboratories. However, the larger commercial firms are establishing well equipped laboratories staffed with highly trained personnel that are capable of both basic and applied research. These laboratories may be expected to make many significant contributions in the future.

Publication of UMC Poultry Research

The department of poultry husbandry of the University of Missouri - Columbia has a long history of research with market eggs and egg products. The following publications in these fields have been issued:

Retarding Thick White Deterioration by Holding Shell Eggs in Sealed Containers. Cotterill, O. J., and F. A. Gardner. Poultry Sci. 36:196-205, 1957.

Relationship Between Temperature and Carbon Dioxide Loss From Shell Egg. Cotterill, O. J., F. A. Gardner, E. M Funk, and F. E. Cunningham. Poultry Sci. 37: 479-483, 1958.

Seasonal Variation in Egg Quality. Funk, E. M., G. Froning, R. Grotts, J. Forward, and O. J. Cotterill. Mo. Agri. Exp. Sta. Res. Bul. No. 529, Mar., 1958.

Titration Curves and Turbidity of Whole Egg White. Cotterill, O. J., F. A. Gardner, F. E. Cunningham, and E. M. Funk. Poultry Sci. 38: 836-842, 1959.

Micro-wave Heating for the Determination of Total Solids in Liquid Egg White. Cotterill, O. J., and I. Delaney. Food Technol. 13:476, 1959.

Farm Egg Coolers Produce "Sealed Container Effect". Cotterill, O. J. Poultry Processing and Marketing 65 (I): 18, 1959.

The Effect of Season and Age of Bird. I. On Egg Size, Quality, and Yield. Cunningham, F. E., O. J. Cotterill, and E. M. Funk. Poultry Sci. 39: 289-299, 1960.

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A Simple Procedure for the Estimation of Total Lipids in Liquid Egg White. Cotterill, O. J. Poulry Sci. 40: 1514-1517, 1961.

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Factors Affecting Heat Coagulation of Egg White. Cunningham, F. E., and O. J. Cotterill. Poulry Sci. 41: 1454-1461, 1962.

Importance of Egg Products in Egg Industry's Future. Cotterill, O. J. Missouri Poultry News, Vol. 15: 11, 1962.

A Study of Egg Composition in Relation to Quality and Utilization of Eggs in Market Channels. Cotterill, O. J. Mo. Agri. Exp. Sta. Spec. Rep. No. 33, July, 1963.

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Effect of Chemical Additives on Yolk Contaminated Liquid Egg White. Cotterill, O. J., F. E. Cunningham, and E. M. Funk. Poultry Sci. 42: 1049-1057, 1963.

Effect of pH and Lipase Treatment of Yolk-Contaminated Egg White. Cotterill, O. J., and E. M. Funk. Food Technol. 17: 103-108, 1963.

Factors Affecting Acid Coagulation of Egg White. Cunningham, F. E. and O. J. Cotterill. Poultry Sci. 43: 53-59. 1964.

Effect of Centrifuging Yolk-Contaminated Liquid Egg White on Functional Performance. Cunningham, F. E., and O. J. Cotterill. Poultry Sci. 43: 283-291, 1964.

A Modified Monomolecular Film Test for Micro-Quantities of Lipids in Foods. Colburn, J. T., O. J. Cotterill, and E. M. Funk. Mo. Agri. Exp. Sta. Res. Bul. No. 856, April, 1964.

Improving Yolk-Contaminated Egg White by Heat Treatments. Cotterill, O. J., W. E. Seideman, and E. M. Funk. Poultry Sci. 44: 228-235, 1965.

Spray-Drying Egg White at Various pH Levels. Hill, W. M., O. J. Cotterill, E. M. Funk, and R. E. Baldwin. Poultry Sci. 44: 1155-1163, 1965.

Salmonella Food Poisoning. Joule, T. L., and O. J. Cotterill. Leaflet. Univ. of Mo. Ext. Serv., 1965.

Egg Product Utilization. Cotterill, O. J., Poultry Research Report, Poultry Dept. Publ. No. 1, July, 1965.

Evaluation and Measurement of Quality of Poultry and Eggs. Cotterill, O. J. Food Quality Symposium. Am. Assoc. Adv. Sci. Pub. 77: 179-191, 1965.

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A Scientist Speaks about Egg Products. Cotterill, O. J. (Primary author). Published as a leaflet by Poultry and Egg Natl. Board, Chicago, Ill., 1967.

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High Temperature Storage of Egg White Powder. II. Electrophoretic Mobility, Conalbumin-Iron Complexing, Sulfhydryl Activity, and Evolution of Volatile Bases. Cotterill, O. J., R. E. Baldwin, and M. Meyers. Poultry Sci. (Accepted for publication).

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Factors Influencing Production of Clean Eggs. Funk, E. M., Sta. Bul. 384, 1937.

Improving the Keeping Quality of Eggs by Cleaning With Sodium Hydroxide. Funk, E. M. Res. Bul. 277, 1938.

The Profitable Utilization of Soiled Shell Eggs. Funk, E. M., Proc. 7th World's Poultry Congress and Exposition-492, 1939.

Improving the Keeping Quality and the Market Value of Eggs by Proper Cleaning. Funk, E. M., Sta. Bul. 394, 1938.

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Treating Shell Eggs to Maintain Quality. Funk, E. M. Sta. Bul. 659, 1955.

Egg Products Produced in Missouri

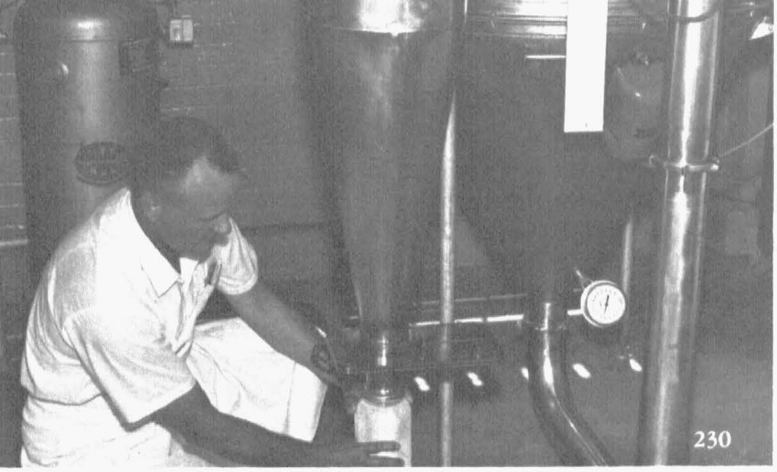
Missouri firms in 1967-68 were producing and distributing liquid, frozen, and dried products as listed in Table 6. These products are used by the baking industry, confectioners, and in many other food products (Table 7).

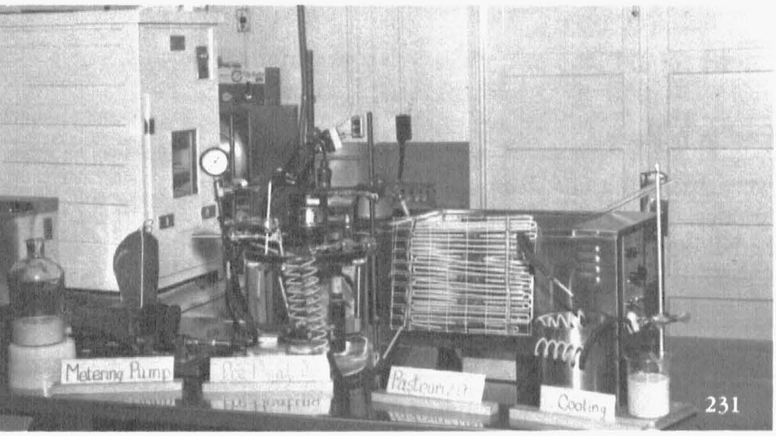
Table 6 EGG PRODUCTS PRODUCED BY MISSOURI FIRMS; 1967-68

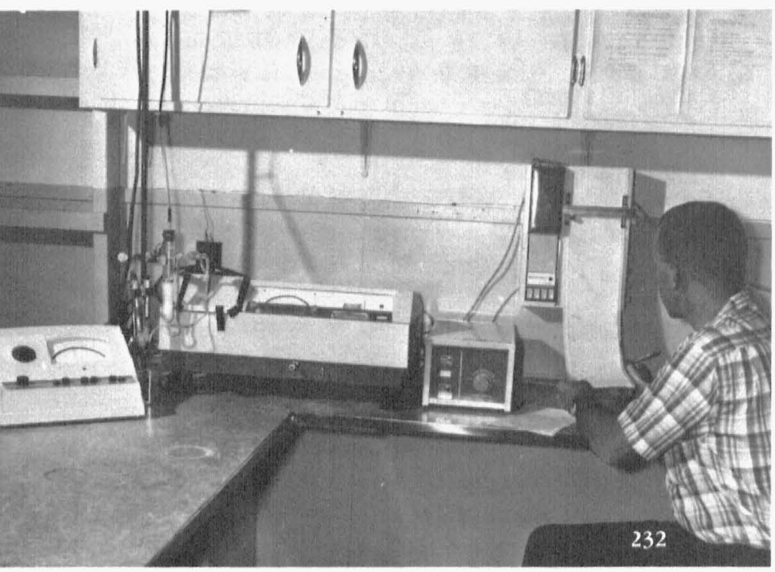
Fresh or liquid:
Liquid plain whole eggs
Liquid whole eggs fortified with yolks
Liquid sugared whole eggs
Liquid plain yolks
Liquid sugared yolks
Liquid egg whites
Liquid egg products
Frozen:
Frozen plain whole eggs
Frozen salted whole eggs
Frozen fortified whole eggs and stabilizer solids
Frozen plain yolks
Frozen sugared yolks
Frozen salted yolks
Frozen whites
Frozen egg products
Dried:
Dried plain whole eggs
Dried desugared whole eggs enzyme or yeast stabilizer
Dried sugared whole eggs
Dried whole eggs fortified with yolks
Dried fortified whole eggs and stabilizer solids
Dried plain yolks
Dried sugared yolks
Spray-dried albumen (Pwdrd)
Pan-dried albumen (Pwdrd)
Fluff-dried albumen
Dried egg products

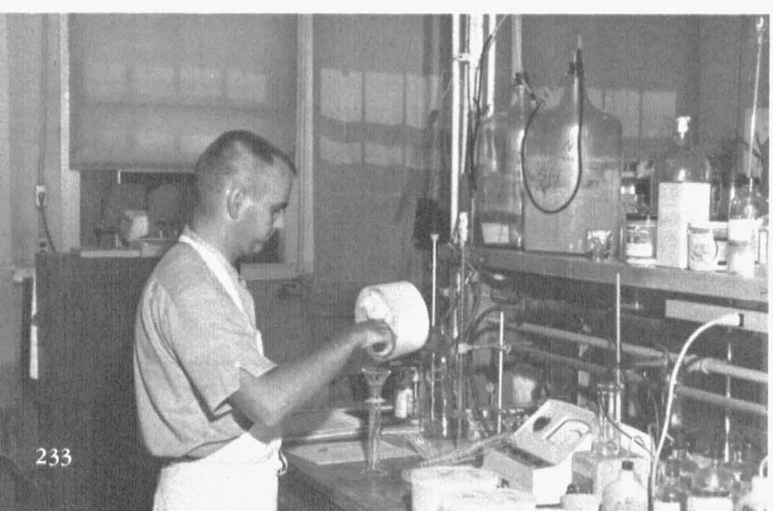
Table 7 FOOD PRODUCTS USING EGG PRODUCTS OR EGG SUBSTITUTES AS AN INGREDIENT (From USDA Marketing Research Report 608)

Baking Industry:
Bread
Rolls and buns
Sweet goods
Cakes (all types)
Layer-type cake
Sponge cake
Angelfood cake
Doughnuts
Puff pastry
Cookies
Fruit pies
Soft pies
Frozen pies
Frozen cakes
Frozen dough
Other frozen items
Other products
Icings
Confectioners:
Cream-filled chocolates
Nougats, nougatines
Marshmallows
Bar-type candy
Hard candy
Fudge, penuche
Hand-rolled creams
Kisses
Chocolate-coated candy
Jellies
Peanuts and roasted nuts
Coconut candies
Caramels
Coated nuts
Nut brittle
Gum
Other products









Egg Products Research at the University

Many academic disciplines are needed to conduct an egg products research program. The people who carry out the program must be trained in various sciences. Also, a suitable laboratory must be developed (see Fig. 230-233). Egg products research is a study of the chemical, physical, microbiological, and functional systems associated with the utilization of the egg as food. The primary emphasis is on the study of systems rather than a single scientific discipline or technique. This approach is necessary because of the nature of problems encountered. A process, such as egg pasteurization, must be accomplished so all pathogenic bacteria are destroyed and the many functional properties retained. There are advantages in conducting these studies simultaneously. As information is discovered about one phase, its influence can be applied to another.

The egg products program at the University of Missouri was developed along multi-disciplinary lines. Also, the work has concerned many aspects of production, processing, and product development or modification. An attempt has been made to understand the mechanisms involved as well as to observe changes due to processing. The following investigations have been conducted or are in progress:

The role of chemical additives in altering functional, chemical, and physical properties of egg white was the subject of a Ph.D. Dissertation by Fred Gardner. This work was initiated in 1956.

Most chemicals of a given type cause the same changes in an egg white system. The study indicated that the beneficial effects of an anionic detergent, such as sodium lauryl sulfate, results from a combined effect of protein complexing and reduction of surface tension. The role of triethyl citrate is much less understood. Later, Dr. Frank Cunningham found that TEC increased insolubilization of protein at the air-liquid interface of an egg white foam. While this work did not show all mechanisms involved, it did contribute to a clearer understanding of the role of additives in egg white.

Several investigations have been conducted on methods to improve egg white containing small amounts of yolk. These efforts furnished more information about methods already in use as well as showing additional techniques. These methods or conditions included chemical

Fig. 230—O. J. Cotterill removing egg white sample from collector of pilot model spray dryer.
Fig. 231—Laboratory model pasteurizer used in egg pasteurization research.
Fig. 232—Ion-exchange fractionation of egg yolk by Walter Seideman.
Fig. 233—Egg white foam stability tests in the University egg products laboratory.

additives (detergents and esters), lipase, pH, heat, centrifugation, and aeration. Only limited information is available on the use of these methods in combination with each other.

A pilot spray dryer is a vital component of an egg products research program. Without one, research and teaching are definitely limited. Obtaining a spray dryer without a sufficient budget was difficult. Several Missouri egg products companies contributed money to initiate construction. Dr. Dwight Bergquist's (Henningsen Foods, Inc.) advice and encouragement during planning and construction were valuable beyond estimation. This dryer will evaporate 25 lbs. of water per hour and can process a single experimental sample as small as 2 lbs. It has been used for studies on yolk-contaminated egg white, high temperature long time storage of egg white powder, egg white pH prior to drying, and changes in yolk fractions caused by drying. Further use of the dryer depends on the interests of graduate students. We would like to initiate work on the flavor of spray dried egg products. Also, it is hoped that a wet-collector can be installed on the dryer so products inoculated with Salmonella can be dried safely. In addition, many students have received classroom instruction on the design and operation of a spray dryer.

Several factors affecting the pasteurization efficiency of egg products were evaluated. Most attention has been given to pH. Egg white can vary easily between pH 8.0 and 9.3. The pH of the product is probably the singly most important variable which alters the temperature—time requirements for egg pasteurization. Actually, the pH of products should be specified for each pasteurization process (for example, pH 6.5-7.0 for the AL++++ process). Otherwise, the pasteurization conditions should be altered to meet the requirements of a specific pH. Salt is another important variable. The temperature (3-¾ minutes holding time) required to kill large inoculum levels of Salmonella in 10% salted yolk was found to be 156 degrees F. These and other data have been used by USDA to help establish minimum pasteurization requirements.

The percentage yield of liquid yolk and white, as well as the composition (particularly solids), has received considerable attention at the University of Missouri. If one wants to obtain maximum yolk yield with respect to case weight, then break the smaller eggs from older birds. The effects of season and breed of bird have also been studied.

Other studies in progress, of interest to the egg products industry, concern the fractionation of whole egg and yolk. Observations have been made on the physical, chemical, and functional properties of the various fractions. Fractionation by centrifugation can be used to improve heat damaged liquid whole egg. As of Sept. 1, 1967, this program was transferred to the newly formed Food Science and Nutrition Department.

Missouri Firms Producing Liquid And Frozen Eggs (1967)

KANSAS CITY

Monark Egg Corp., 601 E. 3rd St.
Tranin Egg Products Co., 500 E. 3rd St.

MARIONVILLE

Continental Foods Corp.

MARSHALL

Kraft Foods Co., 123 N. Miami

MONROE CITY

Henderson Produce Co., 315 Winter St.

NEOSHO

Kraft Foods Co.

ST. LOUIS

Greenlee Egg Products Co., 21 O'Fallon St.
Standard Brands, Inc., 8501 Page Blvd.

SHELBINA

M.F.A. Poultry and Egg Division

SPRINGFIELD

Producers Produce Co., 501 N. Main

Missouri Firms Producing Egg Solids (1967)

KANSAS CITY

Monark Egg Corp., 601 E. 3rd St.
Tranin Egg Products Co., 500 E. 3rd St.

MARIONVILLE

Continental Foods Corp.

MARSHALL

Kraft Foods Co., 123 N. Miami

SEDALIA

M.F.A. Poultry and Egg Division

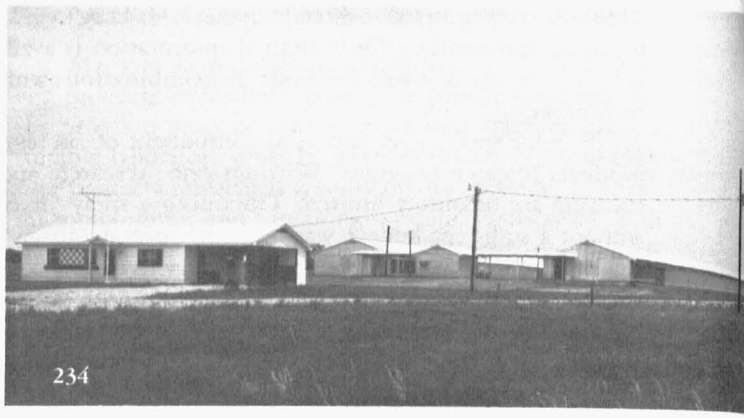
SPRINGFIELD

Henningsen Foods Inc., 2501 College

MONROE CITY

Henderson Produce Co., 315 Winter St.

Missouri's Broiler Industry



The broiler industry of Missouri has been declining in recent years, but in 1967, Missouri produced 20,867,000 broilers valued at $9,933,000 and ranked 17th in the nation In 1966, Missouri ranked 14th in the nation, producing 21,965,000 broilers. The industry is localized in Southwest Missouri epecially in McDonald, Barry, and Stone Counties; Stoddard County in Southeast Missouri; and in Miller and Osage Counties in Central Missouri. In these counties broilers are a major source of farm income.

The following photographs were made in those areas during 1968 to illustrate the latest facilities and practices.

In recent years there has been discussion in agricultural meetings of the advantages and disadvantages of integration. And, the broiler industry has been used by some speakers as an example of what other agricultural industries should avoid. The question of integration in the broiler industry is settled, it is an integrated industry. This method of doing business proved to be more efficient than other systems, and thus, in the competition that prevailed, integration won out in the broiler industry.

Most Efficient Meat Producers in World

It is true that integration has not solved the problems of price and the industry has suffered from low prices. However, consumers have been the beneficiaries of the most efficient meat producing industry in the world.

The turkey industry is following the path of integration blazed by the broiler industry and it is highly probable that the swine industry, as well as other agricultural industries, may ultimately imitate the integration that developed in the broiler industry. Competition will bring efficiencies and vertical integration may prove to be the most efficient and economical system for many other agricultural industries to follow.

Ninety-Five Percent Under Contract

It is estimated that in 1968, more than 95 percent of commercial broilers were grown under a contract arrangement. The independent grower has practically vanished due to economic conditions which have developed in the industry. Integration by one or a few firms has proved to be a more efficient and economical way of doing business than the many independent firms or middlemen that once prevailed. Essentially, integration has eliminated most middlemen, shortened the route from producer to consumer, and reduced the charges required under such a system of marketing.

There are many contracts in effect, but one contract used in McDonald County in 1968 provided that the grower furnish the building and equipment, labor, utilities, and water. The integrating firm provides the chicks, feed, litter, medicine, and supervision. The grower received 2¼ cents per pound for the meat (live weight).

Whatever the contract, it must return sufficient income to the grower to make this his best alternative for the use of his labor and facilities. Otherwise, the integrator cannot maintain or increase the volume of production needed by his firm. It is recognized that alternative opportunities for the use of buildings and equipment used in growing broilers are limited.

Small Number Primary Breeders

Remarkable progress has been made in breeding chickens for meat production (broilers). Competition among breeders has reduced the number of breeders of female lines and male lines in the United States to less than 10 of each. Most of these breeders have specialized on either a male or female line, developing lines that "nick" or combine well with other lines. However, some of the breeders have developed both male and female lines. Missouri broiler chicks are hatched from multiplier flocks (matings of males and females from primary breeders).

Improve Housing

Housing for breeding stock and growing broilers is continually being improved. Larger units with more insulation and permanent construction are now being used. The trend is toward controlled environment, where light, ventilation, temperature, and humidity can be controlled more accurately. Houses that provide controlled environ-

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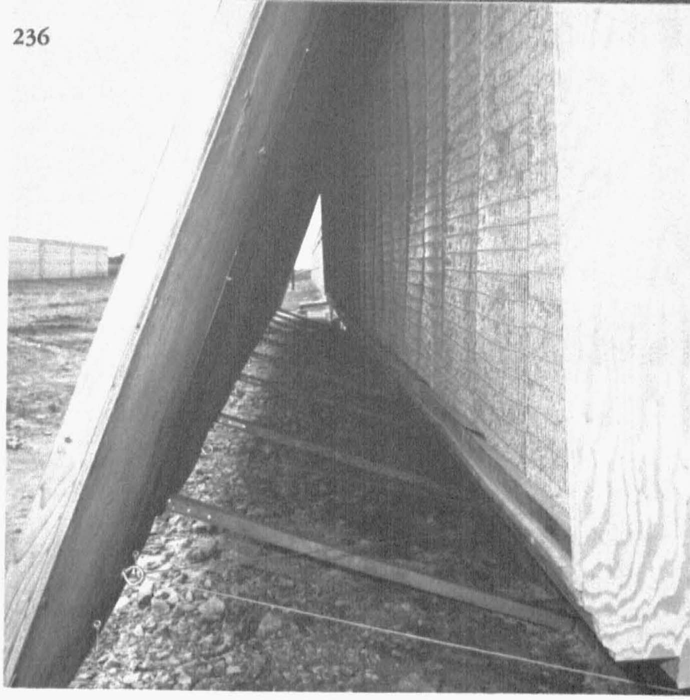

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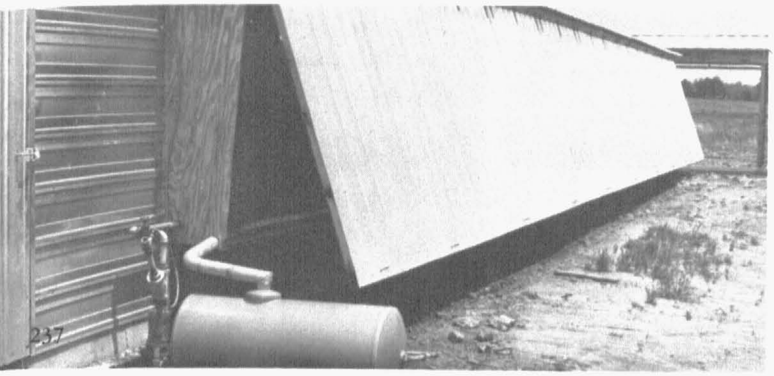

Fig. 234—Family farm set-up for producing broiler hatching eggs. Two houses (5000 breeder each) connected with an egg room.
Fig. 235—Environmentally controlled houses for broiler breeding stock. Bulk feed tanks and egg room are at end of driveway.
Fig. 236—Evaporative cooling pad used on houses for broiler breeding stock.
Fig. 237—Water system used to circulate water through cooling pad on broiler breeder house. Hinged hood can be closed in winter.
Fig. 238—Broiler breeding stock; Cornish type males x White Rock females.
Fig. 239—Close-up of broiler breeding stock at automatic feeders.

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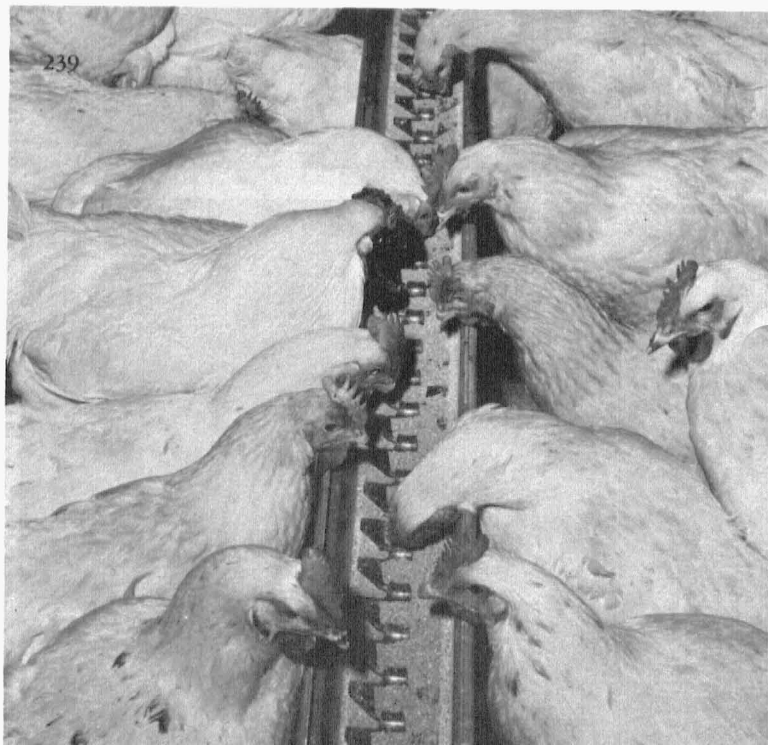

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ment are more expensive to construct, but those who use them are convinced that the added growth and profits more than pay for the extra investment.

"Family units," for producing broiler hatching eggs, have been built in Southwest Missouri (Fig. 234). These units provide a modern home for the breeding flock and two environmentally controlled houses, (5,000 breeders each). Controlled farms are kept under strict quarantine with all houses under lock and key (Fig. 235-244).

Modern buildings for broiler grow-out operations have been constructed in Missouri Figs. 256-261). Most of these houses are environmentally controlled (light, heat, ventilation, and humidity).

Hatcheries Specialize

Hatching chicks for broiler production has become specialized. Some hatcheries hatch only broiler-strain chicks, while others hatch only chicks for egg production (Figs. 245-255). Hatcheries are operated under sanitary conditions, producing only pullorum-typhoid clean chicks. Hatcheries producing broiler chicks are now trying to control respiratory disease by using hatching eggs from breeding stock tested or clean for Mycoplasma Gallisepticum. The hatchery must make every effort to control all egg borne diseases that affect the health of chicks.

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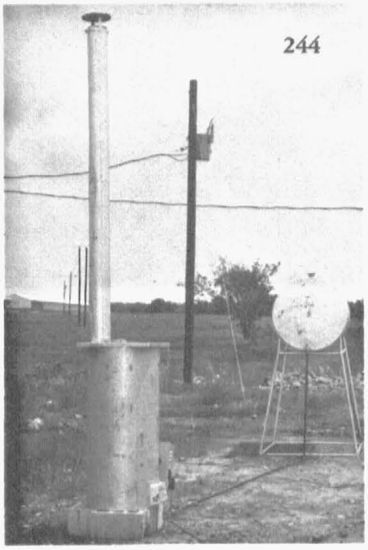
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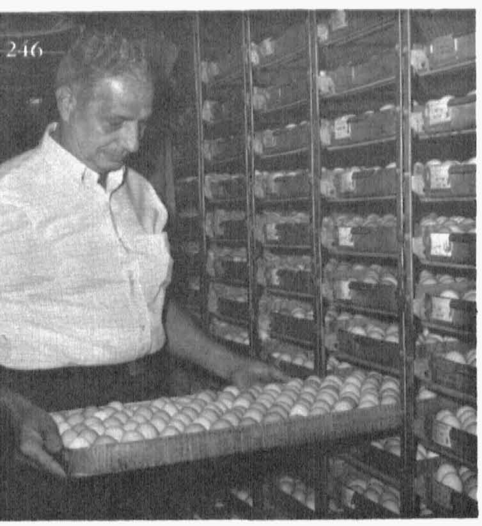
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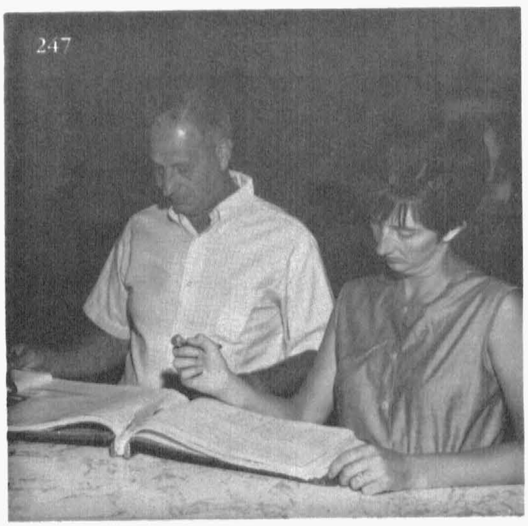
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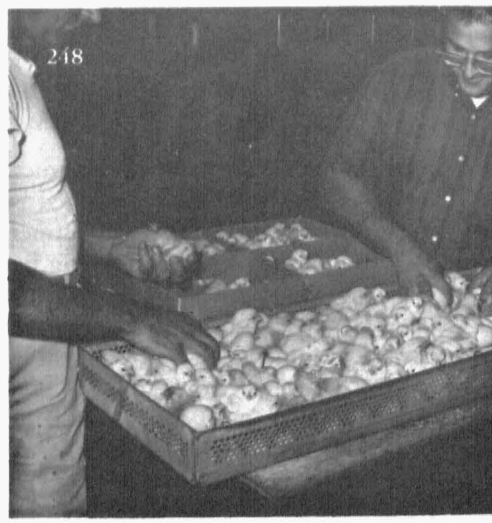
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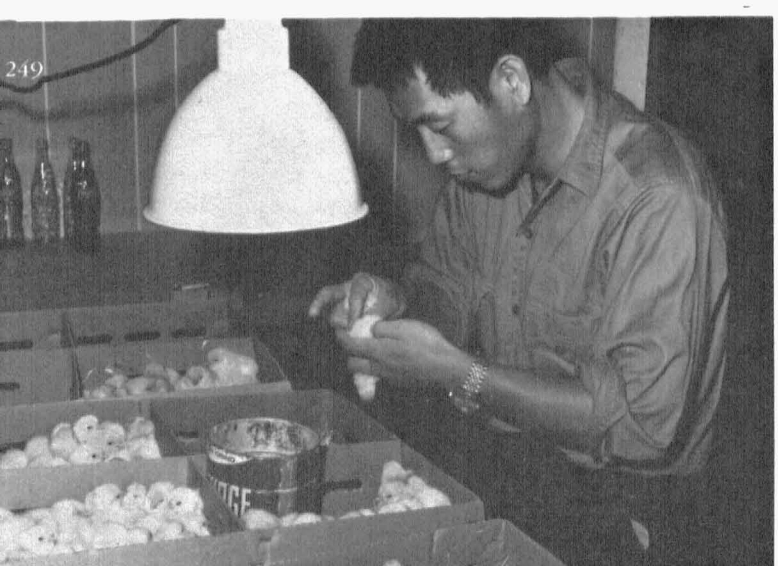
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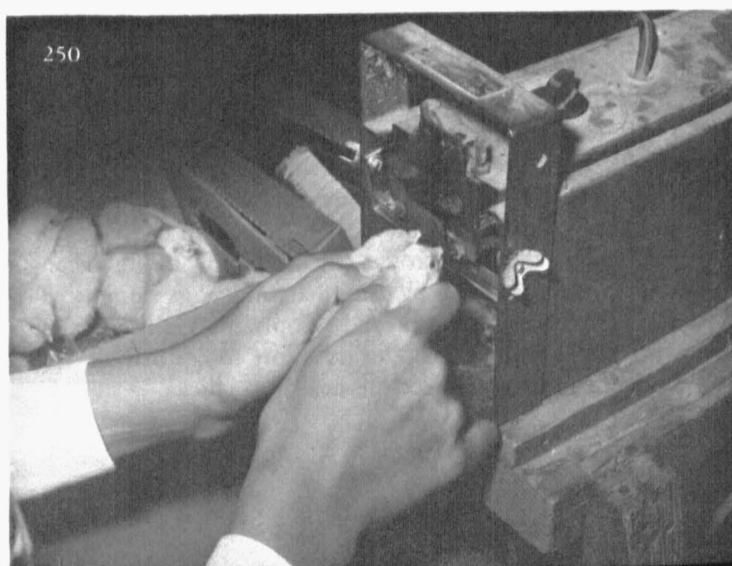
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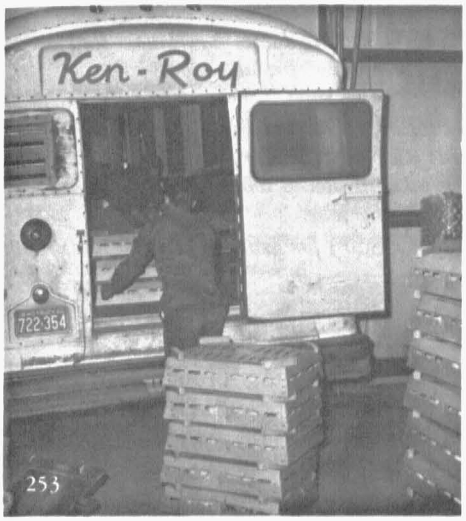


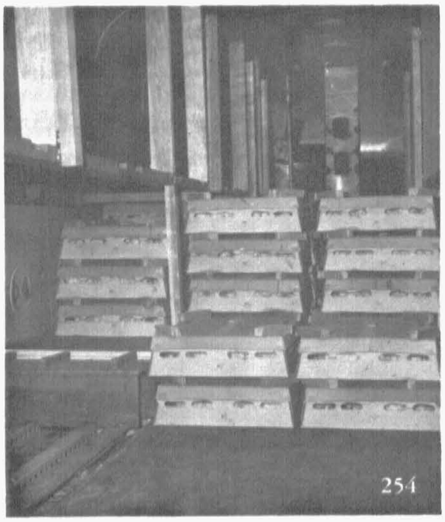
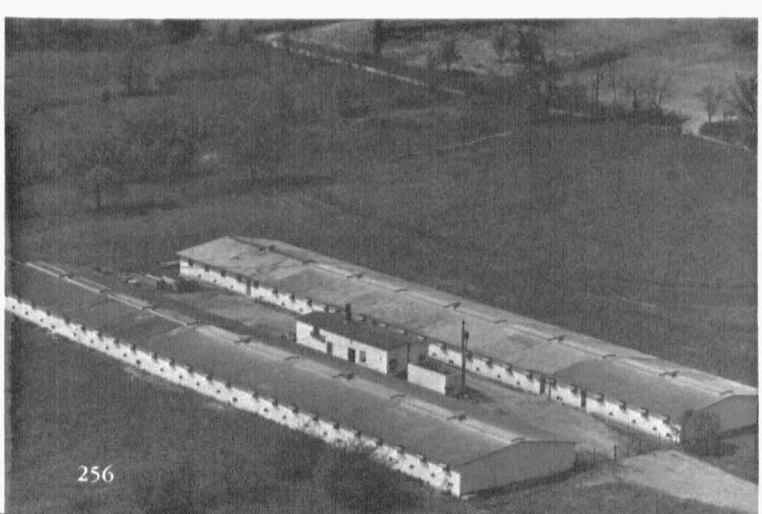


Fig. 240—Broiler breeding stock maintained under strict quarantine with all houses under lock and key.
Fig. 241—Gathering hatching eggs for broiler production.
Fig. 242—Moving hatching eggs from laying house to egg room. Soiled eggs are cleaned and eggs are held until sent to hatchery.
Fig. 243—Apparatus used for water medication and vaccination of broiler breeding stock.
Fig. 244—Oil burning incinerator in use on broiler breeder farm.
Fig. 245—Ken-Roy Hatchery, Berger, produces 80 to 90 thousand chicks weekly.
Fig. 246—Hatchery owner observes eggs being incubated to produce broiler chicks.
Fig. 247—Hatchery manager and secretary check orders for chicks.
Fig. 248—Selecting and boxing broiler chicks.
Fig. 249—Sexing broiler chicks, two at a time.
Fig. 250—Debeaking broiler chicks, two at a time.
Fig. 251—Broiler chicks boxed and ready for loading into vans.
Fig. 252—Chick vans used in delivering chicks.
Fig. 253—Loading chicks into chick van.
Fig. 254—Racks for stacking boxes five high in van that carries 40,000 chicks.
Fig. 255—Modern broiler hatchery operated under strict quarantine.
Fig. 256—Skyview of broiler grow-out facilities.
Fig. 257—New broiler house 32′ x 300′ for 12,500 day-old broiler chicks.



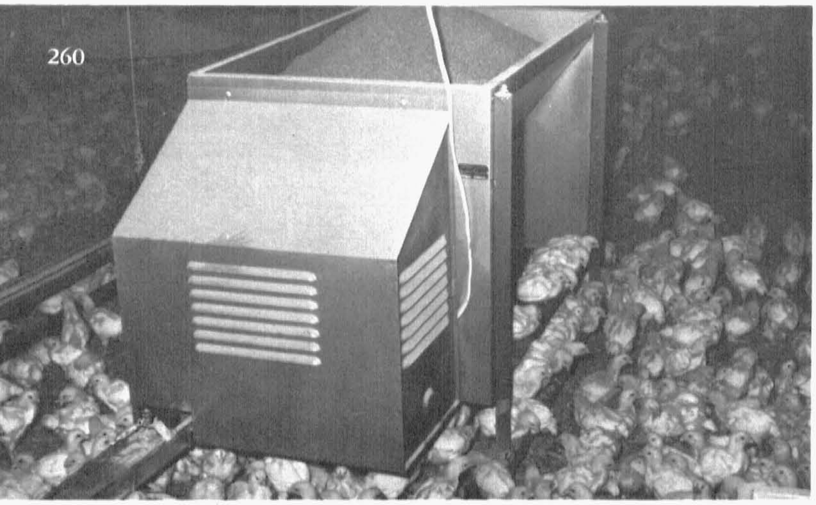


Fig. 258—Day-old chicks; paper beneath hover and shavings are used for litter.
Fig. 259—Starting day for 12,500 broiler chicks. Note plastic jar waterers and cut-down chick boxes for feeders for first few days. Gas-burning "Pancake" brooder stoves are used.
Fig. 260—Two-week old broiler chicks. Feed is augured from outside bulk tank into automatic feeder.
Fig. 261—Broilers being grown in houses where two broods of turkeys were started during the year.
Fig. 262—Brooder house (32' x 300') for growing 12,500 broilers.

The "pancake" type LP gas burning brooders are generally used for brooding broilers in Missouri (Fig. 262). Shavings are generally used for litter (Fig. 263), and the litter is changed after each brood. Cement floors are being built into the newer houses since frequent and thorough cleaning is becoming a requirement of most contractors.

Night lights, with an intensity of about one-foot candle power at the feeders, are generally used. The broilers are allowed 0.8 to 1.0 square foot per chick.

Chicks are taught to eat by making feed readily available on chick box lids or cut-down chick boxes. They are gradually shifted to regular feeders within 5 to 10 days.

Automatic feeders are generally used in new installations. Feed wastage is always a problem because feed is the major cost in producing broilers.

The integrator, who decides the rations to be used and the feeding program to be followed, supplies the feed in bulk trucks.

A coccidiostat is generally used in the feed to prevent coccidiosis.

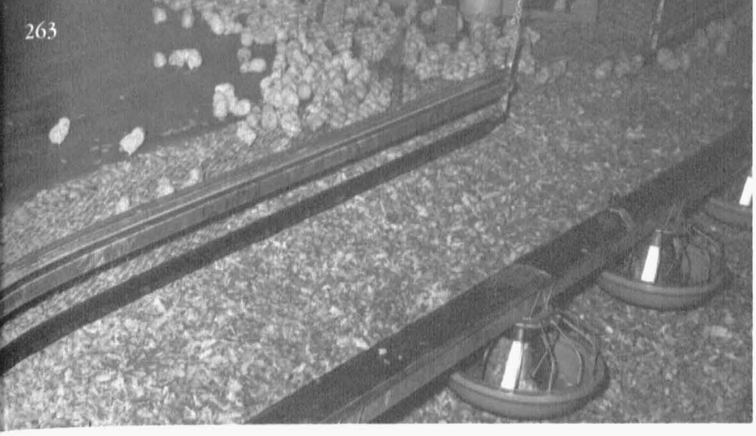
Guides to Broiler Management

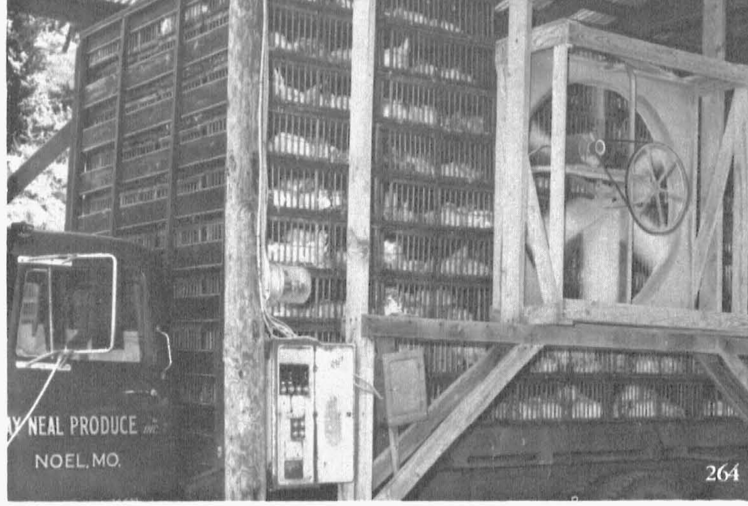
Efficient management is paramont in broiler production where profit margins are low. USDA Agriculture Handbook 320, "Commercial Broiler Production," lists the following guides to good broiler management:

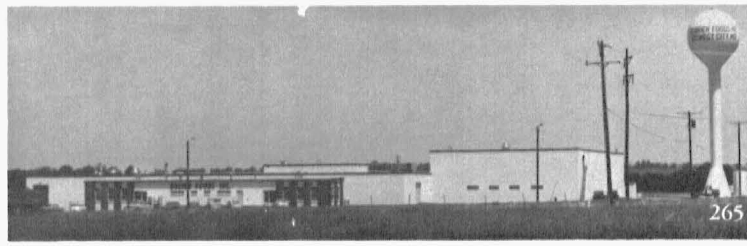
Family Unit Size: 45,000 broilers.

Labor: With automatic feeders, not over 18 minutes per 1,000 per day; without automatic equipment, not to exceed 31 minutes.

House-Unit Size: 7,200 to 20,000 per house; desirable







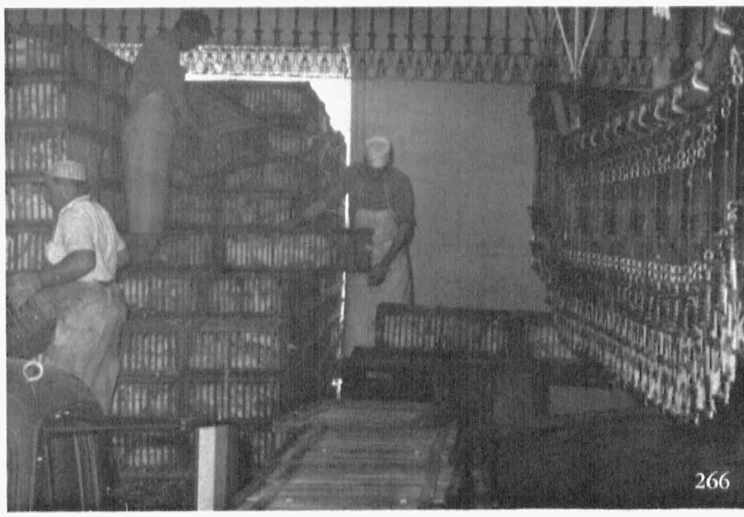


Fig. 263—Day-old broiler chicks. Automatic feeders and waterers will be used when chicks are trained to eat and drink at a few days old.
Fig. 264—Truck load of live broilers waiting to unload.
Fig. 265—O'Brien's Poultry Processing Plant, Southwest City
Fig. 266—Unloading coops of broilers onto conveyor that moves coops to the shackle line.
Fig. 267—Removing broilers from coops and hanging them on shackles.

size is 15,000 in 40- by 300-foot house.

Pen Size: 1,200 to 2,500 per pen.

Floor Space: 0.8 square foot per 3- to 3.75-pound broiler; 1 square foot for summer-reared and per 4-pound bird and over.

Brooder Space: 750 to 1,000 chicks per 1,000-chick size hover; varies with season, insulation, and mechanical ventilation.

Litter: 2 to 4 inches—less in hot weather.

Fountains: 1-gallon fountain per 100 chicks to two weeks old.

Water Space: Three 8-foot automatic waterers per 1,000 add one more per 1,000 birds when temperature is 90° F. or higher.

Feeder Lids: One feeder lid per 100 chicks.

Feeder Space: Allow fifteen 15-inch diameter 30-pound capacity hanging feeders per 1,000; allow 1 linear foot per 12 broilers for mechanical feeders.

Feedings: Follow directions of feed manufacturer or formulator.

Lights: After two weeks, use all-night lights; one 25-watt bulb per 100-square foot floor space.

Security Management: Follow good management practices as far as is economically feasible.

Marketing Broilers

Processing plants, operated by integrating firms, market most Missouri broilers. However, there are some independent broiler processing plants in the state. Recently, a modern broiler processing plant was built at Southwest City. The photos which follow (Fig. 264-283), were made in that plant. Photo captions tell the story of processing broilers in a modern plant.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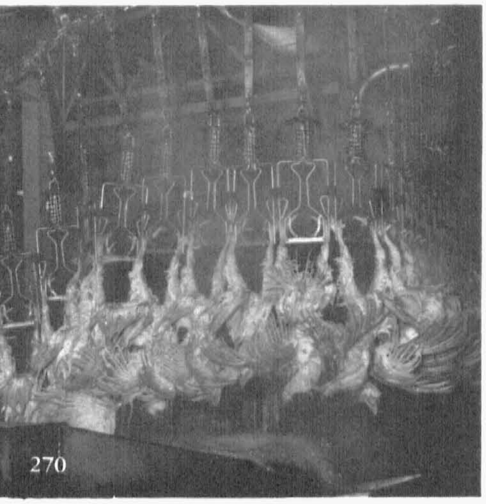
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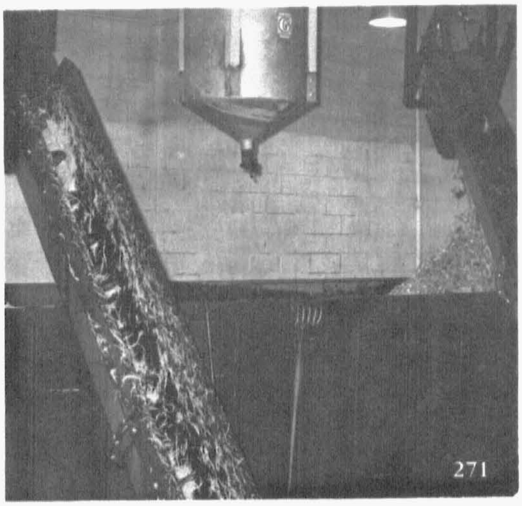
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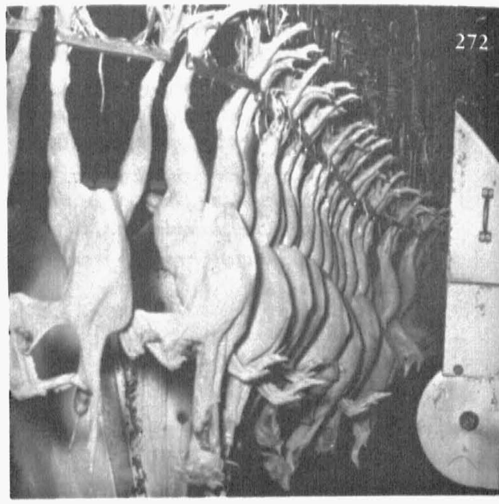
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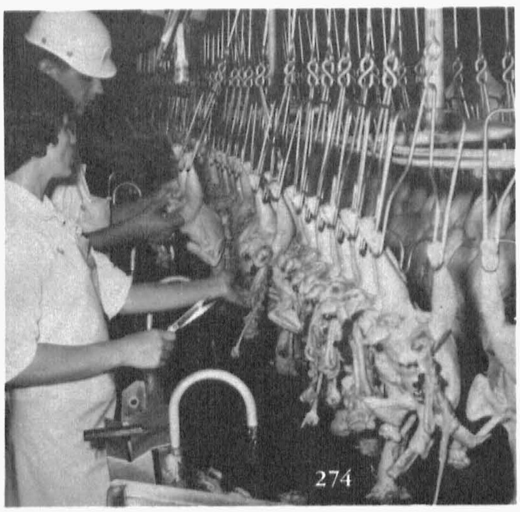
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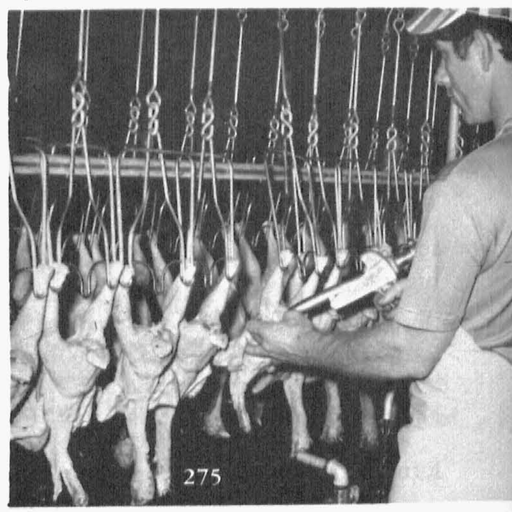
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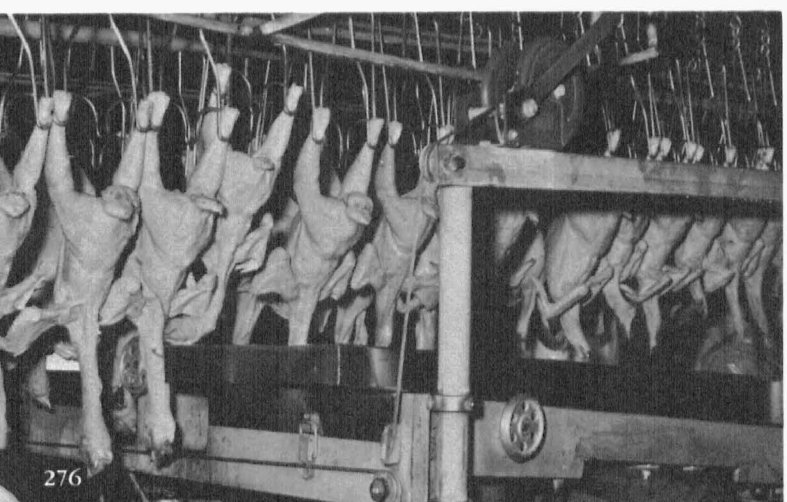
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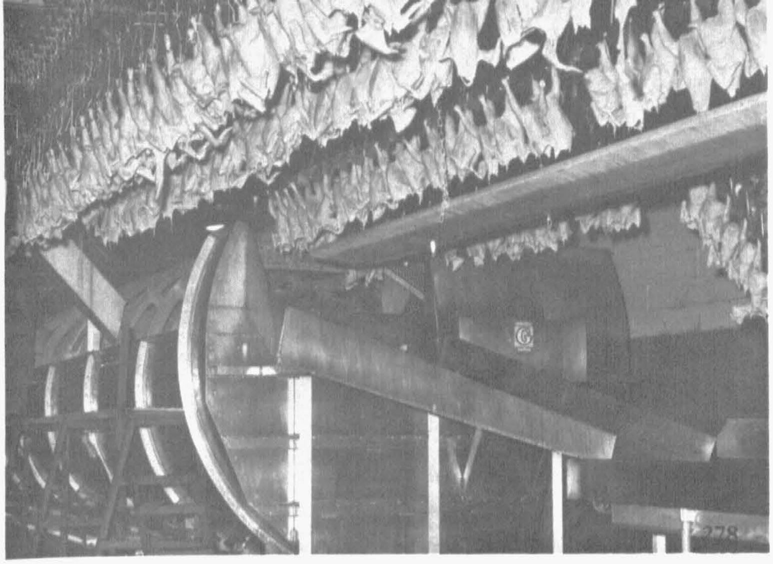


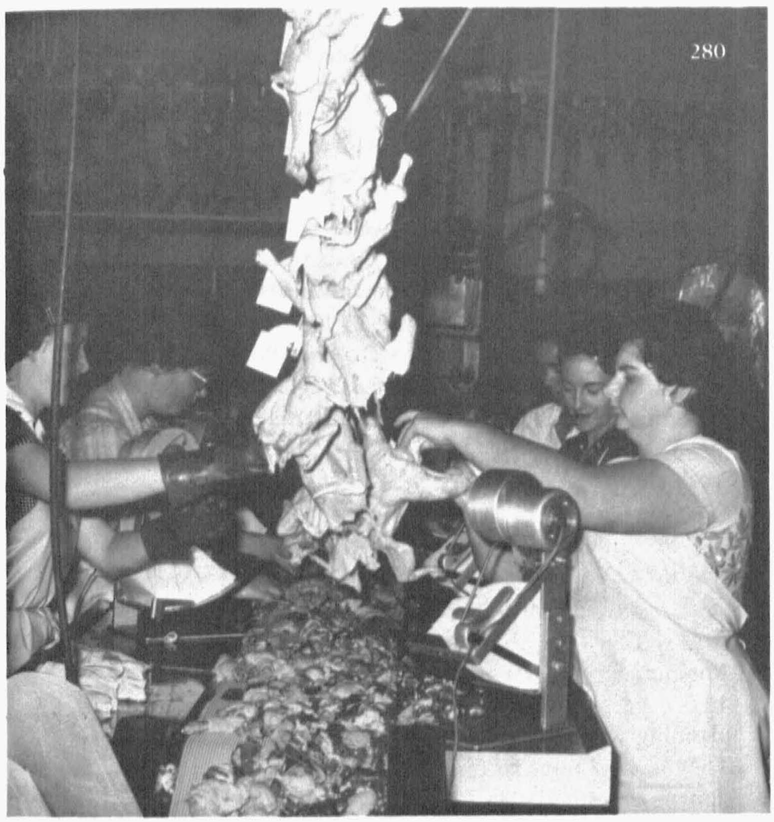
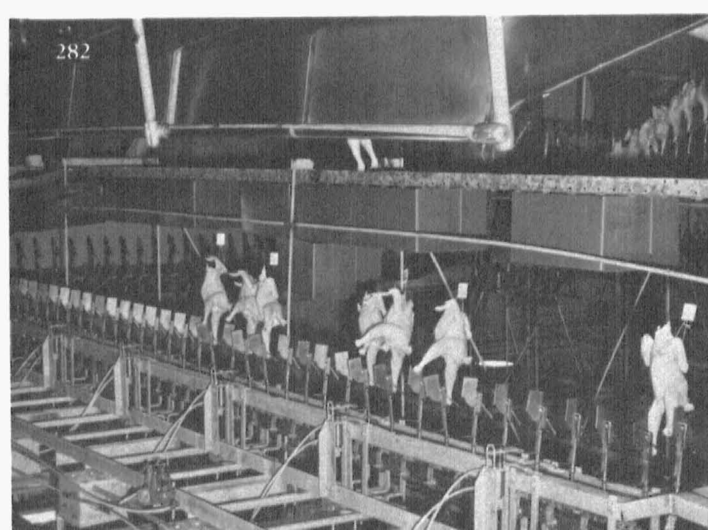
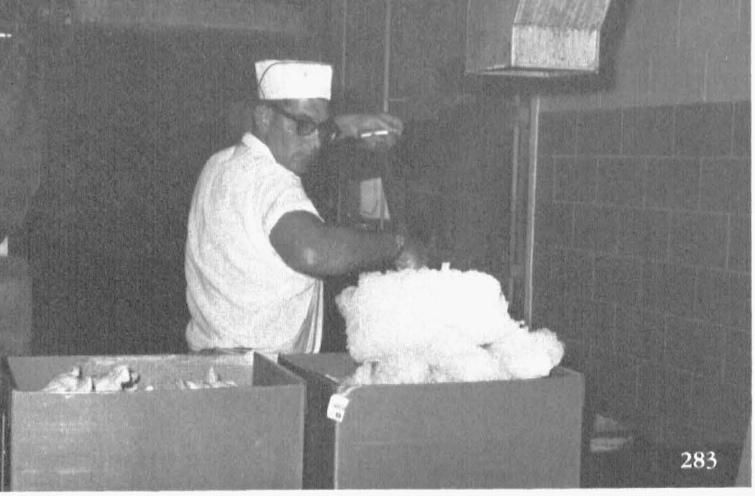


Fig. 268—Unloaded truck from Peterson, Decatur, Ark.
Fig. 269—Broilers throats are cut and bled birds, left, go on to the scalder.
Fig. 270—Broilers moving out of the scalder.
Fig. 271—Conveying feathers and offal into trunk for transportation to a by-products processing plant.
Fig. 272—Dressed broilers coming out of the picking machines.
Fig. 273—Opening the body cavity.
Fig. 274—Veterinary inspection of exposed viscera.
Fig. 275—Removing kidneys and lungs with suction pump.
Fig. 276—Head removing machine.
Fig. 277—Chilling tanks for cooling broilers.
Fig. 278—Broilers draining after being removed from the chilling tanks.
Fig. 279—Machine that slits, cleans, and removes the lining of gizzards.
Fig. 280—Wrapping giblets and inserting them into body cavity.
Fig. 281—Tagging broilers to show brand name and USDA grade.
Fig. 282—Broilers passing over a sizing machine where ***they trip a scale and are classified as to weight.***





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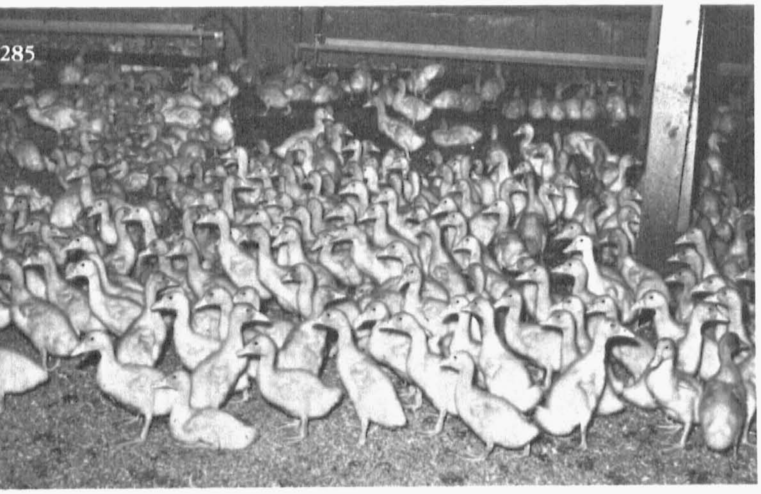

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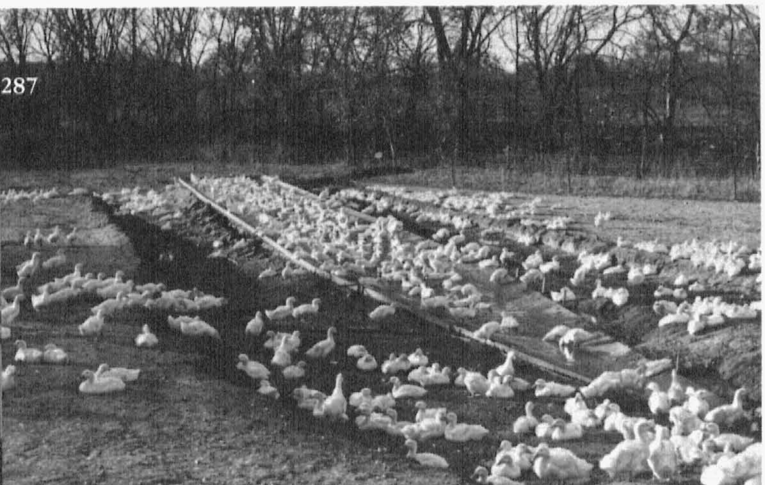

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Miscellaneous Poultry

The raising of miscellaneous poultry (waterfowl, pigeons, guineas, etc.) in Missouri, in 1969, is at a low ebb. Whether these species, which were once popular on Missouri farms, will ever become popular again is quite doubtful. Some commercial duck production may be developed.

Production of Waterfowl

The production of waterfowl in Missouri, once a sideline on most farms, is almost non existant. Missouri produced thousands of geese annually in the 1920's and 1930's. That type of production has disappeared. In 1959, Missouri farmers reported selling only 22,360 ducks and 16,676 geese. The Morrow Milling Co., Carthage, are planning to expand the production of ducks in that area. They have a 'pilot farm" where they have tested production methods and determined costs, and now plan to expand this phase of their business (See photos in Figs. 284-288).

More recently, a demand for geese to eat the weeds in cotton fields, nurseries, etc., revived an interest in geese as "weeders." However, the more general use of herbicides to control weeds in cultivated crops has now replaced geese as weeders.

The Heart of Missouri Poultry Farm, Columbia, developed one of the nation's largest (250,000 egg capacity) goose hatcheries when there was a heavy demand for weeder geese. They distributed goslings and started geese throughout the United States. They have maintained their hatchery by diversifying production to include ducks as well as geese (Figures 289-295). This hatchery sells day-

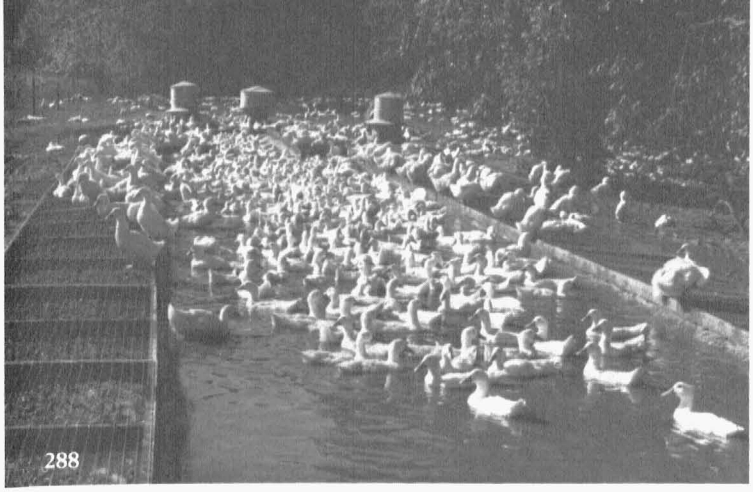

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Fig. 283—Icing box of packed fresh-killed broilers.
Fig. 284—White Pekin duck breeding stock. Shade and pool with running water are important for ducks.
Fig. 285—Two-week old ducklings in cool room after two weeks in brooder room.
Fig. 286—Market ducks in outside pens. Note self feeders for feeding pelleted feed.
Fig. 287—Ducks in pens where there is running water in concrete pools.
Fig. 288—White Pekin ducks being grown for market. They are supplied running water in plastic lined pool.
Fig. 289—Modern incubators used for hatching waterfowl.
Fig. 290—Newly hatched ducklings ready for shipment to their future home.
Fig. 291—White Chinese geese used as breeders to supply eggs for production of goslings.
Fig. 292—Thousands of goose eggs being incubated in a commercial hatchery.

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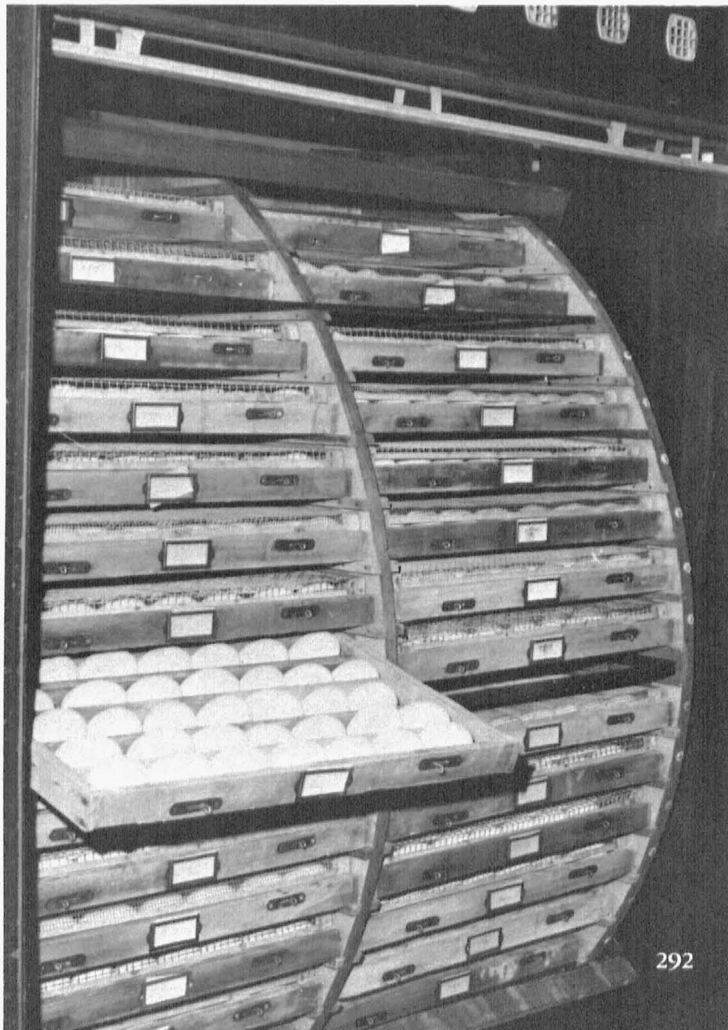

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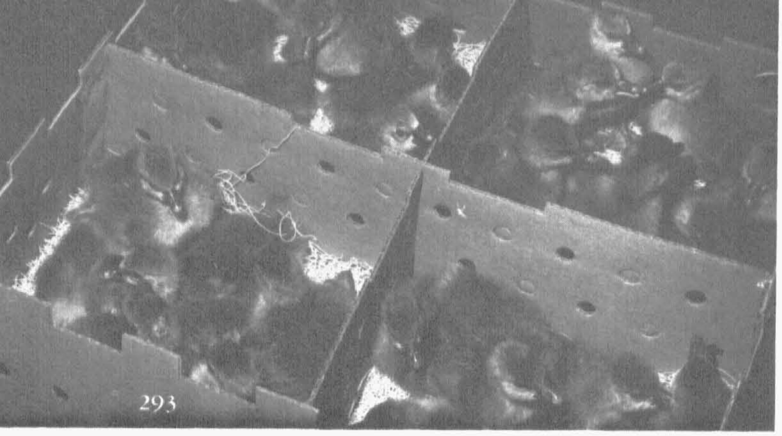


Fig. 293—Newly hatched Toulouse goslings boxed and ready for shipment to producers.
Fig. 294—Hatching ducklings (left) and goslings (right).
Fig. 295—Newly hatched Rouen ducklings ready for shipment.
Fig. 296—L. E. Hummel and his pigeon loft, Columbia. His 500 Swallow pigeons make the largest loft of Swallow pigeons in the world.
Fig. 297—Flock of Swallow breeding stock.

old and started goslings of the following breeds: Embden, Toulouse, African, White Chinese, and African x. W. Chinese. They ship goslings to customers throughout the nation.

Pigeons

More than 175 breeds are listed in pigeon books and there are 152 varieties of the Modena breed alone. Pigeons may be grouped in four classes: (1) Utility breeds for squab production; (2) Racing breeds; (3) Show type; and (4) The ornamental breeds. Squab production has declined in recent years, but the breeding and showing of fancy pigeons has maintained its interest (see Pigeon Encyclopedia by Levi).

Figure 296 shows a pigeon loft in Columbia, where Dr. L. E. Hummel maintains possibly the largest (500 adult pigeons) flock of Swallow pigeons in the world. Figure 297 shows some of the beautiful exhibition or fancy pigeons developed by pigeon breeders.

Guineas and Pheasants

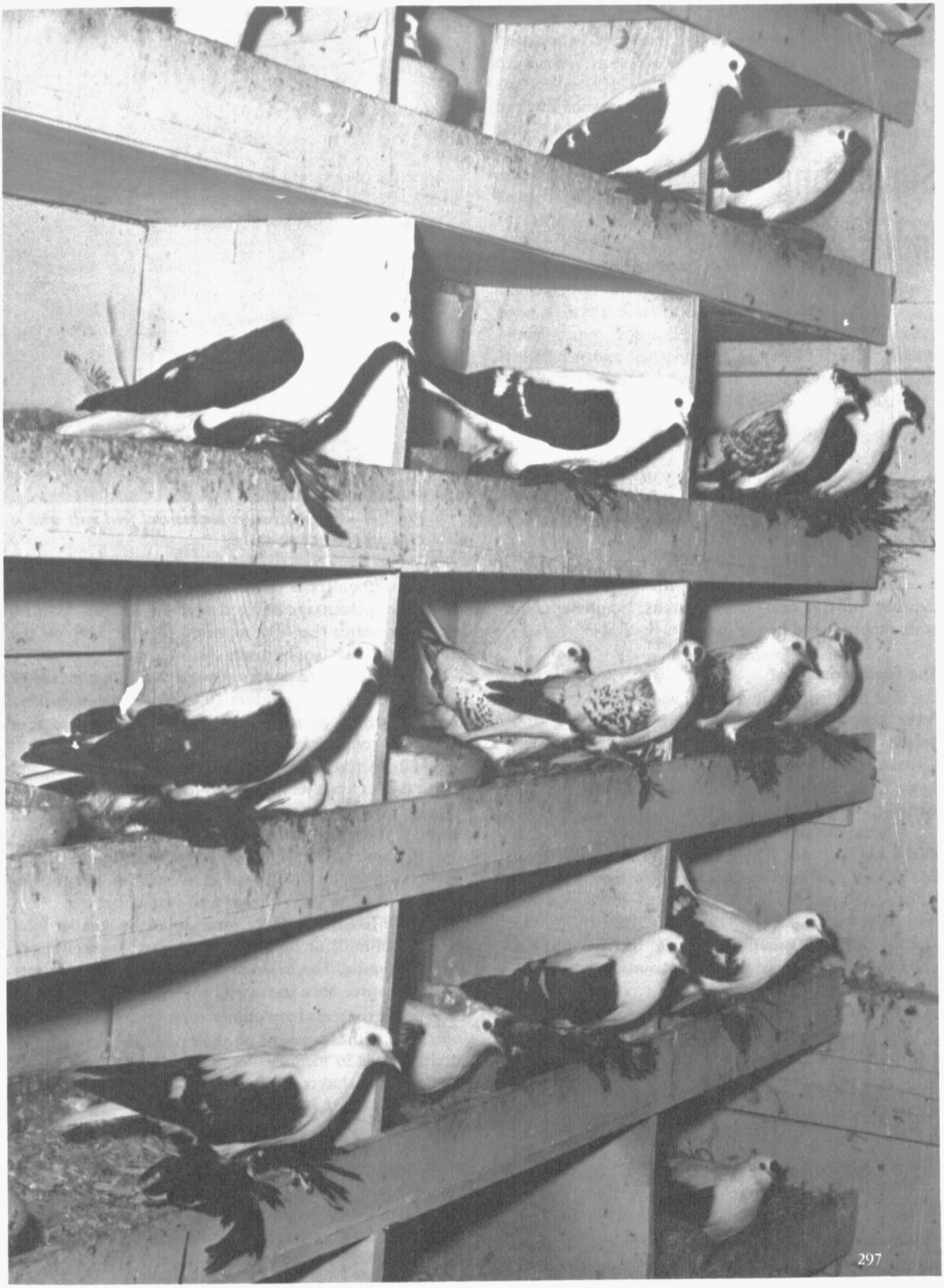
During the early part of the 20th Century, Missouri farmers produced thousands of guineas for shipment to the East.

Some Missouri firms have experimented with commercial production of pheasants, but these efforts have been abandoned because the pheasant could not compete with the chicken and turkey in producing meat for human consumption.

Production of Game Birds

In recent years there has been an increase in private hunting preserves. These farms are stocked with quail, pheasants, partridge, etc., that are raised on the preserve or purchased from game bird farms. Pheasants are the most popular game bird.

The State Conservation Commission can supply a list of licensed producers of game birds, and the names and addresses of hunting preserves.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Poultry Supporting Industries

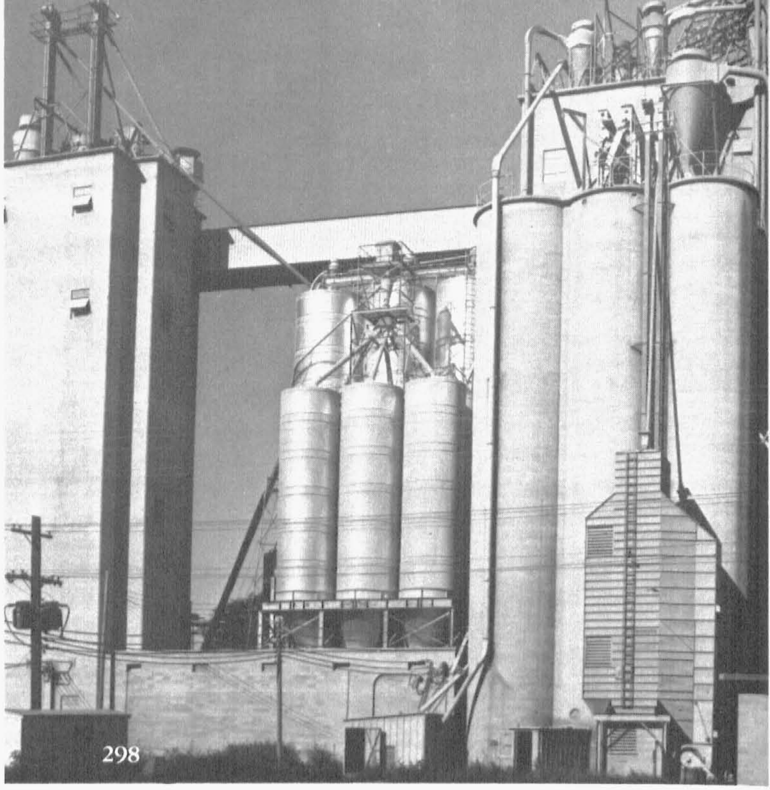


Fig. 298—Large Missouri commercial feed mill with a capacity of 500 tons daily.

There are many firms allied with the poultry industry; they provide feed, chicks, poults, equipment, and other supplies used by the industry.

The Feed Industry

The feed industry in Missouri and throughout United States is a major industry employing approximately 250,000 people. It is the largest manufacturing industry serving agriculture and the 14th largest manufacturing industry in the U.S., producing products worth 5 billion dollars annually.

The poultry feed industry is the largest sector of the mixed feed industry. The American Feed Manufacturers Association estimated in 1968 that their members distributed feed by species as follows: poultry 46%, swine 20%, dairy 18%, beef and sheep 12%, and others 4%. The Feed Division of the Missouri Department of Agriculture reports the following feed sold in Missouri in 1965-66:

Mixed Feeds for Missouri Livestock
Sold in Missouri in 1965-66

	Tons	%
Swine	535,186	32.3
Poultry	522,324	31.6
Dairy Cattle	412,643	24.9
Beef Cattle	183,992	11.1
Sheep	1,428	.1
	1,655,573	100.0

This does not include feed mixed and used by the manufacturer in feeding their own animals or animals on contract. Since poultry is more integrated than other livestock, the percentage of feed used in feeding poultry would be nearer the 46% reported for the U.S. by the American Feed Manufacturers Association.

The 1968 AFMA report showed the following use of poultry feeds: egg type layers 19%, broilers 16%, turkeys 6%, and starter—grower (egg type) 5%, making a total of 46% of all commercially mixed feeds.

Manufacturers may be classified as farm, local and national. In recent years, larger producers of poultry and other livestock have established their own feed manufacturing plants. Such operations require large capital outlays. In some areas, the cooperatives have rendered this service so that the small producers can avail themselves of the savings that result from feed manufacturing.

There has also been an increase in the smaller local mills (mini-mills or hub mils) that serve as satellites of the larger mills. The number of local mills, both private and cooperative have increased.

Larger concerns have opened additional mills and in cooperation with dealers, or on their own, have constructed satellite mills to manufacture 50 to 75 tons of feed daily for nearby producers.

Integration

The feed industry has been a leader in the integration of the poultry industry. Feed companies have entered into contracts with growers where they have assumed the major risks involved in production and guaranteed the producer a return per pound of broiler, turkey, or per dozen eggs. This has increased their volume of feed produced.

In some cases the producer has integrated his operations by maintaining breeding flocks, hatching chicks or poultry, growing out the broilers, turkeys or producing eggs. Generally, the producers have not integrated to the point of processing the broilers or turkeys.

Anyone considering the manufacturing of feed for poultry or livestock should recognize that the preparation of a ration under present-day conditions is a complex process requiring technical knowledge of nutrition and feed manufacturing. They should know and consider all the costs involved in producing rations for animals. A good reference on this subject is USDA Marketing Research Report 815, March 1968, "Costs and Economies of Scale in Feed Manufacturing," by Carl J. Volsch, Jr.
(See Table 8)

With the development of large poultry operations (50,000 layers, 100,000 market turkeys or broilers) there are opportunities for those with proper training and experience to develop on the farm feed mills suited to their operations. They may purchase pre-mixes and concentrates from dependabe sources and secure technical advise and service from such firms. The commercial feed manufacturers must compete or cooperate with such competition. There are advantages for both types of operation, and competition should determine which shall survive under each condition.

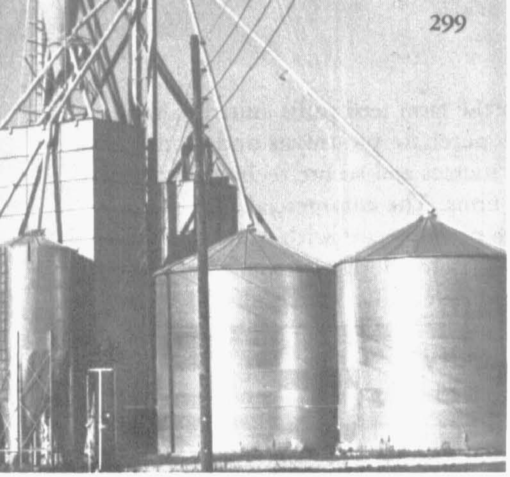
Decentralizing the Industry

In recent years the feed industry has tended toward smaller manufacturing plants (satellite or mini-mills). Such mills are located nearer the poultry or animals to be fed. They depend on the "mother" or larger mill to supply them with pre-mixes or concentrates to mix with grains grown nearby. This appears to be the trend of the future. It should reduce transportation costs and thereby reduce feed costs to the producer. Some very efficient small mills have been erected in Missouri (see Figs. 299 and 300).

Table 8 OPERATING COST PER TON FOR 80-TON (PER 8 HR.) MODEL FEED PLANTS, BY OPERATION, 1967.

Cost Item	Method of Operation A	B	C	D	E	F	G	H	I
Fixed:									
Depreciation:									
Equipment . . .	.49	.57	.55	.67	.75	.73	.62	.71	.69
Building	.29	.31	.30	.30	.32	.31	.31	.32	.32
Administrative . .	.74	.74	.74	.74	.74	.74	.74	.74	.74
Taxes	.14	.17	.16	.18	.19	.19	.17	.19	.18
Insurance	.14	.17	.16	.18	.19	.19	.17	.19	.18
Interest	.46	.52	.50	.56	.61	.59	.54	.61	.58
Total	2.26	2.48	2.41	2.63	2.80	2.75	2.55	2.76	2.69
Variable:									
Labor:									
Production . . .	.76	1.36	1.73	.98	1.59	1.96	1.08	1.71	1.09
Maintenance . .	.28	.28	.28	.32	.32	.32	.32	.32	.32
Supervisory . .	.31	.35	.35	.35	.35	.35	.39	.39	.39
Utilities	.34	.34	.34	.72	.72	.72	.55	.55	.55
Maintenance and repairs	.53	.60	.58	.66	.70	.68	.63	.69	.68
Supplies	.10	.10	.10	.10	.10	.10	.10	.10	.10
Miscellaneous . . .	.25	.25	.25	.25	.25	.25	.25	.25	.25
Total	2.57	3.28	3.63	3.34	4.03	4.38	3.32	4.01	4.38
Grand total. . .	4.83	5.76	6.04	5.97	6.83	7.13	5.87	6.77	7.07

Operation	Mash	Pelleted	Bagged
	Percent	Percent	Percent
A	100	--	--
B	100	--	50
C	100	--	100
D	--	100	--
E	--	100	50
F	--	100	100
G	50	50	--
H	50	50	50
I	50	50	100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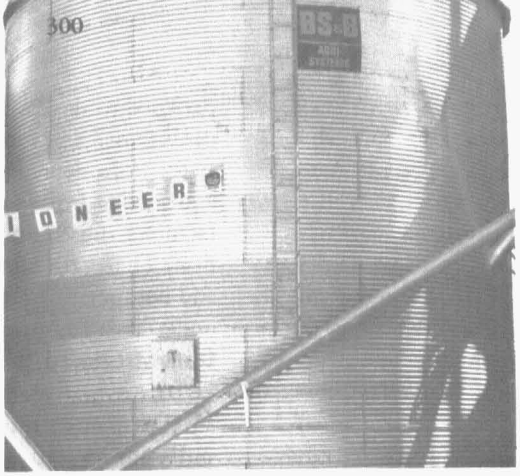

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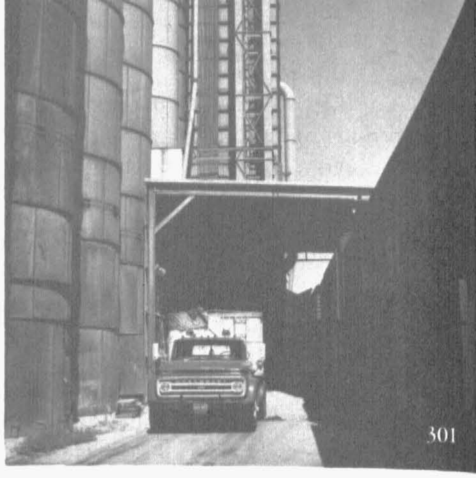
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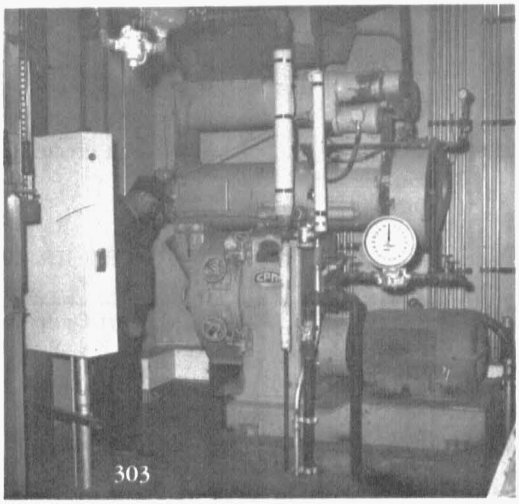
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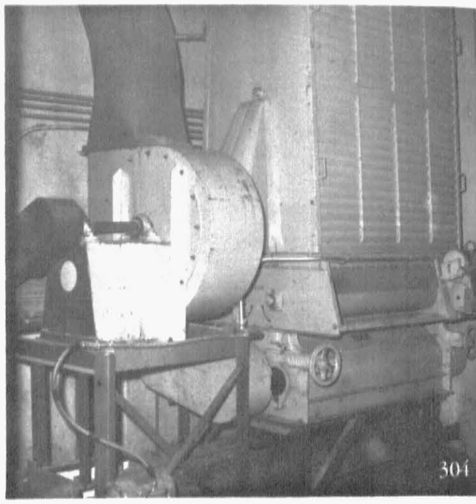
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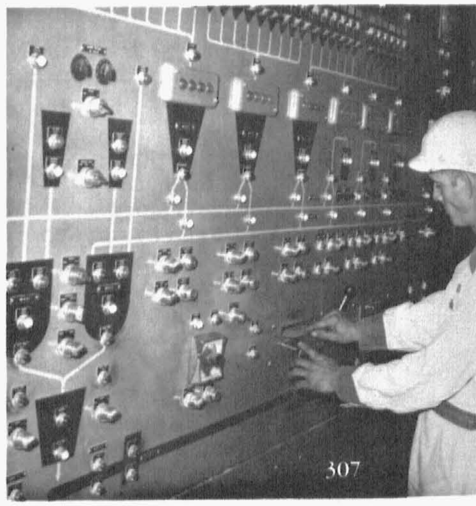
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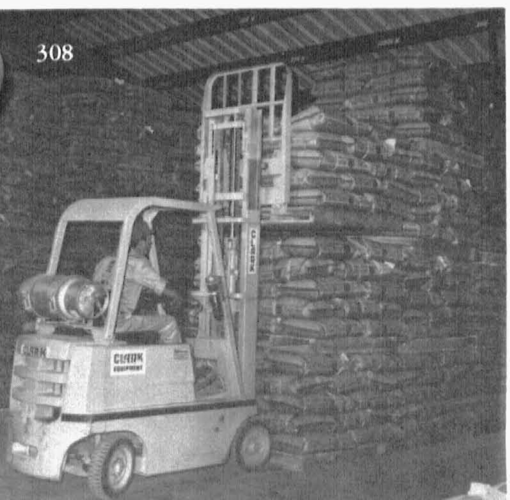

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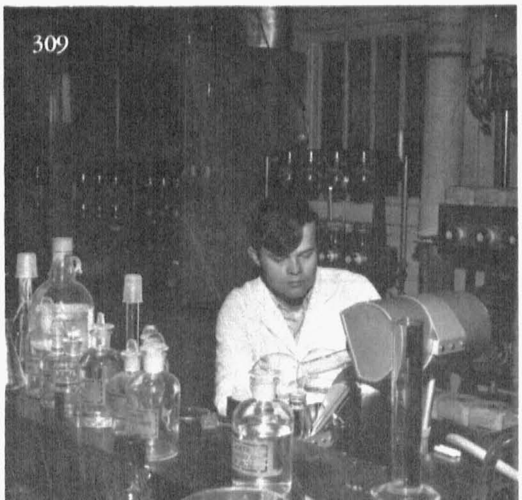
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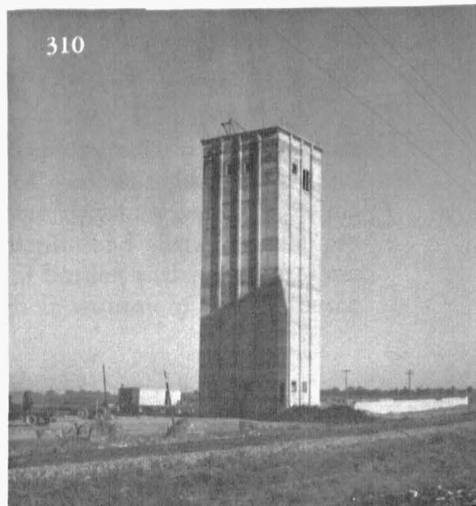
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Mills Electronically Controlled

The modern feed mill uses electronic controls to automate the production of feed. Figure 307 shows an IBM card being inserted into a control panel. This card has been punched to direct the mill to mix certain ingredients of a poultry ration.

Ingredients used in poultry rations vary greatly in chemical composition and biological value. Modern feed manufacturers maintain laboratories where the ingredients as well as the ration can be analyzed for their chemical composition (see Fig. 309). The real test of any ration is the result secured by feeding it to the animal for which it was prepared.

The larger manufacturers can maintain better equipped and staffed laboratories than the smaller manufacturer. The farmer must depend upon the manufacturer to deliver rations that produce good results and return the highest profit. Unless the feed will do that, the producer will find another source of feed.

The use of computers to formulate least-cost poultry rations is becoming common practice in the feed industry. With a computer, the nutritionist can formulate his ration from many possible ingredients in a short period of time. It enables a nutritionist to determine in minutes, the formula of the least-cost ration that will suit his needs with any given set of feedstuff prices.

Use Linear Programming

Linear programming (LP) is based on the theory that there is no "one best formula," because there is a great deal of interchangeability possible among various feedstuffs, on a nutritional basis. One must assume a *complete* interchangeability among nutrients from different feedstuffs, or linear programming is of no value to the nutritionist. Naturally, there are situations in which this cannot be true. A nutritionist must recognize these situations, and if possible, supply the computer with the necessary information. A computer cannot think. The human element, the nutritionist, is still a necessary link in the formulation of feeds using a computer.

Fig. 299—Missouri satellite with a capacity of 50 to 75 tons daily.
Fig. 300—Grain bins and auger system used in moving grains to mill.
Fig. 301—Receiving area for incoming ingredients being unloaded at a Missouri feed mill.
Fig. 302—Magnetic scalper used to remove metal from grains, before they are ground.
Fig. 303—A pellet mill preparing pelleted feed for poultry.
Fig. 304—Cooler for removing heat from pellitized feed.
Fig. 305—Machine that bags at the rate of 20 bags per minute.
Fig. 306—Loading bulk truck with loose feed thus eliminating bags and reducing labor.
Fig. 307—Operator inserting IBM card into control panel which will direct the mill to mix a specific feed formula.
Fig. 308—Using a fork lift to stack feed in a warehouse.
Fig. 309—Laboratory for analyzing feeds produced in a feed mill.
Fig. 310—New feed mill under construction at Moberly.
Fig. 311—Modern feed mill on a Missouri farm.

Automation in the Feed Industry

Approximately a million tons of poultry feed are used annually in Missouri. A tremendous amount of energy is required to handle that much feed, but fortunately the industry has become highly automated so that a minimum of man hours are required.

Feed mills are approaching the "push button" stage. An IBM card punched into the control panel can direct the machines to mix specific formulas and move the feed thru all the operations of grinding, mixing, pelleting and delivering the feed to bins or loading areas. Figures 298 to 316 show some facilities and operations in Missouri feed mills.

Scraps of metal are sometimes found in the grains or other ingredients used in rations. This metal can be eliminated by installing a magnet in the line to pick out metal in the feed.

Poultrymen favor pellets and crumbles for most of their feeding. Pelleting minimizes waste and improves the feeding value of a ration. The heating that accompanies pelleting tends to reduce bacterial contamination. The heat generated by pelleting is removed by special air blast coolers.


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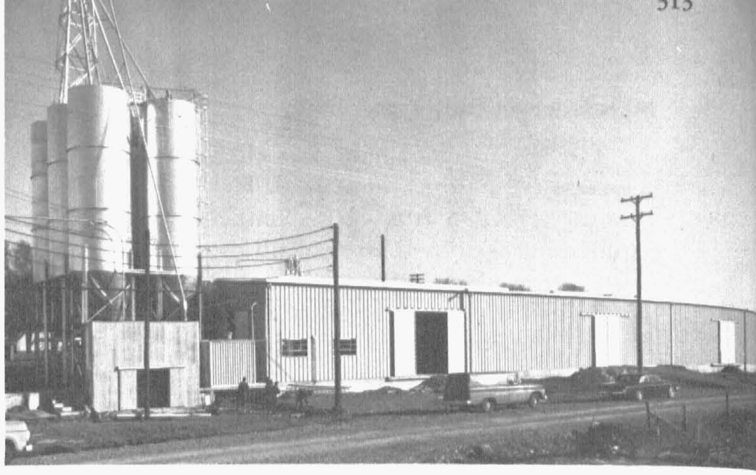
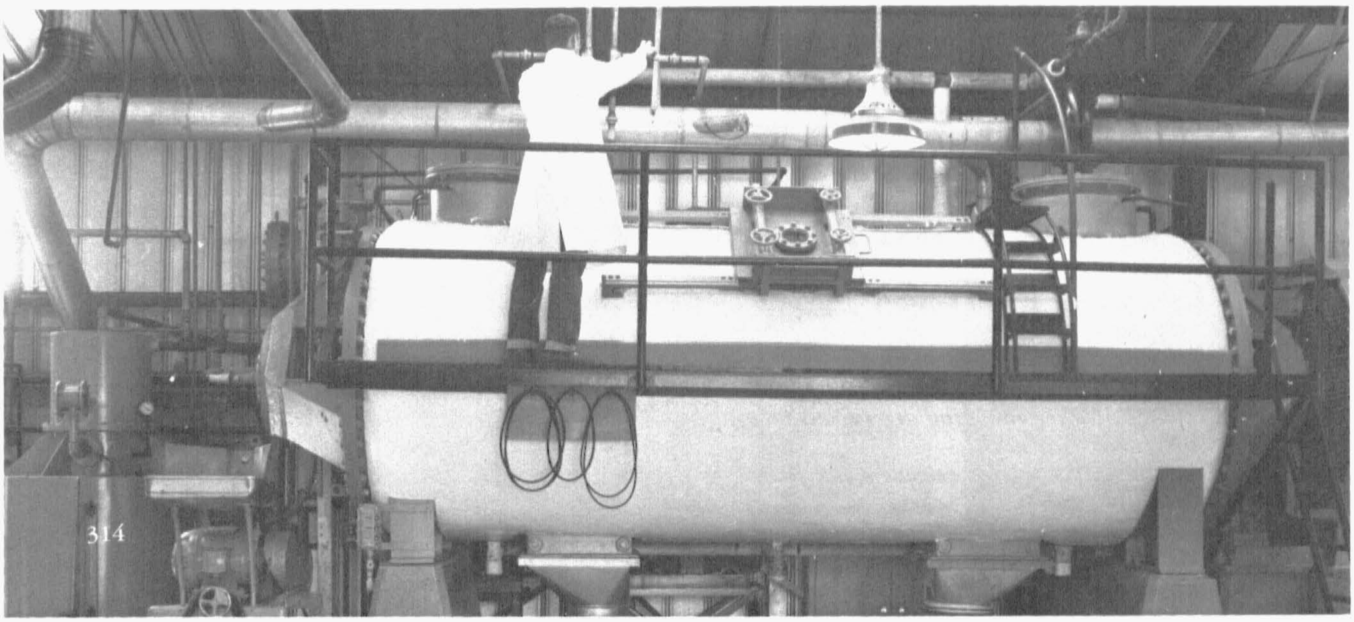


Fig. 312—An old feed mill that used water power in early days.
Fig. 313—Building used for premixing vitamins; storage tanks for diluents used in premixes.
Fig. 314—Rotary vacuum dryer used in preparing calcium pantothenate—AB—vitamin for poultry feeds.

Fig. 315—Fractionating column and equipment for recovery of solvents used in chemical processes and vitamin purification.
Fig. 316—Processing, sizing, and drying equipment used in chemical plant to prepare vitamins.



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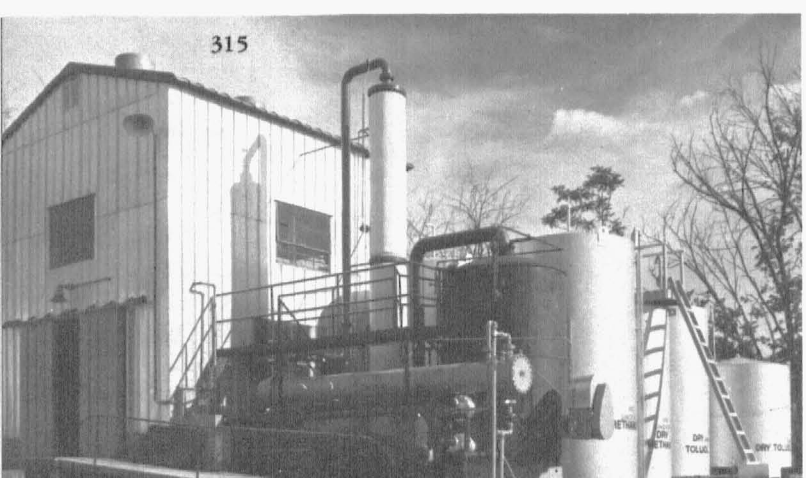

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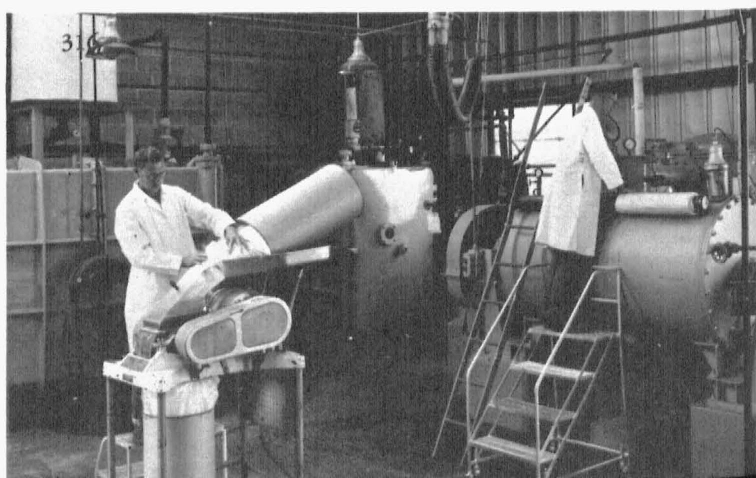

The delivery of feed has changed greatly in recent years, from the producer "picking up" two or three bags of feed once a week to feed his poultry and livestock, to the delivery by the mill of several tons of loose feed with bulk trucks directly into the bins of the producer.

An intervening stage in feed delivery was the use of paper bags instead of cotton or burlap bags. The cotton bags had prints which encouraged their use in making aprons, dresses, etc.

Feed Ingredients

There are literally hundreds of different feedstuffs or ingredients available for use in poultry rations. Space does not permit the listing or description of individual ingredients. However, we may list the different classes of feedstuffs used in feeding poultry as follows:

Grains and their by-products—corn, wheat, etc. Primary carbonaceous feeds
Protein supplements; Animal, Vegetable
Vitamin supplements
Mineral supplements
Drugs—antibiotics
Other feed additives

New feed mills to serve the poultry and livestock industries of the state are being constructed (Fig. 310). These mills are equipped with the latest automated machinery to reduce costs. Most of these mills serve the entire livestock industry, but some serve the poultry industry exclusively.

Larger mills are establishing new satellite mills. Some of these are built by private industry and others are cooperative. As producers expand to larger units there will be more feed mills or grinding and mixing operations set up by producers.

Regulation of the Feed Industry

The Missouri Commercial Feed Law of 1959, specifies that this law shall be administered by the Commissioner of Agriculture. This law requires that commercial feed shall be registered before being sold in the state. Custom formula feeds are exempt. The law also requires that any commercial feed distributed in the state shall be labeled to show: (1) net weight, (2) name or brand, (3) guaranteed analysis, (4) the common or usual name of each ingredient and (5) the name and address of the person distributing the feed. The Feed Division of the State Department of Agriculture is financed by fees collected by that division as required by law. The present fees require a registration fee of $2.00 for each brand of feed registered and an inspection fee of .08 cents per ton of feed sold.

In 1966, 1019 firms registered 9033 brands of feed. The inspectors of the Feed Division collected 4668 sampes of which 4336 samples were analyzed chemically and micro-analysis were made on 1620 samples. One hundred and fifty-six samples failed to meet their chemical guarantee.

For more detailed information on the Missouri Feed Law, the reader is referred to the Missoui Department of Agriculture, Jefferson City, for their latest "Feed and Seed Report."

Food and Drug Administration

The feed industry is also subject to federal laws (Federal Food, Drug and Cosmetic Act) pertaining to feed, which is administered by the Food and Drug Administration with a regional office at 1009 Cherry Street, Kansas City, Mo.

Sales and Service

Modern feed manufacturers promote sales thru service and by helping the growers solve their production problems in nutrition, disease control, and marketing. To be an effective salesman, one must have a fundamental knowledge of nutrition, and know about care and management of poultry and livestock. There is no substitute for thorough training in poultry and animal science.

The feed company can train their sales and service people in the company's procedures, but they cannot give the fundamental training they need in husbandry.

Research

The modern feed industry depends upon the fundamental research of the universities and colleges, and upon industry's applied research to arrive at the proper rations for each species.

Missouri is fortunate in having possibly the largest and best equipped and staffed feed industry research farm in the United States (Ralston Purina Research Farm, Gray Summit).

The Hatchery Industry

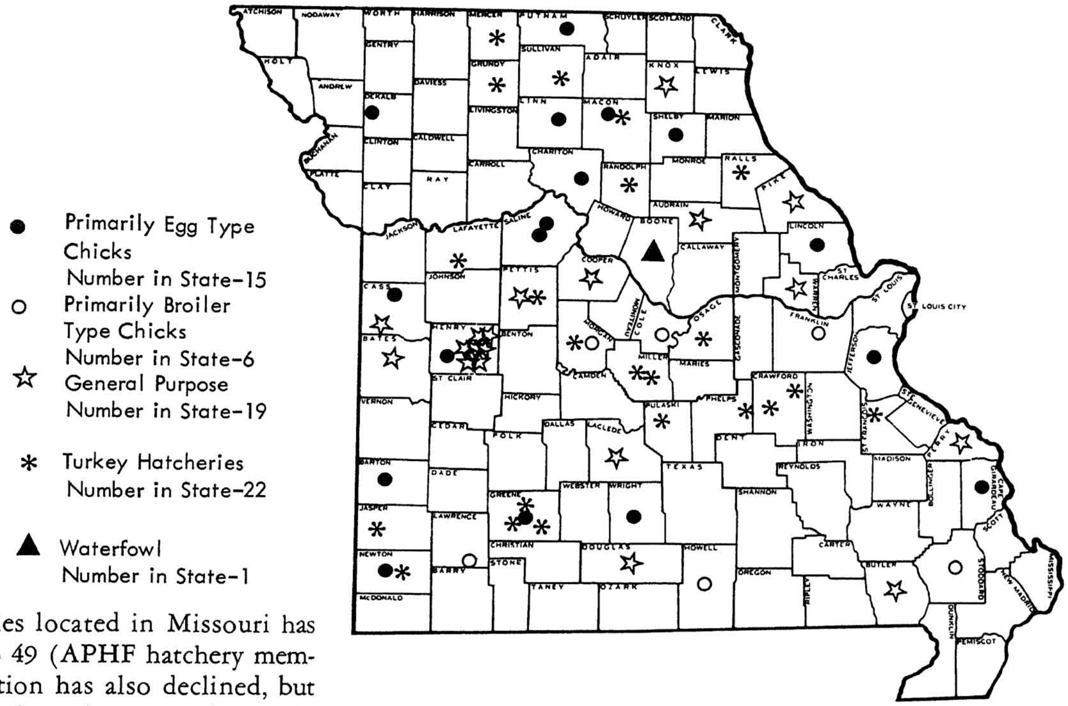

Fig. 317—Poultry hatcheries in Missouri, 1968.

The number of hatcheries located in Missouri has declined from 417 in 1938, to 49 (APHF hatchery members) in 1968. Chick production has also declined, but much less, from 135,473,000 in 1943, to 37,841,000 in 1967.

The number of turkey hatcheries in Missouri, as well as the number of poults hatched, have been increasing. In 1967, 16 turkey hatcheries produced 10,188,000 poults. This same year Missouri raised 11.5 million turkeys.

Before the advent of integration in the poultry industry, hatcheries operated as independent businesses, but now many hatcheries are a part of an integrated firm or they produce for such a firm. In some cases the hatchery has developed into an integrated firm. In other instances a feed manufacturer or processor has incorporated a hatchery into an integrated set up. We may expect more integration and the disappearance of the independent hatchery. The hatchery of the future must diversify and integrate its operations or develop some working relationship with an integrated firm.

Detailed hatchery operations are shown in the section on the Turkey Industry in Figures 18-37, in the section on Shell Egg Industry in Figures 135-144, and in the section on Broiler Industry in Figures 245-254. A study of these illustrations should be helpful in understanding the operation of a hatchery.

The present-day hatchery specializes in producing chicks for broiler production or egg production. There are a few that produce both types of chicks, and a very few that sell the general purpose chick. The demand for started pullets of the egg type chick has forced hatcheries into the started (20-22 weeks old) pullet business.

The hatching of turkeys is discussed and shown in the section on The Turkey Industry of Missouri. The hatching of layers and the hatching of broiler chicks are discussed and shown in the sections on the Shell Egg Industry and the Broiler Industry.

Missouri has been a leader in poultry and turkey improvement. Even in the fancier days, when improvement was judged by the shape and color of the bird, Missouri was in the forefront with annual poultry shows in most counties and large winter shows in Kansas City and St. Louis. When attention shifted from fancy to economic considerations, Missouri became one of the first states to initiate a certified poultry breeding program (1920) that emphasized egg production. When the National Poultry Improvement Plans were inaugurated, Missouri was enrolled in these programs the first year (National Poultry Improvement Plan, 1935, and the National Turkey Improvement Plan, 1943).

In 1967, Missouri's participation in the NPIP consisted of 1034 flocks (3rd), containing 515,872 birds, supplying eggs to 45 hatcheries, with egg capacity of 11,231,280 eggs (9th). Participation in the NTIP consisted of 95 turkey breeding flocks, containing 192,842 birds, supplying eggs to 11 hatcheries, with a capacity for 3,442,000 eggs.

Since a number of poultry diseases are egg-borne, the hatchery is the key point for the control of diseases. At present, control programs have been developed for Salmonella Pullorum, S. gallinarium (typhoid), mycoplasma gallisepticum (PPLO), and S. typhimurium. Carriers of these diseases can be detected by blood tests. For many years Missouri hatcheries (both chicken and turkey) have operated as U.S. Pullorum—Typhoid Clean and as tested for S. typhimurium and PPLO. Other diseases will no doubt be included in hatchery programs as reliable tests are developed.

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Processing of Poultry Meat

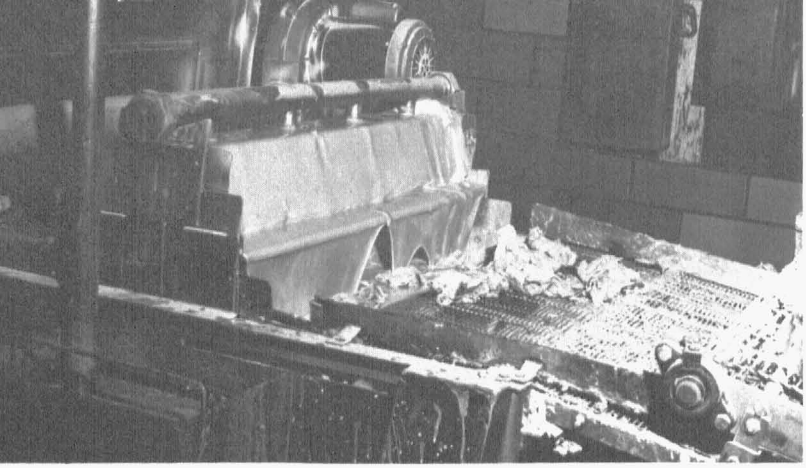
The food industry, including the poultry industry, must be on the alert to satisfy the demand of consumers for more ready-to-serve products with built-in maid services. The poultry industry has responded to this demand by processing its products into pre-cooked dinners, pies, canned products, etc. The further processing of turkey products is discussed in the section on the Turkey Industry of Missouri. Here we shall discuss the further processing of chicken meat.

The F. M. Stamper Co., Macon and Marshall, process large quantities of poultry meat into chicken and turkey dinners, chicken and turkey pies, and other products. The Marshall plant employs 800 to 1,000 people and Macon 400 to 500 workers.

The Macon plant specializes in Banquet Fried Chicken Dinners with production in 1968, reaching 20,000 dozen dinners per day, or approximately a quarter million dinner per day. They require 20 trailer truck loads of dressed fryers per week. These come from Georgia, Mississippi, and Arkansas. These dressed fryers weigh 20-28 ounces each. This plant is a well managed food industry plant. Many of the operations performed are shown in the accompanying photography (Fig. 318 to 328).

The Marshall plant produces chicken pies, beef pies, and turkey pies and dinners.

Fig. 318—"Tote cartons" containing several hundred pounds of ice-packed whole fryers (without giblets) received at Macon from southern processing plants.
Fig. 319—Fryers being cut into halves on band saw. Steel mesh gloves reduce injuries.
Fig. 320—Preparing chicken for dinners.
Fig. 321—Inspecting chicken parts for fried chicken dinners.



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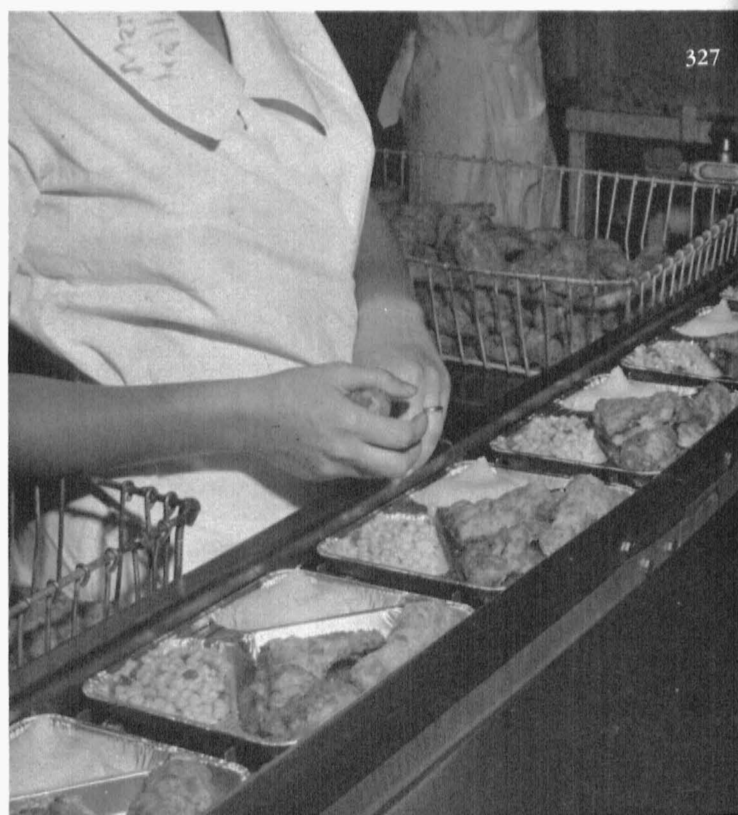

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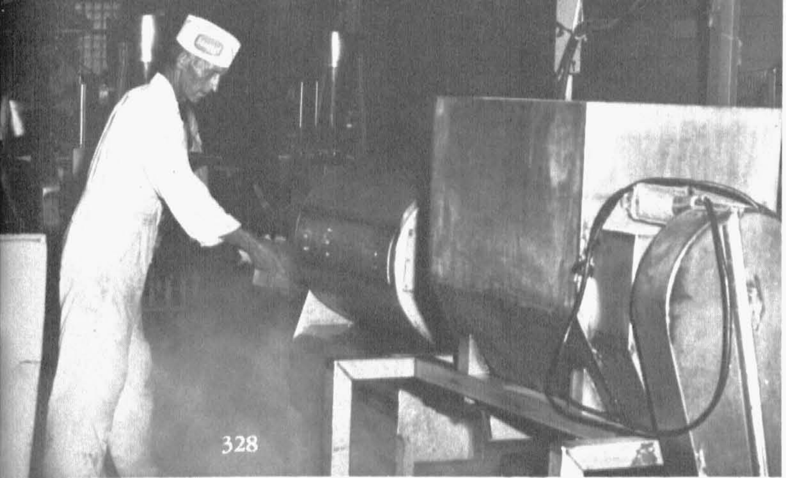

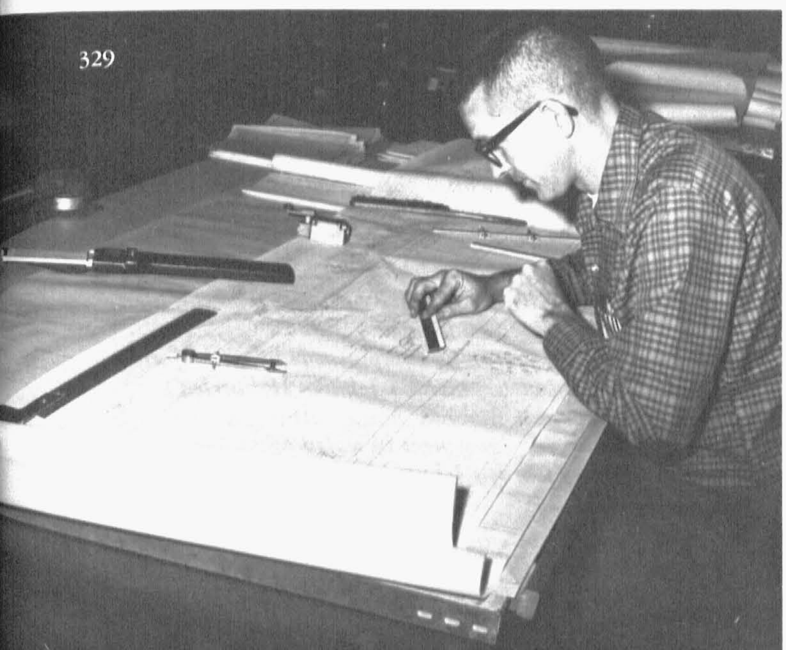

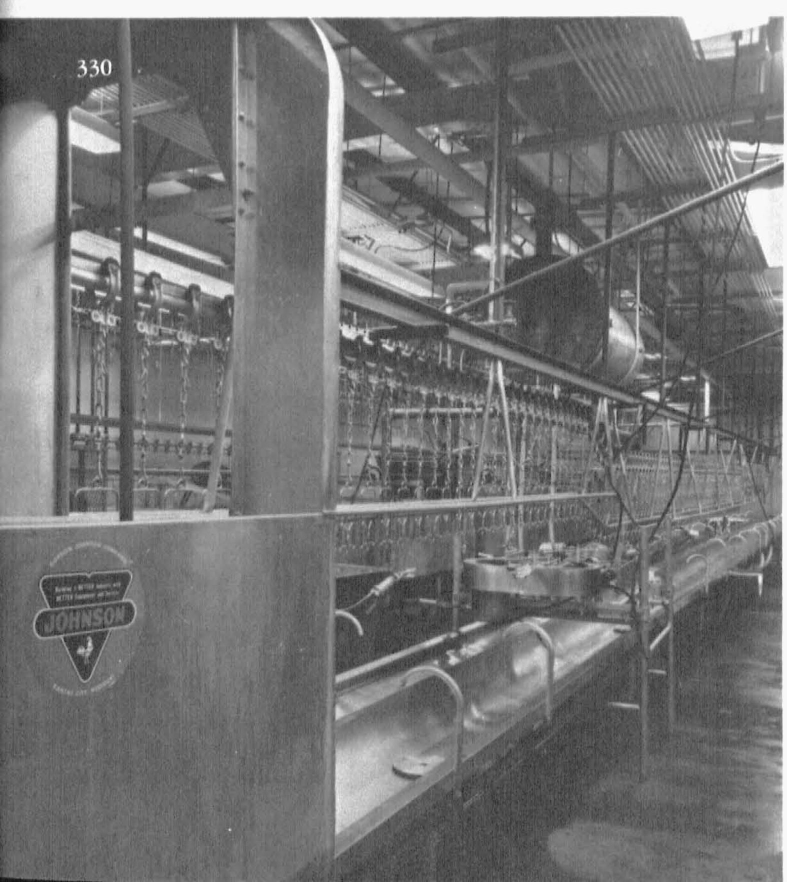

Fig. 322—Cooked chicken covered with batter ready for further cooking in deep fat.
Fig. 323—Fried chicken coming from fryer in which it was browned in deep fat.
Fig 324—Cooked chicken parts in cooler before they are placed on dinner trays.
Fig. 325—Corn dispensing machine places corn in proper compartment on tray.
Fig. 326—Placing three pieces of fried chicken on each fast moving tray.
Fig. 327—Complete chicken dinner, including chicken, corn, and potatoes.
Fig. 328—Cleaning with live steam between each shift. Sanitation is under USDA veterinary inspection.
Fig. 329—All new poultry equipment begins on the drawing board of an engineer.
Fig. 330—Poultry eviscerating line. (Courtesy Gordon Johnson Industries, Kansas City)

Equipment Manufacturing

The poultry industry uses a wide variety of equipment and supplies. Most of these are secured from firms that are located in other states, but are distributed nationally.

Missouri firms are leaders in manufacturing and distributing poultry processing equipment. The Gordon Johnson Company, Kansas City, has pioneered in the development and manufacture of this equipment. Their display of equipment at the annual Poultry Fact Finding Conference held in Kansas City each February is not only the largest display, but is of the highest quality.

Figures 329-336 show scenes from plants manufacturing poultry processing equipment. The use of this equipment is shown in the section on The Turkey Industry in Figures 65-93 and 98-110, and in the section on the Broiler Industry in Figures 266-283.

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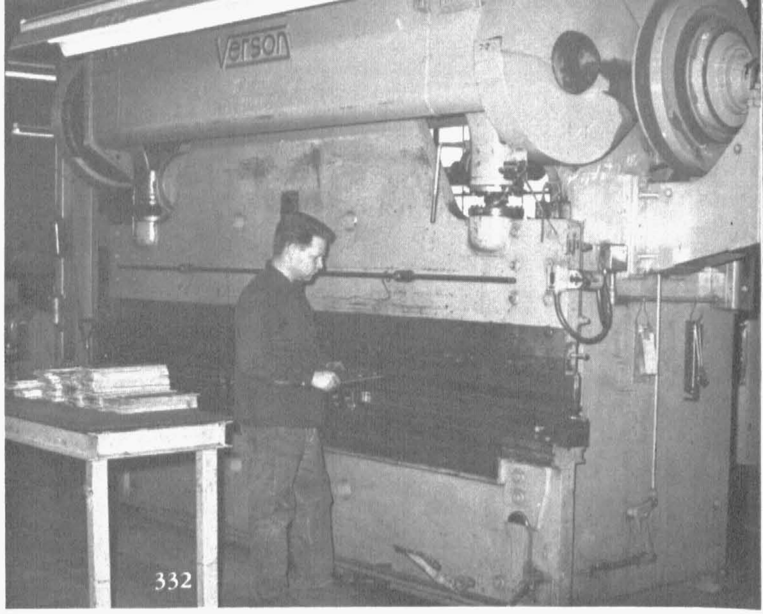

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Fig. 331—Assembling poultry packaging machines.
Fig. 332—Massive machines are used to shape the stainless steel used in poultry equipment.
Fig. 333—Building poultry picking machines.
Fig. 334—Packaging machine for cut-up or whole broilers. (Courtesy Gordon Johnson Company, Kansas City)
Fig. 335—Poultry processing equipment leaving the factory in Kansas City (Courtesy Gordon Johnson Industries, Kansas City)
Fig. 336—Processing equipment in sealed container for export. (Courtesy Gordon Johnson Industries, Kansas City)

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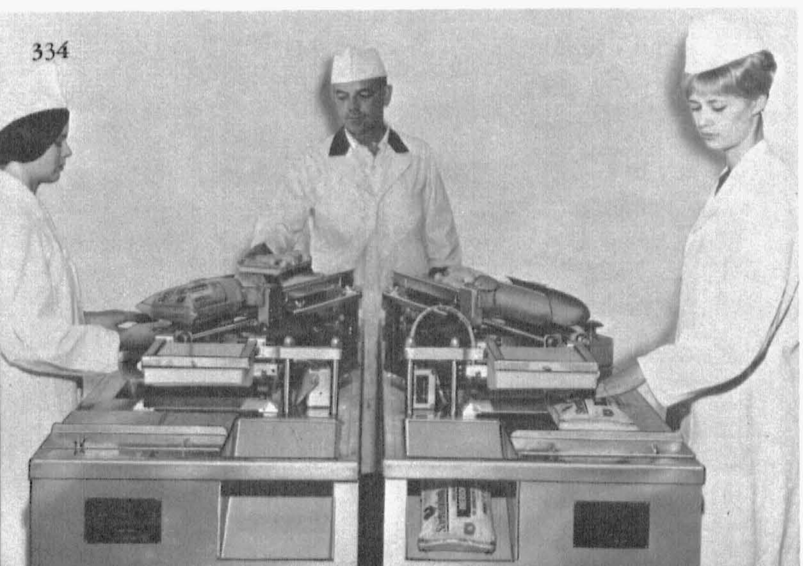

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Drugs and Pharmaceuticals

Efficient and economical poultry production requires the use of drugs and other pharmaceuticals to prevent and control the various diseases and parasites that attack poultry.

Prevention of disease is the goal of all producers. The best management practices (including sanitation) are helpful in disease prevention. However, there are certain diseases, such as coccidiosis, that are so common that the industry has adopted the use of coccidiostats in the feed as a preventive measure against coccidiosis.

Some poultry diseases can be prevented by using vaccines to immunize the birds against the disease. Most chickens are now vaccinated against Newcastle disease, bronchitis, and fowl pox.

Two Missouri firms produce and distribute vaccines and drugs to the poultry industry: Ralston Purina Company, St. Louis, and I. D. Russell Company, Kansas City. Most of the national firms have sales & service representatives working in Missouri.

New Industries

There are several new, but small industries that have been developed in Missouri to supply the poultry industry with equipment or other poultry operation supplies.

One of the most satisfactory materials for litter is shavings. Recently, some modern shavings plants have been built in Missouri to service primarily (80 to 90 percent) the poultry industry, especially for turkeys and broilers. Figure 337 shows one of these plants built in Central Missouri. This plant estimates that 80 percent of their shavings are used for poultry, 10 percent for swine, and 10 percent for other animals. Figure 42 shows a truck being loaded with by-product shavings from a plant which produces furniture and panelling.

The use of carts for delivering feed to caged layers inside the house, and in gathering eggs in large modern houses, has created a demand for such carts. At least two Missouri firms produce carts. Figures 338 and 339 show two of these manual carts. The use of electric carts for doing poultry house chores is discussed and shown in the section on the Shell Egg Industry. None of these electric carts are manufactured in Missouri.

Missouri firms produce and sell turkey loaders. These loaders save labor in loading. If not used properly, they may produce more bruised turkeys than birds which are loaded by hand. Therefore, some turkey growers prefer to load by hand. Those who have learned how to use the

Fig. 337—New wood shavings plant, Smithton, Mo. (Courtesy of Rural Electric Missourian, Jefferson City)
Fig. 338—Gathering eggs and feeding layers with cart manufactured by E-Z Roll Cart Corp., Lamar.

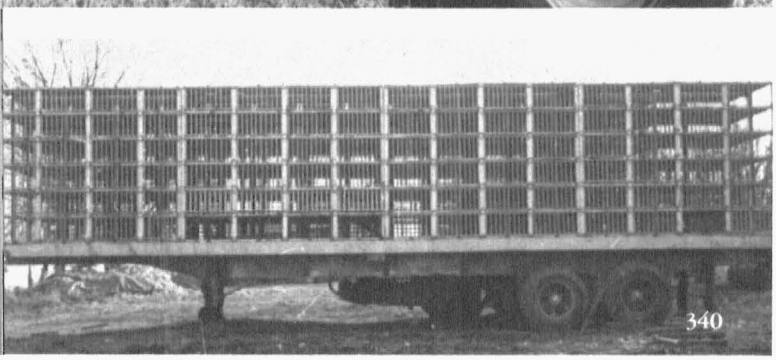

Fig. 339—Egg and feed cart manufactured by Davis Brothers, Pineville.
Fig. 340—Poultry coops made by Koechner Mfg. Co., Tipton.

mechanical loaders report a saving in labor and a reduction in bruises.

Special turkey coops are manufactured for truck trailer beds as shown in Figure 340.

Public Services

The poultry industry is served and regulated by federal, state and local agencies.

Many services essential to the poultry industry of Missouri are performed by the U.S. government. Some of these are provided free, and others are paid for by the firms receiving the service. The poultry industry questions the propriety of paying for services which are performed at the demand of the public and to protect the general public welfare.

U.S. Department of Agriculture

The USDA has a long and distinguished record of service to agriculture, including the poultry industry of Missouri. The services available are classified under Consumer and Marketing Service, Agricultural Research Service, Extension Service, Farmer Cooperative Service, Statistical Reporting Service, Economic Research Service, Foreign Agriculture Service, and the Commodity Exchange Authority.

Consumer and Marketing Service. The Poultry Division of CMS is responsible for developing grades and standards, providing grading services for industry, poultry meat inspection, expanding market outlets, surplus removal, and related marketing services including market news.

Agricultural Research Service. Research on poultry problems is conducted at several locations. The Poultry Research Branch at Beltsville, Md. is investigating poultry breeding, improvement, nutrition, physiology, and poultry products. Other poultry research conducted at Beltsville includes research on poultry health, disease, and parasites; engineering (housing); human nutrition; economic research; market quality; marketing facilities; and transportation.

The Agricultural Research Service also operates the Regional Poultry Research Laboratory at East Lansing, Michigan; North Central Regional Poultry Breeding project, Lafayette, Indiana; Southern Regional Poultry Breeding Project, Athens, Georgia; Southwest Poultry Experiment Station, Glendale, Arizona; South Central Poultry Research Laboratory, State College of Mississippi; the Southeast Poultry Research Laboratory at Athens, Georgia, and the Western Utilization Research Laboratory at Albany, California.

Federal Extension Service. This agency serves as a coordinating link between the USDA agencies and the Cooperative Extension Service as conducted by the 50 respective states. Both production and marketing are included in this service.

Farmer Cooperative Service. The objective of this service is to improve the economic well being of farmers through increased cooperation.

Statistical Reporting Service. This service collects and disseminates data on poultry with respect to estimates, production, prices, and marketing.

Economic Research Service. This service includes statistical analysis, which is responsible for the poultry outlook.

Foreign Agriculture Service. This service assists the poultry industry of the United States in developing export markets for their products.

Department of Health, Education and Welfare. The Food and Drug Administration is an important part of this department. It is responsible for enforcing the federal laws which prohibit the interstate shipment of adulterated or misbranded foods.

The Public Health Service provides consultative services to the states on health and sanitation problems associated with the processing, storage, transportation, and sale of poultry.

State Regulatory Services

The poultry industry of the state is regulated and served by the State Department of Agriculture through the Egg Division, the Feed Division, the Marketing Division, and the State Veterinarian.

The **Egg Division** serves the poultry industry and the public by enforcing the provisions of the State Egg Law. The Missouri Egg Law provides for the sale of shell eggs in retail stores by grade. This law has improved the retail quality of shell eggs.

The **Feed Division** enforces the Missouri Commercial Feed Law which requires that commercial feeds (except customer-formula feeds) be registered. This law requiries that feed distributed in the state be accompanied by a legible label which lists (1) net weight, (2) name or brand, (3) quaranteed analysis, (4) the common name of the ingredients used, and (5) name and address of the distributor.

The **Marketing Division** has a balanced marketing program designed to be of service to all segments of Missouri agriculture. This division's main service to the poultry industry concerns the daily market summary which reports the markets for turkeys, eggs, and poultry, not only in Missouri, but throughout the country.

The *State Veterinarians Office* supervises the control of poultry diseases. Its greatest service to the poultry industry has been the operation of the poultry diagnostic laboratory at Springfield, where approximately 200,000 turkeys are tested each year for pullorum, typhoid, typhimurium, and PPLO. Fig. 60. All authority for livestock and poultry diseases control is vested, by law, in the State Veterinarian.

Division of Health

This division is charged with about the same responsibilities for protecting the health of the people of Missouri as the US Food and Drug Administration is for the health of all the people of the United States (except that regulations pertaining to animal feeds are handled by the Feed Division of the Missouri Department of Agriculture).

The Division of Health supervises the processing of poultry in Missouri plants, not under USDA Veterinary Inspection. They do not inspect egg processing plants because their supervision and inspection in Missouri is delegated to the state Egg Division.

University of Missouri

The services of the University of Missouri - Columbia in research, teaching, and extension are discussed in detail in S.R. 85-68, *The History of the Department of Poultry Husbandry,* by E. M. Funk, published in 1968, by the University of Missouri. Egg products, research, and teaching are discussed in greater detail in the section of this publication on the Egg Products Industry of Missouri. Current research with turkey is discussed in the section on the Turkey Industry of Missouri.

Mountain Grove Experiment Station

The Poultry Experiment Station located at Mountain Grove, established in 1911, has served the poultry industry by conducting laying tests and random sample tests on laying strains of chickens. The National Egg-Laying Contest was started in 1911, making this the oldest egg-laying contest in the United States (Fig. 341).

In recent years, more emphasis has been placed on the Random Sample Tests which most breeders believe is a better measure of the worth of egg laying strains be-

Fig. 341—Charles McElyea, director of the Poultry Experiment Station, Mountain Grove, in front of new Administration Building.

cause the entries are samples at random and include more measurements than were made in the Standard Tests.

The Missouri final report for 1966-67, for 350 days, showed 27 entries of 30 birds, each bird averaged 73.0 percent hen-housed production, or 255.6 eggs per bird. Only 40 birds of 810 entered died during the 50 weeks, less than 5 percent. All awards are made by the point system in which eggs weighing 24 ounces per dozen are valued at 1.0 points. Eggs above 24 ounces receive 1.05 points, and eggs weighing 26 ounces or more receive 1.10 pts. Eggs weighing less than 24 ounces lose .05 pts. for each ounce under 24 to 18 ounces. Eggs weighing less than 18 ounces are not counted.

In 1953, a Random Sample Egg Production Test was started. This test was made with floor managed layers and is still being continued. In 1966, a Colony Cage Random Sample Egg Production Test was initiated. These random sample tests are the most comprehensive conducted in the United States and have been well managed. The facilities for these tests are excellent. The following is from the final summary of the 13th floor test:

Conduct Laying Sample Tests

The Missouri Random Sample Laying Tests are conducted at the Missouri State Poultry Experiment Station, Mountain Grove, Missouri. Charles W. McElyea is Director of the Station and Supervisor of Tests and Ray Hargrave is his assistant. The Laying tests are designed to assist commercial poultrymen of Missouri in evaluating the productivity of stocks of layers that are available to to them in commercial quantity. A six-member poultry board, appointed by the Governor, representing the various poultry interests of the state, establishes policies and practices which best serve this purpose.

This summary report of the 1966-67 Floor Laying Test covers performance from March 6, 1966, through July 18, 1967, when the flocks reached 500 days of age.

Chicks for each entry were hatched at the site from a 540-egg sample. The eggs were selected by random procedure from the nests, baskets, or setting trays of 1000 or more breeders by representatives of NPIP in the sample locations. One hundred-eighty sexed pullets (when available) were wing banded for intermingled brooding. At eight weeks of age, pullets were moved to the range and matured to 150 days of age. At 150 days, pullets were housed in replicate test houses with 50 birds per replicate for each entry, a total of 150 pullets for each entry. All laying house records were kept by replicates for use by the breeder and U.S.D.A. combined summary. Poultry producers will receive the combined report, but may receive the replicate report by requesting same.

All pullets were immunized against Newcastle disease, fowl pox, infectious bronchitis, and laryngotracheitis during the growing period. All pullets were debeaked at 16 weeks of age.

Rules for 15th Missouri Random Sample Floor Egg Production Test

ANNOUNCEMENT

The Fifteenth Missouri Random Sample Floor Egg Production Test was initiated February 9, 1968, and will terminate July 15, 1969, when the stock will be 500 days of age. The objective of this test is to evaluate the economic characteristics of stocks available to Missouri poultrymen and compare the performance of stocks maintained under comparable conditions.

RULES & REGULATIONS

1. Any individual, firm or organization offering baby chicks or hatching eggs to Missouri poultrymen is eligible to enter stock in the Fifteenth Missouri Random Sample Floor Egg Production Test. The primary breeder will initiate or approve all applications.
2. In considering applications for the Fifteenth Floor Test, the management will consider the availability of the stock to Missouri poultrymen, location of the firm making application, and performance of the stock in past Missouri tests, as well as performance in other tests.
3. A maximum of 33 stocks will be accepted. An entry will consist of 220 mature pullets to be divided into four replicates at housing time. Replicate "M" (40 pullets) will be housed at a density of 2.3 square feet per bird; Replicate "N" (70 pullets)—1.3 square feet per bird; Replicate "O" (50 pullets)—1.9 square feet per bird; and, Repicate "P" (60 pullets)—1.5 square feet per bird. Income over chick and feed cost per pullet housed for each replicate will be reported on the quarterly and final reports. In developing the entry, sixty dozen eggs will be selected at random on the farm of the applicant or from the flock selected by the test management.
4. Eggs will be set February 9, 1968. Chicks will be sexed at hatching time and chicks from each stock will be placed under the brooders.
5. Eggs secured will be from flocks located as near the test as feasible, and from the flock of the grade and designation placed upon the application form. Substitutions will not be permitted without prior approval of the test management. Eggs must reach the Missouri Poultry Experiment Station, Mountain Grove, between February 5th through 8th, 1968.
6. Each entry must be from pullorum-typhoid clean flocks or equivalent.
7. No culling or selecting will be practiced during the test.
8. At time of hatch, chicks in each entry will be wing-banded as a means of identification.

9. All chicks will be immunized against Newcastle disease, bronchitis, laryngotracheitis, and Fowl Pox.
10. All chicks will be debeaked. All pullets will be debeaked at random by one technician for Floor laying operation.
11. All entries will be fed the same "all mash" diet as formulated by the Missouri State Poultry Experiment Station.
12. During the growing period, data will be collected regarding feed consumption, mortality, and cause of mortality. Feed consumption records throughout the growing period will be maintained and the feed consumption per entry will be estimated, based upon the number of pullets surviving, and the body weight of pullets at housing time.
13. Monthly reports summarizing progress will be supplied only to the breeders whose stock is under test. All progress reports are supplied for the purpose of informing the breeder regarding the status of his stock for the period under consideration. The data is incomplete and thus should be considered confidential. Upon request, final test reports will be issued to interested individuals.
14. Records to be kept during the egg production phase of the test will include:

A. Egg production per entry by replicates.
B. Egg size distribution—to be determined by weighing each egg produced on one day of each week.
C. Egg prices—based on the daily Missouri Egg Market Report for Missouri market egg selling price.
D. Feed consumption per replicate to be secured and feed consumption per pound of eggs produced calculated. Feed conversion will be based upon bulk weighing of all eggs one day each week.
E. Feed prices to be the cost of feed ingredients as delivered to Missouri State Poultry Experiment Station feed mill.
F. Egg quality characteristics: Shell thickness will be measured as to specific gravity—as recommended by the Council of Official Poultry Tests. The percent of eggs with meat spots and blood spots will be recorded. Interior quality (albumen height) will be measured as Haugh Units. Egg Solids (yield) determined from all eggs produced one day each quarter for each entry. Comparison of yolk color by replicates.
G. Body weight of each hen will be secured at the time of housing and at the conclusion of the test.
H. Age to 50 percent production will be reported.
I. Mortality records will be maintained. An autopsy will be performed in an effort to determine cause of mortality.
J. Income over chick and feed cost—The value of eggs containing unsaleable meat and blood spots as determined by candling will be subtracted from income.

15. All eggs produced throughout the test and all pullets remaining at the end of the test will become the property of the Missouri State Poultry Experiment Station. Eggs and hens will be sold as market eggs and market fowl. The identity of all pullets will be lost prior to marketing.
16. Pullets developed from the Regional Cornell Control Stock will be used as the control stock.
17. The grade, description or designation, as reported on the entry form by the applicant, will remain unchanged throughout the test period. Ownership of the entry as indicated on the application form is non-transferable.
18. The applicant will supply the quoted price of day-old chicks as of spring, 1968, F.O.B. the local hatchery, or hatchery from which chicks of this grade may be secured in lots of 1,000 without deductions of any kind.
19. Any misuse of the reports or information secured from this test declared unethical or unfair by the breeder-hatchery code for the poultry industry or in violation of these rules and regulations, will constitute grounds for rejecting future entries from the breeder involved.
20. Part year records may not be used by the breeder or his associates for advertising or in the sales promotion.
21. An entry fee shall be $100 for out-of-state breeders and $50 for Missouri breeders. The fee must accompany the application. In the case of associate or franchised hatchery, when the breeding establishment is outside of the state, the out-of-state fee shall prevail—regardless of where the eggs are selected. The entry fee of all applicants whose stock is not accepted for testing will be returned.
22. The final date for acceptance of applications will be January 10, 1968.

Management and Feeding Studies; Random Cage and Floor Tests

In the Third Random Cage Test, February 28, 1968, a density study has been set up and will be carried out on the basis of eight, ten, and twelve birds per cage of 672 square inches (24" x 28"). One year's results may be sufficient for the density of the twelve birds per cage. A two and three cage density will probaby replace the twelve-bird study for the Fourth Cage Test. A density study for the Fifteenth Missouri Random Sample Floor Test was housed August 1, 1968. Replicate "M" was housed at 2.3 sq. ft. per bird; "N", 1.3 sq. ft. per bird; "O", 1.9 sq. ft. per bird, and "P", 1.5 sq. ft. per bird.

A low lysine grower ration, lysine 0.52%; protein, 15.4%, and, 700 Cal/lb. was fed to a group of approximately 200 white Leghorn pullets from seven weeks through twenty-one (21) weeks. At housing time, these birds were changed to a 17% all-mash laying ration having 3.2% fiber and 916 Cal/lb. An 18% layer ration having 3.93% fiber, 4.5% fat and 892 Cal/lb. is being fed to A, B, C, D, E, and G replicates. An 18% layer ration having 4.85% fiber, 874 Cal/lb and containing high energy fat of 1.5% of the total ration is being fed to H replicate; the Cal/lb has been reduced by 40 and the fiber increased by 0.92% to determine effects on preventing the fatty liver condition in cage layers. A 17% all-mash layer ration, having 3.2% fiber and 916 Cal/lb, that was used for the recently completed Second Cage Test, is being fed to replicate K. A comparison of the three different layer rations and the effects of low lysine grower ration will be made.

More growout management practices on replacement pullets for future cage tests will be carried out.

Fig. 342—Loading turkeys for delivery to processing plant.
Fig. 343—Chick van in front of modern hatchery.
Fig. 344—Truck (left) for bringing hatching eggs to hatchery and van for delivering poults to turkey growers.
Fig. 345—Loading turkey hatching eggs on a plane in California for shipment to Missouri. (Photo courtesy Flying Tiger Line.)
Fig. 346—Unloading eggs at egg breaking plant.
Fig. 347—Unloading turkeys onto the processing line.
Fig. 348—Unloading turkeys from trucks and hanging by shackles on slaughtering line.
Fig. 349—Driving turkeys into Zebarth loader. Truck partly loaded.

Services by Industry

Individual firms, cooperatives, and corporations provide many of the services needed by the poultry industry.

Transporting Missouri Products

In Missouri, there are approximately 12 million turkeys, 100 million dozen eggs, and 20 million chickens to be transported to market annually. There are also about 10 million poults and 40 million chicks to be transferred from Missouri hatcheries to the producers. More than one billion pounds of feed is required to produce these products. To move these products, feed, and supplies requires and supports a large transportation industry.

Most of these products are now moved by truck, but rail and water transports are used occasionally. Highly perishable, and more valuable products, such as hatching eggs, chicks, and poults, are moved by air.

Movement from the Farm

Eggs, broilers, chickens, and turkeys are moved from the farms (point of production) to processing plants by trucks. Small trucks may move the eggs from small production units, however large insulated or refrigerated trucks are used to move the shell eggs from the larger farms to the processing plants. Broilers and turkeys are produced in large flocks and are transported in specially constructed trucks from farms to processing plants.

Movement of the finished products from the processing plants is usually by refrigerated truck. However, car lot rail shipments are used by processors to move frozen products to customers located on the coasts or in other distant locations.

Tank trucks are used to move liquid eggs from breaking plants to drying plants.

Poultry and Egg Storage

Dressed poultry and eggs are stored in public and private warehouses. Some private processing plants can store as much as 3,500,000 pounds of frozen poultry at one time.

A 1966 survey of the 15 Missouri public refrigerated warehouses (10 reporting) showed that shell eggs are no longer stored in these warehouses. Until 1950, thousands of cases of shell eggs were stored in these warehouses each year. The storage of eggs has shifted to egg products, primarily frozen eggs.

Table 1. shows that large quantities of frozen eggs are held under refrigeration throughout the year, but there is a seasonal pattern in these holdings with a peak in July, and a low in February.

Since turkey production in Missouri has increased in recent years, and now exceeds 200 million pounds annually, the storage of frozen turkeys has increased accordingly (see Table 1). The storage pattern in turkeys is also quite seasonal with a build-up as the marketing season advances from June to November. The peak storage of turkeys in 1966, was in November, when there was 16 million pounds of dressed turkey in storage. It should also be noted that large quantities of turkey parts and further processed turkey products are held under refrigeration, especially in private processing plants.

The storage of frozen chicken in Missouri warehouses has declined in recent years, but as shown in Table 9, nearly five million pounds was held in public storage warehouses in November, 1966.

The total revenue derived by public refrigerated warehouses from the storage of poultry and egg products was estimated for 1966 to be near $500,000. Storage charges

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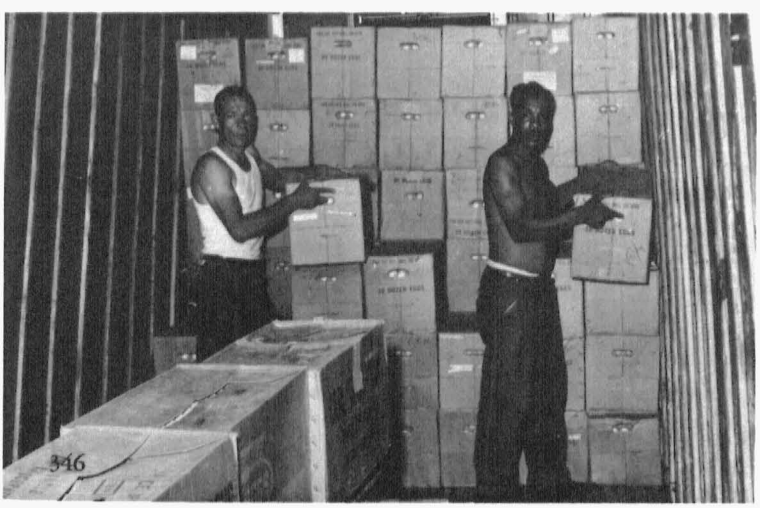
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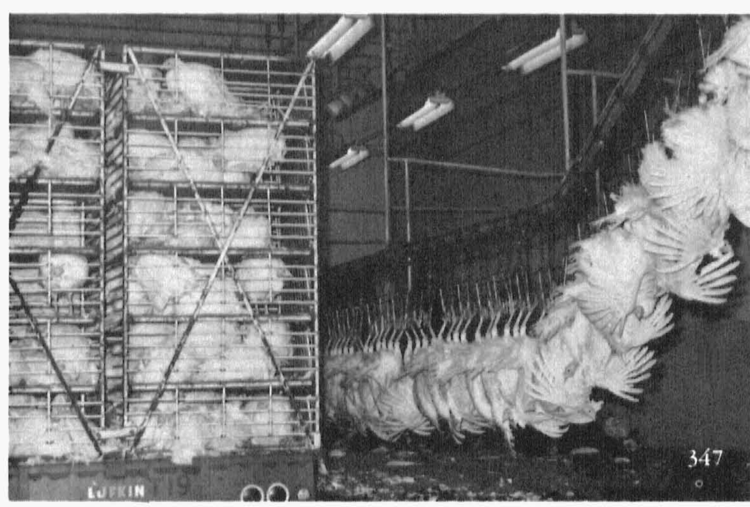

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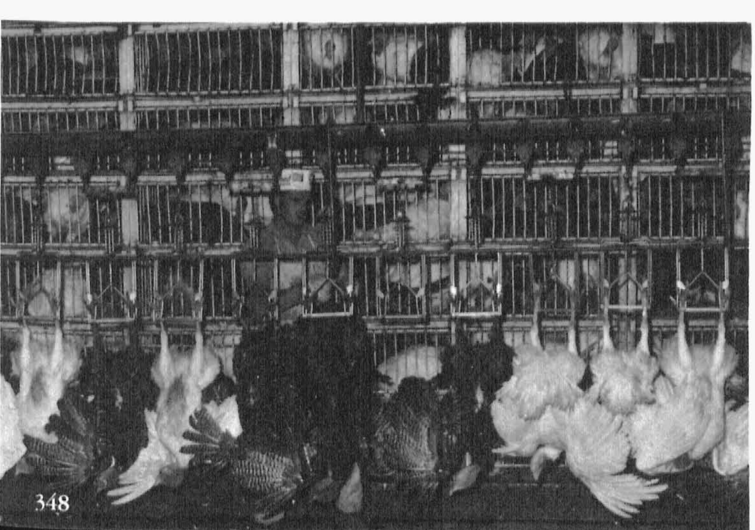
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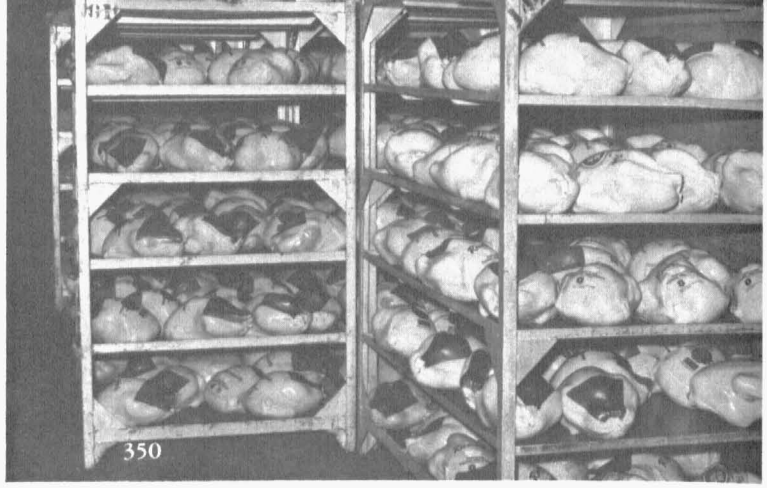
for 1967 listed by a representative public refrigerated warehouse were:

Eggs, frozen, per 100 pounds	Handling in and out	storage per month
Less than 100 lbs.	.38	.30
1,000—4,999	.32	.25
5,000—14,999	.26	.20
15,000 lbs. or more	.24	.19
Dried eggs in cooler, per 100 pounds		
Less than 2000 lbs.	.40	.25
More than 2000 lbs.	.27	.21
Poultry in boxes or barrels, per 100 lbs.		
Less than 1000 lbs.	.55	.50
1,000—4,999	.42	.33
5,000—14,999	.35	.27
15,000 lbs. or more	.34	.24

Table 9 POULTRY PRODUCTS STORED IN MISSOURI PUBLIC WAREHOUSES, 1966
(10 of 15 warehouses reporting)

POUNDS HELD IN STORAGE BY MONTHS
(If none please write none and return)

	Chickens	Turkeys	Eggs Frozen	Eggs Shell	Eggs Dried
January	3,254,474	10,424,790	2,125,374	0	127,472
February	2,451,502	8,770,680	1,416,509	0	99,938
March	1,541,096	6,259,993	1,631,067	0	145,013
April	1,282,769	4,048,008	1,672,491	0	166,120
May	1,226,344	2,886,086	2,613,314	0	196,481
June	1,208,880	1,740,402	3,727,560	0	289,901
July	1,342,083	2,648,198	4,255,821	0	313,129
August	1,851,866	5,600,774	3,699,671	0	244,758
September	2,594,844	10,425,854	3,476,286	0	161,380
October	4,270,258	14,948,382	3,430,907	0	148,793
November	4,697,603	15,928,795	3,034,682	0	98,982
December	3,911,985	15,124,106	2,557,122	0	75,570
TOTAL	29,633,704	98,806,068	33,640,804		2,067,537
Average	2,469,475	8,233,839	2,803,400		177,254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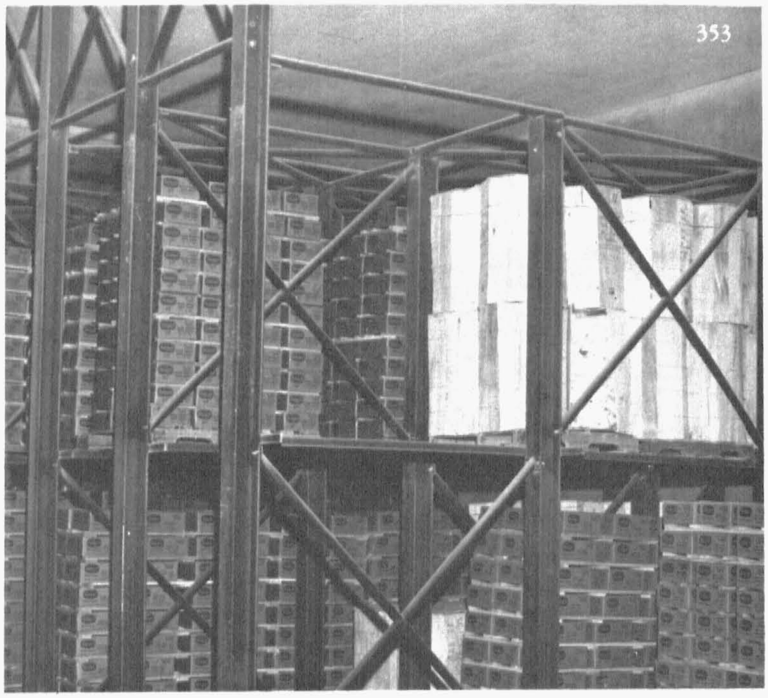
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Financing the Poultry Industry

Every industry has its financial problems, and the poultry industry is no exception. Though poultry and eggs are basic foods, used by almost every family, the price situation in recent years has caused bankers to be very cautious in making loans to poultrymen. U. S. Government agencies, such as Production Credit, have been more friendly, but the egg and turkey prices that prevailed in 1967, have caused PCA to have second thoughts about all but the most secure loans to poultry producers. This reluctance on the part of financial agencies to finance poultry loans has resulted in financing from feed companies and other firms with financial backing finacing and otherwise integrating the industry.

An industry that returns to producers of Missouri 80 to 90 million dollars annually and generates approximately 300 million dollars of business each year requires millions of dollars of financing from bankers, firms, U. S. government agencies, and individuals. The cost of financing poultry production and marketing represents an important part of the price of the final product as purchased by the consumer. Anything that can be done to reduce these costs will benefit the producer and consumer.

Utility and Service Needs

The poultry industry of Missouri requires the utilities needed by all industry: water, electricity, gas, telephone,

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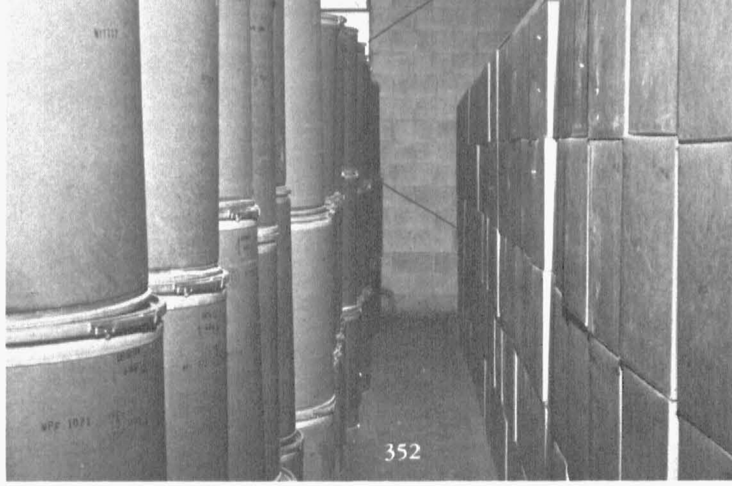
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Fig. 350—Partially frozen turkeys being held in storage to complete freezing.
Fig. 351—Egg solids (flake albumen) storage in fiberboard containers, Training Egg Products co., Kansas City.
Fig. 352—Storage of dehydrated egg products, Henningsen Foods Inc., Springfield.
Fig. 353—Storage barrels and turkey products (boxes).

telegraph, postal service, etc. A large processing plant may use 1½ million gallons of water in one day and 30,000 k.w.h. of electricity. If one assumes 200 days of operation, 300 million gallons of water, and 6 million kilowatt hours of electricity would be used by one poultry processing plant in one year. Though only an estimate, the 1967 production of poultry products required approximately 365 million gallons of water; 120 million gallons of water to produce 120 million dozen eggs, 29 million gallons of water to produce 20 million broilers and 225 million gallons of water to produce 11.5 million turkeys. These production estimates do not include wastage and water used in cleaning.

Since the industry has become highly automated, it uses large amounts of electrical energy. It is also estimated that Missouri producers use one million dollars of electricity in producing eggs, broilers and turkeys. Enclosed buildings require a dependable source of electric power. Stand by units are necessary in such operations as hatcheries and large cage layer set ups to avoid serious losses from current interruptions.

Most of the gas used for brooding and other farm operations is bottled propane gas. Processing plants, feed manufacturers, and other poultry industrial groups use natural gas. It is estimated that Missouri poultry producers use one million dollars of fuel annually.

Poultry Industry Stimulates Related Activities

There are several activities that are closely related to and associated with the poultry indutry, such as chicken barbecues, poultry exhibits, conventions, poultry journals, and trade associations.

Chicken Barbecue Popular

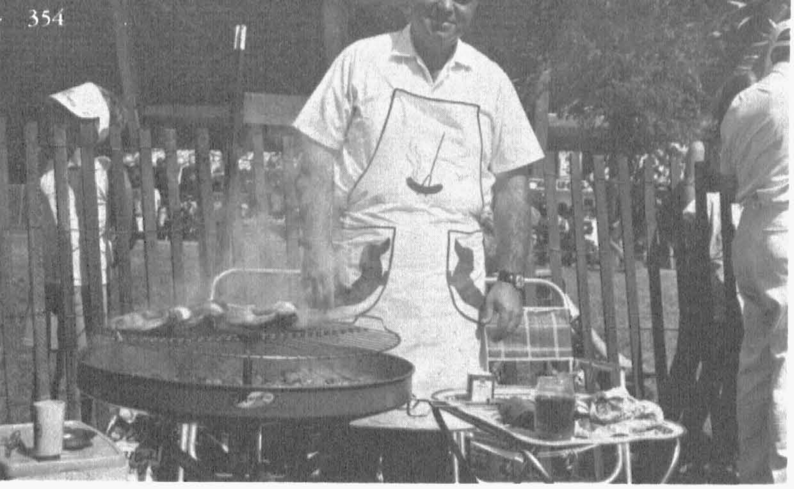
Thousands of back yard chicken barbecues are held each summer in Missouri. Chicken is the most popular meat for backyard barbecues.

The chicken barbecue has developed into a fund raising enterprise for many charitable projects. The Missouri State Fair has developed a chicken barbecuing contest that attracts 15 to 20 contestants each year and several thousand spectators. $300 in cash prizes and 8 trophies are offered contestants in this contest (Fig. 354).

Anyone interested in barbecuing chicken should secure a copy of Folder No. 23 from the Missouri Agricultural Extension Service.

Poultry Shows Disappearing

Poultry shows, which were once held in most Missouri counties, have almost disappeared. Poultry is exhibited at the Missouri State Fair and some products are shown. The showing and judging of fancy or exhibition poultry was once a hobby for thousands of Missouri people, but few people now exhibit the larger strains of poul-



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try. Some Bantams and pigeons are grown and shown by fanciers of these species. Figures 355 and 356 show two famous international judges of Bantams and pigeons who live in Missouri.

Many Poultry Conventions

Missouri, with a central location and two large cities, is favored by many organizations for holding conventions. More national poultry meetings are held in Missouri than in any other state.

The Poultry Fact Finding Conference sponsored by the Institute of American Poultry Industries is held in Kansas City, each February. This convention attracts 4 to 5 thousand people from the United States and many foreign countries (Fig. 357). The American Poultry and Hatchery Federation hold their conventions in Missouri (St. Louis or Kansas City) in a rotation system, visiting different regions of the U.S. Their attendance is about 3000. The National Turkey Federation follows the same system. They held their Convention in St. Louis in 1958, and again in 1968. The attendance at this convention is usually about 3000.

The Missouri Poultry Improvement Association, which includes the Missouri Turkey Federation, Missouri Egg Council, and the National Poultry and Turkey Plan Breeders and Hatcheries hold an annual convention each year. In recent years it has been held in Springfield, with an attendance of 300 to 500 (Fig. 358).

Poultry Journals

In Missouri, as throughout the nation, many specialized poultry journals were started from 1885 to 1925 when poultry was raised on 90 percent of the farms in the state. Table 10 lists the Missouri journals and the year they were founded. None of these journals existed as late as 1940. The journals with national circulation replaced these local journals.

Poultry and Egg Weekly published in Kansas City, has a national circulation.

Trade or association publications have found a place with the modern industry. The APHF News, published by the American Poultry and Hatchery Federation, Kansas City, has widespread National circulation.

The Missouri Turkey Federation, Columbia, publishes a quarterly publication, "The Missouri Turkey News," and the Missouri Egg Council publishes the "Missouri Poultry and Egg News."

Articles about the Missouri poultry industry appear frequently in the *Missouri Ruralist,* Fayette, The *Missouri Farmer,* Columbia; *Kansas City Star,* and the *St. Louis Post Dispatch.*

In 1968 the number of poultry journals with national circulation is less than one dozen, and most of them are published by one firm.

Table 10 POULTRY JOURNALS PUBLISHED IN MISSOURI

(From O. A. Hanke's B.S. degree thesis, U. of Wisc. 1926--A History of American Poultry Journalism 1870-1926)

Year	Name	Location
1885	Nest Egg	Burlington Jct., Mo.
1886	Poultry Record	St. Louis, Mo.
1891	Poultry Topics	Warsaw, Mo.
1897	Poultry Culture	Kansas City, Mo.
1898	Record	Macon, Mo.
1899	Poultry and Belgian Hare Standard	Kansas City, Mo.
1900	Orff's Farm and Poultry Review	St. Louis, Mo.
1902	Mid-West Fancier	Kansas City, Mo.
1903	Ladies Poultry Journal	Moberly, Mo.
1909	Useful Poultry Journal	Trenton, Mo.
1913	Central Poultry Journal	Kansas City, Mo.
1916	Outdoor Enterprises	Kansas City, Mo.
1920	National Poultry and Stock Journal	St. Louis, Mo.
1925	Standard Poultry Journal	Pleasant Hill, Mo.

Trade Organizations

Trade organizations are national or state, and usually organized around a commodity. The National Poultry organizations, with members in Missouri, are the American Poultry and Hatchery Federation, the National Turkey

Federation, National Egg Council, Institute of American Poultry Industries, and American Feed Manufacturer's Association.

State Poultry organizations in Missouri work together through the Missouri Poultry Improvement Association, which was incorporated in 1928. This Association includes the four organizations of the Missouri Turkey Federation, the Missouri Egg Council, and the National Plan Chicken Hatcheries and Dealers, and the National Turkey Hatcheries and Breeders.

The activities of these groups include those things that affect their particular business or interest.

National Improvement Plans

Missouri has participated in the National Poultry Improvement Plan and the National Turkey Improvement Plan since their respective beginnings in 1935 and 1943. In fact, Missouri had state poultry improvement plans as early as 1920 when the Agriculture Extension Service initiated a project known as Certified Poultry Breeding.

Since about 1928, poultry improvement work has been supervised by the Missouri Poultry Improvement Association. The official State Agency, an MPIA Committee, is recognized as the agency that cooperates with the United States Department of Agriculture in administering the National Poultry Improvement Plan, and the National Turkey Improvement Plan in Missouri.

Though the number of hatcheries and flocks participating in the National Plans has declined in recent years, in 1967 Missouri produced, under the supervision of these plans, approximately 10 million poults and 40 million chicks.

These plans are essentially disease control plans with the emphasis in chickens being on S. pullorum, S. Gallinarium (typhoid) and PPLO. In turkeys these programs try to control S. typhimurium, as well as the above diseases.

The turkey flocks qualified as US Pullorum-Typhoid Clean, U.S.M. Gallisepticum Tested, and as participating

Fig. 354—A contestant in the State Barbecuing Contest at the Missouri State Fair, 1968.
Fig. 355—L. E. Hummel, Columbia, internationally famous judge of pigeons, examing some of his Swallow pigeons.
Fig. 356—John Wunderlich judging a Sebright Bantam.
Fig. 357—Some of the 5000 people attending Poultry Fact Finding Conference, Kansas City, Mo., Feb., 1968.
Fig. 358—Missouri Egg Breakfast at the Missouri Poultry Convention.

in the U.S. Typhimurium Control Program. The chickens, ducks, and geese qualified as U.S. Pollorum-Typhoid Clean.

Improvement Assn. Activities, 1967

The Missouri Poultry Improvement Association, supervises the National Poultry Improvement Plan in Missouri. The Association tests 15 percent or more of the flocks for each hatchery, making hatchery inspections during the hatching season, supplying the hatcheries with materials, labels, etc. In 1967, Missouri had 51 hatcheries, 1051 flocks, and 550,177 birds under the program. Monthly and yearly reports were made to the USDA office in Washington on all hatchery participation.

A short course for selecting and testing agents was held.

The MPIA cooperated with the American Poultry Hatchery Federation National Convention held in St. Louis, and maintained a booth; collected all APHF memberships in Missouri for the National Office; kept records and forwarded checks and records to APHF in Kansas City.

Cooperated with the Missouri Egg Council and Missouri Turkey Federation in the quarterly magazines, and published hatchery information in these publications, as well as yearly listing of all hatcheries and breeds of chicks they sell.

Held a State Convention in Springfield in October.

The MPIA also supervised the operation of hatcheries and breeders operating under the National Turkey Improvement Plan by inspecting their flocks and hatcheries twice each year, and supply them with bands, labels, and other supplies. In 1967, Missouri had 15 hatcheries and breeders with 99 flocks and 201,192 birds under the program. MPIA made monthly and yearly reports to Washington, and held two board meetings (and often in connection with Missouri Turkey Federation board meetings.)

Cooperated with the National Turkey Federation National Convention in January, 1968, and had a booth at the Convention - helped with the dressed turkey show, ladies luncheon, etc.

Collected National Turkey Federation funds in Missouri for the 17th year.

Egg Council Activities, 1967

1. Sponsored Missouri Egg Day at University of Missouri.
2. Received annual memberships in the Missouri Egg Council and sent certificates.
3. Conducted new membership campaign by mail and via officers of the five districts of the Council.
4. Published and mailed four issues of the Missouri Poultry & Egg Magazine, secured advertising, and maintained mailing list.
5. Cooperated with Poultry and Egg National Board.
6. Initiated the 2 cent check-off program (for each 30 dozen cases of eggs) to raise funds for the activities of the Council—acknowledged receipt of all such funds, kept books, issued certificates, etc.
7. Helped sponsor a booth at the American Poultry & Hatchery Federation Convention in St. Louis in July —passed out literature and badges reading "I'm From Missouri."
8. Cooperated with the State Department of Agriculture-Marketing Division and Egg Division.
9. Sponsored annual Missouri Egg Show and annual Missouri Egg Breakfast at the Missouri Poultry Industry Convention in Springfield in October, and had speakers on the program of the Convention.
10. Sponsored Farm Bureau booth at their annual meeting —passed out literature and hard cooked eggs (compliments Chesterfield Farms.)
11. Held meetings in Columbia, Springfield, Kansas City, Mtn. Grove, St. Louis, and Jefferson City.
12. Cooperated with the Governor's Conference in Jefferson City. The Missouri Egg Council president was appointed by the Governor to a 21-man committee of Missouri leaders in agriculture.
13. Wrote letters, kept books, and performed the general activities of the Council.

Turkey Federation Activities, 1967

1. Sponsored Missouri Turkey Day Program-University of Missouri. Held annual meeting and election of officers.
2. Initiated new membership campaign to cover all segments of the industry. Prepared forms, records, etc., for same. Prepared certificates and sent to all cooperators.
3. Sponsored National Turkey Federation Convention in St. Louis, January, 1968. Helped with registration, turkey show, ladies luncheon, youth career program, largest turkey exhibit, etc.
4. Sponsored Junior Market Turkey Show at State Convention. Contributed trophies, cash awards, and ribbons of approximately $1,000. Secured speakers for program, etc.
5. Cooperated with Market News Service of State Department of Agriculture.
6. Cooperated with Governor's Conference in November, 1967, in Jefferson City. The Missouri Turkey Federation President was appointed to a 21-man committee by the Governor.
7. Held 6 board meetings in January, May, August, October, and December.
8. Published 4 issues of Missouri Turkey News Magazine. Obtained advertising to support same. Maintained mailing lists, etc.
9. Wrote letters, kept books, and carried on the general business of the Federation.

Other Poultry Programs

Those programs related to poultry that are difficult to classify are discussed under miscellaneous.

Poultry Aid Research

Eggs, chickens, and pigeons being relatively small and inexpensive have found a unique place in basic research. Medical and biological research has been conducted with eggs (embryos), chicks, growing chickens, and laying hens. More is known about poultry nutrition than the nutrition of any of the larger species, including man. The first research with vitamins was done with pigeons. C. Funk, in 1912, discovered that polyneuritis in pigeons was caused by a deficiency of a substance he named "vitamine". Pigeons fed polished rice developed polyneuritis, which he was able to "cure" by administering a substance he extracted from rice polishings. This substance is now known as B_1 or Thiamine.

1. Optimum Ratios of Nutrients

Nutrients are to be present in the diet in both their respective required levels and, in some particular ratio. The ratios of protein to energy arginine to lysine, anions to cations, Ca:P ratios, etc. Chicks have been used extensively in investigating the proper ratios of protein to energy, arginine to lysine, anions to cations, Ca:P ratios etc.

2. Metabolic Interrelationships

The metabolic interrelationships of various nutrients have been worked out by using chicks as experimental animals. Excess of calcium or phosphorus, excess of vitamin D, role of phytic acid on utilization of phosphorus, calcium, zinc, excess of unsaturated fatty acids and vitamin E, interrelationships of copper and molybdenum, and of selenium and vitamin E, excess of vitamin A, etc., have been active fields of research in the past few decades.

3. In Basic Biochemistry

In investigations on problems of DNA and RNA in biochemistry and purine biosynthesis avians have played pivotal roles. Pigeons have been used in studies on purine biosynthesis by Buchanan and also by Kornberg.

Examples of basic research using avian species in the field of vitamins are:

B-Complex

Chickens were the first animals to be used experimentally in vitamin B-complex studies. Eijkman (1890) observed beri beri—like paralysis in chickens fed the scraps from a hospital kitchen. Six years after he reproduced this condition by feeding polished rice to fowls. This condition was named by him as "polyneuritis gallinarum". In 1911, C. Funk published series of papers on the isolation from rice polishings of the substance which is responsible for curing beri beri. This substance was supposed to be an amine and hence Funk named it as "vitamine" - organic substance indispensable for life. The final "e" was deleted after it was known that all vitamines are not amines.

Panthothenic Acid

A "Chicken antidermatities factor," which is necessary for restoring growth and preventing dermatities in chicks maintained on a diet of heated grains, was found.

Folic Acid

In 1931, Lucy Wills observed macrocytic anemia of pregnancy in women in India. She also reproduced this nutritional deficiency in monkeys. Because of difficulties of assay in man and monkeys, little progress was made in concentrating the active factors. The discovery of vitamin B_c (chick antianemia factor), by Dr. A. G. Hogan and collaborators at the University of Missouri in the early forties, speeded up isolation work of folic acid which was accelerated by the application of microbiological methods.

Vitamin K

Vitamin K was first discovered by research with chicks. In the late 1920's, Dam observed a hemorrhatic syndrome in chicks raised on a diet low in lipids. In 1935, he named this fat-soluble vitamin K.

4-H Members Carry 271 Poultry Projects

In 1967, 271 poultry projects were successfully completed by Missouri 4-H members. One hundred twenty-nine adults provided leadership. The breakdown of projects and participation is as follows:

Project	No. Members	No. Leaders
Bantam	12	8
Broiler	47	18
Ducks & Geese	14	6
Flock Management	24	14
Pigeons	6	3
Quality Eggs	23	11
Turkeys	25	9
Young Stock	89	43
Science		
a. Force Molting	25	12
b. How Feathers Grow	6	3
Total	271	129

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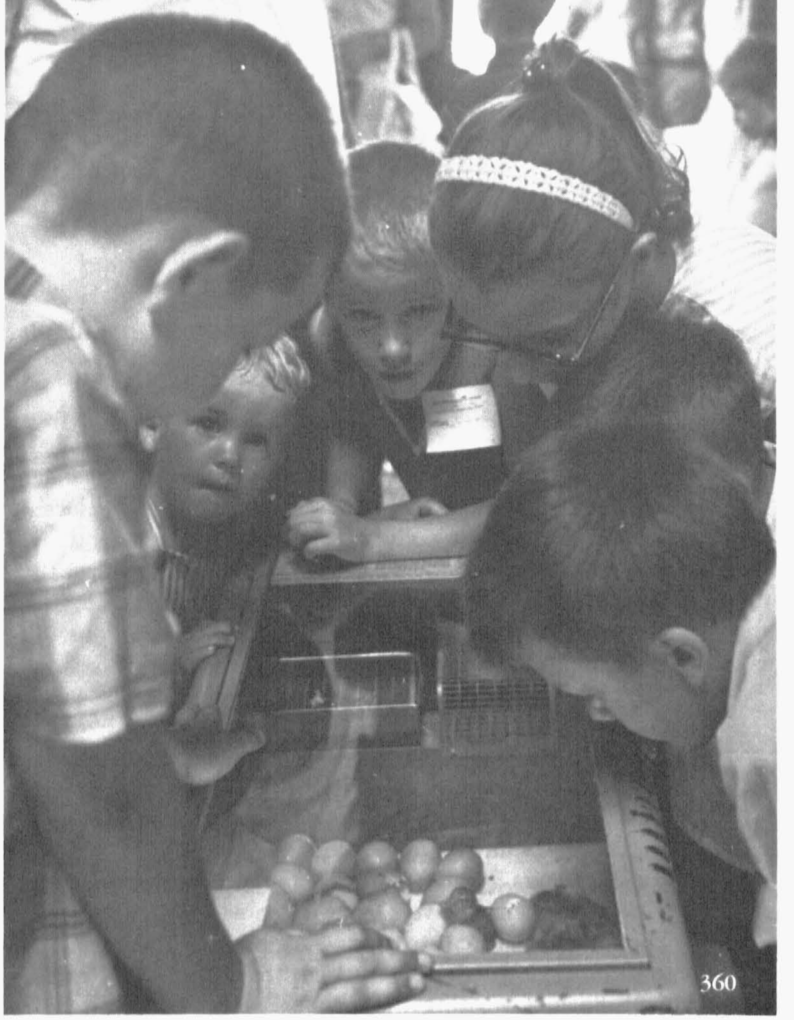

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Fig. 359—4-H Club poultry judging team.
Fig. 360—The hatching of an egg interests people of all ages. FFA Exhibit at the Missouri State Fair, 1968.
Fig. 361—Youth poultry tour sponsored by the Springfield Chamber of Commerce and the Missouri Agricultural Extension Service.
Fig. 362—Handicapped young people care for laying hens. (Courtesy Woodhaven Christian Home, Columbia)
Fig. 363—Wall paper with poultry pattern.
Fig. 364—Eggs decorated with Christmas scenes. Two larger eggs on the left are goose eggs, the egg on the right is a turkey egg, and the small one is a quail egg.

In addition to project work, many youth take part in 4-H activities designed to increase their interest and appreciation of the poultry industry. Such activities include poultry judging on a local, county, state, and national level. The four top individual judges in the state contest represent Missouri in the National 4-H Poultry Judging Contest in Chicago each fall.

A Junior Market Turkey Show is held each year for 4-H and FFA members. Ribbons, trophies, and cash awards, made possible by contributions from industry members, are presented during the Turkey Banquet at the Missouri Poultry Industry Convention in Springfield. Twenty to 25 youths enter the show annually.

Four 4-H delegates, selected on the basis of excellence in project work, represent Missouri at the Annual Jr. Poultry & Egg Fact Finding Conference in Kansas City. Four FFA delegates from Missouri also attend this excellent careers meeting. The St. Louis Butter, Egg and Poultry Exchange sponsors the 4-H delegation. Industry members, through contributions to the Poultry Youth Fund, make possible many of these activities young people enjoy.

The major objective of 4-H poultry work is to stimulate interest in young people for careers in the poultry and related industries and to help boys and girls acquire new skills, experiences, and knowledge by completing a poultry project.

Poultry Science Projects

Young people, teachers, and youth leaders can develop exciting and challenging educational projects using eggs, chicks, and mature birds. Such projects deal with living breathing organisms. They can be used to demonstrate in a simple, inexpensive way, processes, activities, and phenomena of life common to many species.

The egg and chick are easily available and are inexpensive. They are small and ideal for young people to work with, yet large enough to be seen and understood by all involved.

The variety of science projects that have and can be developed is tremendous. Some of the more popular projects deal with the formation and fertilization of the egg, embryology, hatching chicks, building incubators, preserving embryos at various stages of development, and displaying living embryos. Young people are fascinated with demonstrations of hatching chicks (see Fig. 360).

Other science projects deal with studies of the feather molting of young and mature birds, the social behavior of

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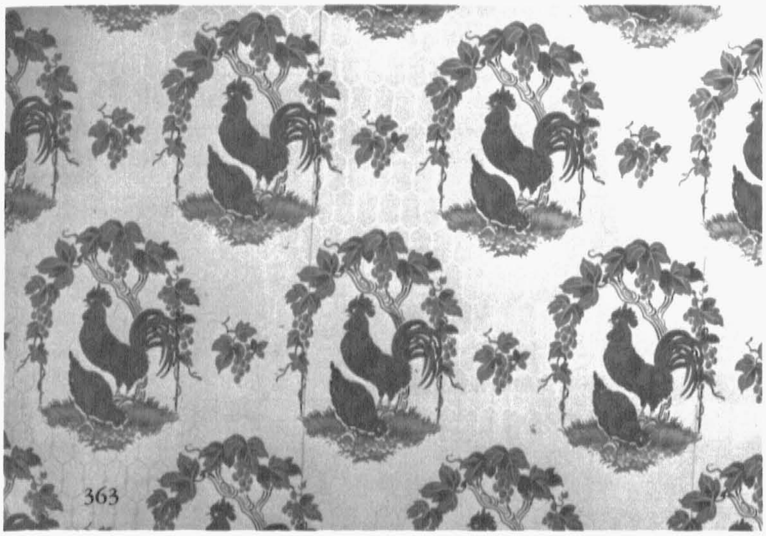
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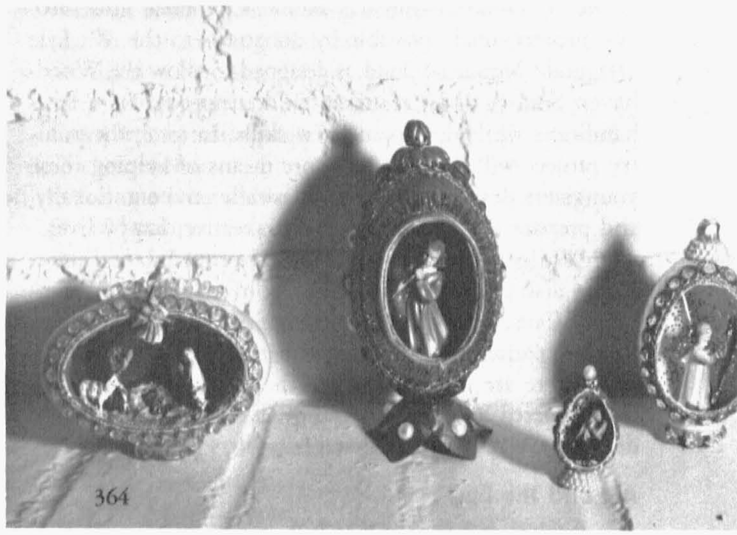
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birds, nutritional disorders due to deficiencies, pigmentation of body tissues, the source of color in egg yolk, skeletal development and function, genetics of the fowl, and color vision of the chicken.

Teachers, youth leaders, and young people themselves can develop poultry science projects, demonstrations and experiments suitable for use in the classroom, at home, or on the farm. Helpful materials and suggestions are available from many sources. Contact your University Extension Center or University Poultry Department. You will find the staff anxious to provide the information you need.

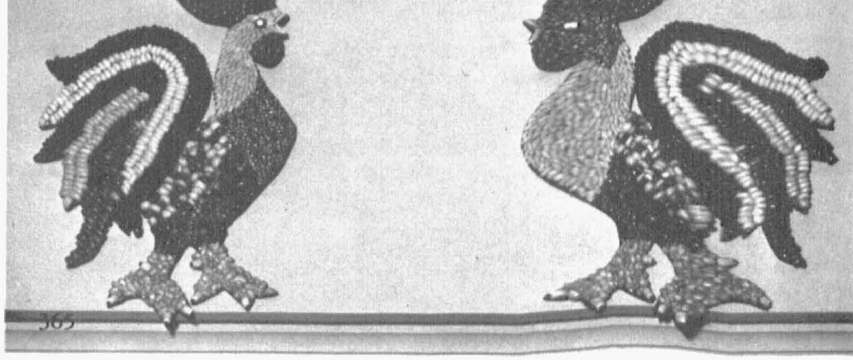
Take Youth on Tours

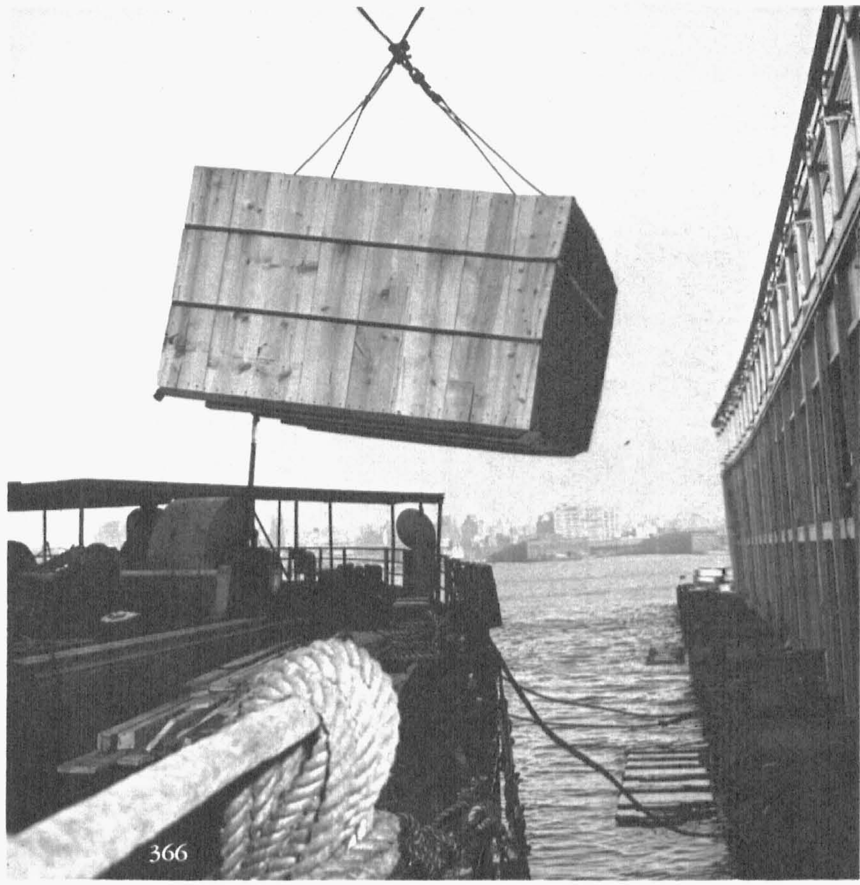
Since poultry production has become large scale and commercialized, and has largely disappeared from the Missouri general farm, youth, including farm-reared people, generally are not acquainted with the industry and the opportunities for a rewarding career in this industry. If this industry is to be serviced by trained personnel, it is necessary to acquaint youth with the industry and its personnel requirements.

The Missouri Poultry Extension Specialists, in cooperation with industry groups, have conducted several tours for youth to acquaint them with this industry. The Poultry Committee of the Springfield Chamber of Commerce, in 1965, 1966, and 1967, financed a tour of the poultry industry of that area for high school students. Each year a 36-passenger Greyhound bus was chartered and students recommended by the Vocational Agriculture teacher and County Youth Agents were shown, not only good production practices, but also the feed industry, poultry and egg processing industries, and equipment manufacturing. The students were lodged at the Holiday Inn in Springfield, and provided a banquet and other meals for two days. They also attended the Poultry Day program at Southwest State College.

The Poultry Department of the University of Missouri, in cooperation with the Colonial Poultry Farms, in 1967, arranged for a bus load of students from Stockton and Eldorado Springs, accompanied by their Vocational Ag. teachers, to attend the Poultry Fact-Finding Conference in Kansas City. The Salsbury Laboratories provided a luncheon for 40 students and teachers in this group.

Youth tours acquaint young people with the poultry industry and should have some impact on careers selected by these youth.





Fi. 365—Wall plaques made with colored grains.
Fig. 366—Loading Missouri produced poultry processing equipment for export. (Courtesy the Port of New York Authority)

Use in Training Handicapped

Poultry and eggs, being relatively small and easy to handle, are ideal for training the handicapped. There are many kinds of jobs involved in the management of the poultry flock and the marketing of eggs that provide varied training and work experiences for the young and adult alike. The poultry house may also serve as a laboratory for providing therapy for the mentally and physically retarded child. The income from eggs laid will maintain the flock.

A modern egg production unit has been established at the Woodhaven Christian Home, Columbia. This 1400-hen project, made possible by donations to the W. Lyle Fitzgerald Memorial Fund, is designed to allow the Woodhaven Staff to assist retarded children to overcome their handicaps while developing new skills. In total, the poultry project will provide one more means of helping these youngsters develop mentally, physically, and emotionally, and prepare them for more useful, creative, happy lives.

While this use of poultry is in the experimental stage, it may also prove to be of real value in mental health programs. The results to date are promising and the program needs expansion and further evaluation.

There are instances where the blind and those who have suffered loss of limbs and other serious physical handicaps have developed profitable poultry projects.

Art and the Egg

Poultry and eggs appear in many paintings and other arts over the centuries antedating recorded history. Hieroglyphics in the ancient tombs of Egypt pictured hens roaming the grounds of kings who ruled 5000 years ago. Eggs have been associated for many centuries with religious ceremonies at Easter and Christmas.

Members of the Russian Orthodox Church in St. Louis have revived the art of decorating eggs. See Globe Democrat, St. Louis, March 26, 1967, for their beautiful decorations.

See Figures 363-65 for other artistic uses for eggs and poultry.

Missouri Poultry Exports

Though exports of Missouri poultry products and equipment to other countries constitute a relatively small percentage of the total production, some Missouri firms have developed important export outlets for their products. Missouri firms, such as Ralston Purina, have exported their "know how" of manufacturing poultry feed to many foreign countries by building and operating feed manufacturing plants around the world. Other Missouri feed manufacturers have developed markets for poultry feedstuffs in many foreign countries.

Missouri poultry breeding stock is shipped as hatching eggs and chicks to other countries. Turkey hatching eggs and poults are shipped to Canada and possibly other countries.

Dehydrated poultry and egg products are exported by Missouri firms to countries in Europe, Asia, Central and South America, and Canada.

The manufacturers of equipment have been most successful in developing foreign markets especially for poultry processing equipment. The Gordon Johnson Company of Kansas City have installed poultry processing equipment in most countries of the world. They also export incubators. Ralph Zebarth, Inc. Kansas City, has also developed an export market for poultry processing equipment.

The Leahy Manufacturing Co., Higginsville, have exported small incubators to South America, India, and South Africa.

Some Missouri firms report their export business as increasing, whereas others report a decline in business, or even discontinuance of exports because of the competitive price situation and transportation costs.

Figure 366 shows poultry processing equipment made in Missouri being loaded on ship in Hoboken, N. J.

Chester B. Franz, an exporter of Missouri poultry products, in August, 1968, reported the following exports:

1. Whole consumer turkeys (Europe)
2. Turkey thighs, drumsticks, legs (Europe)
3. Boneless turkey meat (Europe)
4. Fryer drumsticks and legs (Asia)
5. Whole fryers, fryer wings (Europe)
6. Turkey and fowl livers (Europe)
7. Duck feet (Asia)
8. Roasters, capons, fryer breasts (Pacific Islands)
9. Military sales for use overseas—mainly fryers, stewing hens, turkeys, boneless turkey rolls, shell, frozen, and dried eggs.
10. Relatively small quantities of further processed turkey rolls, roasts, canned whole fowl, canned boneless meat and specialty items to all continents for use or resale mainly to Americans.

The American custom of "eating out" has created a demand for meals served in restaurants and to "take out". A number of chicken restaurants have been developed and organized into chains under a franchise system. The Kentucky Fried Chicken franchise is one of the older nationwide chains that has been developed. The AQ Chicken House is a more recent franchise of this type. There are a number of these chains; some believe this phase of the poultry industry has over expanded. However, there are many communities where fried chicken restaurants could be established and operated at a profit.

The cost of a franchise is in some cases between $5,000 and $6,000 plus 5 percent of the gross receipts each month. The services provided with the franchise are listed by one firm as:

1. Franchise protection within agreed territorial limits.
2. Complete training for yourself (or your designated manager) in all phases of your new business.
3. Help in selecting and leasing the most desirable location and in adapting building design to your site.
4. Distinctive building design, professionally planned for efficient operation, complete with signs.
5. Complete operating equipment—including a special chicken cooker.
6. A full operating manual together with one year's supply of business cards and stationery.
7. Help with licenses, purchasing, bookkeeping, public relations, etc.
8. A success-tested Grand Opening Celebration promotion package, plus supervision during Grand Opening Week—and after.
9. Savings through mass purchasing power.
10. The right to all innovations and/or improvements adopted in the future.
11. A secret formula batter.

Fertile eggs are used in producing vaccines for both humans and animals. Chick vaccines can be produced at a minimum cost. They are especially desirable for producing vaccines for humans and other animals because they do not transmit diseases in the vaccine to these species. However, some contamination has occurred in producing poultry vaccines with chicken embryos and as a result S. Pullorum has been transmitted to clean flocks. Therefore, it is important that eggs used in producing vaccines for poultry be free of all diseases.

Fig. 367—George Bagby, APA judge, examining a Rhode Island Red female for APA standard qualities.

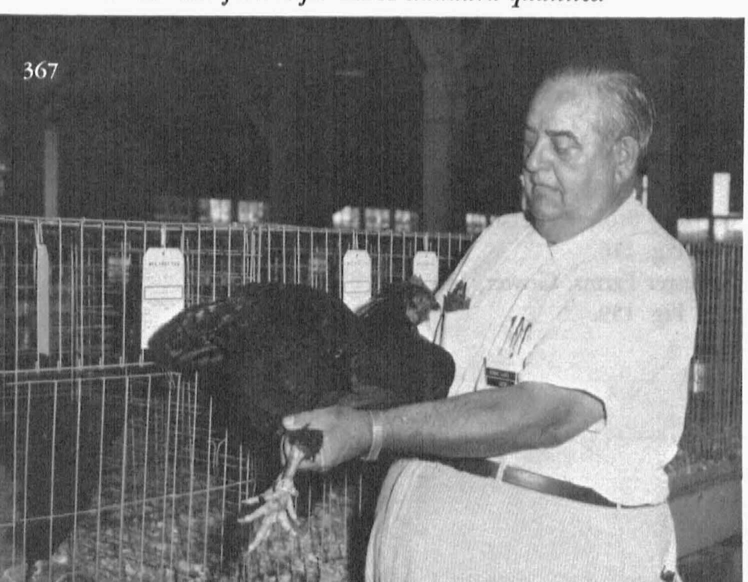
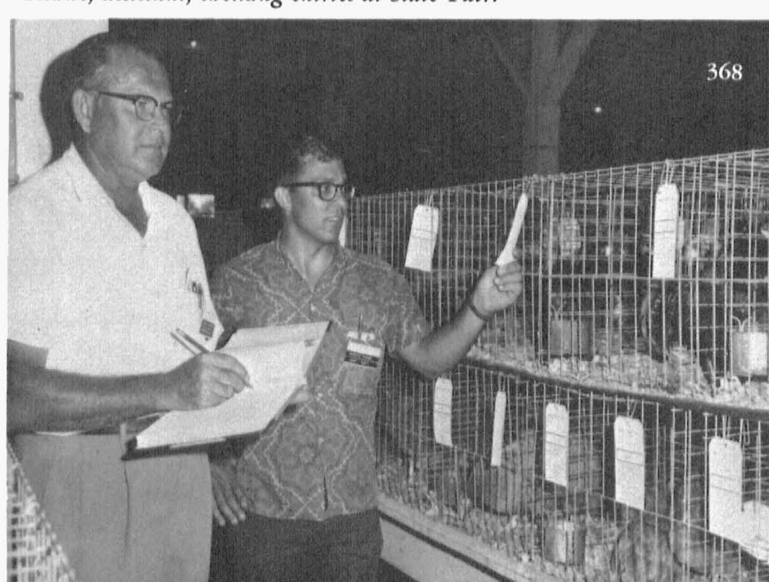


Fig. 368—Charles McElyea, superintendent and Harold Kohne, assistant, checking entries at State Fair.



PHOTOGRAPH ACKNOWLEDGEMENTS

The following individuals and firms gave permission to use photographs taken mostly by Andrew Tau, University photographer:

Bell Egg Farm, Joplin Mo.
Fig. 162, 163, 165, 177, 182.
Borron Turkey Farms and Hatchery, Winigan, Mo.
Fig. 24, 43, 45, 46, 53, 62.
Calhoun's Hatchery, Montrose, Mo.
Fig. 145, 147.
Central Missouri Turkey Hatchery, Inc., Eldon, Mo.
Fig. 37, 39, 42, 47, 48, 54, 59, 61, 342, 349.
Colonial Poultry Farms, Pleasant Hill, Mo.
Fig. 132, 133, 134.
Davis Bros., Pineville, Mo.
Fig. 339.
Elzea Egg Company, Vandalia, Mo.
Fig. 178, 186.
E-Z Roll Cart Co., Lamar, Mo.
Fig. 338.
Mrs. E. M. Funk, Columbia, Mo.
Fig. 363, 364, 365.
Hales and Hunter Co., Mexico, Mo.
Fig. 299, 300.
Mr. and Mrs. James Harrold, Montreal, Mo.
Fig. 157, 189, 190, 192.
Hill Turkey Hatchery, LaPlata, Mo.
Fig. 22.
Heart of Missouri Poultry Farm, Columbia, Mo.
Fig. 289, 290, 291, 292, 293, 294, 295.
Henningsen Foods, Inc., Springfield, Mo.
Fig. 197, 203, 216, 220, 222, 224, 225, 226, 227, 228, 352.
Lawrence Herman, Marshfield, Mo.
Fig. 173, 193.
Hoffman-Taff, Inc., Springfield, Mo.
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Dr. L. E. Hummel, Columbia, Mo.
Fig. 296, 297.
Institute of American Poultry Industries, Chicago, Ill.
Fig. 357.
George Jenkins, Versailles, Mo.
Fig. 51, 52.
Gordon Johnson Industries, Kansas City, Mo.
Fig. 329, 330, 331, 332, 333, 334, 335, 336.
Ken-Roy Hatchery, Berger, Mo.
Fig. 245, 246, 247, 248, 249, 250, 251, 252, 253, 254.
Koechner Mfg. Co., Tipton, Mo.
Fig. 340.
Kraft Foods, Marshall, Mo.
Fig. 209.
MFA Cage Layer, Research Farm.
Fig. 158, 166, 171, 172, 175.
G. Massie, Missouri State Department of Resources and Development.
Fig. 201.
Mexico Egg Ranch, Mexico, Mo.
Fig. 160, 161, 180, 181.
Missouri Poultry Improvement Association
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Mo-Ark Hatcheries, Inc., Neosho, Mo.
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Monark Egg Corp., Kansas City, Mo.
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Morrow Sales Co., Inc., Carthage, Mo.
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Morrow Milling Co., Carthage, Mo.
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Murphy Hatchery, Neosho, Mo.
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McDonald County, Pineville, Mo.
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Ray Neal, Noel, Mo.
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O'Brien's Poultry Processing Plant, Southwest City, Mo.
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Pay-Way Feed Co., Moberly, Mo.
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Port of New York Authority, New York, N.Y.
Fig. 366.
Poultry Experiment Station, Mountain Grove, Mo.
Fig. 341, 367, 368.
Producers Produce Company, Springfield, Mo.
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Ralston Purina, Co., California, Mo. and St. Louis, Mo. Mo.
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Ralston Purina Feed Mill, Montgomery City, Mo.
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Rose-A-Linda Turkey Farm and Hatchery, Concordia, Mo.
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Sav-mor Store, Jefferson City, Mo.
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Schuster Farms, Gower, Mo.
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W. B. Smith
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Smithton Industries Inc., Smithton, Mo.
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F. M. Stamper, Co., Macon, Mo.
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F. M. Stamper, Co., Milan, Mo.
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F. M. Stamper, Co., Moberly, Mo.
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F. M. Stamper, Co., St. Louis, Mo.
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State Veterinarians Office
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Stouts Feed and Supply Co., Inc., Richland, Mo.
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Swift and Company Hatchery, Dexter, Mo.
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Swift and Company Hatchery, Trenton, Mo.
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Tranin Egg Products, Co., Kansas City, Mo.
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Trojan Hatchery, Inc., Troy, Mo.
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University of Missouri - Columbia, Columbia, Mo.
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Gene Waite, Eldon, Mo.
Fig. 261 (broilers)
Watson Photo, Los Angeles, Calif.
Fig. 345.
Calvin Witte, Stover, Mo.
Fig. 50, 57.
Woodhaven Christian Home, Columbia, Mo.
Fig. 362.

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