

FACTORS INFLUENCING ACCEPTABILITY
OF CARTONS FOR EGG PACKAGING

by
Carl Charles Hoyt

AN ABSTRACT

Submitted to the School for Advanced Graduate Studies of
Michigan State University of Agriculture and
Applied Science in partial fulfillment of
the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Poultry Science
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Approved

L. C. Dawson

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Carl Charles Hoyt

ABSTRACT

A series of three experiments were conducted to determine the protection afforded the egg by the carton, and consumer acceptability of eggs packed in cartons of different colors, sizes and styles.

Fourteen different cartons were evaluated both by laboratory and truck tests in Experiment I, to determine the protective qualities of the carton for eggs. A mechanical vibrator was used in the laboratory to test these cartons under conditions approximating rail shipments at fifty miles an hour for 1200 miles. Truck tests of 100 miles, 200 miles and 277 miles were used. No significant differences in egg breakage were found between these fourteen cartons by an analysis of variance. Wolf flats, used to provide additional protection to cartoned eggs, were found to have little value in protecting the eggs under normal transportation conditions. Egg breakage in cartons tested in the laboratory was found to be significantly greater than in truck tests.

Molded and plastic type cartons were found to be more satisfactory than carton-board type cartons for leakers or broken eggs. Cartons with windows exposed the eggs contained therein, to soiling from broken or leaking eggs above these cartons in the case.

Thirteen separate series of five cartons each were ranked by the Detroit Consumer Preference Panel in Experiment II. All cartons were filled with large, grade A eggs, and consumers were asked to rank these

cartons in the same manner they would if purchasing them. When price was used in the carton evaluation, the price charged for the eggs was that price commensurate with procurement and cartoning costs.

A pastel green color on white carton-board was preferred more often than other colors by the panel members.

Eggs in plastic cartons were preferred over cartons with windows when the price was the same, but were rated lower when a premium price commensurate with procurement and cartoning costs was indicated.

Eggs in carton-board cartons with windows were preferred over eggs in cartons without windows. Nondivisible cartons were preferred over divisible cartons.

Eggs packed in two dozen green on white carton-board "piggy-back" cartons were preferred by 40.2 percent of the panel members when there was no price differential between single and multiple dozen units. Two dozen units were found to be preferable to three dozen units, and 1/2 dozen units were least preferred.

Eighty-five percent of the panel members, when given a choice, preferred a multiple dozen unit of eggs when there was a 2 cent per dozen price advantage for the multiple dozen cartons.

Eggs of similar quality were cartoned and offered for sale in four supermarkets in the Lansing area in Experiment III. During a twenty-one week period nearly 74,000 dozens of eggs were marketed through these retail outlets.

Special refrigerated display cabinets were placed in each of the four stores in similar locations. During part one of this experiment consumers had a choice of five different cartons, of which two were two dozen units, with a price advantage of 1 1/2 cents per dozen for the multiple pack. During part two a 1 1/2 cent per dozen price advantage was given for two dozen purchases, where eggs were cartoned in regular one dozen cartons. Part three of this experiment introduced a new brand of eggs to consumers, with four choices of cartons, two of which were the two dozen cartons. These multiple cartons were also priced at a saving of 1 1/2 cents per dozen for the multiple dozen unit.

Consumers preferred multiple dozen units when available at 1 1/2 cents per dozen less than single dozens. Fifty-five to 60 percent of the eggs purchased were in two dozen cartons. In one trial more eggs were purchased in two dozen side by side cartons, while in another more were purchased in the "piggy-back" cartons.

When price advantage for purchases of two dozen was used without the two dozen carton, sales were 17 percent lower than when the price-multiple carton combination was used.

A price advantage of 1 1/2 cents per dozen appeared to be the determining factor in consumer acceptance of eggs packed in multiple dozen units.

Only slight differences were found between the panel preference and store sales in preference for eggs cartoned in multiple dozen cartons.

Abstract

Carl Charles Hoyt

The size of refrigerated display area allocated to eggs, and the size of total store sales area were found to be closely correlated with egg sales.

Egg sales during the period when the new brand of eggs was featured, were 11 percent lower than when an established brand was sold.

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INTRODUCTION

The packaging of eggs has lagged behind that of many other agricultural products and has changed little during the past fifty years. Until recently, in many small retail outlets, eggs were offered from "bulk" displays and dispensed in paper bags.

Although many improvements have been made in packaging and merchandising most food products, egg cartons used today have not been designed to promote the sale of the eggs contained therein. Selection of eggs in retail outlets therefore, is often based on what is expected in the inadequate and frequently unattractive package.

Stern (1954) reported that the package used for food products has three main purposes:

- a. Protection of the product,
- b. Convenience of the customer,
- c. Sales appeal.

Most egg cartons are inadequate in all these factors.

Studies have been conducted to determine the economic loss to the poultry industry caused by broken eggs. Miller, Dakan and Cray (1951) reported that 8.8 percent of all eggs produced at the farm were removed in market channels because they were cracked or broken. Since the average reduction in value was estimated to be 17.5 cents per dozen, the total annual "potential loss" to the Ohio poultry industry was calculated to be \$2,999,840.00. It was further estimated that

about ten percent of this loss occurred after the eggs were cartoned, which indicates that egg losses in cartons results in a decreased expected revenue of \$291,984.00 annually to Ohio poultry producers. This "potential loss" does not include damage to other cartons caused by leakers, nor does it include the broken eggs found by the housewife. Little effort has been made to determine the cause of breakage in cartons, or to evaluate the protective characteristics of different standard cartons available on the market today.

Actual consumer preferences regarding style or color of carton have not been adequately determined, either by research or by trial and error, and seldom have such existing preferences been properly reflected back to the egg packer to force a continued improvement in carton development.

The importance of consumer preference and distributor acceptability was reported by Stern (1954) as follows: "It is amazing how often the consumer who uses the product and the distributor who handles it can, by their collective and objective criticism and suggestions, shock the preconceived and often complacent thinking of a product manufacturer."

Undoubtedly many factors influence consumers' choice of a package. Hoyt et al. (1957) reported that color, product visibility and size of unit were important factors influencing consumers' choice. Seventy-eight percent of a small selected sample of Michigan consumers indicated

a preference for purchasing more than one dozen eggs at a time.

Larzelere and Shaffer (1955) found that over two-thirds of the purchasers reported a purchase of more than one dozen eggs at one time. Some of the people surveyed purchased as many as eight dozen eggs at one time. Taylor, Owens and Jasper (1954) found that 38 percent of a sample of Rhode Island consumers purchased eggs in two dozen lots, and 11 percent purchased their eggs in lots of either one-half, one and one-half or three and one-half dozens. Slocum and Swanson (1954) reported that 30 percent of the persons surveyed in Washington showed a preference for two dozen eggs per purchase, while 5 and 3 percent purchased four and five dozen eggs respectively. In spite of these indicated preferences for multiple dozen units, little effort has been made to market eggs in multiple dozens.

With the introduction of self-service merchandising methods and mass displays, the design and attractiveness of egg cartons have become more important as factors in competitive selling. The advantages of an attractive package have already been demonstrated in the merchandising of many products, but the value of eggs in attractive cartons to the poultry industry, or to the enterprising merchandiser is as yet unknown. This is one area of merchandising which has much opportunity for improvement and advancement in the years ahead.

The population of the United States has expanded rapidly, and during the past twelve years has increased 22.1 percent (Figure 1).

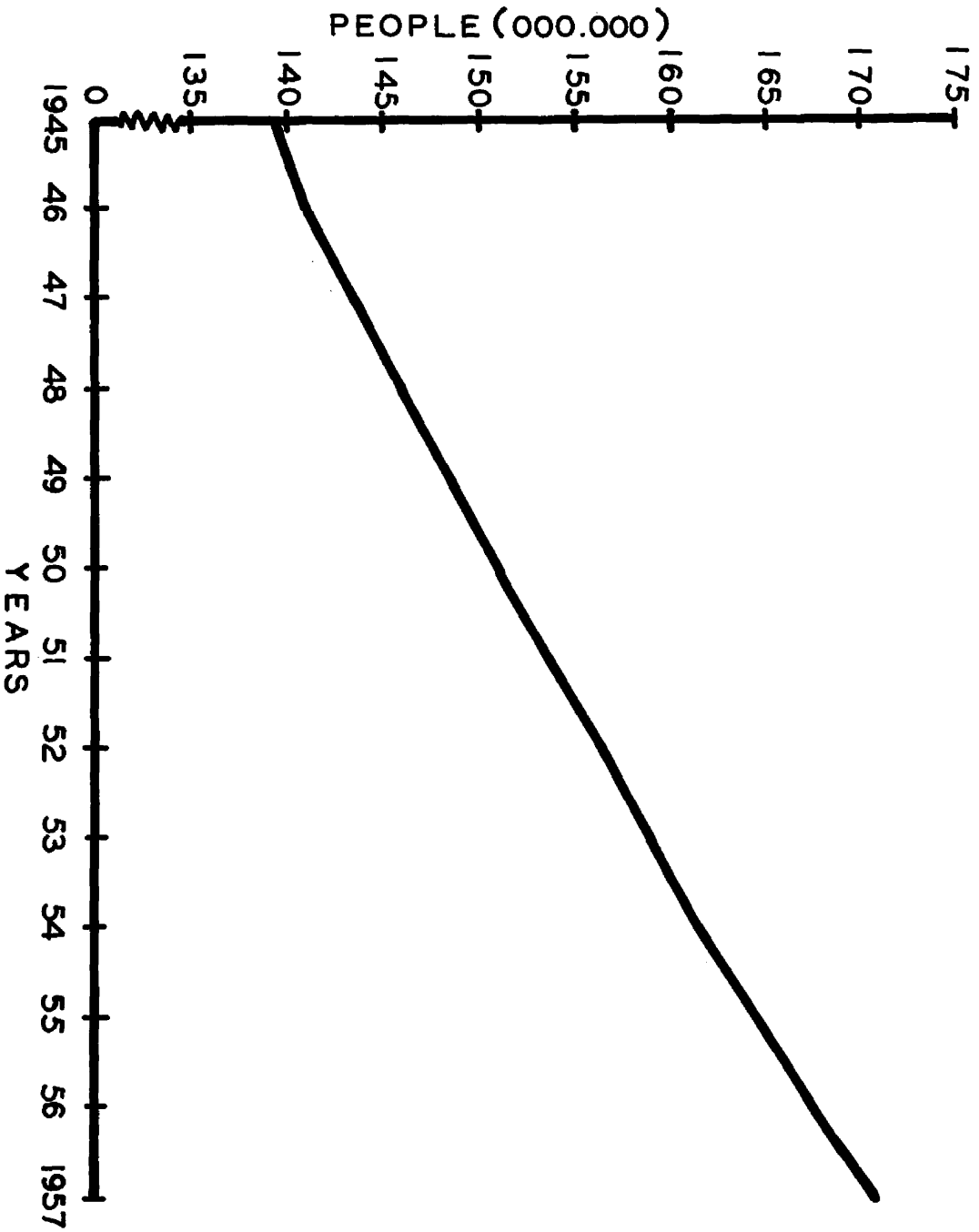


Fig. 1. Population of the United States

Source: Agr. Stat., U.S.D.A., 1957, p. 535

This represents a sizable total population increase during this period, but concurrently the per capita consumption of eggs has decreased 10.9 percent (Figure 2). Good merchandising, coupled with quality control and consumer education may help to increase consumer demand for egg products and reverse the downward consumption trend.

In this study an attempt has been made to select egg cartons which offer the necessary protection to eggs and which could be combined into attractive multiple units. These, filled with Grade A eggs, were offered to consumers in four Lansing area supermarkets.

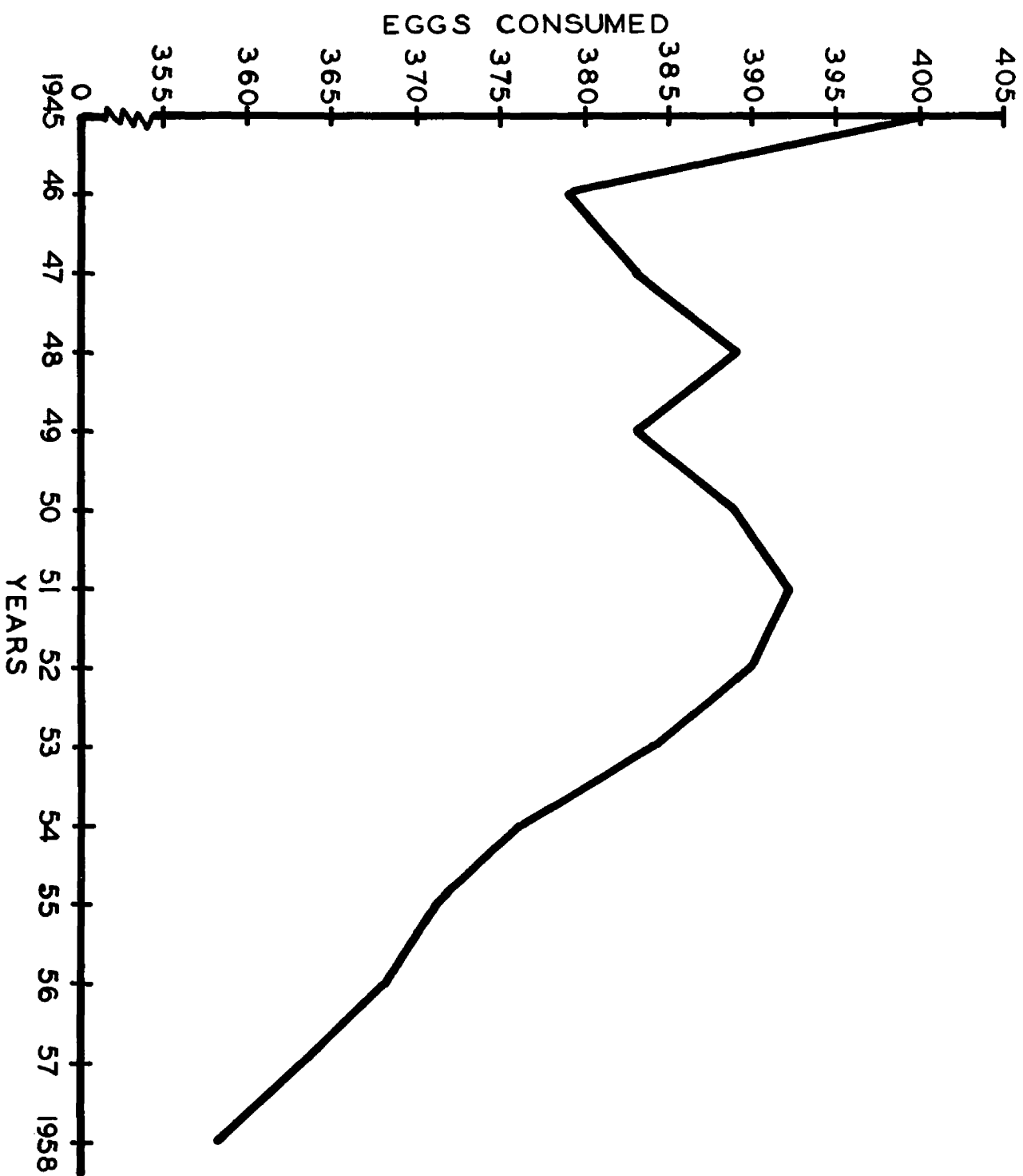


Fig. 2. United States Per Capita Egg Consumption

Source: Poultry and Egg Situations, U.S.D.A., Nov. 1958.

LITERATURE REVIEW

In recent years tremendous advances have been made in merchandising food products in the United States. In spite of this advancement in many food areas, little has been done to make the egg package more attractive to the consumer. In fact, little is known concerning consumer preferences for types of cartons, sales appeal of different cartons, or protective characteristics of cartons currently being used in market channels.

Various investigators have studied the influence of certain characteristics of egg cartons as they affect the egg and the consumer.

Egg Breakage

The fragility of the egg makes the cartoning, transportation and handling of eggs more difficult than many other products. Studies indicate that a high percentage of the dozens of eggs sold through retail outlets have one or more cracks in each carton. Williams (1958) reported that 11.0 percent of the eggs purchased during a one year period had unsound shells. Sixty-one percent of the dozens purchased, however, had one or more eggs with unsound shells. Similar results were reported by Becker (1953) who found that 50.0 percent of the dozens purchased from retail stores contained one or more eggs with checks or broken shells. Broken eggs were found less frequently in cartoned

eggs than in paper bags.

Darrah and Moore (1956) found essentially no difference in egg breakage between eggs in regular cartons and those in plastic cartons. They found that egg breakage in plastic cartons was not as great when packed either lengthwise or crosswise in the case, as when the cartons were packed alternately crosswise and lengthwise.

Egg breakage at different levels in the marketing channel was reported by Miller, Dakan and Cray (1951). They found 2.8 percent broken and removed at the farm, 2.6 percent removed at the time of grading, 2.5 percent cracked in the grading station, and 0.9 percent cracked between the grading station and the wholesaler. They point out that this loss is absorbed by the producer, since prices and margins are adjusted to absorb the share of loss occurring at that point. They estimated that the decreased revenue to the Ohio poultry industry in 1948 was \$2,919,840.

Damage occurring to eggs in rail shipment was reported by Myers and Ringwood (1945) to be 1.9 percent of all eggs shipped. This damage was classed as hidden, thus was in addition to claims paid by railroads for egg damage which was, according to Myers and Bixby (1945), \$650,000 for the year 1944.

Color and Carton Preference

Bevans (1958) reported that package appeal is the main reason a consumer buys one package in preference to another. He stated,

"In our present self-selection, impulse buying market, the package is the most powerful salesman."

The evolution in egg merchandising during recent years is pronounced. As recently as 1948, Nybrotten (1952) found that over one-half of all eggs in a sample of West Virginia stores were sold in paper bags. Where cartons were used, the 3 by 4 molded carton was the most prevalent. Similar findings were reported by Becker (1953), although he did find that among chain stores in the Pittsburgh and Philadelphia area, all eggs were cartoned. In contrast to these earlier reports, Taylor, Owens, and Jasper (1954) reported that 97 percent of a consumer sample in Providence, Rhode Island, purchased their eggs in cartons. Similar findings were released by Goodrich (1958) following a study in 552 supermarkets in the New York area. All eggs sold in these stores were cartoned, and the 2 by 6 paperboard carton was the most prevalent.

Darrah and Carpenter (1954) reported that the use of windowed cartons increased egg sales in Central New York, and that the area devoted to windows in the carton was directly correlated with egg sales. Goodrich (1958) found, in the same area, that 39 percent of 552 sample stores were selling some eggs in windowed cartons. All of these stores featured at least one row of cartons with windows in their displays.

The use of plastic cartons has been a recent innovation. Studies by Saunders (1956), Darrah and Moore (1956), Pasvogel (1958), and

Nybroten (1958) have all indicated a consumer preference for a plastic type carton. Darrah and Moore (1956) reported that only 10 percent of a consumer sample were willing to pay the premium price necessary for the plastic carton. Nybroten (1958) found only 4 percent willing to pay the premium price and Pasvogel (1958) reported that consumers would not pay a premium for eggs packed in plastic.

Egg Displays

Egg merchandising techniques in retail outlets have often lagged behind other food products. Eggs usually compete for space with milk and milk products in the dairy case. Nybroten (1952) reported a definite relationship between the number of "egg offerings" and total sales of eggs per store. Egg offerings were defined as any distinction that gave the customer a choice in the egg selection.

Refrigerated egg displays were found in only one-half of 500 sample stores in a Washington state survey (Stadelman and Jensen, 1950). This contrasts sharply with findings eight years later, by Goodrich (1958) in a study of 552 sample stores in New York state. He reported that 96 percent of the stores had refrigerated display space for the eggs. Stores were arbitrarily classified according to size on the basis of the number of cash registers. Stores with two to four cash registers were classed as small, those with five to six were classed as medium, and those with seven or more were classed as large. The linear feet of egg display space was found to be 3.7 in the small markets, 5.4 in the

medium markets, and 7.2 in the large markets. These findings were in line with a trend, for a refrigerated display area in supermarkets, which was generally observable.

Egg Purchases and Size of Units Purchased

The increase in numbers of modern food supermarkets and household refrigerators has undoubtedly encouraged the practice of purchasing food commodities in larger quantities. Taylor, Owens and Jasper (1954) reported that 66 percent of the families in a Rhode Island survey purchased eggs in quantities of two dozen or more. Similar findings were reported by Larzelere and Shaffer (1955) in a Michigan study. However, Slocum and Swanson (1954) found only 51 percent of a consumer sample in Washington state purchased more than one dozen eggs each purchase.

The introduction of the three dozen "Econopack" resulted in a marked increase in egg sales in sample stores in Ohio (Levinson 1957). Three-dozen cartons were priced advantageously to the customers. Meredith (1957) found a similar three-dozen carton to be particularly desirable for merchandising pullet eggs during the time of year when price was favorable.

Brand Name Influence in Egg Purchases

The trend toward selling more cartoned eggs has influenced the use of brand names in merchandising eggs. Reports indicate that the actual influence of a brand name on the carton varies between geographical areas and among types of consumers. Goodrich (1958) reported

that 84 percent of all stores in a New York survey sold only "branded" eggs. Earlier studies contrast sharply with these findings, thus indicating the trend toward cartoning, and the use of brand names. In a Washington survey, Stadelman and Jensen (1950) found that 50 percent of a consumer sample liked brands and purchased eggs of a particular brand until they got a bad egg; then usually changed brands. Slocum and Swanson (1954) found brand name associated with quality, but only one third of those interviewed had purchased a particular brand at the last purchase. Larzelere and Nichols (1950) found that brand name was considered important by only 20 percent of a sample of Michigan consumers. Baker and Goldman (1951) reported that only 7 percent of a sample of Des Moines consumers purchased eggs by brand, while Jasper and Cray (1953) found less than 0.3 percent of the consumers interviewed in an Ohio study considered brand name when purchasing eggs. Similar findings were reported by Corbett (1933).

Nybrotten (1952) found brand influence important only in large stores in large cities in West Virginia. Slocum and Swanson (1954) found brand influence more pronounced among higher income than among lower income groups in Washington.

Price

Since such items as food and clothing are considered necessities, price should have less effect on sales than it has on luxury items. Shepherd (1947) reported that elasticity of demand for eggs on an annual

basis is about -0.4 , whereas on a monthly data analysis, it is found to be -3.0 . This means that a 1.0 percent change in annual supplies is associated with an annual price change of only .4 of a percent, but a 1.0 percent change (monthly data) in supplies is associated with a 3.0 percent change in price. In other words short time fluctuations in supply affect price more than do long time fluctuations.

Even though egg prices are relatively inelastic, price differences within the same market or market area could conceivably have a marked influence on egg sales. However, on a long time basis, egg prices would be expected to have relatively little influence on egg purchases. This was substantiated by Baker and Goldman (1951) who found only 5.0 percent of a Des Moines consumer sample considered price an important factor when buying eggs. However, Larzelere and Nichols (1950) reported that 57 percent of a consumer sample in Michigan considered price to be an important buying factor. Cron, Burdette, and DeVault (1939) found price to be an important buying factor by only 23 percent of a consumer sample in Baltimore. Similar results were reported by Jasper and Cray (1953) and Slocum and Swanson (1954).

Goodrich (1958) reported that the pricing of eggs on the odd-cent was an overwhelming practice of supermarkets of different types and sizes. Thirty-five of 552 sample stores practiced multiple and split unit pricing, twenty-six stores priced two dozen eggs together, two priced three dozen eggs together (employing the relatively new 6 by 6

paperboard carton), and seven stores priced eggs in one-half dozen units. Levinson (1957) reported that a price differential of one to two cents per dozen on a three dozen pack influenced many customers to purchase larger quantities of eggs at a time as well as more total eggs.

PURPOSE AND GENERAL PROCEDURE

This study was designed to evaluate the protective properties and consumer acceptability of the major types of egg cartons now being used, and to determine the consumer preference for specific color of cartons, design of cartons and size of units offered for sale.

In evaluating preference factors, it was decided to utilize the Detroit Preference Panel^{1/} and actual sales in four supermarkets in the Lansing area. Utilization of identical refrigerated display units in each store made possible an evaluation of this additional display space, and an evaluation of certain price differentials, some of which were controlled by the experimental design.

^{1/} This panel is composed of consumers in the Detroit Metropolitan area.

EXPERIMENT I. PROTECTIVE PROPERTIES OF EGG CARTONS

There is a definite need for protecting eggs in market channels. Various studies have indicated the importance of decreased revenue received from egg sales because of cracked and broken eggs. Although the loss is recognized, little effort has been made to determine the amount of protection given the egg by different types of cartons.

Procedure

Fourteen different egg cartons were evaluated on the basis of protection of the egg. An attempt was also made to measure the extra protection of the egg by the use of "Wolf" flats placed underneath and on top of the cartons in the egg case.^{2/}

In Part A of the experiment, cartons filled with eggs were tested in the laboratory under conditions designed to approximate railroad conditions. A mechanical table vibrator was regulated to operate at a frequency of four and one-half cycles per second. The motion of the table was designed to approximate, in an accelerated manner, the effect of motion experienced in freight cars caused by the normal period of the car springs, rail joints and flat wheels. Figure 3 shows the package

^{2/} The "Wolf" flat is a pulp, crimped flat designed to give protection to cases of cartoned eggs.

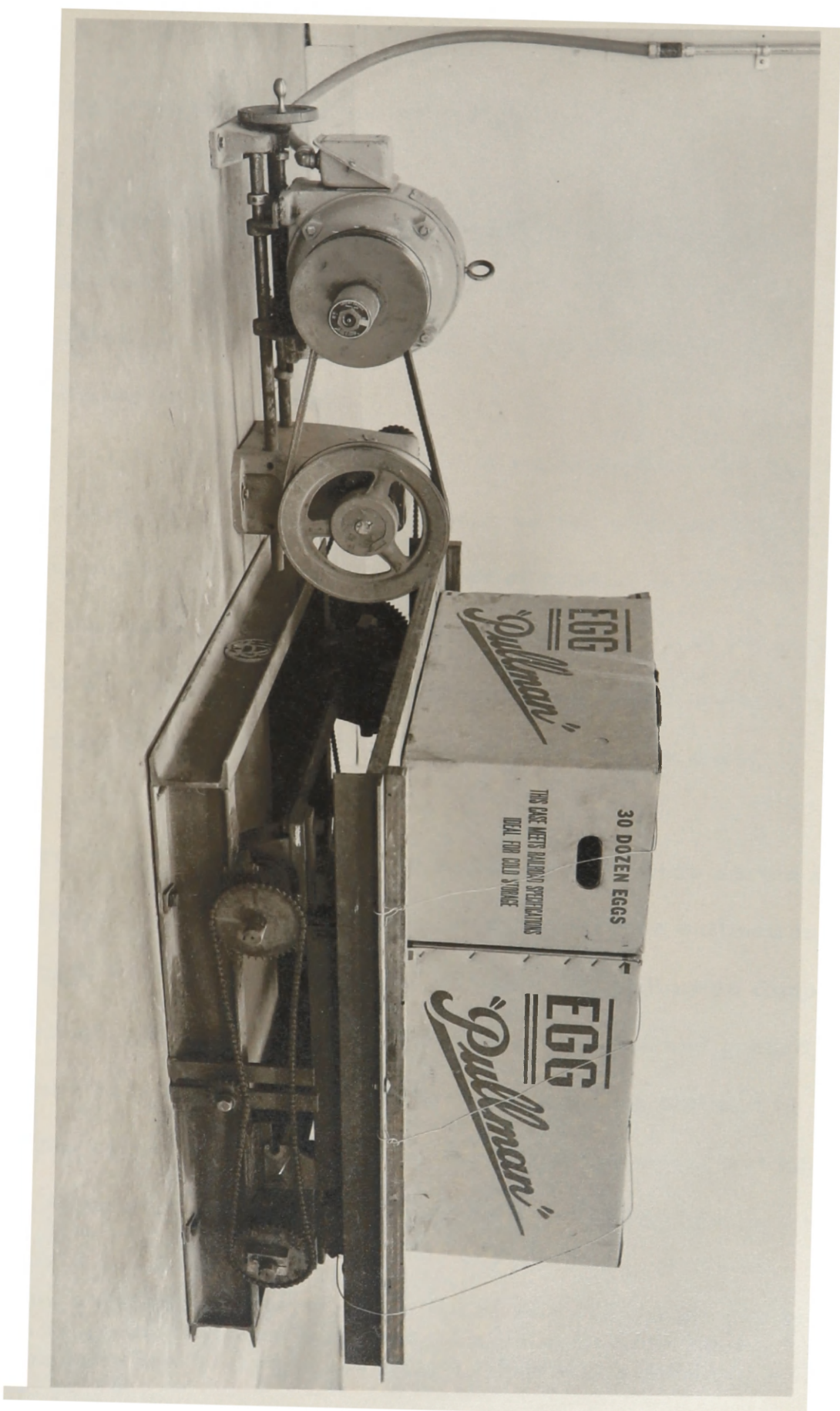


Fig. 3. Mechanical Vibrator used in Subjecting Eggs to Accelerated Railroad Conditions.

vibrator. Eggs were subjected to this treatment for a one hour test period.^{3/}

Eggs of AA and A quality were obtained from the University farms, and any eggs showing tremulous air cells were removed. Eggs were candled individually both at the beginning and end of the experiment for the determination of this quality.

After cartoning, eggs were packed in standard thirty dozen fibre-board egg cases. Five replications of each carton were used in the experiment, and these cartons were placed at random in the case in such a way that each carton was represented in each row in the case according to a randomized table illustrated by Dixon and Massey (1951). The method used to pack the eggs for the vibrator test is shown in Table I.

In Part B of this experiment 270 dozens of eggs were sorted and packed in three different lots according to the procedure outlined in Table I. Eggs were obtained from the Hamilton Farm Bureau Cooperative, Hamilton, Michigan, after they had been weighed and graded. All eggs were recandled according to the specifications outlined in Part A of this experiment. In order to obtain 270 dozens of test eggs, 294 dozens were sorted and 24 dozens were removed because they were

^{3/} The regulation of the vibrator speed at 4 1/2 cycles per second is to approximate railroad travel at 50 miles per hour. The one hour test period represents a treatment similar to a 1200 mile rail trip.

TABLE I
THE RANDOMIZED DESIGN USED FOR PACKING EGGS IN
EXPERIMENT I

Row	CASE 1			CASE 2			CASE 3		
	Carton		Carton	Carton		Carton	Carton		Carton
	Carton			Carton			Carton		
1	1	2	3	4	5	6	13	14	15
2	2	3	1	5	6	4	14	15	13
3	3	1	2	6	4	5	15	13	14
4	1	3	2	4	6	5	13	15	14
5	2	1	3	5	4	6	14	13	15
1	7	8	9	10	11	12	Special Flats		
2	8	9	7	11	12	10			
3	9	7	8	12	10	11			
4	7	9	8	10	12	11			
5	8	7	9	11	10	12			

leakers, checks or had tremulous air cells. Of those removed 70 per cent were checks or leakers, which would indicate that some of the egg breakage found in the carton occurs at the grading station.

The three lots of eggs were loaded on a semi-transport loaded with eggs. Lot 3, destined for the wholesale transport route of 200 miles plus the retail route of 77 miles was loaded in the center of the transport. Lot 2, destined for the 200 mile wholesale truck route was also loaded in the center of the transport, and Lot 1, destined for the 100 mile wholesale route was loaded in the rear of the transport. All cases were taped and labeled according to their point of delivery.

Lot 1 was delivered to the Food Stores at Michigan State University, Lot 2 was delivered to Briggs Dairy Products Company in Detroit, and Lot 3, after being delivered to Briggs Dairy Products Company, was placed on their retail truck and subjected to an additional 77 mile route in Detroit.

All eggs were checked at the close of the tests and cartons were evaluated on the basis of egg breakage in the carton. A special scoring chart was devised with specific values or demerit points for each condition which resulted in a lower market value for the egg. Table II illustrates the scoring chart used for evaluating the cartons in this experiment.

Results

The results of Part A and Part B of the experiment are reported in Table III. An analysis of variance indicated that there was no

TABLE II
SCORE CHART FOR EVALUATION OF EGG CARTONS

Egg Quality Factors	Points per Egg ¹
Slightly tremulous air cell	1
Free moving air cell	2
Air cell, bubbly	3
Crack ²	4
Leaker ³	5

¹ One (1) least serious. Five (5) most serious.

² Crack is defined as an egg with the shell cracked but the membrane unbroken.

³ Leaker is defined as an egg with the shell cracked or broken and the membrane broken, with contents exuding or free to exude.

TABLE III

1

2

EGG DAMAGE AS INFLUENCED BY CARTON AND HANDLING TREATMENT

Carton	Treatments			
	Mechanical	100 Mile	200 Mile	277 Mile
	Vibrator	Transport	Transport	Transport
	Score	Score	Score	Score
1. Self-Locking	5	4	0	8
2. White Chief	6	0	0	2
3. Twin Egg Safety	6	8	0	8
4. Case Ace	25	8	4	5
5. Michigan	17	1	0	9
6. Super Cell	11	0	0	0
7. Hawk	16	8	0	1
8. Pet	19	0	0	0
9. Michigan	29	17	12	0
(6 windows)				
10. Michigan	14	8	38	0
(12 windows)				
11. Self-Locking	20	8	28	0
(6 windows)				
12. Self-Locking	9	1	0	0
(12 windows)				
13. Plastic	17	9	12	0
14. Trifold ₄	9	4	8	0
15. Blank	---	---	---	---
16. Wolf Flats and	10	0	0	1
Carton 12				
17. Wolf Flats and	16	0	0	0
Carton 12				
18. Wolf Flats and	25	0	0	1
Carton 12				

¹ Cartons 1, 4, 11, 12, 14 and Wolf Flats manufactured by General Package Division, Diamond Gardner Co.; Chicago, Ill; Cartons 2, 7 and 8 manufactured by Bloomer Brothers, Newark, N. Y.; Carton 3 manufactured by Gair Co.; Carton 6 manufactured by Interstate Folding Box, Middletown, Ohio; Carton 5, 9, 10 manufactured by Sutherland Paper Co., Kalamazoo, Michigan; and Carton 13 by Kuhl Company, Flemington, New Jersey.

² Computed from Damage Chart, Table I

³ This was the 200 mile wholesale route plus the 77 mile retail route

⁴ This was a blank carton used to fill the thirty dozen egg cases

significant difference in egg damage between eggs packed in the different cartons, or between the cartons without the "Wolf" flats and those with the "Wolf" flats. There was a significant difference between the truck treatments and the mechanical vibrator treatment, however. This would support the need for special packaging of products that are shipped by rail, (Table IV).

An analysis of variance was computed using the data obtained from the vibrator study. This analysis was made according to the procedure described by Goulden (1952) under "Transformations". Although differences in egg damage between cartons were greater in this test, these differences were not significant, (Table V).

Egg damage was significantly greater in the top layers of the cases than in the bottom layers.

Although there were no significant differences between the protective qualities of cartons in the tests, some general observations were made regarding certain cartons. Cartons with windows present a more vulnerable covering for the eggs contained in the carton. If breakage occurs above windowed cartons, the possibility of egg contents getting on eggs in this type of carton is high. Cartons 4, 13 and 14 are good containers, and if eggs become broken in these cartons they are contained by the carton and do not damage other eggs or other cartons. Carton 6 provided some protection to other cartons, particularly, if breakage occurred in the center of the carton. After carton 13 (plastic)

TABLE IV
ANALYSIS OF VARIANCE OF PROTECTIVE QUALITIES OF EGG CARTONS

Source	D F	S S	M S	F	F .05 [*]	F .01 ^{**}
Total	67	4971.81				
Cartons	16	1186.56	74.16	1.64	2.40	1.86
Tests	3	1611.69	537.23	11.86 ^{**}	2.80	4.22
Error	48	2173.56	45.2825			

TABLE V
ANALYSIS OF VARIANCE OF VIBRATOR TREATMENTS
(TRANSFORMED TO $X + 1/2$)

Source	D.F.	S. S.	M.S.	F.	F. 05	F. 01
Total	84	63.2150				
Cartons	16	12.1555	.75972	1.36	1.80	2.30
Rows	4	15.4014	3.85035	6.91**	2.51	3.62
Error	64	35.6581	.55716			

was removed from the refrigerator and allowed to stand at room temperature for a short period of time, condensation on the egg caused puddling in the bottom of the carton.

EXPERIMENT II. SELECTION OF CARTONS-PREFERENCE PANEL

The Detroit Consumer Preference Panel was used to evaluate the cartons tested in Experiment II. This panel was selected as a representative consumer sample from the Detroit Metropolitan area. Individuals were asked to evaluate different styles and colors of egg cartons on the basis of their preference.

Procedure

An evaluation was made of a number of egg cartons and egg carton combinations by the Detroit Consumer Preference Panel. This panel was conducted by Michigan State University in cooperation with Wayne State University.

The panel was originally organized in 1956, and has since functioned at regular intervals. Panel members were selected as follows: Mail questionnaires were sent to about 11,700 names obtained at random from a Detroit telephone directory. About 4 1/2 percent of these were returned by the post office for nondelivery. Twenty percent of the remainder were filled out and returned either from the first or from the follow-up questionnaire. A majority of those selected were high school graduates, had family incomes ranging from \$4,000 to \$10,000, and were in the 31 - 45 age group.^{4/} Most of the panel was selected with

^{4/} For further information regarding the selection of panel members, see Gregg, Smith and Henry Larzelere, (1957).

these characteristics, because more of the returned questionnaires came from people in these brackets than in any of the others.

The distribution of the panel members with regard to age, education and income is not intended to reflect the characteristics of all consumers in the Detroit area. However, the panel group can be considered representative of the Detroit families who have the characteristics outlined above.

Panel members have been rotated to reduce the possibilities of monotony in evaluations, and those participating in each of the series came by invitation to the Wayne State University Home Economics laboratory to evaluate a number of different products. The panel for these series was composed of an average of 135 members.

After a short briefing on the procedure to follow in recording preferences, panel members were asked to rank independently five egg cartons in each series on the basis of preference. All cartons were filled with Large, White, Grade A eggs. Cartons were identified in each of the series by one of the following symbols: *, (), &, #, and %. In each series the symbols were selected at random so panel members did not have a chance to express a choice for a particular symbol instead of a carton. Panel members were instructed to rank the cartons in the same order they would if they were to purchase them. Figure 4 shows panel members evaluating one series of egg cartons.

In evaluating these results a mean preference score was calculated



Fig. 4. Detroit Consumer Preference Panel Evaluating Eggs
Cartons and Other Products.

for each carton, and the percentage of persons preferring each carton was determined. The percentage of panel members ranking a carton first was considered the most reliable evaluation, since a consumer usually makes but one choice in purchasing eggs and does not rank them in order.

In calculating the preference score for each carton the percentage of panel members ranking it first, second, third, fourth, and fifth was calculated. The percentage ranking a carton first was multiplied by five, percentage ranking it second by four, percentage ranking it third by three, percentage ranking it fourth by two, and the percentage ranking it fifth by one. A composite preference score was calculated by addition of each of these five figures. The highest preference score indicated the highest degree of preference and conversely, the lowest preference score indicated the least preference.

A total of thirteen series of five cartons each was evaluated by the panel in this experiment.^{5/} Since egg cartons of multiple units are not readily available it was necessary to improvise in preparing some of the cartons for evaluation. Standard commercial cartons were used to make these combinations.

^{5/} Cartons for this experiment were supplied by Bloomer Brothers Company, Newark, New York; Cornell University, Ithaca, New York; Dudley Paper Company, Lansing, Michigan; Interstate Folding Box Company, Middletown, Ohio; Kuhl Company, Flemington, New Jersey; Marathon Corporation, Menasha, Wisconsin; Shady Nook Farm, Middleton, Michigan; and the Sutherland Paper Company, Kalamazoo, Michigan.

In addition a three dozen commercial 6 by 6 unit was submitted to the panel for evaluation in two of the series.

Eggs were priced according to estimated procurement and carton-ing costs, when price was used as a part of the evaluation. Price differentials for multiple unit packages were one to two cents per dozen lower than for single dozens.

Results

Series 1 and 2 were composed of 3 by 4 cartons with diamond shaped openings over each egg, which had been spray painted red, blue, green, orange and yellow, (Figure 5). Red was preferred by more panel members than any other colored carton. Orange cartons were the least preferred, (Table VI). No significant degree of agreement was found among panel members in these two series. (Coefficient of Concordance.)^{6/}

Series 3 was composed of stock 2 by 6 cartons differing only in color combinations, and "divisible"^{7/} and "non-divisible"^{8/} cartons. The green on white non-divisible carton was preferred by 23.6 percent

^{6/} Preference data were tested statistically by calculating coefficient of concordance and it's tests to determine the degree of agreement among panel members.

^{7/} Divisible carton can be readily separated into two units containing six eggs each.

^{8/} Non-divisible cartons cannot be separated.

E

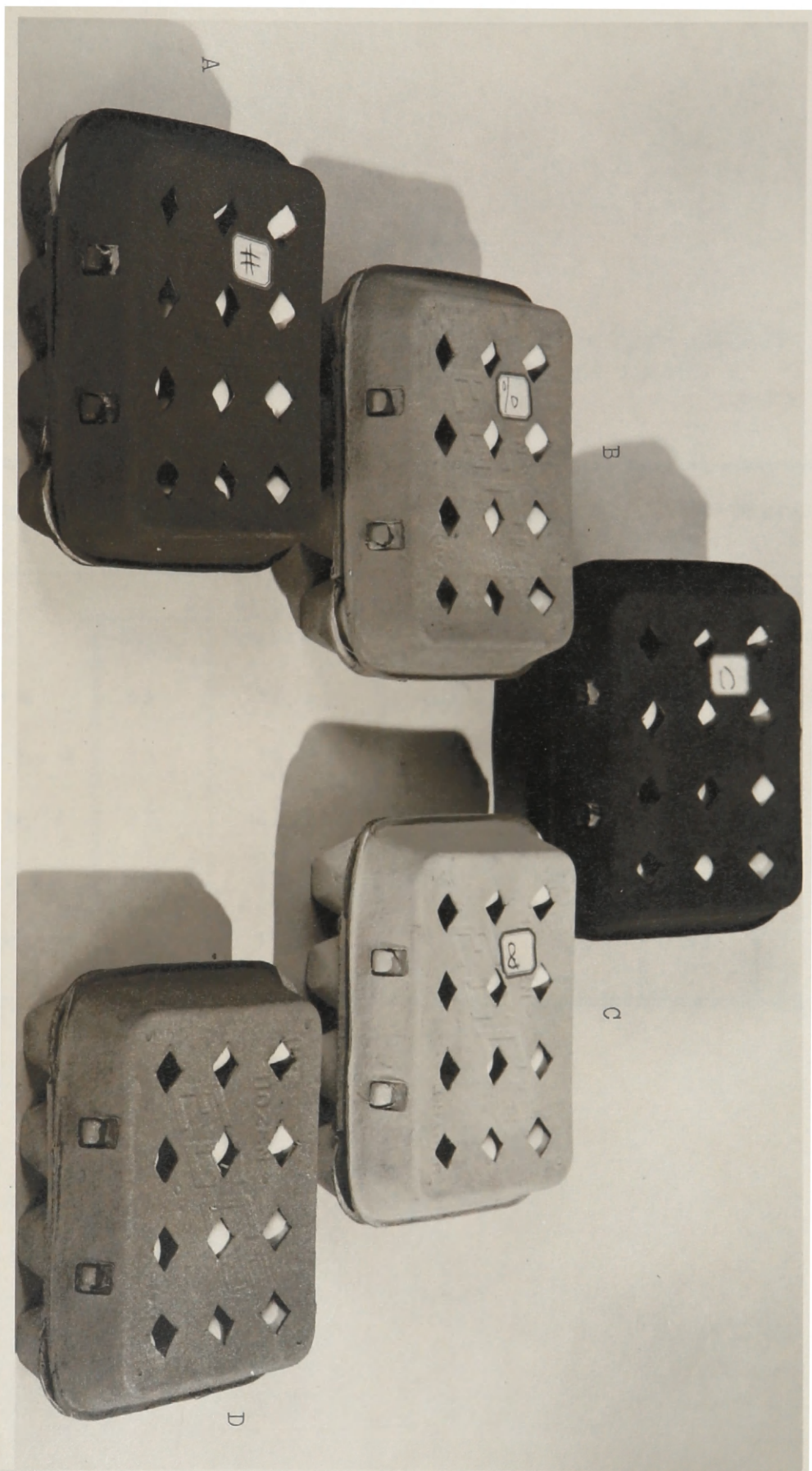


Fig. 5. Series 1 and 2. Three by four cartons differing only in color. (A) Solid red, (B) Pastel green, (C) Pastel yellow, (D) Solid orange, (E) Solid blue.

TABLE VI

PREFERENCES FOR EGGS CARTONED IN DIFFERENT
COLORED 3 BY 4 CARTONS - SERIES 1 AND 2

Style of Carton	Trial 1		Trial 2		Total	
	First Choice Selection of Panel Members					
	No.	Percent	No.	Percent	No.	Percent
Red, 3 by 4	53	32.5	40	26.2	93	29.4
Yellow, 3 by 4	26	16.0	43	28.1	69	21.8
Green, 3 by 4	37	22.7	25	16.3	62	19.6
Blue, 3 by 4	29	17.8	30	19.6	59	18.7
Orange, 3 by 4	18	11.0	15	9.8	33	10.5

of the panel members, followed closely by the blue on white which was preferred by 22.5 percent of the panel. The red on white divisible carton was least preferred, with only 16.8 percent of the panel members favoring this carton (Table VII). A significant degree of agreement (Coefficient of Concordance), was found among panel members in this series, but carton differences were not found to be significant at the .05 level by Chi square analysis.^{9/}

Series 4 made use of the University brand cartons, (Figure 6). Here again, a definite preference was shown for green on white, with 30.7 percent of the panel members choosing this as their first selection. A plain white control carton was least preferred, with only 9.1 percent placing it first, (Table VIII). Differences in preference among panel members for cartons were significant at the .001 level.

Series 5 was made to evaluate a commercial brand carton with different color combinations, (Figure 7). Again, green on white showed the highest preference, with 33.6 percent of the panel selecting this color. The least preferable was the plain white control. The brown on white carton was preferred by only 10.2 percent of the panel members (Table IX). Differences between these cartons were significant, (.001 level).

^{9/} A Chi square analysis was used to determine the degree of preference for one carton over another.

TABLE VII
PREFERENCE FOR COLOR AND STYLE
OF 2 BY 6 EGG CARTONS
SERIES 3

Style of Carton	First Choice Selection by Panel Members	
	Number	Percent
Green on white nondivisible (a)	42	23.6
Blue on white nondivisible (a)	40	22.5
Red on white nondivisible (a)	35	19.7
Blue on white divisible (b)	31	17.4
Red on white divisible (b)	30	16.8

(a) Nondivisible cartons cannot be separated into small units.

(b) Divisible cartons can be separated into two units of six eggs each.

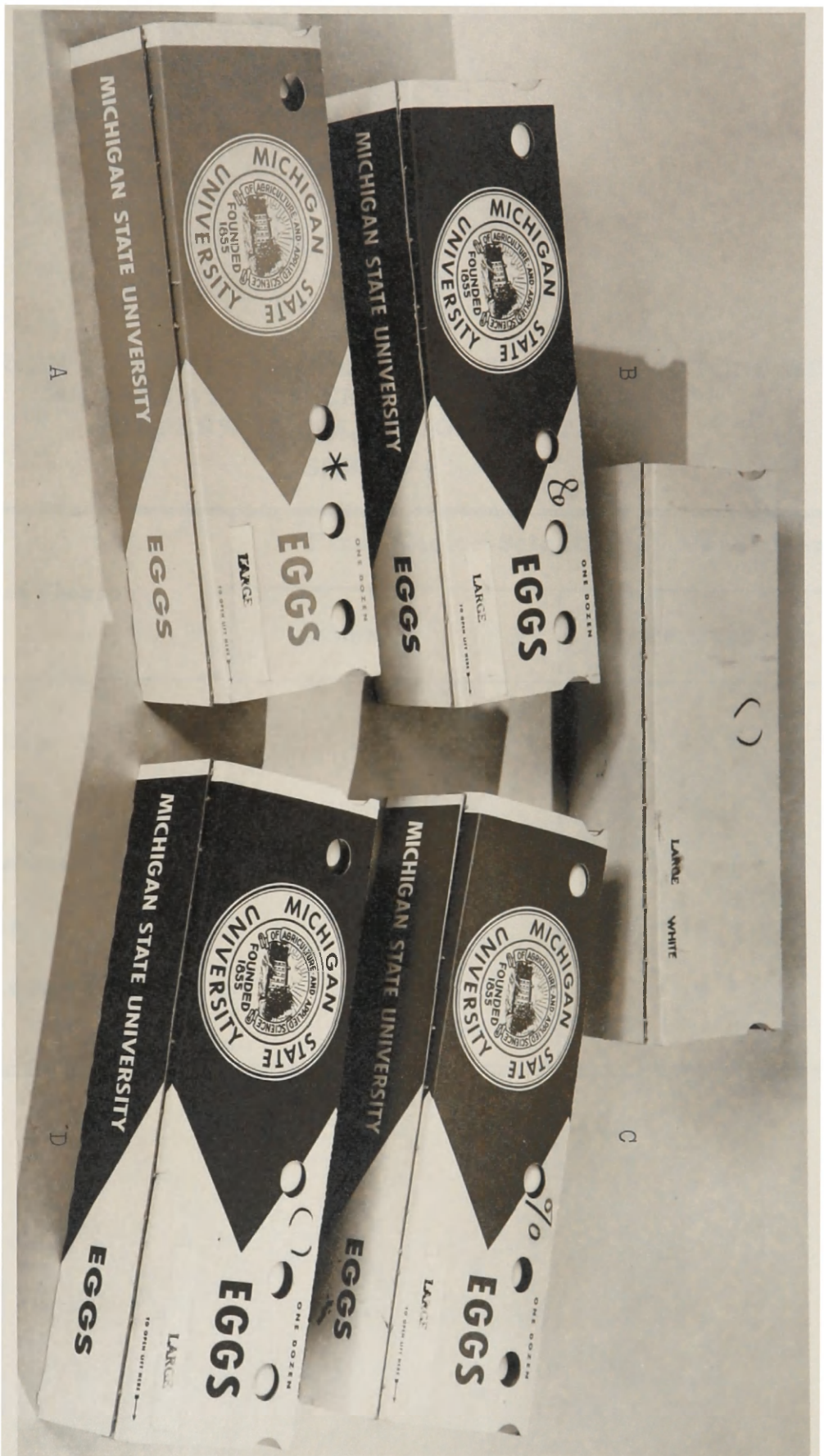


Fig. 6. Series 4. Cartons currently used in sale of Michigan State University eggs, plus a plain white carton. Colors are (A) green on white background, (B) red on white background, (C) orange on white background, (D) blue on white background, (E) control (plain white), each used to market eggs of a specific size. For this evaluation, size differences were eliminated.

TABLE VIII

PREFERENCES FOR EGGS PACKED IN FIVE 2 BY 6 CARTONS WITH
 MICHIGAN STATE UNIVERSITY BRAND AND
 DIFFERENT COLOR COMBINATIONS
 SERIES 4

Style of Carton	First Choice Selection by Panel Members	
	Number	Percent
Green on white	54	30.7
Red on white	39	22.1
Orange on white	34	19.3
Blue on white	33	18.8
Control (plain white)	16	9.1

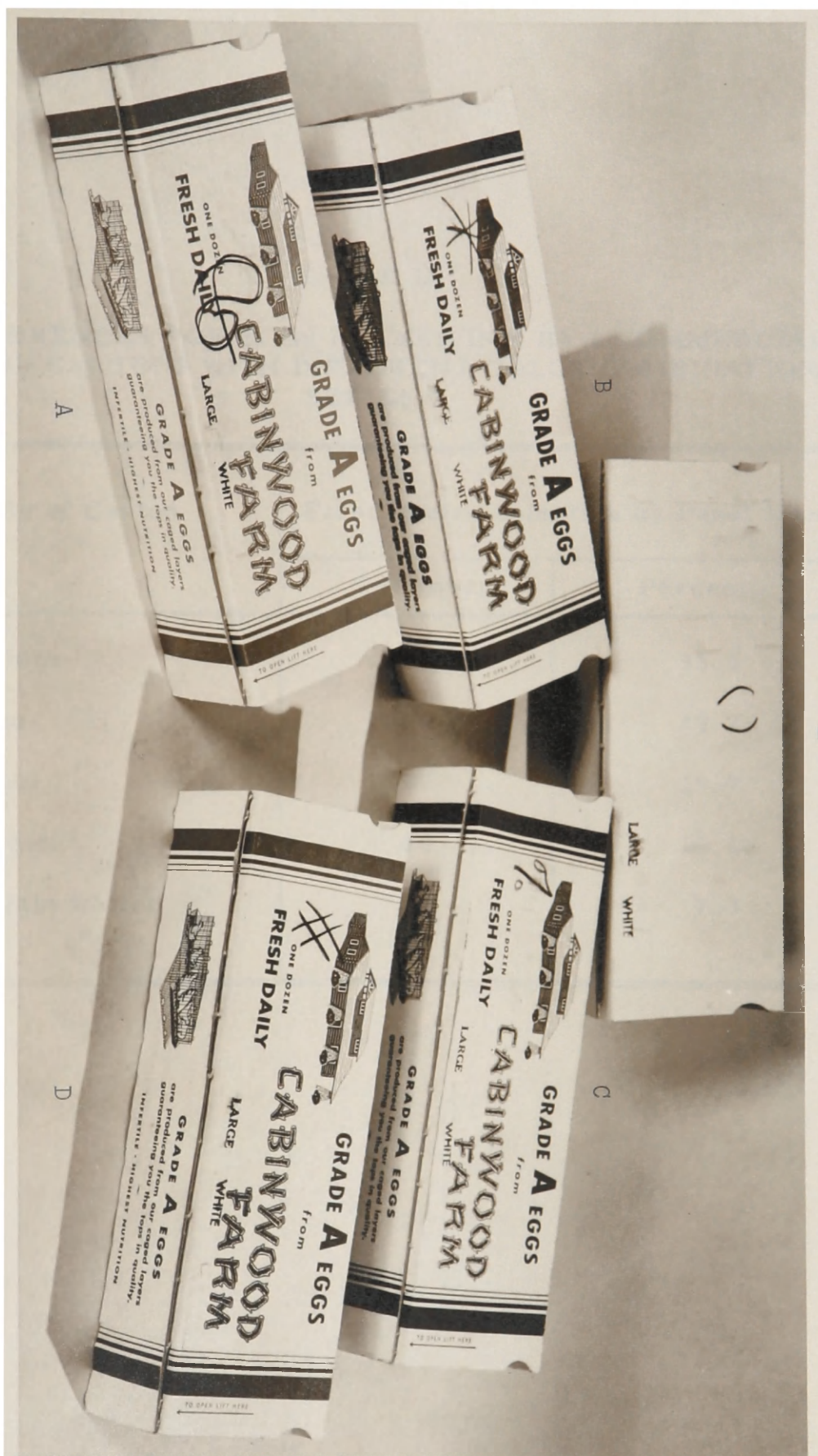


Fig. 7. Series 5. Cartons printed with a commercial brand name, differing only in color. (A) Green on white background, (B) Red on white background, (C) Blue on white background, (D) Brown on white background, (E) Plain white.

TABLE IX

PREFERENCES FOR EGGS PACKED IN 2 BY 6 COMMERCIAL
 BRAND CARTONS WITH DIFFERENT COLOR COMBINATIONS
 SERIES 5

Style of Carton	First Choice Selection by Panel Members	
	Number	Percent
Green on white	46	33.6
Red on white	40	29.2
Blue on white	27	19.7
Brown on white	14	10.2
Control (plain white)	10	7.3

Series 6 was made to evaluate consumer preferences for plastic cartons and cartons with windows, (Figure 8). Blue on white cartons were used along with a plain white control.

The plastic carton was preferred by more panel members than any other, with 40.4 percent of the panel members preferring it. The carton least preferred was the control. The stock blue on white carton with no windows was ranked fourth, with only 12.6 percent of the panel members making this choice, (Table X). Differences in preference between cartons tested in Series 6 were significant, (.001 level).

Two types of plastic cartons were evaluated in Series 7, along with standard carton-board cartons, (Figure 9). Plastic C was the same carton shown in Figure 8, but Plastic E was a more rigid type plastic with a flat top. Plastic E was ranked first by more panel members than any other carton. The paper carton with no windows was least preferred, (Table XI).

Multiple pack cartons similar to cartons currently being used by some retailers were evaluated in Series 8 by the panel members, (Figure 10). One three-dozen pack, three two-dozen packs, and a one-dozen plain white control were used. The combination of two green commercial cartons taped, one on top of the other, was preferred by more panel members than any other; the two-dozen plain white "piggy-back" ^{10/}

^{10/}The term "piggy-back" is used to describe the two-dozen unit composed of two single units, taped one on top of the other.

A



Fig. 8. Series 6. An assortment of cartons differing in type of construction. (A) Plain white - solid, (B) A divisible blue on white, with no openings, (C) Blue on white with six square openings, (D) Blue on white with large egg-shaped openings, (E) Transparent plastic.

TABLE X

PREFERENCES FOR PLASTIC CARTONS AND CARTONS WITH WINDOWS
SERIES 6

Style of Carton	First Choice Selection by Panel Members	
	Number	Percent
Plastic	61	40.4
Blue on white with six square openings	30	19.9
Blue on white with egg-shaped openings	28	18.5
Blue on White, no windows	19	12.6
Control (plain white)	13	8.6

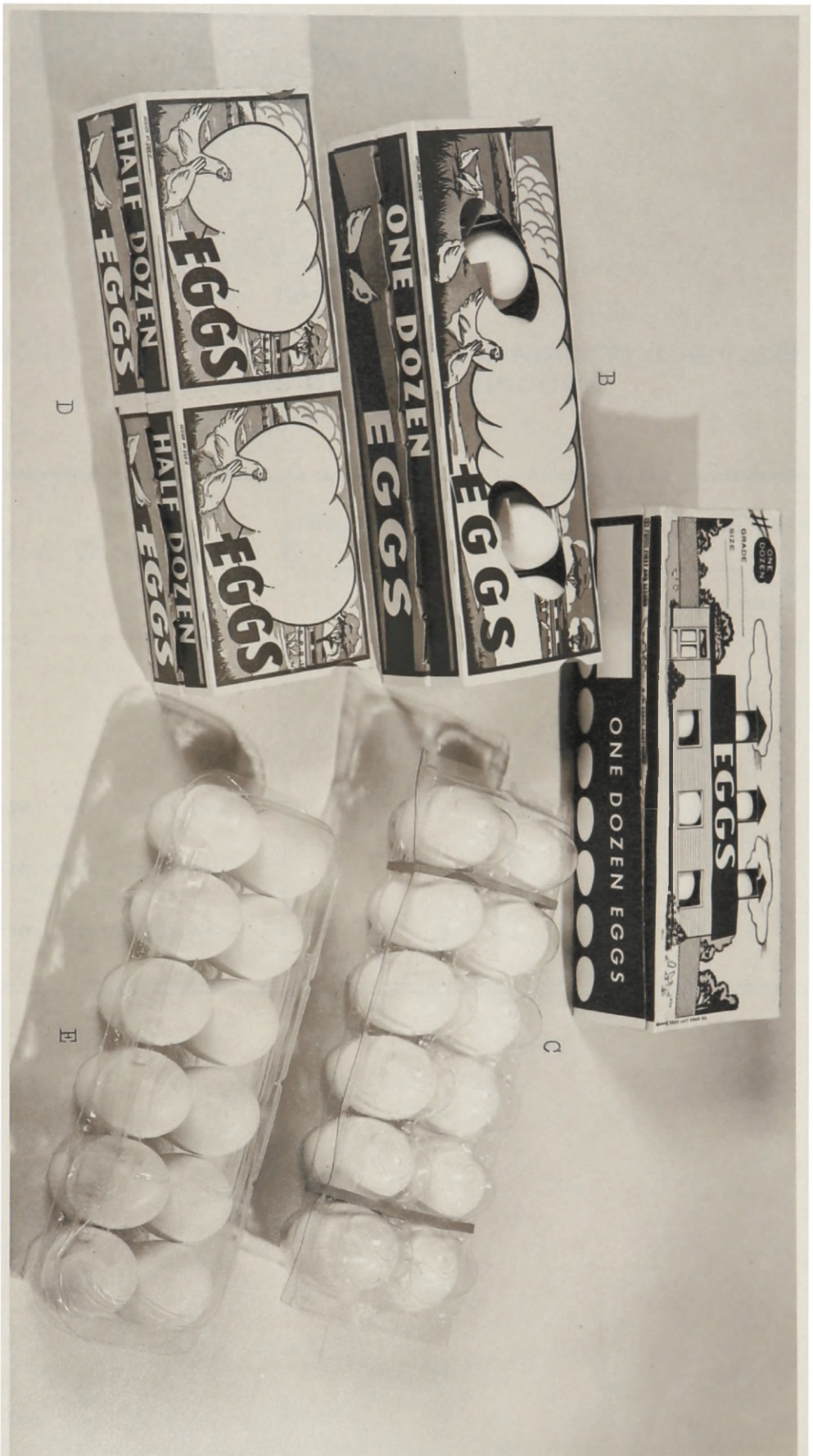


Fig. 9. Series 7. An assortment of cartons differing in type of construction. (A) Blue on white with six square openings, (B) Blue on white with two large egg-shaped openings, (C) Transparent plastic "B" style, (D) Blue on white-divisible-no openings, (E) Transparent plastic "A" style-flat top.

TABLE XI
 PREFERENCES FOR PLASTIC CARTONS, WINDOWED CARTONS AND
 CARTONS WITHOUT WINDOWS
 SERIES 7

Style of Carton	First Choice Selection by Panel Members	
	Number	Percent
Plastic E	80	56.7
Plastic C	24	17.0
Blue on white, six windows	17	12.1
Blue on white, two windows	11	7.8
Blue on white, no windows	9	6.4

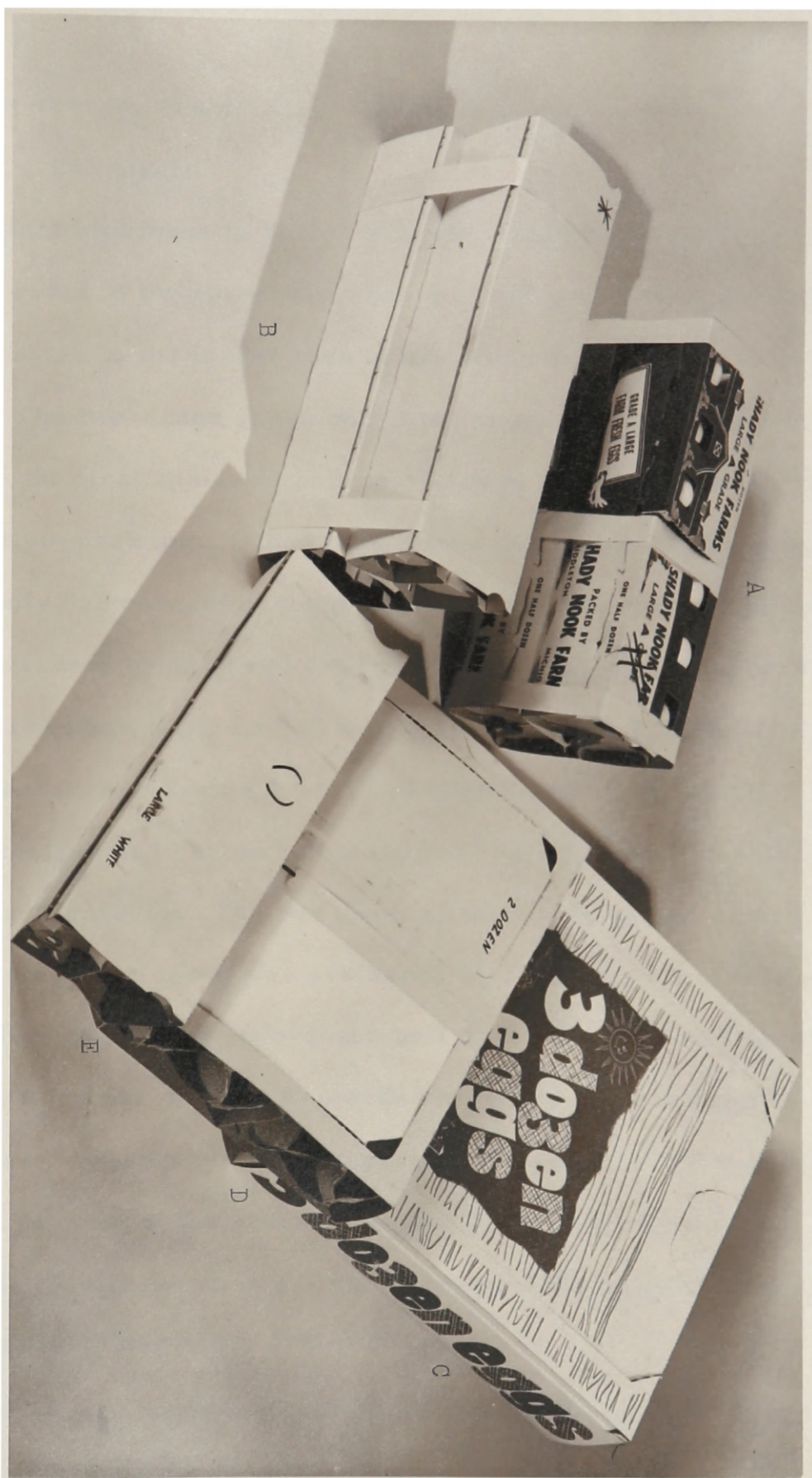


Fig. 10. Series 8 and 9. An assortment of cartons, including "multiple" packs. (A) Two green on white, taped together; (B) Two plain white, taped together; (C) A commercial three dozen pack, blue on white; (D) Two dozen eggs in plain white; (E) Single plain white.

was least preferred, (Table XII). Carton differences in Series 8 were significant, (.001 level).

An effort was made in Series 9 to see whether or not panel members would react in the same way when multiple packs were priced with a slight advantage to the larger size units. Only the unit price was given the panel. The two-dozen green on white "piggy-back" carton continued to be the first choice in both tests, even though it was the highest priced multiple pack unit. The three-dozen unit which had been preferred by only 8.5 percent of the panel members in the previous tests now was preferred by 16.9 and 22.1 percent of the panel members. The one-dozen plain white carton was ranked second, (Table XIII). Carton differences in Series 9 were not significant, (.05 level).

The cartons and carton combinations evaluated in Series 10 are presented in Figure 11. The two dozen molded pulp carton priced at a two cent savings per dozen was preferred by 37.7 percent of the panel. Second choice was another two-dozen unit with a plastic top with only a one cent saving per dozen. The order of rating of these top two cartons was reversed when the composite preference score was used. Seventy-six percent of the panel chose one of the two dozen packs, (Table XIV). A significant degree of agreement (Coefficient of Concordance) was found among panel preferences.

Series 11 was conducted with molded pulp and carton-board cartons in one, two and three dozen units, (Figure 12). Forty-three percent

TABLE XII
INFLUENCE OF MULTIPLE PACK CARTONS ON PANEL PREFERENCE
SERIES 3

Style of Carton	First Choice Selection by Panel Members					
	Trial 1		Trial 2		Total	
	Number	Percent	Number	Percent	Number	Percent
Two dozen, green on white "piggy back"	20	40.8	27	39.7	47	40.2
One dozen, plain white	15	30.6	16	23.5	31	26.5
Two dozen, side by side white	9	18.4	13	19.1	22	18.8
Three dozen	5	10.2	5	7.4	10	8.5
Two dozen, white "piggy - back"	0	0.0	7	10.3	7	6.0

TABLE XIII
EFFECT OF PRICE AND MULTIPLE PACK ON PANEL PREFERENCE
SERIES 9

Style of Carton	First Choice Selection by Panel Members							
	Trial 1				Trial 2			
	Unit price	Price per dozen	No.	Per-cent	Unit price	Price per dozen	No.	Per-cent
Two dozen, green on white "piggy-back"	.99	.49 $\frac{1}{2}$	25	28.1	\$.90	\$.45	25	29.1
One dozen white	.49	.49	21	23.6	.47	.47	19	22.1
Three dozen blue on white	1.40	.46 $\frac{2}{3}$	15	16.9	1.33	.44 $\frac{1}{3}$	19	22.1
Two dozen, white, side by side	.97	.48 $\frac{1}{2}$	11	12.3	.90	.45	15	17.4
Two dozen, white "piggy-back"	.97	.48 $\frac{1}{2}$	17	19.1	.89	.44 $\frac{1}{2}$	8	9.3

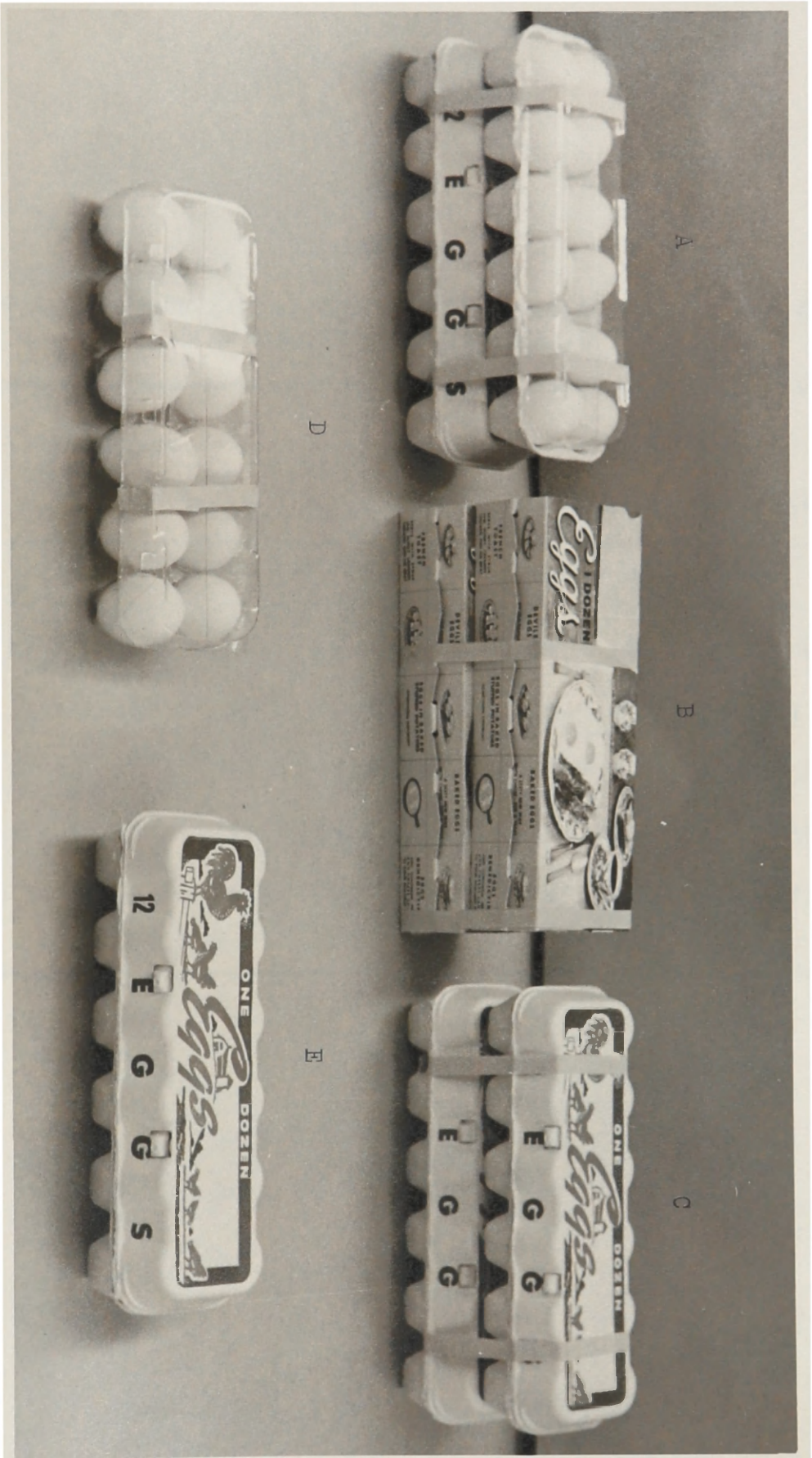


Fig. 11. Series 10. An assortment of egg cartons differing in style, color and size of unit. (A) Two dozen molded pulp with plastic top, (B) Two dozen four color "piggy-back", (C) Two dozen molded pulp "piggy-back", (D) One dozen plastic, (E) One dozen molded pulp.

TABLE XIV

RANK AND PREFERENCE SCORE FOR EGGS PACKAGED IN FIVE CARTON
COMBINATIONS. SERIES 10

Carton	Price		1st.	Rank by Panel Members					Com- posite Prefer- ence Score
	Per Unit	Per Dozen		1st.	2nd.	3rd.	4th.	5th.	
	Dollars	Dollars	Percent	Number of persons					
A (2 doz.)	1.08	.54	26.3	30	40	22	12	5	365.3
B (2 doz.)	1.08	.54	12.3	14	25	39	18	13	306.4
C (2 doz.)	1.06	.53	37.7	43	14	23	20	9	348.8
D (1 doz.)	.57	.57	14.0	16	20	5	13	55	233.0
E (1doz.)	.55	.55	9.7	11	11	19	45	23	246.1

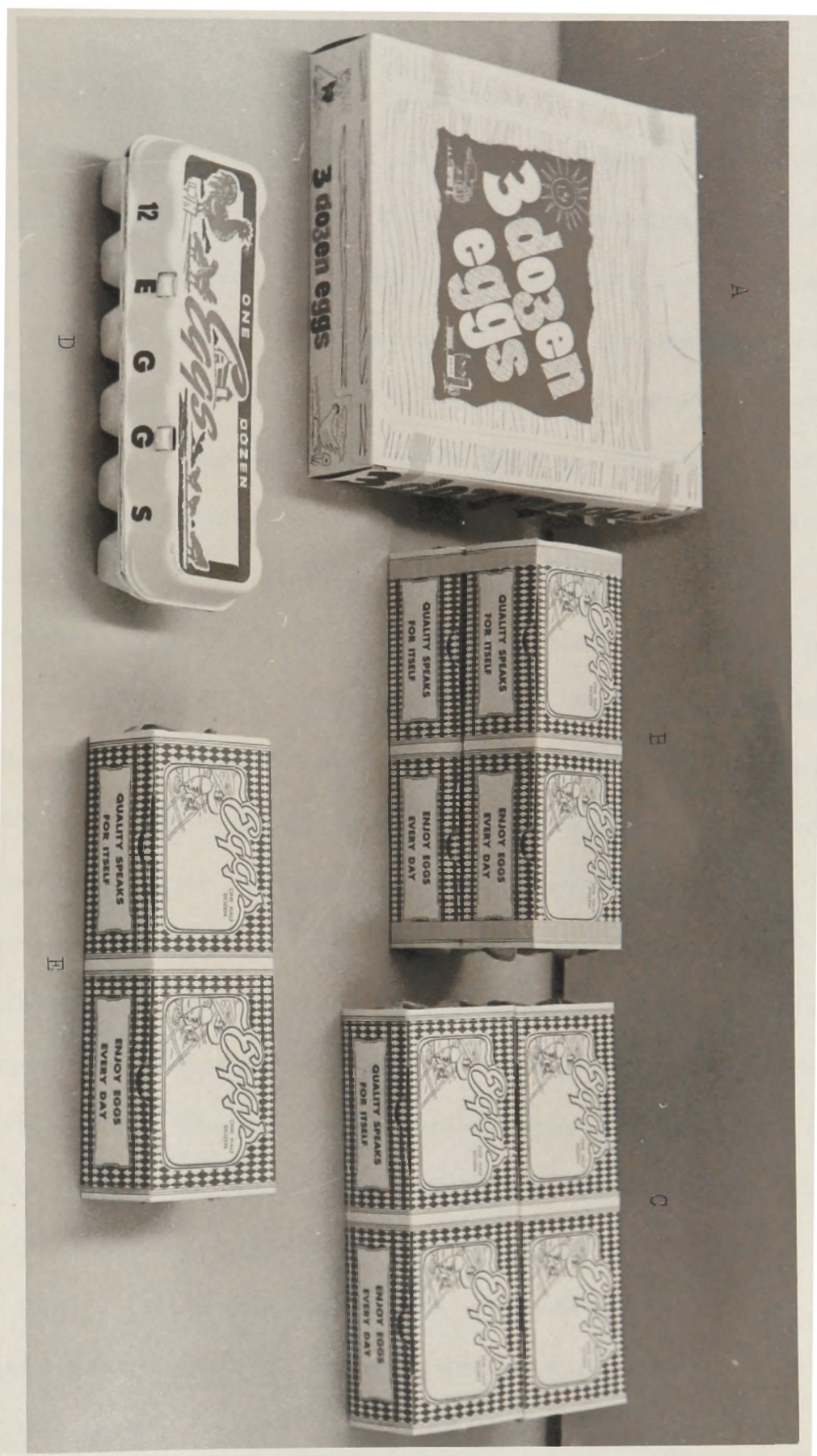


Fig. 12. Series 11. An assortment of egg cartons differing in style, color and size of unit. (A) Three dozen, blue on white, commercial pack, (B) Two dozen red on white, "piggy-back", (C) Two dozen red on white, "side by side", (D) One dozen molded pulp, red and blue on white, (E) One dozen, red on white.

of the panel members preferred the "piggy-back" style carton-board Carton B, as compared to 13 percent preferring the same carton in a side by side arrangement of Carton C. Carton B was also rated first on the basis of preference score. With only a one cent price advantage per dozen, 56 percent of the panel members preferred one of the two-dozen units. With the same price difference, only 16 percent preferred the three dozen unit. Multiple packs were preferred by 74 percent of the panel members, (Table XV). A significant degree of (Coefficient of Concordance) agreement was found among panel preferences.

The highest preference score in any of the series conducted and also the first choice of the largest percentage of panel members was Carton A in Series 12. This was a two-dozen green on white carton-board carton of "piggy-back" design. Sixty percent of the panel members selected this carton over the others exhibited in the series. Twenty-two percent selected one of the single dozen units and only 2 percent selected the one-half dozen carton. There was no appreciable discrepancy in this series between preference score and first place rating, (Table XVI). The five carton combinations evaluated in Series 12 are shown in Figure 13. These differences were significant, (.001 level).

Preference for one, two and three dozen units was obtained in Series 13, Figure 14. A three-dozen green on white "piggy-back" carton ranked first (Carton B), with 46 percent of the panel members preferring this carton; however, on the basis of preference score

TABLE XV

RANK AND PREFERENCE SCORE FOR EGGS PACKED IN FIVE CARTON
COMBINATIONS. SERIES 11

Carton	Price			Rank by Panel Members					Com- posite Prefer- ence Score
	Per Unit	Per Dozen		1st.	2nd.	3rd.	4th.	5th	
	Dollars	Dollars	Percent	Number of persons					
A (3 doz.)	1.62	.54	16.5	19	6	14	10	57	219.9
B (2 doz.)	1.08	.54	43.5	50	28	18	10	3	388.3
C (2 doz.)	1.08	.54	13.05	15	44	24	22	3	331.7
D (1 doz.)	.55	.55	13.05	15	12	18	42	20	257.5
E (1 doz.)	.55	.55	13.9	16	23	35	21	14	301.8

TABLE XVI

RANK AND PREFERENCE SCORE FOR EGGS PACKED IN FIVE CARTON
COMBINATIONS. SERIES 12.

Carton	Per Unit	Per Dozen	Rank by Panel Members						Com- posite Prefer- ence Score
			1st.	1st.	2nd.	3rd.	4th.	5th.	
	Dollars	Dollars	Percent	Number of persons					
A (2 doz.)	.94	.47	60.5	49	12	10	9	1	422.0
B (2 doz.)	.97	$.48\frac{1}{2}$	14.8	12	41	14	7	7	354.1
C (1/2 doz.)	.25	.50	2.5	2	6	8	18	47	174.2
D (1 doz.)	.51	.51	11.1	9	5	9	33	25	225.9
E (1 doz.)	.49	.49	11.1	9	17	40	14	1	323.5

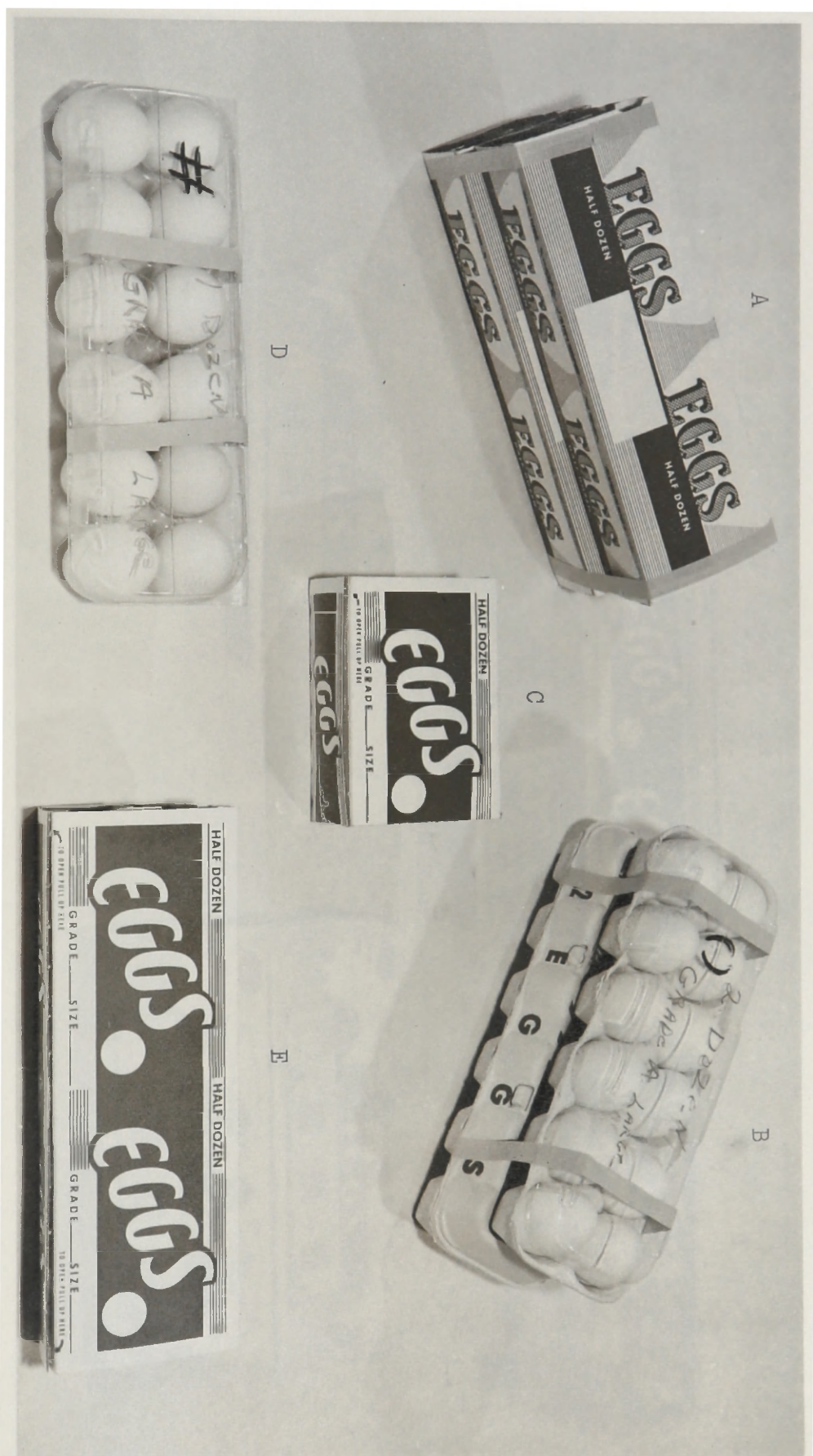


Fig. 13. Series 12. An assortment of egg cartons differing in size of unit, color and construction. (A) Two dozen green on white "piggy-back", (B) Two dozen molded pulp with plastic top, "piggy-back", (C) One-half dozen green on white, (D) One dozen clear plastic, (E) One dozen green on white.



Fig. 14. Series 13. An assortment of cartons differing in size of unit, color and construction. (A) Two dozen green on white, "piggy-back", (B) Three dozen green on white, "piggy-back", (C) Two dozen molded pulp (red and blue on white), "piggy-back", (D) One dozen green on white, (E) Two dozen green on white, "side by side".

Carton A was rated first. Only 13 percent of the members selected the one-dozen carton as their first choice, and 87 percent selected one of the multiple carton units first. The price differential was two cents per dozen for the two dozen packs and three cents per dozen for the three dozen packs, (Table XVII).

Preference data included in all of the series in Experiment II were tested statistically calculating the coefficient of concordance and its tests as given by Kendall, (1948).

A significant degree of agreement was found among the panel members for the trials reported in Tables VIII, IX, X, XI, XII, XIII, XIV, XV, XVI AND XVII.

A Chi square analysis on the results expressed in the preceding tables indicated that carton differences in cartons illustrated in Tables VI, VIII, IX, X, XI, XII, XIV, XV, XVI, AND XVII were highly significant when the hypothesis that there was no difference in carton preference was used, (.001 level). Carton differences shown in Tables VII and XIII were not significant.

TABLE XVII

RANK AND PREFERENCE SCORE FOR EGGS PACKED IN FIVE CARTON
COMBINATIONS. SERIES 13.

Carton	Price		Rank by Panel Members						Com- posite Prefer- ence Score
	Per Unit	Per Dozen	1st.	1st.	2nd.	3rd.	4th.	5th.	
	Dollars	Dollars	Percent	Number of persons					
A (2 doz.)	.94	.47	17.8	15	40	23	4	--	370.8
B (3 doz.)	1.38	.46	46.4	39	1	7	11	24	320.4
C (2 doz.)	.94	.47	17.9	15	27	17	18	5	329.1
D (1 doz.)	.49	.49	13.1	11	4	14	20	33	227.3
E (2 doz.)	.94	.47	4.8	4	13	22	28	15	253.4

EXPERIMENT III. FACTORS INFLUENCING EGG SALES

Numerous discrepancies exist between studies based on questionnaires or surveys and those based on actual store sales. Consumer acceptance of different types of egg cartons was measured in the Lansing area in Experiment III by a series of trials in four super-markets.

Procedure

Four super-markets under the same management, located in the Lansing area, were the setting for a merchandising study designed to evaluate sales of eggs in different cartons and carton combinations. Two brands of eggs were sold in these stores with the usual selection of egg sizes. Both suppliers participated in separate parts of the study. Records were kept at each store of the number of eggs sold through the special display cabinets as well as total eggs purchased.

Egg cartons were donated by the Diamond Gardner Company, Chicago, Illinois and the Inter-state Folding Box Company, Middletown, Ohio. Display cases were rented from the C. V. Hill Company, Trenton, New Jersey. Identical five-foot refrigerated display cabinets were placed at the end of a gondola across from the meat counter, in each of the four stores. This display area was in addition to the regular refrigerated display cases being used for eggs in the stores. The special display cabinet is shown in Figure 15.

Since the experimental cartons featured only large eggs in the



Fig. 15. Refrigerated Display Case and Some Experimental Egg Cartons.

special display cabinets and other eggs were available in the regular display area, an effort was made to measure the change in total egg sales from each store as well as the change in large egg sales during this period. The 1959 sales records were compared with records from the corresponding period in 1958.

Trial 1. Carton Influence on Egg Sales. In Trial 1, five different types of cartons were evaluated. Since the display cabinets would accommodate only four rows of cartons a "Youden Square" design was used, so that all cartons received equal treatments. The details of this arrangement are shown in Table XVIII. This trial was conducted from January 5 through February 7, 1959, a five-week period. Eggs were displayed in special cartons with no manipulation of price except that eggs sold in the two-dozen units were priced three cents lower than two single dozen units. The cartons used in this trial were of carton-board and molded pulp construction. Carton A was a control. This was the carton being used in the store by one supplier, and was the same type carton being used in the store for the merchandising of all eggs. It was a molded bleached pulp, red and blue on white carton of 2 by 6 design. Since this was a brand carton, the brand name was more prominent than it was on other cartons used in the test.

Carton B was a "Self-Locking" 2 by 6 divisible type carton, and was green on white. A rubber stamp was used to identify the packer and producer. The identification which follows on page 63.

TABLE XVIII
"YOU DEN SQUARE" DESIGN, TRIAL 1

Week	Carton Identification			
1	A	B	C	D
2	B	C	D	E
3	C	D	E	A
4	D	E	A	B
5	E	A	B	C

Grade A

Large

Produced and Graded by W. W. Mueller & Son
Dansville, Michigan

One-quarter inch letters were used for "Grade A" and "Large", while only one-eighth inch letters were used for the rest of the identification.

Carton C was a green on white sleeve type, 2 by 6 divisible carton manufactured by the Inter-state Folding Box Company. Cartons D and E were similar to Carton C.

Carton D was a two-dozen, 4 by 6 carton identical to Carton C, except that the two cartons were attached side by side, and the carton identification was two-dozen, instead of one-dozen.

Carton E was an improvised two-dozen "piggy-back" type carton. This was identical to Cartons C and D, except that the two single units were fastened together by tape, one on top of the other. The one-dozen identification was covered with the figure "2". Figure 16 shows the cartons used in Trail 1. Weekly data were received from each of the stores, and the results were analyzed by stores using the procedure described by Youden (1940), and outlined in the appendix, page 112.

Trial 2. Price Influence on Egg Sales. Trial 2 was conducted from February 9, through March 7, 1959. During this four week period equal space was allotted for eggs of each of the two suppliers. Since only large eggs were featured in the special display, two rows were allotted for each brand of eggs. One row was priced the same as large eggs in the regular display, while a second row was marked three cents

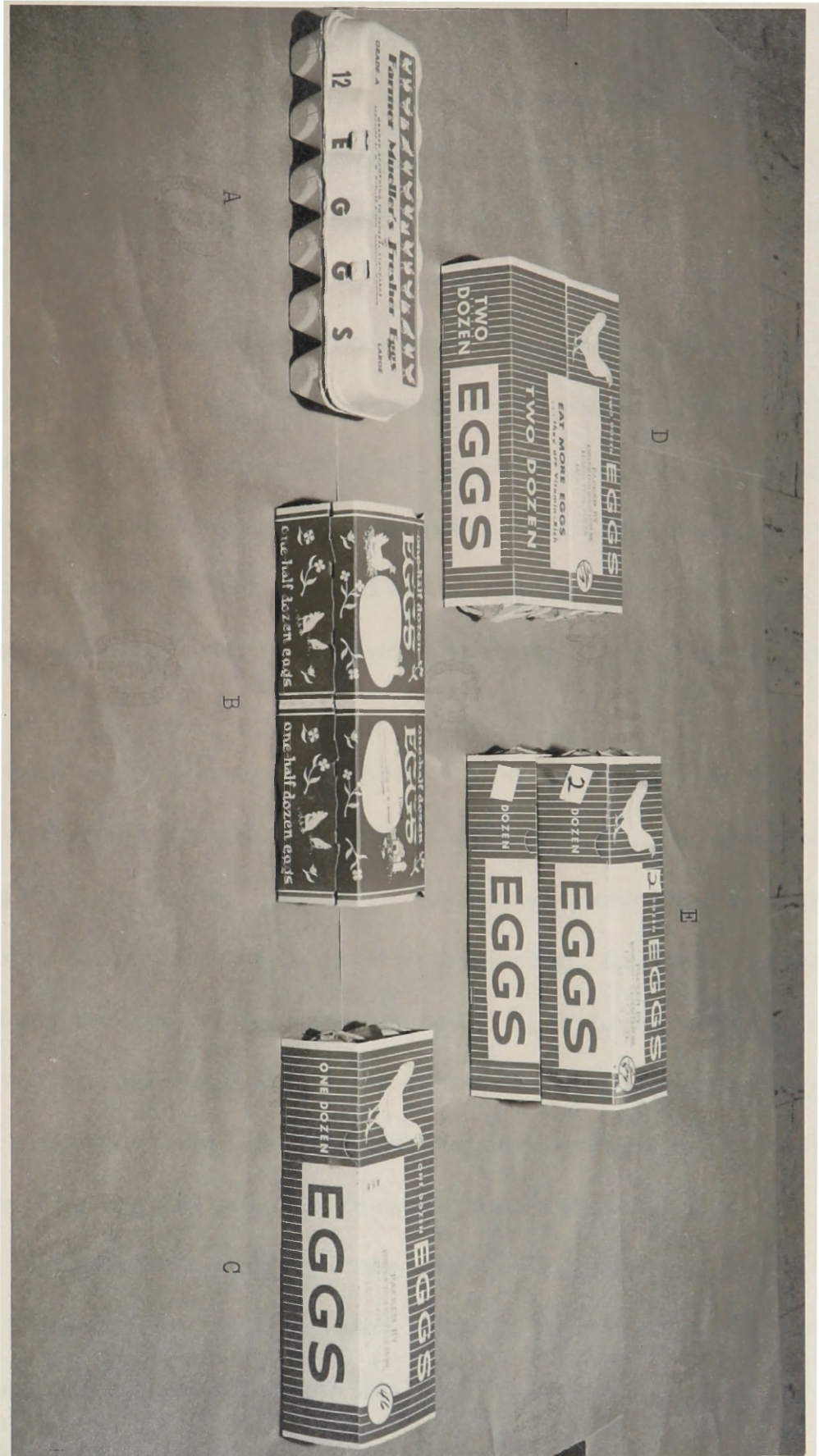


Fig. 16. Cartons used in Trial 1. (A) One dozen molded pulp, control; (B) Green on white, one dozen, self-locking carton; (C) Green on white, one dozen super-cell; (D) Green on white, two dozen "side by side"; (E) Green on white, two dozen "piggy-back".

less per two dozen. Shoppers had a choice of either brand, and either singly or in two-dozen multiples at the reduced price. Molded cartons of the 2 by 6 design were used by both suppliers with their respective brand names.

Cartons A and B were brand cartons of supplier B, and were identical except for pricing. This was not the brand of eggs used in the first part of the study where multiple cartons and price reductions were studied. Carton A was the carton marked with the two dozen special price. Carton B was marked at the regular price for large eggs. Brand B eggs had been sold in the store, however, in the regular display.

Cartons C and D were brand cartons of supplier A, identical to the control carton featured during Trial 1 of this study. In addition to the advantage of familiarity, and these eggs being associated with the special display cabinet during the preceding period, Brand A eggs were priced one cent per dozen lower than Brand B eggs during most of the trial. Pricing was not experimentally controlled since an automatic, normal mark-up was taken, and the price difference was the result of supplier A billing eggs at one cent less per dozen than supplier B.

A 4 by 4 Latin Square design was used for displaying the eggs in the cabinet. This design is illustrated in Table XIX. Weekly records were summarized by computing the analysis of variance, and this difference was compared by use of the studentized range.

TABLE XIX

FOUR BY FOUR LATIN SQUARE DESIGN USED FOR PRICE STUDIES
IN TRIAL 2 AND TRIAL 3

Week	Carton	Carton	Carton	Carton
1	A	B	C	D
2	D	A	B	C
3	C	D	A	B
4	B	C	D	A

Trial 3. Brand Influence on Egg Sales. During a four-week period, March 30 to April 25, 1959, consumers in the Lansing area were confronted with a new brand of eggs, which had not been featured in these stores prior to this time. In order to control the experiment as completely as possible, the following procedure was used. The brand of eggs featured by supplier B was removed from the store and his new brand was substituted. This substitution was made in the regular display, and was also featured in the special display in the stores during this trial. Although various sizes of eggs were merchandised in the store, only large eggs were featured in the special display case. In an effort to eliminate the price variable between suppliers, the management agreed to stabilize the price, so that eggs of both suppliers were priced identically during Trial 3.

The special display during Trial 3 was composed of four different types of cartons placed in the display in a 4 by 4 Latin Square design. A 4 by 4 Latin Square design was used in each of the four super-markets as reported in Table XIX, page 67.

The following types of cartons were used in the study. Carton A was a molded pulp carton with a regular brand name printed on the carton. Carton B was the same two-dozen side by side carton used in Trial 1 of this experiment, but with the new supplier brand stamped on the top of the carton. Carton C was similar to Carton B, except that it was a single unit. Carton D was the same as Cartons B and C,

except for the design. It was a "piggy-back" type of carton, and improvised for the study. Figure 17 shows the display and the cartons used for Trial 3 in this experiment.

Results

During the period covered by Experiment III, 73,543 dozens of eggs were sold through the stores participating. Differences in sales of two dozen units were found among stores. Many of these differences were undoubtedly due to the store location, the store clientele, and the size of display area in the store allocated to eggs.

Display Space and Physical Layout of Participating Stores. Store 1, a medium size super-market, is located in a residential area of the city, on highway U.S. 127. The total store area is 9,680 square feet, and the sales area has 7,200 square feet.

Parking facilities are limited to 48 cars. The store has five check-out counters. When classified according to the system used by Goodrich (1958), it would be considered a medium sized store. Compared to Super Valu Study (1959), it would be considered slightly below the average sized store.

The display area for eggs in this store is located in one end of the dairy case. Dairy products occupy nearly 73.5 percent of this space. A total of 79 lineal inches is devoted to egg displays. This compares favorably with the space allocated for egg displays reported by Goodrich (1958) for medium sized stores. Considerably more space



Fig. 17. Cartons and Special Display in Trial 3.

is allocated than was found in the Super Valu Study (1959), when only ^{70.}
one foot nine inches linear floor area was found allocated to egg displays.
Two different brands of eggs are featured in the store and a total of seven
egg offerings are available to the consumer, including a one-half dozen
unit. ^{11/}—

Store 2 is a neighborhood shopping store, located in a residential
area, with a large percentage of the customers coming from the nearby
homes. Since this area is heavily populated with negroes, the shoppers in
this store are largely of the negro race. Purchases in the store are
relatively small per visit, but visits are more frequent than in most
large super-markets.

The store area occupies 5,600 square feet, and the sales area is
composed of 4,700 square feet. There are three check-out counters,
and the store is classed as a small super-market (Goodrich, 1958), and
(Super Valu Study, 1959).

Display area in this store is limited. The dairy case occupies
eighteen feet and eight inches, with four feet of this space utilized by
eggs. Eggs occupy 21 percent of the total area of the display case, and
this is a favorable ratio according to Goodrich, (1958). Four egg offer-
ings are available to consumers in this store.

Store 3 is located in a shopping center. This store has shown more
rapid growth since it's opening than other super-markets included in this
study. It has nearly 13,000 square feet in the store and the sales area

^{11/}Offering is defined as anything that would make a difference in
the consumers choice; i. e. , brand, price, size, etc.

is composed of about 9,000 square feet. Since this is in a shopping center, ample parking is available. Six check-outs are located in this store, thus according to Goodrich, (1958), it would be classed as a medium sized store. The total dairy case occupies seventeen linear feet and thirty-eight percent of this area is allocated to eggs. This is a considerably larger display area for eggs than was reported by Super Valu (1959) and Goodrich (1958) for stores of this size.

Store 4 is the newest of the super-markets in the study. It was opened in January, 1958, thus the physical layout represents a considerably more elaborate plan than the other stores. Located on highway U. S. 16, outside of East Lansing, the store includes about 20,000 square feet, and the sales area is composed of 13,000 square feet. This store has seven check-out counters, and is the only store in the study, when classified according to the plan used by Goodrich, (1958), that would be considered a large super-market. One hundred fifty parking places are available for automobiles, and customers have a special pick-up station.

The dairy display case in this store is forty feet and four inches long. The egg display area occupies eleven feet and ten inches of this space, or 29 percent.

It should be pointed out that both Store 3 and 4 were designed to attract customers from neighboring towns, and the ample parking space makes it more attractive to shoppers located some distance away. With a heavier store traffic, it would be expected that the space allocated to egg sales should be in proportion to the volume of business done by the store. Since the egg display area in Store 3 is not proportional to

the total store display area, it would be expected that additional space allocated to egg displays in this store would bring a better response in egg sales than in the other stores.

The display area for eggs in each store is shown in Figure 18. Store size as measured by the sales area is shown in Figure 19. Total egg sales during the twenty-one week test period are reported in Figure 20.

Trial 1. Carton Influence on Egg Sales. Differences in egg sales during Trial 1 represents the combined effect of multiple cartons and pricing practice.

The acceptability of two-dozen cartons as compared to single dozen cartons is shown by comparing total egg sales from the special display cabinet with the number of dozens sold in two-dozen units. Table XX shows the average weekly sales of eggs from each special display cabinet in each store during the five week period of this trial.

Equal space was allotted each carton in the display and it was expected that if cartons were the same, as far as consumer acceptance was concerned, each carton would be represented by 20 percent of the sales. Carton A had 20 percent of the sales, but not Carton B or C. In contrast, Carton D sales totaled 30 percent of the total, and Carton E over 25 percent. The combined sales of the two dozen units, Cartons D and E, accounted for over 55 percent of the eggs sold through the special display cabinet. Two dozen unit sales ranged from 50 percent in Store 2 to nearly 59 percent in Store 3.

The percentage of large and total eggs sold through the special display cabinets is shown in Table XXI. This percentage varied among

TABLE XX

AVERAGE WEEKLY EGG SALES THROUGH SPECIAL DISPLAY CABINETS
DURING TRIAL 1

Cartons	Store				Total
	1	2	3	4	
Two dozen	241.2	181.2	280.0	198.0	900.4
One dozen	205.4	180.0	196.6	148.6	730.6
Total	446.6	361.2	476.6	346.6	1631

TABLE XXI
LARGE AND TOTAL EGG SALES BY STORES, TOTAL AND SPECIAL
DISPLAY, TRIAL 1

Store	Total Egg Sales	Total Large Egg Sales	Special Display		
			Total	Percent of Total	Percent of Total Large
Dozens					
1	3714	2748	2233	60.1	81.3
2	3566	2624	1806	50.6	68.8
3	6666	4440	2383	35.7	53.7
4	4298	2940	1733	40.3	58.9
Total	18244	12,752	8155	44.7	64.0

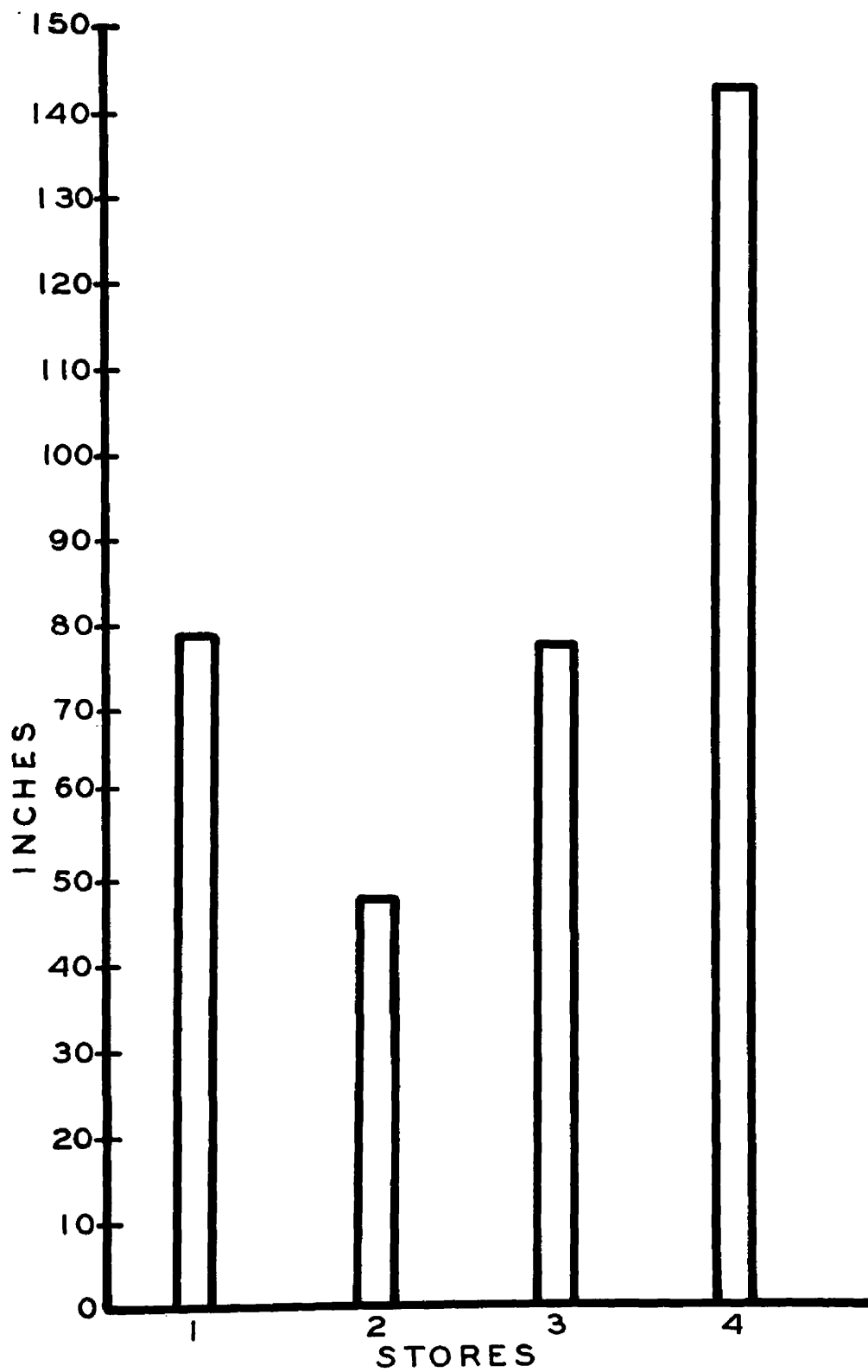


Fig. 18. Refrigerated Display Area Allocated To Eggs, by Stores.

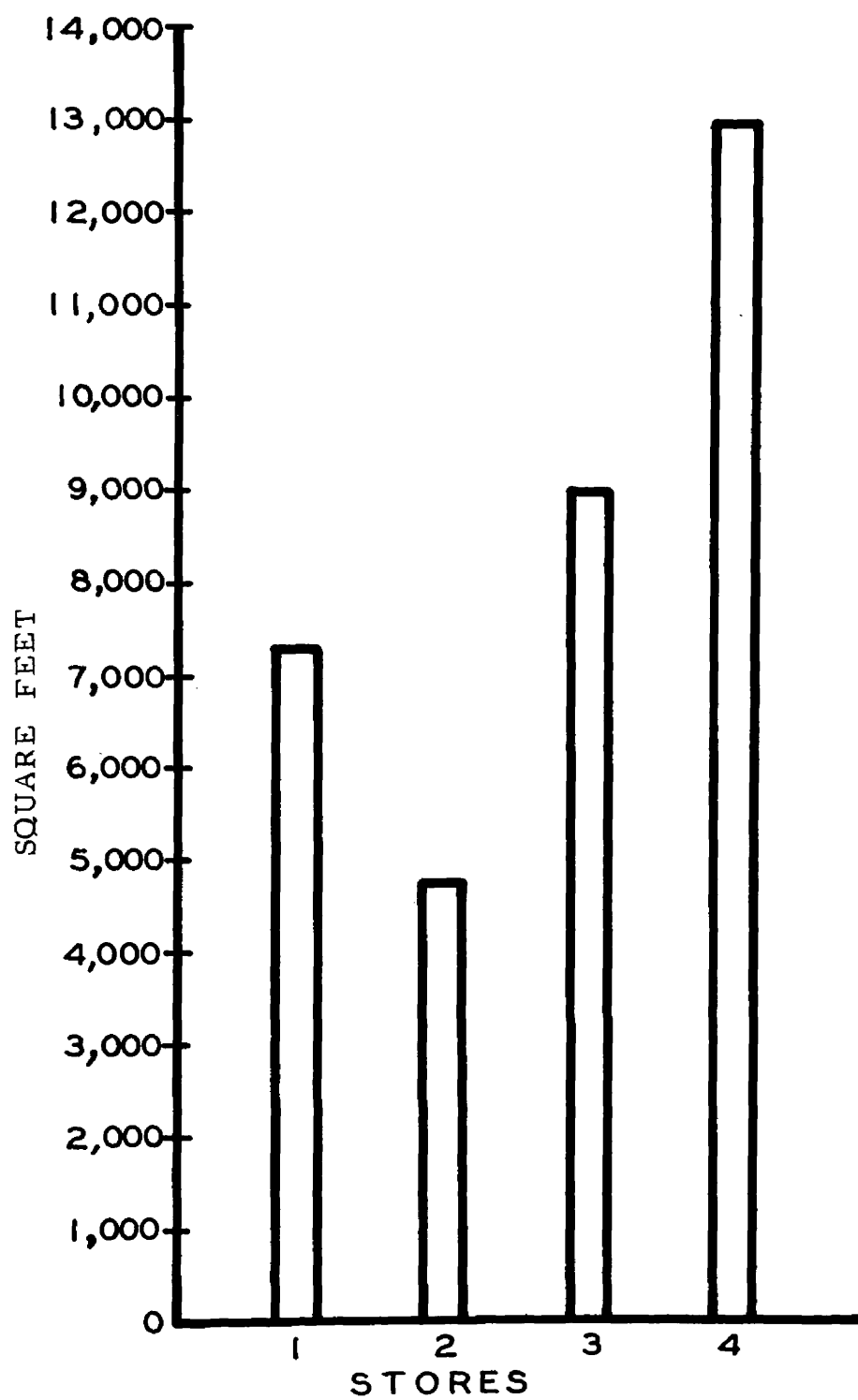


Fig. 19. Sales Area for Each Store

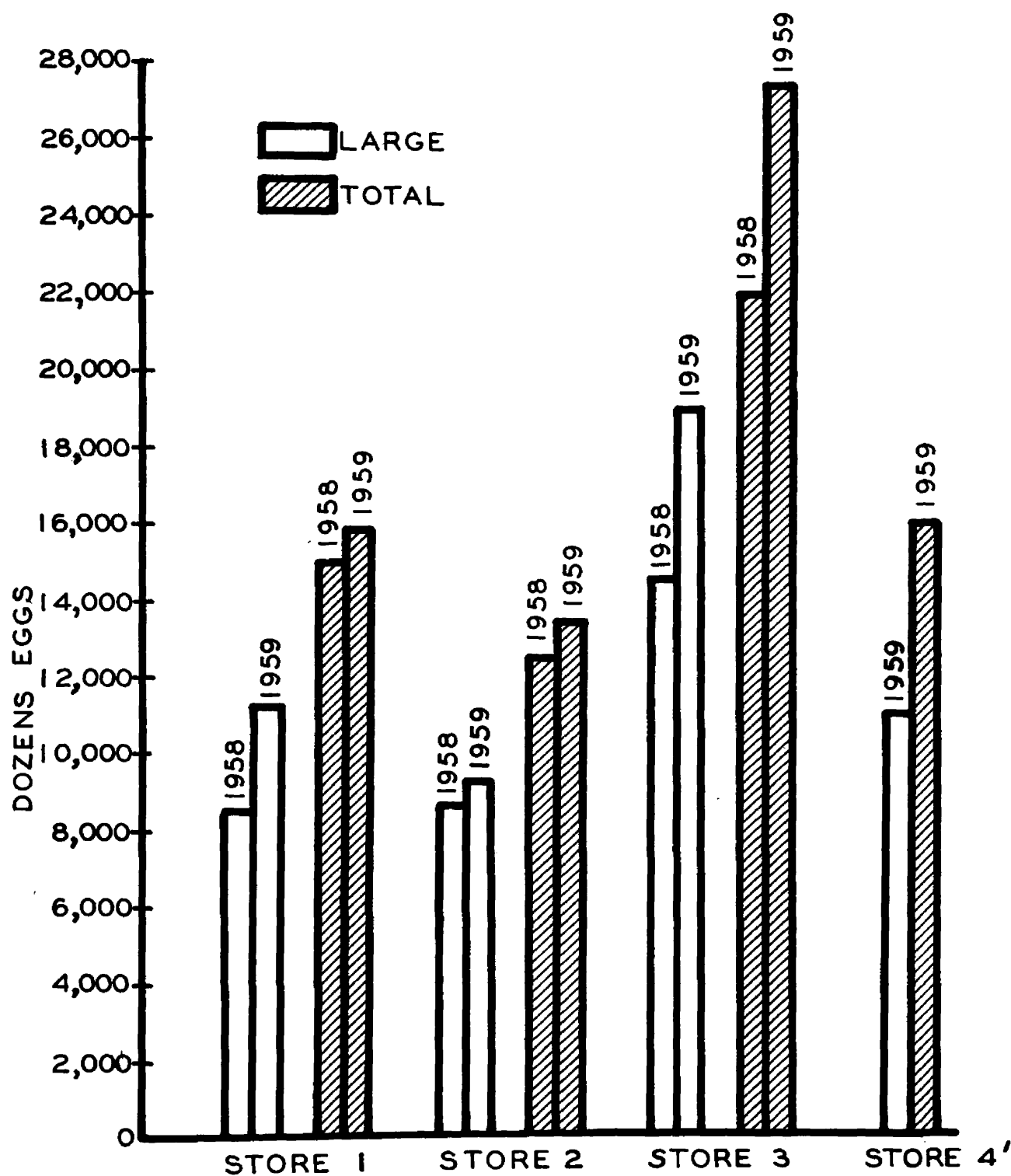


Fig. 20. Sales of Eggs in Four Stores During the Test Period 1958-1959 and the Corresponding Period 1957-1958.

1. Opened during 1958.

stores from 60 percent of the total eggs sold through the special case to 35 percent of the total. The percentage of large egg sales ranged from 53 percent in Store 3 to 81 percent in Store 1. Average weekly egg sales by stores during Trial 1 is shown in Table XXII.

The increase in display area added by the special display cabinet is illustrated in Figure 21. It will be noted that this represents only a 39 percent increase in Store 4, but in Store 2 represents a 116 percent increase. Stores 1 and 3 had increased display areas of 71 and 72 percent respectively.

An analysis of variance was computed on the data and significant differences were measured by use of the studentized range.

Significantly more eggs were sold in Carton D than in Carton C or B. In Store 3, egg sales in Carton D, were significantly higher than in all other cartons, and in Store 4, they were higher than in Carton A, in addition to B and C, (.01 level). At the .05 level significantly more eggs were sold in Carton D than in Cartons A, B or C in Store 1, than B or C in Store 2, while in Store 3 and 4, egg sales in Carton D exceeded the sales in any other carton.

Significantly more eggs were sold in Carton E (two-dozen "piggy-back"), than in Carton B in all stores, (.01 level). In Store 1, egg sales in Carton E exceeded those in Carton C, and in Stores 3 and 4, it exceeded egg sales in Cartons A and C. At the .05 level more eggs were sold in Carton E than in Cartons C or B in all stores. In Stores 2 and 4, egg sales in Carton E were also higher than those in Carton A.

Sales of eggs in Carton A (control) were greater than those in

TABLE XXII
AVERAGE WEEKLY EGG SALES, ALL EGGS, TRIAL 1

Size	Store				Total
	1	2	3	4	
Extra Large	151.2	128.4	235.2	132.4	647.2
Large ¹	549.6	524.8	888.0	588.0	2550.4
Medium	42.0	60.0	210.0	127.2	439.2
Small				12.0	12.0
Total	742.8	713.2	1333.2	859.6	3648.8

¹ Large eggs only were featured in the special display cabinets.

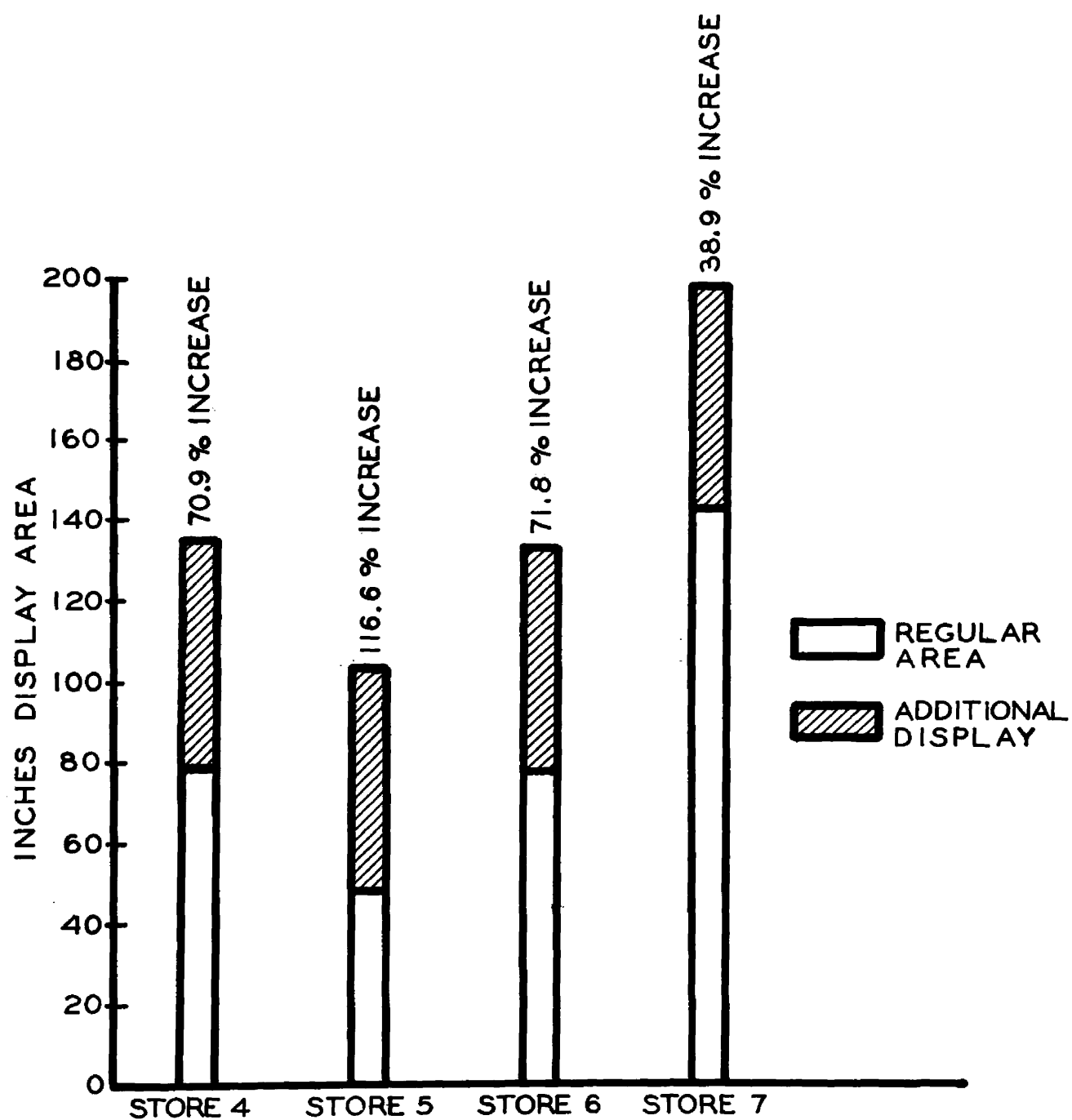


Fig. 21. Linear Egg Display Area

Carton B in all stores except Store 6, (.01 level). Sales of eggs in Carton A exceeded those in Carton C in Stores 4 and 7. They also exceeded sales in Carton B in Store 3, (.05 level).

In comparing total large egg sales during this period with egg sales during the corresponding period in 1958, it is noted that the highest percentage increase in the sale of large eggs was in Store 1 with a 29 percent increase. Stores 2 and 3 had increases in large egg sales of 25.0 percent and 26.5 percent respectively. Increases in total sales of all eggs ranged from -0.3 percent in Store 1 to 30 percent in Store 3. For this comparison Store 4 is not considered, since it is a new store, and did not open until the middle of the control period considered in 1958, (Table XXIII).

An analysis of Variance of the data is shown in Tables XXIV, XXV, XXVI, AND XXVII.

Trial 2. Price Influence on Egg Sales. The sale of eggs through the special display case was substantially reduced during Trial 2 from what it had been during Trial 1. This occurred in spite of a price decline of about two cents per dozen during this period. The Lenten season came during the second week of this trial, hence an increased demand for eggs was expected. Table XXVIII shows egg sales through the special display cabinets during the two trials. Average weekly sales through the special display cabinets decreased in all stores. This decrease ranged from 13.3 percent in Store 4 to 25.4 percent in Store 1.

TABLE XXIII
EGG SALES BY STORES DURING TRIAL 1, 1959 AND CORRESPONDING PERIOD 1958

Period Covered	Store						Total	
	1		2		3			
	Dozens							
	Large	Total	Large	Total	Large	Total	Large	Total
Trial 1, 1959	2748	3714	2624	3566	4440	6666	12,752	18,244
Corresponding Period 1959	2130	3725	2100	3282	3510	5124	10,560	16,355
Change in Sales	+618	-11	+524	+284	+930	+1542	+2192	+1889
Percent Change in Sales 1959 over 1958	+29	-.3	+25.0	+8.7	+26.5	+30.1	+20.8	+11.5

TABLE XXIV
ANALYSIS OF VARIANCE, TRIAL 1, STORE 1.

Source	S S	D F	M S	F	F .05 *	F .01 **
Total	53522.55	19				
Positions	7328.55	3	2442.85	2.19	4.07	7.59
Weeks	4901.30	4	1225.32	1.10	3.84	7.01
Cartons	32359.37	4	8089.84	7.24	3.84	7.01
Error	8933.33	8	1116.67			

TABLE XXV
ANALYSIS OF VARIANCE, TRIAL 1, STORE 2

Source	S S	D F	M S	F	F .05 *	F .01 **
Total	25614.20	19				
Positions	1424.20	3	474.73	0.595	4.07	7.59
Weeks	3652.70	4	913.18	1.14	3.84	7.01
Cartons	14156.37	4	3539.09	4.44*	3.84	7.01
Error	6380.93	8	797.62			

TABLE XXVI
ANALYSIS OF VARIANCE, TRIAL 1, STORE 3

Source	S S	D F	M S	F	F .05 [*]	F .01 ^{**}
Total	78148.55	19				
Positions	4466.55	3	1488.85	1.27	4.07	7.59
Weeks	5350.30	4	1337.58	1.14	3.84	7.01
Cartons	58982.10	4	14745.52	12.62 ^{**}	3.84	7.01
Error	7349.60	8	1168.70			

TABLE XXVII
ANALYSIS OF VARIANCE, TRIAL 1, STORE 4

Source	S S	D F	M S	F	F .05 [*]	F .01 ^{**}
Total	35494.55	19				
Positions	930.55	3	310.18	0.765	4.07	7.59
Weeks	12764.80	4	3191.20	7.87 ^{**}	3.84	7.01
Cartons	18557.07	4	4639.27	11.45 ^{**}	3.84	7.01
Error	3242.13	8	405.27			

TABLE XXVIII

AVERAGE WEEKLY EGG SALES THROUGH SPECIAL DISPLAY CABINETS
DURING TRIAL 2

Purchasing Unit	Store				Total
	1	2	3	4	
	Dozens				
Two dozen	179.5	162.3	265.0	175.0	781.8
One dozen	153.5	143.2	147.3	125.5	569.5
Total	333.0	305.5	412.3	300.5	1351.3
Change in Sales Trial II over Trial I	-25.4	-15.4	-13.5	-13.3	-17.1

The average decrease in egg sales through the special display was slightly over 17 percent. Special display sales during Trial 1 and Trial 2 are shown in Figure 22.

During this trial, average weekly sales of all eggs in the four stores decreased more than 7 percent from Trial 1. The decrease ranged from 1.2 percent in Stores 1 and 3 to 21.5 percent in Store 2. Table XXIX shows the total egg sales during these two trials.

Since the cartons used in this trial were identical, but prices were different, the sales of one carton over another either represent a preference for one brand over another, or a purchase of a particular carton, because of the price advantage. Due to the store pricing Carton D (two-dozen unit of supplier A) was one cent per dozen less than Carton A (two-dozen unit of supplier B), or two cents less on the two-dozen purchase. Carton C was also priced one cent less than the competing single dozen brand, Carton B.

In Store 3, egg sales in Carton D exceeded those of all other cartons. In Stores 1 and 2, egg sales in Carton D were greater than those in Carton B or A, and in Store 4, than Carton B, (.01 level). Only in Store 2 did egg sales of Carton C exceed sales in any other carton. At the .05 level egg sales in Carton C were greater than those in Cartons A and B. Average weekly egg sales of all eggs during Trial 2 were 7.2 percent below the average for Trial 1. Egg sales from the special display cabinet were 17.1 percent below the average for the

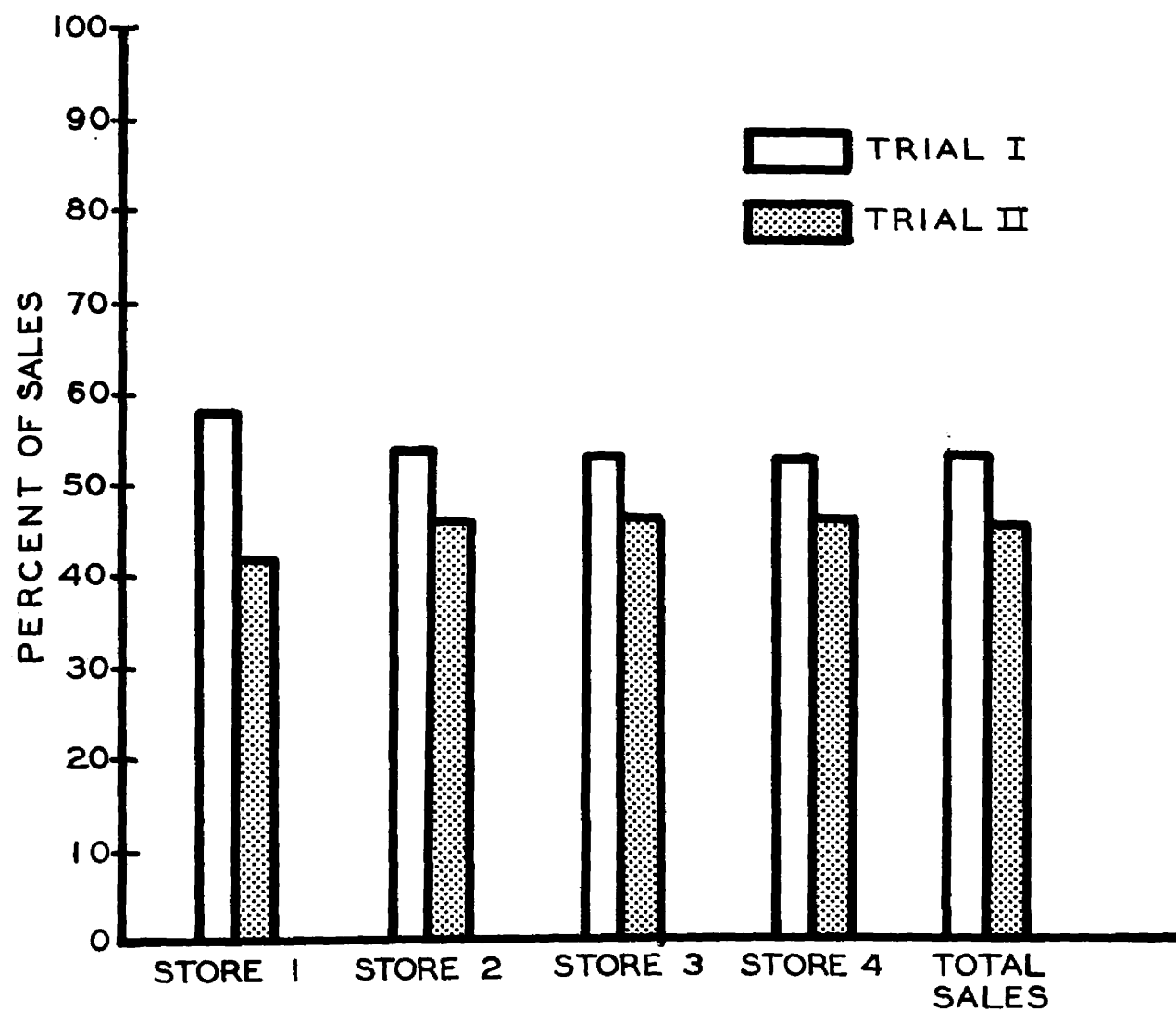


Fig. 22. Egg Sales From Special Display Cabinets During Trial I and Trial II.

TABLE XXIX
AVERAGE WEEKLY EGG SALES, ALL EGGS, TRIAL 2

Egg Size	Store				Total
	1	2	3	4	
Extra Large	120.0	76.5	229.5	108.0	534.0
Large ¹	591.3	446.8	967.5	592.5	2598.1
Medium	22.5	37.5	120.0	75.0	255.0
Total	733.8	560.8	1317.0	775.5	3387.1
Change	-1.1	-21.4	-1.2	-9.8	-7.2

¹ Large eggs only were featured at the price advantage for purchases in two dozen lots.

Trial 1 period.

Trial 3. Brand Influence on Egg Sales. During Trial 3 it was found that egg sales in Carton D, the two-dozen "piggy-back", were significantly higher than all other cartons in all stores. In Stores 3 and 4 egg sales in Carton B (two-dozen side by side), exceeded those in Cartons A and C, (.01 level). Since Cartons B and D were the two dozen units, this further emphasized the acceptance of two-dozen packages by Lansing area consumers, even when a new brand was introduced. The new brand was compared with an established brand by comparing egg sales during Trial 3 with Trial 1, when an established brand was sold through the special display. Table XXX shows the average weekly sales during these two periods. Total sales through the special display cabinets averaged 10.8 percent lower when the new brand was introduced, than during Trial 1. The percentage of eggs sold in two dozen cartons increased from 55 percent to 60 percent during this period. Two-dozen cartons were allocated 50 percent of the display area, however, whereas in Trial 1, only 40 percent of the display area was allocated to the two-dozen cartons.

A comparison of total egg sales in all stores during the period when the new brand was introduced with sales during Trial 1, with the established brand, showed that total sales decreased 15.2 percent during this latter period. The amount of variation ranged from a decrease of 1.8 percent in Store 1, to 23.9 percent in Store 2. Table XXXI shows

TABLE XXX

AVERAGE WEEKLY EGG SALES BY STORES BETWEEN NEW AND ESTABLISHED BRAND IN
SPECIAL DISPLAY CABINET

	Store				
	1	2	3	4	Total
A	432	331	305	303	1371
B ¹	322	316	442	348	1428
C	201	280	262	210	953
D ¹	530	394	720	422	2066
Total	1485	1321	1729	1283	5818
Ave. Weekly Sales	371.25	330.25	432.25	320.75	1454.5
Ave. Weekly Sales ² Trial 1	446.6	361.2	476.6	346.6	1631
Percent Change in Sales with New Brand	-16.9	-8.6	-9.3	-7.5	-10.8
Percent Sales Made in 2 doz. Cartons	57.4	53.7	67.2	60.0	60.1
¹ Two dozen cartons					
² Trial 1 Special Display featured established brand.					

TABLE XXXI

AVERAGE WEEKLY TOTAL EGG SALES BY STORES BETWEEN NEW AND ESTABLISHED BRAND

	Store				Total
	1	2	3	4	
	Dozens				
New Brand	729.8	543.0	1097.0	725.5	3095.3
Established Brand	742.8	713.2	1333.2	859.6	3648.8
Percent Change in Sales with New Brand	-1.8	-23.9	-17.7	-15.6	-15.2

the average weekly sales of all eggs during the two trials.

DISCUSSION

The carton used in merchandising eggs has a three fold purpose. First, the carton provides protection from forces that would cause damage to the eggs in the carton; second, it makes egg handling more convenient; and third, it gives "eye appeal", so that it will create a desire for the product inside the package.

Since eggs are fragile and breakage may result in oozing or seepage, the importance of the carton as a container cannot be overlooked. Some cartons contain the seepage from leakers or crushed eggs, while others permit the broken contents to soil other cartons and eggs in the case. The fact that many eggs with shell defects are packed in cartons makes the problem more acute.

In view of current merchandising practices, it becomes increasingly important to have cartons that promote impulse buying. These factors were evaluated by experimental tests, consumer panel surveys, and store sales.

Differences in protective value between egg cartons tested in the mechanical and truck route trials were not significant. Several observations were made, however, regarding these cartons during the tests. The molded and plastic cartons held the contents of leaking eggs. Although this is advantageous as far as protection of other products is concerned, it also means that any broken eggs are still in the carton

when the housewife get them home ready for use.

Cartons with open windows provide visibility for the product, but they allow the contents of the carton to become soiled by broken eggs outside the carton.

Since most eggs are packed in cartons of the same size, considerable movement of eggs may take place within the carton, particularly when small and medium sized eggs are packed. This movement was more evident in the Case Ace, Trifold and Plastic cartons.

Undoubtedly many factors influence consumer acceptance of a package. Some of these factors are more important with eggs than with less fragile products. A flexible plastic carton was rated considerably below a more rigid plastic carton.

A definite preference was shown for pastel green colored cartons on a white background. Cartons providing good visibility of the product were also rated above those with little visibility. Since consumers do have a preference for these characteristics, the enterprising poultryman can attract more customers to a particular brand or display by using cartons that have these characteristics.

During a twenty-one week period, egg records were kept at four super-markets. Egg sales during this period totaled nearly 74,000 dozens. Considerable differences were found in egg sales between different stores. This was to be expected since the size of the stores and egg display areas varied considerably.

Egg sales during the 1959 period increased in all stores over the corresponding period in 1958. Figures 23, 24 and 25 show egg sales by stores for these two time periods. In 1959, at the beginning of the third week, the special display cabinets were moved into the stores and egg sales through these cabinets were recorded. Egg sales increased as reported in Figures 23, 24, 25 and 26. Trial 1 started with the sixth week, and the five special cartons were used. Regular cartons were sold during the eleventh and fourteenth week period, when egg sales in multiple units were priced below single dozens. The new brand of eggs was sold during the eighteenth to twenty-first week period.

Increased egg sales from the twelfth to the seventeenth week may have been influenced by the Lenten season.

More eggs sold when offered in multiple units than did eggs packed in single dozen cartons.

Price differentials were undoubtedly one of the incentives for the purchasing of eggs in multiple dozens, however, when price differentials were used alone, sales through the special display cabinet declined, even though this occurred during the Lenten period.

Total egg sales reached a peak during the Easter season with an average weekly sales exceeding 4,000 dozens, whereas, for the twenty-one week period, the average was about 3500 dozens per week.

Egg prices by weeks during the twenty-one week study period, and the corresponding period, 1957-1958, are illustrated in Figure 27.

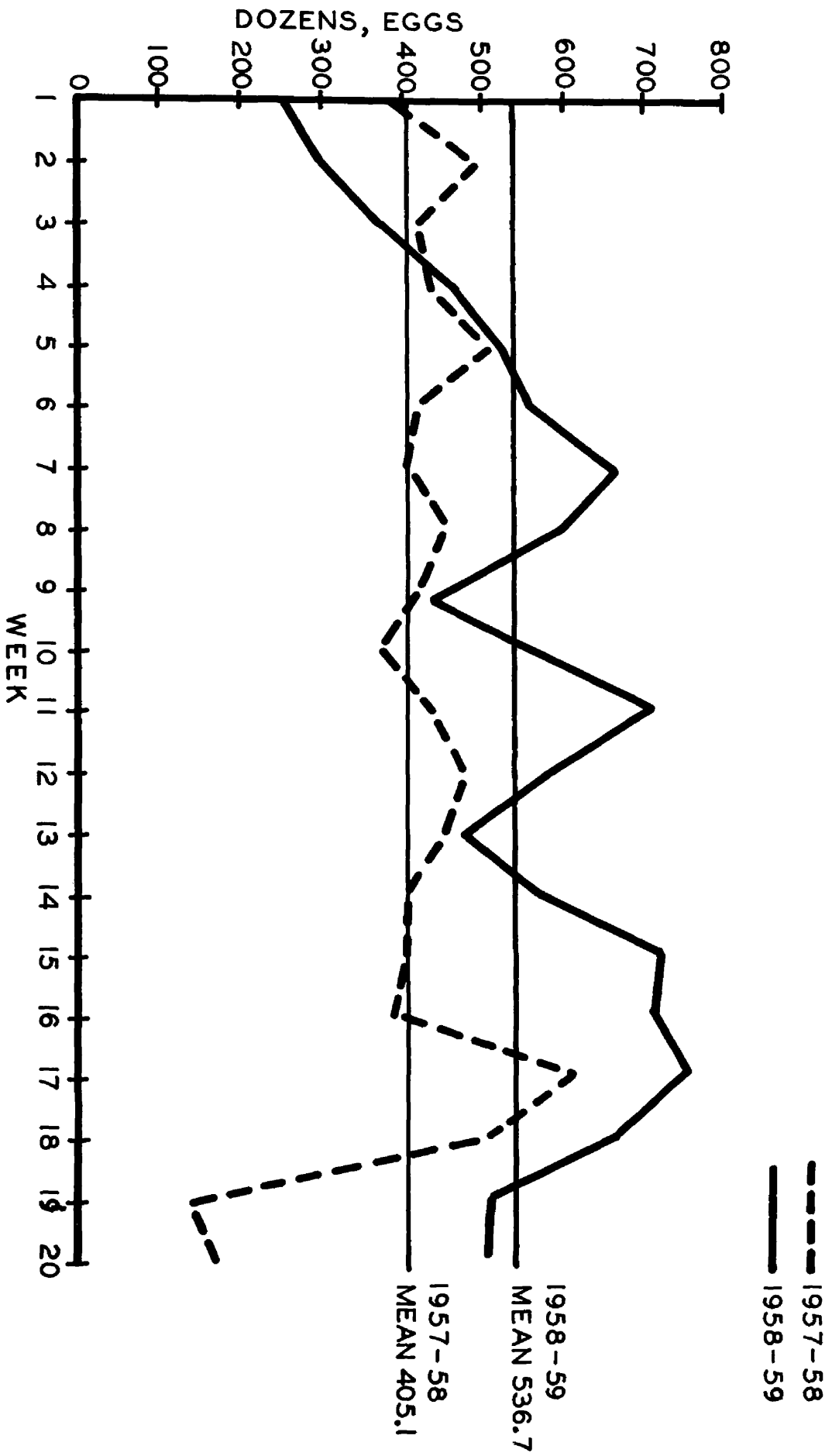


Fig. 23. Large Egg Sales by Weeks, Computed on Two Week Moving Average of Egg Purchases. Store 1.

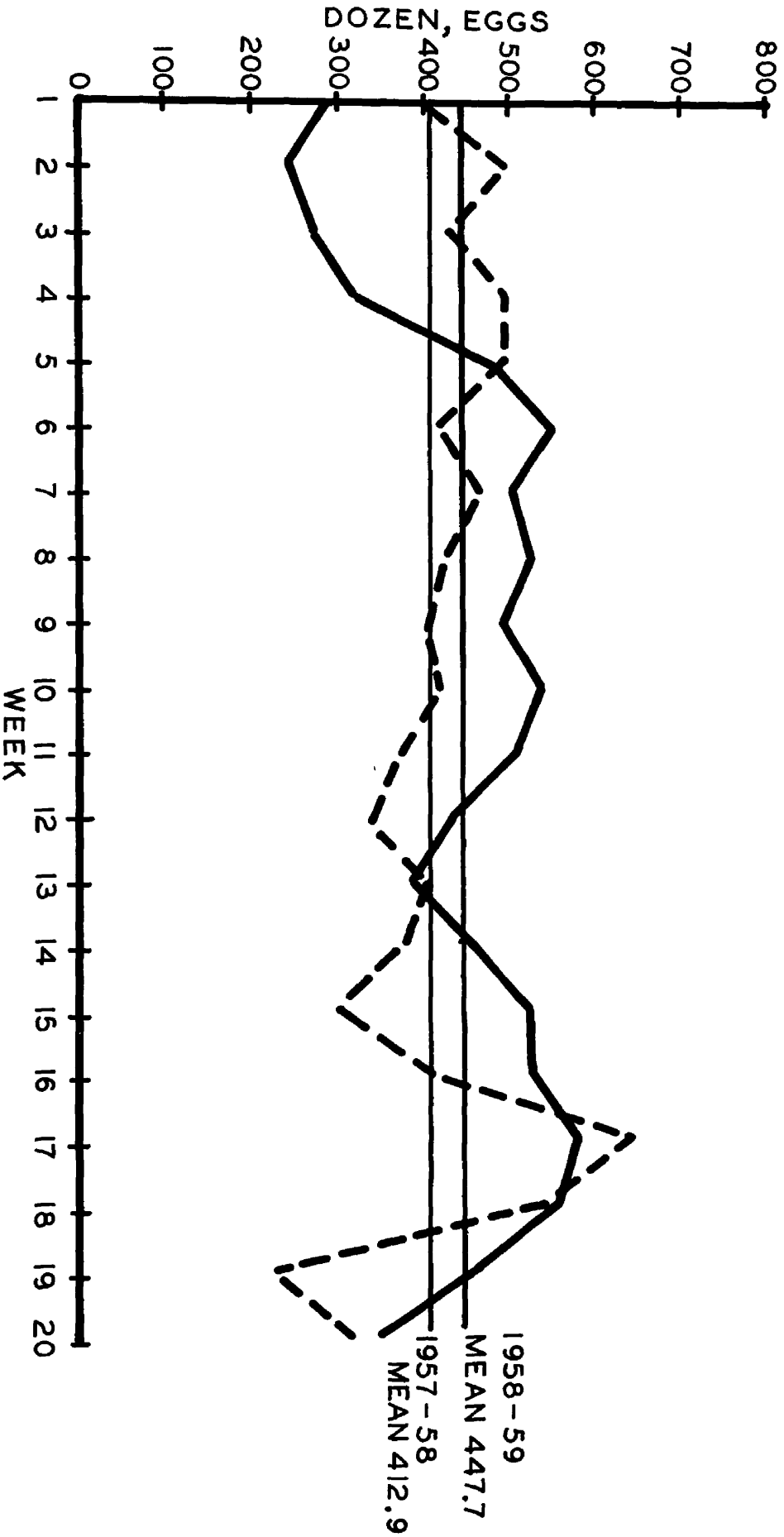


Fig. 24. Large Egg Sales by Weeks, Computed on Two Week Moving Average of Egg Purchases Store 2.

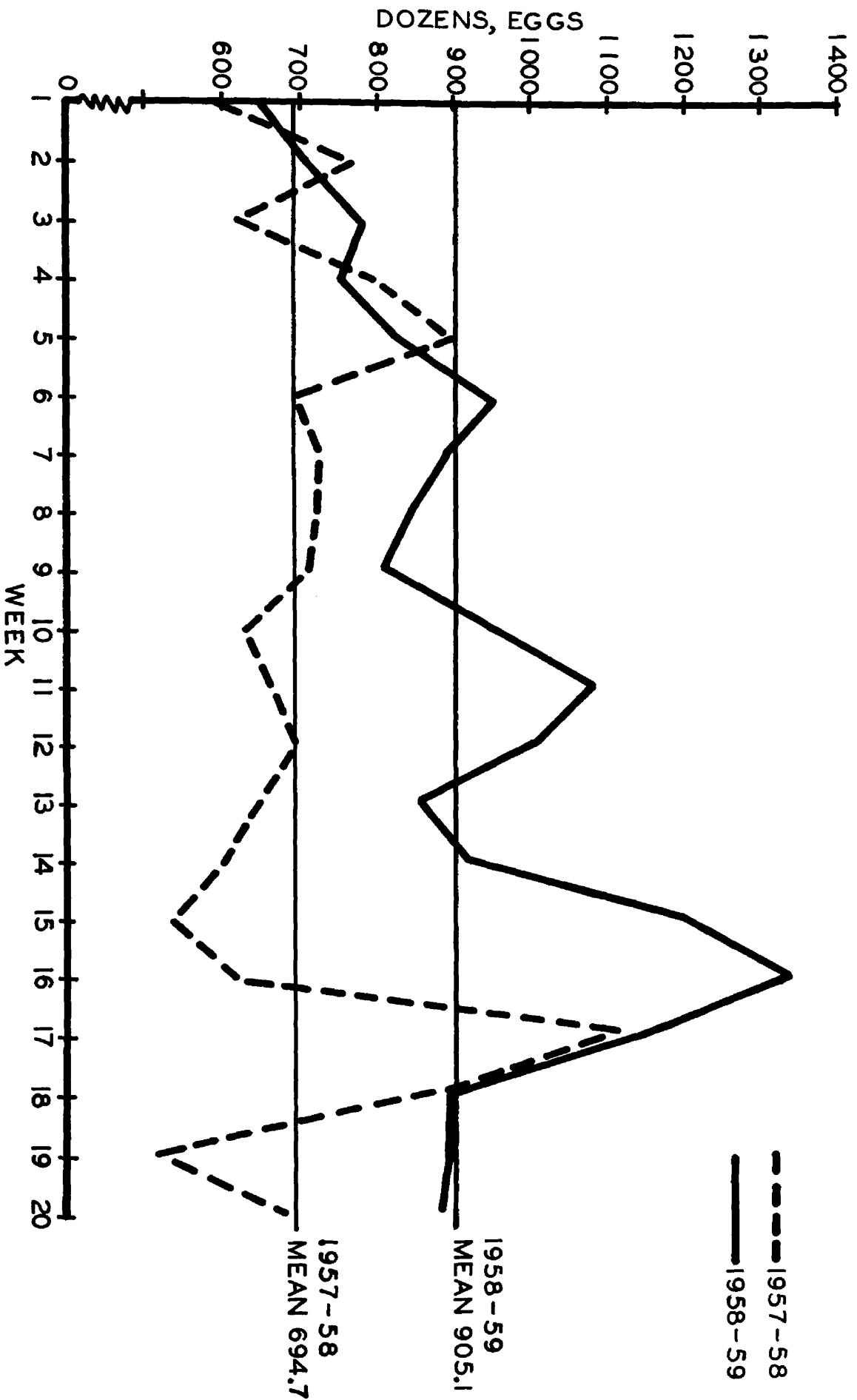


Fig. 25. Large Egg Sales by Weeks, Computed on Two Week Moving Average of Egg Purchases
Store 3.

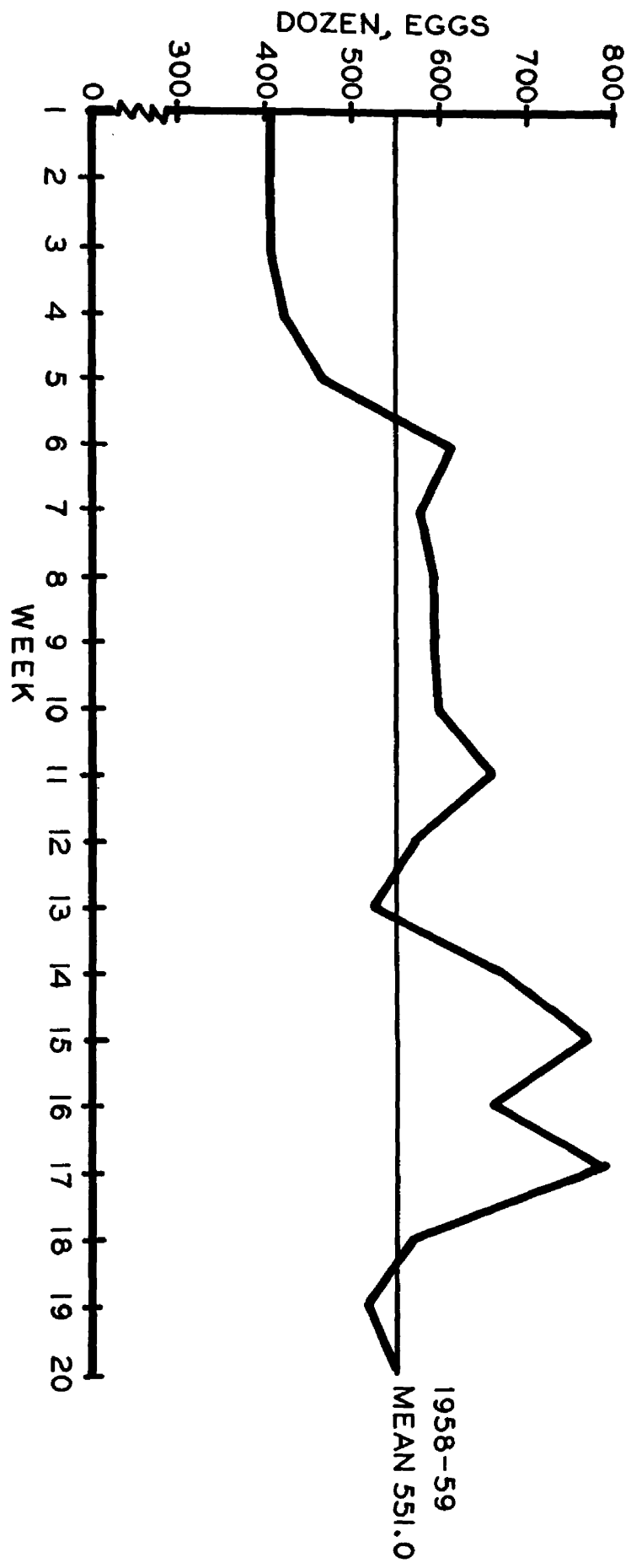


Fig. 26. Large Egg Sales by Weeks, Computed on Two Week Moving Average of Egg Purchases
Store 4.



Fig. 27. Prices for Grade A, Large, White Eggs at Detroit, Michigan during 21 Weeks of the Study and Corresponding Period - - - 1957-1958

Source: Federal-State Market News Service, Detroit, Michigan

SUMMARY AND CONCLUSIONS

Experiment I. Fourteen egg cartons, representing five different designs, were evaluated for their protection of eggs on a mechanical vibrator and during normal transportation. No significant difference in egg damage was found among these fourteen cartons. Wolf flats used to provide additional protection to cartoned eggs were found to have little value in protecting cartoned eggs in normal transportation.

The mechanical vibrator treatment which approximated railroad conditions was more severe than truck transportation. No difference was found between eggs transported 100 miles, 200 miles and 277 miles.

Molded and plastic type cartons were more satisfactory than carton-board type cartons for leakers or broken eggs. Windowed cartons provided good visibility for the egg contained therein, but gave little protection from egg contents resulting from broken eggs packed above.

Experiment II. The Detroit Consumer Preference Panel evaluated and ranked 13 different series of cartoned eggs. Five cartons were evaluated in each series.

Green on white carton-board was the preferred color for egg cartons by panel members.

Eggs in plastic cartons were preferred over those packed in cartons with windows when the price was the same, but were rated low when a two cent premium was indicated.

Eggs in paper cartons with windows were preferred over eggs in cartons without windows. Non-divisible cartons were preferred over divisible cartons.

Eggs in two-dozen green on white "piggy-back" cartons were preferred by 40.2 percent of the panel members when there was no price differential between single and multiple dozen units. Two dozen units were found to be preferable to three dozen units. Eggs displayed in one-half dozen cartons received the lowest preference rating by panel members.

Eighty-five percent of the panel members preferred a multiple dozen unit of eggs (2 cents less per dozen) when a choice was offered.

Experiment III. Eggs of similar quality were cartoned and offered for sale in special display cabinets in four Lansing Super-markets. Over 73,000 dozens of eggs were purchased from these stores during a twenty-one week period.

Consumers preferred multiple dozen units when available for one and one-half cents per dozen less than single dozens. Fifty-five to 60 percent of the eggs purchased were in two-dozen cartons. More eggs were purchased in a two-dozen side by side carton in one trial, while in a second trial more eggs were sold in the two-dozen "piggy-back" carton.

A price advantage of one and one-half cents per dozen appeared to be the determining factor in consumer acceptance of eggs packed in

multiple dozen units.

When price alone was the only advantage for purchasing multiple dozens, egg sales from the special display were 17 percent less than when the multiple carton and price combination was used.

Only slight differences were found between the panel preference score and store sales in preference for multiple dozen cartons.

The size of egg display area and size of total store sales area were found to be correlated closely with egg sales.

During the period when a new brand of eggs was introduced, egg sales were 11 percent lower than during the period when an established brand was featured.

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APPENDIX

APPENDIX

I. Statistical Formulas

A. Chi Square Analysis.¹

$$H: P_1 = P_2 = \dots P_5$$

$$\Rightarrow P's = 20\%$$

$$X^2 = \sum_{i=1}^5 \frac{(f_i - F_i)^2}{F_i}$$

When:

f = observed frequency
 F = expected frequency
 H = hypothesis
 P = percent

$$X^2 \quad (4 \text{ D.F.}) = \begin{matrix} .05^* & .01^{**} & .001^{***} \\ 9.49 & 13.28 & 18.46 \end{matrix}$$

¹ Dixon and Massey (1951) p. 185.

B. Analysis of Variance of Incomplete Block
 (Youden Square) Trial 1

Source	D. F.	S S
Total	19	$\sum x^2 - (\sum x)^2 / 20 = \text{C.T.}$
Positions	3	$\sum P^2 / 5 - \text{C.T.}$
Weeks	4	$\sum W^2 / 4 - \text{C.T.}$
Cartons	4	$\left[\frac{T - 1}{NK(K-1)} \right] \sum Q^2$
Error	8	Subtract

K = No. of cartons in each week = 4

N = 20

T = No. of different cartons = 5

Q = Computed by stores - 4 times sum
of cartons, minus L

L = Sum of weeks A, B, etc.

$$\sigma_{\text{Cartons}} = \sqrt{\frac{K}{N} \frac{(T-1)}{(K-1)}} \sigma^2$$

Comparison made by use of studentized range.

¹ When these data are analyzed as a Latin Square with one row missing, the results are the same as described by Yakes, (1936).

C. Analysis of Variance of 4 x 4 Latin Square
Used in Trials 2 and 3

Source	S S	D. F.	M. S.	F
A effect	$C \sum_i (\bar{X}_i - \bar{X})^2 = S_1$	$r - 1$	$S_1/r - 1 = s_1$	s_1/s_3
B effect	$r \sum_j (\bar{X}_j - \bar{X})^2 = S_2$	$c - 1$	$S_2/c - 1 = s_2$	s_2/s_3
Error	$\sum_{ij} (x_{ij} - \bar{x}_i - \bar{x}_j + \bar{x})^2 = S_3$	$(r-1)(c-1)$	$S_3/(r-1)(c-1) = s_3$	
Total	$\sum x_{ij}^2 - rc\bar{x}^2 = S_4$	$rc - 1$	$S_4/rc - 1 = s_4$	
	$i = 1, 2 \dots \dots \dots r$ $j = 1, 2 \dots \dots \dots c$			

¹ Mood (1950) p 331

D. Coefficient of Concordance

$$W = \frac{12 S}{m^2 (n^3 - n)}$$

W = Coefficient of Concordance

m = Observers

n = Number of Choices

S = Sum of Squares

Test for W value computed by:

$$X_r^2 = m(n-1)W = \text{Significance}$$

$$X^2 (4 \text{ D.F.}) = \text{Chi Square}$$

.05 [*]	.01 ^{**}
9.488	13.277

¹ Kendall (1955) pp 94-106. W was used primarily to measure the relative ratio of agreement or concordance among the different series.

II. Chi Square Analysis of Tables in Experiment II.

115.

X^2 (4 D.F.)

.05

9.49

.01 **

13.28

.001 ***

18.46

Table VI

f	F	(f-F)
93	63.2	29.8
69	63.2	5.8
62	63.2	-1.2
59	63.2	-4.2
33	63.2	-30.2
316	316	0

$X^2 = 29.32$ ***

Table VII

f	F	(f-F)
42	35.6	6.4
40	35.6	4.4
35	35.6	-.6
31	35.6	-4.6
30	35.6	-5.6
178	178	0

$X^2 = 3.18$ Not sig.

Table VIII

f	F	(f-F)
54	35.2	18.8
39	35.2	3.8
34	35.2	-1.2
33	35.2	-2.2
16	35.2	-19.2
176	176	0

$X^2 = 21.10$ ***

Table IX

f	F	(f-F)
46	27.4	18.6
40	27.4	12.6
27	27.4	-.4
14	27.4	-13.4
10	27.4	-17.4
137	137	0

$X^2 = 36.03$ ***

Table X

f	F	(f-F)
61	30.2	30.8
39	30.2	-0.2
28	30.2	-2.2
19	30.2	-11.2
13	30.2	-17.2
151	151	0

$X^2 = 45.52$ ***

Table XI

f	F	(f-F)
80	28.2	51.8
24	28.2	-4.2
17	28.2	-11.2
11	28.2	-17.2
9	28.2	-19.2
141	141	0

$X^2 = 123.79$ ***

Table XII

f	F	(f-F)
47	23.4	23.6
31	23.4	7.6
22	23.4	-1.4
10	23.4	-13.4
7	23.4	-16.4
117	117	0

$X^2 = 45.52$ ***

Table XIII Trial 1

f	F	(f-F)
25	17.8	7.2
21	17.8	3.2
15	17.8	-2.8
11	17.8	-6.8
17	17.8	-.8
89	89	0

$X^2 = 6.56$ Not. sig.

Table XIII Trial 2

f	F	(f-F)
25	17.2	7.8
19	17.2	1.8
19	17.2	1.8
15	17.2	-2.2
8	17.2	-9.2
86	86	0

$$X^2 = 9.12 \text{ Not sig.}$$

Table XIV

f	F	(f-F)
30	22.8	7.2
14	22.8	-8.8
43	22.8	20.2
16	22.8	-6.8
11	22.8	-11.8
114	114	0

$$X^2 = 31.69 ***$$

Table XV

f	F	(f-F)
19	23	-4
50	23	27
15	23	-8
15	23	-8
16	23	-7
115	115	0

$$X^2 = 40.09 ***$$

Table XVI

f	F	(f-F)
49	16.2	32.8
12	16.2	-4.2
2	16.2	-14.2
9	16.2	-7.2
9	16.2	-7.2
81	81	0

$$X^2 = 86.35 ***$$

Table XVII

f	F	(f-F)
15	16.8	-1.8
39	16.8	22.8
15	16.8	-1.8
11	16.8	-5.8
4	16.8	-12.8
84	84	0

$$X^2 = 42.00 ***$$