THE CORRUGATED BOX INDUSTRY IN OKLAHOMA

By

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PREFACE

While inspecting the South West Box Company at Sand Springs, Oklahoma, during a class field trip, the writer became interested in the manufacture of corrugated boxes. A person readily recognizes the importance of this industry when he realizes just how much merchandise is shipped in this type of container. Realizing the importance of the commodity, the writer embarked upon the study of the corrugated box industry in Oklahoma.

The purpose of this thesis is to give a geographic interpretation of the corrugated box industry in Oklahoma with some references to regional and national considerations. The South West Box Company at Sand Springs, Oklahoma, received full treatment as it was used as a model corrugated box plant. The Koerner Corporation, which consists of several corrugated box plants in the central part of the United States, includes the Sand Springs factory. This corporation is discussed to show the regional geographic distribution of the box plants within this corporation. The study also necessitated an introduction into the history and the early development of paperboard and the evolution of the corrugated box. The manufacture of kraft paper, the major material used in the manufacture of corrugated boxes, is also discussed. The three remaining corrugated box plants in Oklahoma are described.

Principal sources for the material of this thesis were from field studies by the writer. He made several trips to the South West Box Company and at least one trip to each of the other box companies in Oklahoma, observing the manufacturing processes in operation and questioning plant employees. The representatives of each of these plants were very cooperative in contributing information for this study. Other source material includes paper trade journals, special reports, publications pertaining to specific box companies and corre-

spondence with all the corrugated box plants in the Hoerner Corporation.

The writer wishes to extend his gratitude for valuable information concerning the manufacture of corrugated boxes especially to Mr. E. E. Boyd, Time Study Engineer and Safety Director, and Mr. F. C. Baker, Office Manager of the South West Box Company; to Mr. M. P. MacDougall, Vice President and General Personnel Manager of the Hoerner Corporation and all other representatives of the organization; to Mr. M. D. Wrenn, Office Manager, Muskogee branch of the Container Corporation of America; to Mr. William J. Kiethley, Supervisor of the Clarksburg Paper Company; to Mr. Floyd L. Shields, Manager of the Sooner Corrugated Box Company; and to Mr. I. Y. East, Manager, Southern Kraft Division, International Paper Company for information concerning the manufacture of wood pulp and kraft paper. Mr. Alton P. Juhlin, Head Reference Librarian at Oklahoma A. & M. College, helped in obtaining reference material.

The writer is indebted to the Faculty of the Geography Department and especially to Dr. David C. Winslow, Assistant Professor Geography, under whose direction this study was made; and to Professor Robert C. Fite, Assistant Professor of Geography, for valuable suggestions in the preparation of this thesis.

W. A. F.

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THE PAPERBOARD CONTAINER INDUSTRY

Purpose of the Study

The purpose of this study is to give a geographic interpretation of the corrugated box industry in Oklahoma with some references to the regional and national picture. A typical plant, the South West Box Company at Sand Springs, Oklahoma, and its typical plant group, the Hoerner Corporation, are treated. Three other Oklahoma plants, the Muskogee branch of the Container Corporation of America, the Clarksburg Paper Company of Ada, and the Sooner Corrugated Box Company of Oklahoma City are described. The trade territory of the Oklahoma concerns and the Hoerner Corporation are explained. The history of the corrugated box industry in the United States is given showing significant trends. Throughout there is an analysis of the geographic and other conditions leading to the establishment, manufacture, production and trade development of this industry. The final or summary chapter considers the Oklahoma plants, interpreting their relative importance in production, stage of development and future expansion possibilities. Geographical factors concerning evolutionary processes are stressed.

Definition of Paperboard

The corrugated box is seldom called by its proper name; but more often the common name of "cardboard box" is used. This ordinary designation is too broad in its meaning, for it includes all types of paperboard boxes including the corrugated box. Hence "cardboard" is a general term used only

by the public, and not as a recognized term in the trade.[1]

"The term 'paperboard," (also commonly called 'board' or 'fibreboard') is used to embrace all grades of fibrous materials, made on a paperboard machine, that are 12/1,000 of an inch or more in thickness."[2,3] Paper materials less than 12/1,000 of an inch in thickness are technically described as paper. The most common thicknesses of paperboard are 0.06, 0.08, 0.09, or 0.10 of an inch.[4]

Corrugated Board

Corrugated board is that material formed by gluing a corrugated sheet to a flat piece of paper.

Corrugated board is chiefly formed into four different structural types (See Figure 1).

1. Corrugated sheets: The chief constituent of corrugated board. This sheet is made from straw and kraft[5] and must have a uniform thickness of not less than .009 of an inch.[6] The corrugated sheets should be either A-flute,[7] having approximately thirty-two corrugations per foot; B-flute, having approximately fifty corrugations per foot; or C-flute, having approximately forty-two corrugations

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[1] Handbook--Corrugated Fibreboard Boxes and Products, p. 7.

[2] All three of these terms will be used to lend variety and to acquaint the reader with the use of such terminology.

[3] Norbert G. Rennicke, The Manufacture of Paperboard, p. 2.

[4] Handbook--Corrugated Fibreboard Boxes and Products, p. 8.

[5] Sulphate virgin pulp, paper, or paperboard.

[6] Federal Standard Stock Catalog, Federal Specifications for Boxes; Fiber, Corrugated (For Domestic Shipment), Part 5, Section IV, p. 2.

[7] One indulation of the inner portion (corrugating material) of corrugated fibreboard.

per foot.[8]

2. Corrugated Board, Single-faced: It consists of a corrugated element glued to a flat liner, permitting free bending in one direction. Principal uses are for wrapping and cushioning.
3. Corrugated Board, Double-faced: This board is formed of a corrugated inner member glued between two flat facings or liners. Its use is in making corrugated paperboard boxes and corrugated products.
4. Corrugated Board, Double-Wall: Double-wall board is composed of three flat liners and two corrugated sheets combined in the following order: a flat liner, a corrugated sheet, a (center) flat liner, a corrugated sheet, and a flat liner. This board is used where extreme strength is desired.

Paperboard Group of Industries

The paperboard group of industries, that are concerned mainly with the box making industry, is composed of the following subdivisions:[9]

1. Paperboard mills: These mills manufacture many grades of paperboard which are sold to converting plants.[10]
2. Converting plants: Converting plants are composed of the following special type plants:
   a. Corrugated and solid fibre shipping container plants.
   b. Folding box plants.
   c. Set-up box plants.

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[8]Federal Standard Stock Catalog, op. cit., p. 2.

[9]Rennicke, op. cit., p. 1.

[10]Plants having corrugators are referred to as corrugating plants, and plants having pasters are designated as solid fibre box plants.

d. Fibre cans, drums, tubes, and specialty plants.

The grades of paperboard manufactured may be classified in many different ways, but the primary classification used in the paperboard mill industry is in accordance with the industries for which the boards are produced. This classification is as follows:

1. Container boards, meaning boards produced for the corrugated and fibre container industries. Container board may be divided into liner boards, .009 inch thick corrugating material and chipboard.[11]
2. Box boards, which are subdivided as follows:
   a. Folding box boards. These grades are used for folding boxes, of which familiar varieties are the cereal and toothpaste boxes.
   b. Set-up box boards. These grades are used for set-up or rigid boxes. Generally they are made in two pieces, the cover and the body. The shoe box is a good example of this type.
3. Other miscellaneous grades. Paperboard is also produced for the following uses: cans and tubes, wall boards, building papers, ice cream cans, egg case partitions, mounting boards, match and match box covers, large fibre drums, binding boards, advertising, place cards and show cards, tablet backs, gaskets, insulating boards and many other uses.

All the above paperboard box industries have their place in the packaging industry, but only the corrugated box industry will be treated in this study. It is differentiated from the other paperboard container industries by the increased production of this type of shipping container. The corrugated box

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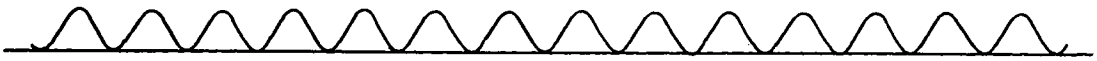
[11]This is a paperboard generally made from wastepaper. It is used for many purposes, including the filler of solid fibreboard used in manufacture of solid fibreboard boxes.

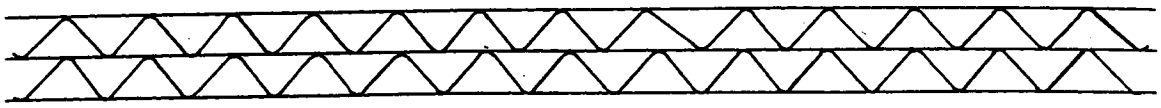
CORRUGATED BOARD

CORRUGATED SHEET



SINGLE-FACED SHEET

DOUBLE-FACED SHEET



DOUBLE WALL SHEET

FIGURE 1

industry will often be compared to its closest competitor, the solid fibre box industry.

Size and Scope of the Paperboard Container Industry

The paperboard box industry has experienced a considerable growth in production between 1939 and 1949, hence it has now reached a record high production. In 1940, the production of corrugated and solid fibre boxes was 3,114,000 tons, and by 1948 this production had increased to an estimated 4,900,000 tons.[12] During this ten year period the solid fibre case continued to be produced at approximately the 1940 rate of 365,000 tons, while the production of corrugated cases increased some sixty-five percent. This increase represents the real growth of the industry and also the definite trend toward the more popular corrugated container.

However, during the recent war years from 1941 to 1945, the production of the solid fibre industry increased some, but during 1946 to 1948 it decreased to about three billion square feet. (See Figure 3.) By comparison, in 1948 the corrugated box production was approximately fifty-eight billion square feet.

Changes in our thinking during World War II, and modifications in transportation, handling, and merchandising methods have produced trends toward more efficient cases. Light weight construction and low cost of manufacture are requirements which the corrugated container meets.

Increased Consumption

Increased population, enlarged consumption per capita, and new paperboard

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[12]E. H. Balkema, "An Analysis of Corrugated Shipping Cases From a Buyer's Viewpoint," Packaging Series No. 31, Cost Reduction in Materials Handling and Shipping, p. 30.

developments are responsible for the continuous rise in paperboard production. In 1941 the per capita consumption of paperboard containers was 118.4 pounds, while it is expected to be 151.5 pounds per capita in 1950.[13] Table I gives the growing use in paperboard containers in four years between 1928 and 1948.[14] Note that consumption has more than doubled.

TABLE I

Increase in Paperboard Containers Used

Year	Number of Containers Used (Billions)
1929	43.4
1939	59.9
1947	96.8
1948	92.3

The figure of 92.3 billion containers used was equivalent to about 352.8 million containers utilized per day, or over 1.7 containers supplied per day for every man, woman, and child in the United States. The number of different types of paperboard containers used per day in 1948 is shown in Table II.

It is difficult to realize that consumption of paperboard containers is so large, but it is more easily understood when it is considered that practically every item that is ultimately consumed requires a box for handling. In addition, there is the unseen consumption of boxes involved in merchandise moving along industrial or commercial channels. For examples, part of the

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[13] Fibre Containers, Vol. XXXIV, No. 8, (August, 1949), p. 76.

[14] Ibid., p. 74.

TABLE II

Type of Containers Used

Type of Container	Number Consumed Per Day in 1948
Folding cartons	207,200,000
Set-up boxes	18,600,000
Corrugated and solid fibre boxes	16,900,000
Fibre cans and tubes	10,100,000
Fibre drums, pails, and tubes	49,000
Total	252,849,000

sub-assemblies moving to radio, automobile and refrigerator manufactures require boxes for shipment; many containers move food or other things to hotels, restaurants, or other wholesale concerns with the containers unseen by the public, are a necessary portion of the eventual consumption of the involved merchandise.

Although the number of folding cartons required per day is much larger in number than the corrugated and solid fibre boxes, it must be realized that many of these folding containers are packed in one of the single corrugated or solid fibre boxes for shipment. Even here, a larger container for handling is necessary.

Importance During War

Paperboard and paperboard containers were not recognized as an important item by the Government and military organizations until World War II. In fact, at the beginning of the war, representatives of the governmental agencies were convinced that paperboard was a relatively non-essential item in modern war. They quickly reversed their opinions when it was realized that paperboard for

packaging was so intricately a part of the whole mass-production system that the system would fail without it. After the war ended, paperboard came to be regarded as one of the most vital elements in the economy. The National Security Resources Board decided that in any future war, paperboard products will be maintained at a maximum level of production.[15]

Uses in Industry

Prior to World War II, most products were shipped in packages weighing around 100 pounds and were packed in corrugated and solid paperboard shipping containers. Exceptions were some export shipments and certain products such as fresh meats, fruits, and vegetables which were to be stored or shipped in a moist condition. Recent improvements in strengthening, water proofing, impregnating and applying layers of impervious substances have made it possible to use paper containers under heavier stress and greater moisture conditions.

The paperboard shipping container, made of corrugated and solid fibre, serves all American industry as shown in Table III. This is borne out by the fact that, aside from food, few classes of products, by themselves, utilize very large percentages of the total corrugated and solid fibre box production. It can be truly said that corrugated or solid fibre box containers are used to move most of the products that are produced by American industry.[16]

Why Use Paperboard Containers?

No single paperboard container is best suited for meeting all the require-

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[15] Ibid., p. 74.

[16] Albert W. Luhrs, "Corrugated and Solid Fibre Containers," Modern Packaging Encyclopedia, p. 778.

ments demanded by the many types of products shipped, while on the other hand, it is not practical to manufacture a different type of container for each product being shipped. Standardization has resulted, but still 3,900 different kinds of boxes were designed in a period of two years by the South West Box Company alone to meet customer demands. The nature of the paperboard container is such that styles of containers and the type of printing can be varied on short notice to meet the requirements of a particular product to be packaged.

Paperboard containers have gone "hand in hand" with the mass-production of goods, for which the United States is noted. It has even been necessary to provide a container that can be manufactured in mass-production having considerable strength, light weight, and flexibility to use so that packaging can be geared to high production output. By using the paperboard carton, merchandise flows freely to market in containers which are sanitary, highly protected and readily transported, easily stored, quickly inventoried, and used.

The use of corrugated and solid fibre shipping containers is due to many reasons; some of the most important are: light weight, low cost, ease in setting up and sealing, small storage space required, attractive printing can be put on the box, can be handled automatically, adaptable to interior packing, cushioning properties, wide source of supply, and disposable.[17]

There are certain requirements which the individual container must meet for satisfactory use. The chief ones vary with the commodity and the method of shipment. However, these requirements may be summarized as follows:[18]

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[17] Ibid., p. 778.

[18] A. W. Werner, The Manufacture of Fibre Shipping Containers, p. 7.

1. High resistance to the failure at the "scored" edges that result from the thrust of the box.[19]
2. Resistance to crushing through compression loads and through other objects striking or falling on the box.
3. Resistance to mashing when dropped on a corner.
4. Resistance to puncturing by sharp objects.
5. Ability to absorb shock without damage to the box contents.
6. Resistance to diagonal distortion and twisting.

Paperboard Containers for Air Transport

The Armed Forces' specifications for shipping containers during World War II, stated that lightness, strength, dimension limits and weather resistance must be given special consideration. When applied to air transport, lightness of the container was the most important feature. Next in importance was weather resistance because of the existing lack of adequate air terminal facilities.[20] Usually paperboard shipping containers satisfactorily met the requirements of lightness, strength, dimension limits and weather resistance.

Distribution and Kinds of Fibre Box Plants in the United States

Figure 2 shows that the distribution of paperboard plants in the United States are relatively concentrated in the large industrial areas where the demand for their products is greatest, while in less densely populated areas there are few plants. Two of the major reasons for this concentration are the

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[19]"Scored" refers to an impression or a crease made in corrugated or solid fibreboard to facilitate folding.

[20]Luhrs, op. cit., p. 780.

DISTRIBUTION OF FIBRE BOX PLANTS IN THE U.S.

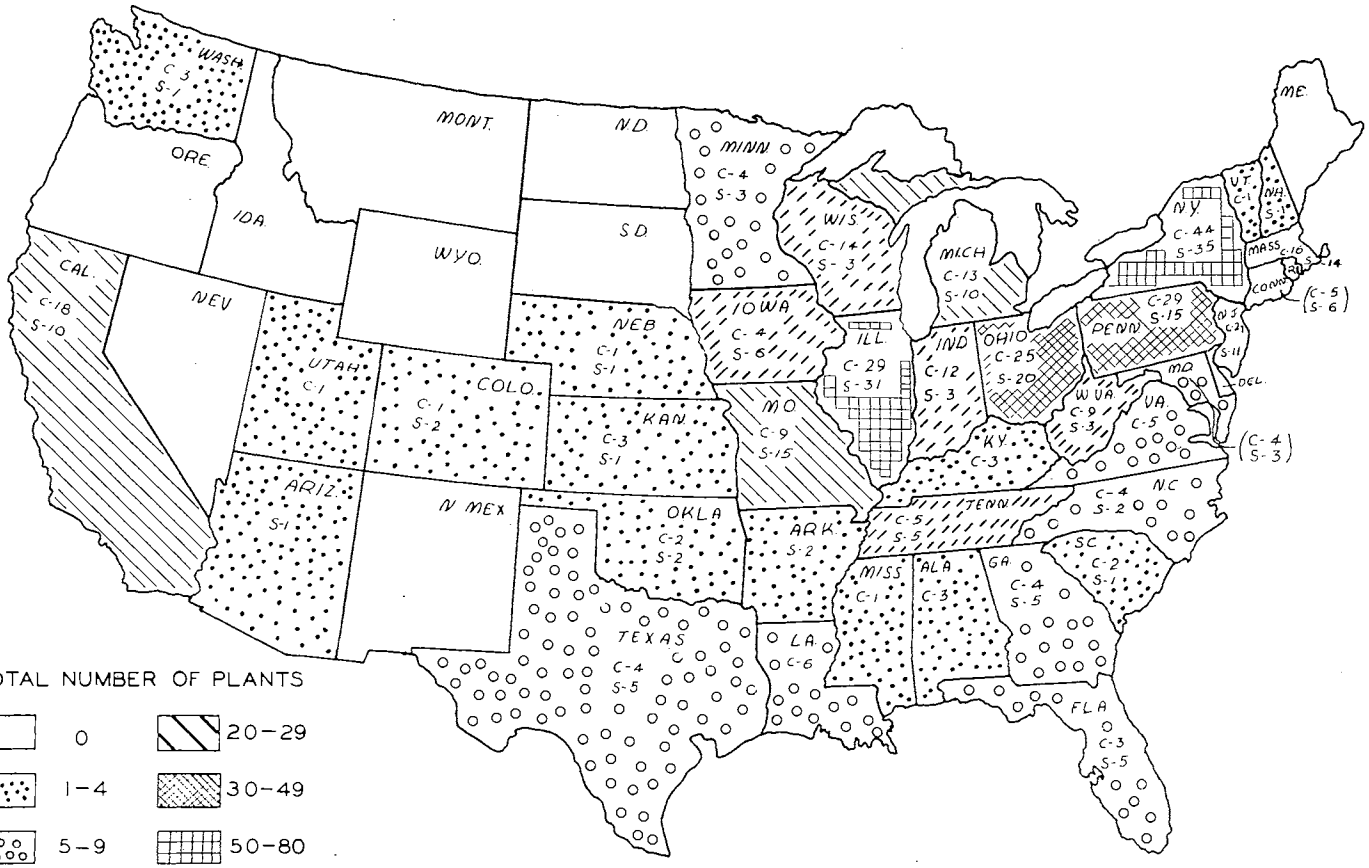

FIGURE 2

freight rates on the boxes, and the desire to be near markets where more efficient service can be provided.

There are two primary types of plants producing corrugated paperboard boxes: (1) converter plants and (2) sheet plants. Converter plants are defined as those plants which have corrugators when reference is made to corrugated box plants.[21] These plants manufacture the completed box starting with paper as the raw material. They make their own corrugated sheets, and finish processing the completed box. The plants with corrugators, as they are referred to in this study, have complete one-unit plants. Sheet plants obtain the trimmed corrugated sheets from converter plants and then finish fabrication of the complete corrugated box.[22] Independent sheet plants usually buy corrugated sheets from any converter plant they desire, while those that are members of a large concern usually get their corrugated sheets from the nearest converter plant in their organization.

The total number of converter and sheet plants in the United States increased from 102 in 1920 to 537 in 1949. In 1949 there were 314 converter plants and 223 sheet plants in the nation with an estimated value of $247,250,000, which was about seven times the investment in 1920.

Articles Shipped in Paperboard Containers

The kind of articles shipped in corrugated paperboard boxes is varied making the list of items large. The following limited list is representative, nevertheless, of articles shipped in corrugated boxes:[23]

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[21]Fibre Container, op. cit., p. 139.

[22]Ibid., p. 139.

[23]Handbook--Corrugated Fibreboard Boxes and Products, op. cit., p. 11.

Books	Glass and other fragile articles
Boots and shoes	Hardware
Butter and margarine	Liquor, beer, ale & other beverages
Canned goods in glass or tin	Matches
Cereals	Medicines and drugs
Cigarettes, cigars, and tobacco	Paper and paper products
Clothing and dry goods	Radios
Coffee and tea	Refrigerators
Eggs (in shell)	Soap
Electrical goods	Toys
Dried and fresh fruits	Furniture

However, it is realized that a number of these articles and many others are shipped in solid paperboard containers. Table III shows the relationship between corrugated and solid fibre boxes as they are used as shipping containers.[24]

Importance of This Industry in the National Economy

The paperboard group of industries, includes both the paperboard mills and converting plants, and employ over 223,000 people with an annual payroll slightly over $631,000,000. The number employed in Oklahoma totals 137.

In 1948, the paperboard mills used 6,175,313 tons of pulp, 5,897,100 tons of wastepaper, 523,600 tons of raw straw and 28,000 tons of other fibrous raw materials.

The paperboard container industry touches upon the life of the average person to such a large extent that approximately 1.2 to 1.3 percent of the national income is spent on paperboard containers.[25] The average consumption per capita is 1.7 boxes per day.

The size of the paperboard group of industries makes it a major field in the national economy. The impact of this field on the economy is much greater than that of any other industrial group of similar size because containers

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[24]Luhrs, op. cit., p. 779.

[25]Fibre Container, op. cit., p. 76.

TABLE III

Uses of Corrugated and Solid Fibre Boxes

Description	Corrugated Percent of total	Solid Fibre Percent of total
Agricultural implements and tools	0.5	---
Ammunition and component parts	3.0	1.3
Airplane parts and supplies	1.7	0.4
Automobiles, trucks, parts, and supplies	3.4	0.7
Beverages (including boxes used for shipment of inner containers later used for beverages)	4.4	4.0
Tobacco and tobacco products	0.9	0.4
Sales direct to any department or branch of the U. S. Government	3.4	8.8
Building materials, lumber, supplies and furniture, hardware	3.8	1.0
Clothing	2.3	0.3
Boots and shoes	1.4	1.0
Drugs and pharmaceuticals	2.2	0.1
Cosmetics	0.4	0.1
Electrical products (industrial)	3.3	0.7
Confectionary	1.5	0.8
Food and food products (including boxes used for shipment of inner containers later used for food)	33.8	73.6
Household goods including such items as furniture, vacuum cleaners, refrigerators, and the like)	6.8	0.2
Machine tools, parts, and accessories	2.3	0.4
Paints and varnishes	0.8	0.2
Chemicals	1.2	0.9
Paper and paper products	8.0	2.1
Matches	0.4	---
Petroleum products	1.0	---
Printing and publishing	1.7	0.1
Retail stores, jobbers and mail order establishments	2.0	0.2
Rubber products	1.4	0.6
Soap and cleaners	2.5	1.2
Textiles, yarns, blankets, sheets, etc.	2.1	0.1
Products not used as shipping containers such as cabinets, advertising, novelties, etc.	0.3	---
Toys, bicycles, and sporting goods	0.6	0.2
All others	2.9	0.6
Totals in percent	100.0	100.0

Source: Modern Packaging Encyclopedia

are necessary for the transportation and distribution of practically all products.

TABLE IV

Value of Converted Paperboard Products
(In Thousands)

Year	Fibre Box Corrugated & Solid Fibre	Folding Box	Set-Up Box	Other Converted Board Products	Grand Total
1929	$139,995	$ 95,727	$ 85,382	$ 59,000*	$ 380,104
1930	---	---	---	---	---
1931	105,622	73,345	60,520	36,700	282,864
1932	---	---	---	---	---
1933	---	---	---	---	---
1934	145,983	80,700*	61,700*	54,000	342,383
1935	156,902	85,347	62,556	53,300*	302,805
1936	176,479	98,468*	77,000*	65,100*	417,047
1937	215,769	119,063	77,945*	90,400*	503,176
1938	168,431	107,930*	68,300*	56,300	400,961
1939	202,665	126,873	73,941*	82,600*	486,086
1940	231,083	135,730*	76,850*	102,100*	545,763
1941	389,982	187,749*	95,019*	133,400*	806,150
1942	372,138	189,943*	96,670*	159,700*	818,442
1943	492,087	240,830*	104,700*	194,600*	1,032,217
1944	537,099	256,100	105,885*	235,800*	1,134,884
1945	543,412	277,245*	113,460*	214,600*	1,148,717
1946	641,544	345,173*	130,276*	199,400*	1,316,393
1947	882,208	455,702*	221,151*	253,400*	1,812,462
1948	871,140	453,431*	209,231*	356,000*	1,889,300

*Estimated

Note: Corrugated and solid figures from the Fibre Box Association except 1929 and 1931 which are from the U. S. Bureau of Census. Figures for other products are from the Bureau of Census except those marked as estimated.

It is for these reasons that government agencies, leading statistical agencies, the National Association of Purchasing Agents, leading newspapers

and journals are paying increasing attention to the trend in the paperboard mill inudstries. They have proved to be such an important commodity in business that the indices of orders, activities and production quite accurately forecast well in advance upward or downward trends to be expected in general business conditions.

Table IV shows the value of converted paperboard containers and paperboard products for selected years from 1929 to 1948.[26] In Table IV "Other Converted Board Products" include fibre cans, tubes and drums, wet food conteiners, liquid tight containers, plates and other board products; excluding building board, building board stock, wet machine board, egg cases filler board and certain other board products.

The 1948 production of corrugated and solid fibre boxes increased about six hundred percent over the 1929 production. Similar increases are noted in the increased production of folding boxes, set-up boxes and other converted products.

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[26] Ibid., p. 76.

CHAPTER II

HISTORY OF THE PAPERBOARD AND CORRUGATED CONTAINER INDUSTRY

The development of the corrugated shipping container is a phase in the history of the paper industry. The exact date when the first paperboard shipping box was manufactured is unknown, but its origin is in the transition period between paperboard and the development of the paperboard box. The approximate time of this transition was at the end of the fifteenth century.

It is difficult to name any one person responsible for the invention of the corrugated shipping container. As with most inventions, the credit for this development must go to several men, each of whom contributed his part to the improvements. Some of those who made significant contributions will be discussed later.

Early History of Paper and Paperboard

Origin of the art of papermaking belongs to the Chinese. According to a generally accepted tradition, the inventor of the papermaking process was Tsai Loun (Ts' ai Lun) in the first century A. D.[1]

Tsai Loun lived in the district of Hung-Tcheou, province of Hounan, north of Canton. The oldest known documents written on paper are Buddhist texts going back to the Second and Third centuries A. D. Microscopic analysis of these papers showed that they are a mixture of hemp, bark and old rags.

The methods of making paper during the early period are naturally vague after a lapse of two milleniums. There are no records to indicate the manner in which the Chinese first made paper, but evidence shows that about 2,000

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[1]Andre Blum, On the Origin of Paper, p. 16.

years ago paper was made from disintegrated fibre laid upon flat moulds. Paper is still formed in this fashion, the only difference being in the treatment of the pulp.

After the art of papermaking was initially established in the East, the technique was brought westward, reaching Samarkand about 750 A. D. In 793, papermaking methods had spread to Bagdad and Damascus. By 1100, the knowledge had reached Morocco. Fifty years afterwards it extended into Europe, having authenticated manufacturing in Sativa, Spain. The art was taken into France where the first papermaking was done at Herault in 1189. Then the art spread to Germany, being introduced either at Cologne in 1320 or at Nurmberg by Ulman Stromer in 1390. In 1494, paper was fabricated in England by the John Tate Mill, but the mode of manufacture was not introduced into Holland on the continent until almost a hundred years later. The technique of papermaking was brought to the New World by William Rittenhouse, two hundred years after the first mill was established in England.[2]

The early history of paperboard preparation is not clear because of the confusion of its processing with that of paper. This was quite natural because paperboard making grew out of the paper industry. The clevage between paper and paperboard was gradual at first. It appears that the first separation occurred at the end of the fifteenth century when book-boards[3] first appeared. This was after moveable type had been invented in 1440.[4] Book-boards were first made from wood and later were formed by pasting together pages of old books or scraps of paper from the printing plant. In 1580,

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[2]Dard Hunter, Papermaking Through Eighteen Centuries, p. 109.

[3]Book-boards were early book covers, usually made of wood.

[4]Harry J. Bettendorf, Paperboard and Paperboard Containers, A History, p. 17.

actual commercial production of paperboard (laminated paper) may be said to have started in Europe. Paperboard cartons as we know them were made in France prior to 1751.[5]

These early paperboards show the primary difference which distinguishes paperboard from paper--structure. It is important to note that structure is the dominating characteristic separating paperboard from paper, for without supporting structural material to give it shape and form, a paperboard box would not be a box, it would be a bag.

During 1728, in Massachusetts, the first hand-made paperboard (either pasted or moulded) was made in the United States. A variety of hand-made paperboard boxes were manufactured in Boston and in Philadelphia in 1835. In 1831 the first paperboard mill equipped with machinery was established near Chambersburg, Pennsylvania.

It is interesting to note at this point that most of the paper developments occurred first in China and later in Europe, while almost all of the significant paperboard developments happened in the United States. The nineteenth century changes contributed most of the elements for the expansion of the paperboard industries, but the firm establishment of paperboard as the world's mass-production packaging material was not reached until the start of the twentieth century.[6] The history of the evolution of paper centered outside the United States until recent times, but paperboard development has been principally in the United States.

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[5] Ibid., p. 24

[6] Ibid., p. 17.

Paperboard Development in the United States

William Rittenhouse had established the first hand-made paperboard mill in the New World in 1690 on Wissahicken Creek, Germantown, Pennsylvania. From Pennsylvania, the hand-made paperboard industry spread to New Jersey, Massachusetts, Maine, Virgina, Rhode Island, Connecticut, New York, etc. It appears that the early boards were formed by pouring a layer of pulp mixture, or "furnish," into a mould, in the same manner as practiced in France in the early eighteenth century in making pulpwood cartons.

The oldest paperboard manufactured in the United States which is still in existence appears to have been made in 1728. The Dard Hunter Paper Museum at the Massachusetts Institute of Technology has a sample of such paperboard made by hand in that year at Milton, Massachusetts.[7]

In 1800, Fuller's board, cardboard, bonnet board, and pasteboard were products of the Massachusetts mills. All of these boards were hand-made. Boards at this time appear to have been formed of a "furnish" consisting of wastepaper or rag content. In appearance, they resemble chipboard or binder's board of today, except that the rag content made the board much stiffer, stronger, and more permanent.

George A. Shryock founded the first machine-equipped paperboard mill in 1831 near Chambersburg, Pennsylvania. The mill produced binder's board and box board. The growing demand for book-boards and the ready acceptance of the hand-made box influenced establishment of the Shryock mill. Its capacity was 100 pounds per hour, or to use board manufacture terminology, one-fifth ton per twenty-four hour day.[8]

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[7] Ibid., p. 25.

[8] Ibid., p. 25.

TABLE V

Board and Paper Tonnage Showing Relationship

Year	Paperboard	Percent	Paper	Percent	Total	Percent
1859	8,150	6.4	118,739	93.6	126,889	100.0
1879	20,014	4.4	432,093	95.6	452,107	100.0
1889	149,901	16.0	784,710	84.0	934,611	100.0
1899	394,111	18.2	1,773,482	81.8	2,167,593	100.0
1904	559,700	18.0	2,546,900	82.0	3,106,600	100.0
1909	883,100	21.4	3,238,500	78.6	4,121,600	100.0
1914	1,291,800	25.1	3,860,900	74.9	5,152,700	100.0
1919	1,867,100	31.3	4,099,000	68.7	5,966,100	100.0
1925	3,286,580	35.8	5,895,624	64.2	9,182,204	100.0
1929	4,451,187	39.9	6,689,048	60.1	11,140,235	100.0
1930	4,060,700	40.0	6,108,400	60.0	10,169,100	100.0
1932	3,303,371	41.3	4,694,501	58.7	7,997,872	100.0
1933	4,076,290	44.3	5,113,727	55.7	9,190,017	100.0
1934	4,073,261	44.3	5,113,337	55.7	9,186,598	100.0
1935	4,695,890	44.8	5,783,205	55.2	10,479,890	100.0
1936	5,454,637	45.6	6,520,915	54.4	11,975,552	100.0
1937	5,802,000	45.2	7,035,000	54.8	12,837,000	100.0
1938	5,103,800	44.8	6,277,000	55.2	11,380,800	100.0
1939	6,105,000	45.2	7,404,600	54.8	13,509,600	100.0
1940	6,449,500	44.5	8,034,200	55.5	14,483,700	100.0
1941	8,400,000	47.3	9,362,400	52.7	17,762,400	100.0
1942	7,969,200	46.6	9,114,700	53.4	17,083,900	100.0
1943	8,620,400	50.6	8,415,300	49.4	17,035,700	100.0
1944	8,962,600	52.1	8,220,200	47.9	17,182,800	100.0
1945	8,913,700	51.3	8,457,200	48.7	17,370,900	100.0
1946	9,504,200	49.3	9,773,400	50.7	19,277,600	100.0
1947	10,409,000	49.3	10,692,900	50.7	21,101,900	100.0
1948	10,853,900	49.2	11,194,900	50.8	22,048,800	100.0

U. S. Bureau of Census

Table V shows the relative growth of paperboard and paper tonnage for selected years from 1859 to 1948, also giving the percentage relationship of paperboard and paper tonnage to the total tonnage for each year.[9] Between 1859 and 1948, both paperboard and paper production continued to increase. In 1859, paperboard production was only 6.4 percent as large as paper production, but by 1948 paperboard production only lacked 1.6 percent of being as much as paper. In 1943, 1944, and 1945, paperboard production by weight exceeded paper production.

History of the Corrugated Box Industry in the United States

Fluted collars on the costumes of the courtiers, who lived some centuries ago, represent the first recognized appearance of a corrugated form which had some relationship to the present corrugated box of today. The first fluted material, which was closely related to the present fluted member of corrugated board, is believed to have appeared in England on July 7, 1856, when a patent was granted to Edward Charles Healey and Edward Ellis Allen.[10] This patent covered the fluting of paper or other materials to be used as a lining or cushion for the sweat band of hats. It is thought that corrugating was first accomplished by wetting the material and then pressing it between a pair of heated corrugators or embossed rollers.

Growth of the Industry in America

Corrugated materials had been used in the past, but the first time such material was used for the protection of merchandise was described as these two quotations show:

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[9]Fibre Containers, op. cit., p. 100.

[10]Bettendorf, op. cit., p. 61.

> The first real patent for corrugated materials that is directly traceable to the present corrugated box was patent number 122,023 granted on December 19, 1871, to an American Albert L. Jones, for an "Improvement in Paper for Packing."[11]
>
> Be it known that I, Albert L. Jones of New York City ... have invented a new and Improved Corrugated Packing-paper of which the following is a specification. The subject of this invention is to provide means for securely packing vials and bottles with a single thickness of the packing material between the surface of the article packed; and it consists in paper, cardboard, or other suitable material, which is corrugated, crimped, or bossed, so as to present an elastic surface ... The corrugated material being wrapped around the glass vial, presents an elastic surface, which is a protection to the vial, and more effective to prevent breaking than many thicknesses of the same material would be if in a smooth state, like ordinary packing-paper. Instead of wrapping the vials or bottles with the corrugated material, the latter may be made into packing boxes, so that the vial or bottle may be surrounded by the same elastic surface. I do not confine myself to vials and bottles in the use of this packing, as it may be used to advantage for various purposes; neither do I confine myself to any particular material or substance, as there are many substances beside paper or paperboard which can be corrugated for this purpose ...[12]

The chief interest in the Jones patent from the box-maker's standpoint is the basic principle of corrugating paper for a cushion.

Certain other patents which are historically important in the development of the corrugated box industry are those issued to Oliver Long, particularly United States Patent Number 154,498 for "Packing for Bottles, Jars, etc." Also on May 5, 1874, a patent, number 150,588, was issued to Oliver Long for a cork liner or wastepaper packing for bottles. It was Long's interest in lined cork or wastepaper pads which led to his interest in corrugated linings.[13]

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[11] Ibid., p. 62.

[12] Wilbur F. Howell, A History of the Corrugated Shipping Container Industry in the U. S., p. 12.

[13] Bettendorf, op. cit., p. 62.

Corrugated materials were not considered seriously as having practical possibilities as shipping containers until about fifteen years later; nevertheless, the Long patent in 1874, for lining wastepaper, cork, and corrugated material, laid the basis for the corrugated box industry that was to follow.

Corrugating in other forms such as pleating, crimping, and fluting had been done for centuries on material other than paper. Even the "Jones Patent" was not limited to flute corrugations but covered corrugating, crimping and bossing. All the principles of corrugation as applied to paper, are contained in the gauffer iron, which was used to crimp or flute materials, and probably dates back to the fashionable ruffs of Queen Elizabeth's time. It is uncertain whether the idea of corrugating paper came from this source or whether it was an independent and later invention.[14]

On May 11, 1873, Jones made certain improvements in his original patent in the form of a crude unlined corrugated box with folding ends, and during this same year Henry D. Morris acquired Jones' patent and started making corrugating materials for packing glass bottles. In the meantime, the record of another pioneer in the corrugated board field, Robert H. Thompson, appeared. It is not entirely clear, but appears to be that Thompson may also have been making corrugated sheets about this same time. More certain is the fact that Thompson was interested in and was featuring a cork-lined paper for packing beer bottles, glass and other articles.[15]

About this time another pioneer, Robert Gair, entered the paperboard container field. It appears that Gair obtained interest in the Long patent, and by 1878, he had been producing corrugated material for some time.

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[14]Howell, op. cit., p. 11.

[15]Bettendorf, op. cit., p. 62.

After Gair entered the industry, Thompson and Norris found themselves in competition with each other; Norris producing a corrugated packing and Thompson a lined granulated cork packing. In 1875, Thompson and Norris decided to pool their forces as the partnership of "Thompson and Norris" for the development of both materials.

In 1878, Gair became engaged in legal difficulties with Thompson and Norris. They charged Gair with infringement of their patent rights. The legal battle lasted for about ten years and was settled on July 13, 1888, on a compromise basis. Gair recognized the validity of Thompson and Norris patents, and he, in return was allowed to manufacture corrugated material on a royalty basis. Thompson, Norris and Gair exercised a virtual monopoly throughout the life of the patents which lasted approximately to 1897.

The First Corrugator

The methods of making corrugations were guarded by patents and secrecy, and only recently has it become clear just how the original corrugated materials were produced. Fluted rolls were in operation in laundries in New York City during the 1870's and 1880's and it is quite possible that Mr. Norris copied the idea from them. "The late Wm. G. Chapin, Secretary of Thompson and Norris for many years, said that the first corrugated (board) was produced by Mr. Norris with a simple pair of meshed metal rolls, driven by a hand crank."[16] The early corrugated material was made in sheets and not in rolls. The sheet was first dipped in water and then was passed through heated rolls. Gas jets were first used in the rolls for heating, but due to fire and explosions, steam heated rolls were introduced in 1880.

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[16] Ibid., p. 64.

Such corrugated sheets were used for packing glass vials, bottles, etc., but they had one essential drawback and that was that the corrugated sheet would lose its cushioning quality through stretching (See Figure 1). To prevent this undesirable stretching, another sheet was glued to the corrugated sheet to form the single-faced corrugated sheet. Later, another sheet of flat paper was glued to the single-face sheet, resulting in a rigid board, more commonly called a double-faced board.

Inception of the First Hand-Made Boxes in the United States

Many efforts have been made to determine the early history of boxmaking in the United States. However, few records have been preserved. Very few of the early boxes, unfortunately, are available. Under such limitations, little of anything has been written on the subject.[17]

The first boxes made in the United States were hand-made and were used to store hats: hence the first boxes were called hat boxes.

The Atwater Kent Museum, a museum of Philadelphia lore maintained by the city of Philadelphia, contains some of the earliest hand-made boxes. The oldest box in the museum is a cap box belonging to the famous Philadelphia Quaker minister, Rebecca Jones. It is said that the box was made especially for her to use on a trip to England in 1785. The construction of this box shows that it must have been moulded, possibly as if a number of sheets of paper had been pasted together and while wet had been pressed by the use of some form of mould to shape the bottom and cover. The paper from which the box was constructed was material derived from re-pulping used rag papers. The box is extremely strong and even appears as if it had been impregnated with

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[17] Ibid., p. 33.

some stiffening substance, possibly animal glue. It is understood that this box was not a true paperboard box in a modern sense, but it is one of the earliest known hand-made paper boxes.

Other kinds of hat boxes appeared between 1800 and 1830, each of which had the following general characteristics:[18] (1) The boxes were all built of a form of hand-made chipboard (made of waste rag content papers), either by pasting sheets of paper together or by pouring pulp on a hand-mould (2) The boxes show every evidence of having been hand-made, the pieces being painstakingly and individually cut and fitted together (3) They were doubtlessly covered by hand with wall paper. As a rule this wallpaper contained some type of a design (4) The joints, in all cases, were sown together with thread.

Mr. Harry J. Bettendorf, who wrote Paperboard and Paperboard Containers, A History, stated that he had examined some of the early effects of George Washington and other leading historical figures. He found no paperboard boxes among these many relics, except references to band boxes, evidently made of leather or wood. The indication is quite clear that there were few, if any, paperboard boxes as we know them today, made in the United States before 1790.[19]

Early Box Manufactures

Business directories of Philadelphia list six box manufactures as being a business before 1800. In 1785 the earliest listing of such a manufacture, is that of Frederick Newman.[20]

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[18] Ibid., p. 35.

[19] Bettendorf, op. cit., p. 38.

[20] Howell, op. cit., p. 40.

It is generally believed that the initial commercial development of set-up boxes (boxes made by forming paperboard and wood pulp) started in the United States in 1839 when Aaron L. Dennison, made such boxes in his jeweler's shop at Boston, Massachusetts. Up until this time, all jewelry boxes used by Boston jewelers were imported from Germany. Dennison decided that the local jewelers would prefer to buy domestic boxes of better quality and also to get quicker delivery. Therefore, he started the manufacture of set-up jeweler's boxes, cutting them out by hand, using a knife T-square, and shaping and covering them over wood forms. This Dennison box is thought to have started the actual commercial production of paperboard boxes in the United States.

Present and Future Significance

To realize how complete the transition from the wooden to corrugated box has been, all a person has to do is ask a grocer or any other retailer for a wooden box. Today it would be difficult for one of them to comply, because most of the stock is received in corrugated shipping containers. Wooden boxes are also becoming more expensive for shipping most merchandise, except where cheaper woods and new reinforcement methods are used.

Corrugated and solid fibre shipping containers came into being about the same time, but the corrugated container has won much wider popularity. In 1916 almost 37 percent of the shipping cases were of the solid fibre type. In 1937, the solid fibre tonnage was only about seven percent of the corrugated tonnage, so the trend has been strongly in favor of the corrugated container as illustrated by Figure 3.[21] However, small

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[21] Ibid., p. 48.

cartons, such as those used for paper cups, frozen food, ice cream and butter, may be about as valuable as corrugated boxes. Nevertheless, the production in square feet is much larger for corrugated boxes than it is for solid fibre boxes, and the recent production statistics favor the corrugated boxes.

During World War I, a shortage of lumber for boxes gave the corrugated container industry considerable stimulus and since then the industry has grown rapidly.

Paperboard accounted for 45 percent of the total paper production or 6,100,000 tons by 1939. The total production in the United States in 1939 was estimated at 13,441,500 tons. This included newsprint, bookpaper, wrapping paper, writing paper, paperboard, tissue, building paper and many miscellaneous uses of paper. The largest percentage of the paperboard was employed in the manufacture of shipping containers. The corrugated shipping container industry used 2,575,645 tons or 42 percent, while the solid fibre container industry used 376,804 tons, or six percent, a combined total of 48 percent of all the paperboard produced.

Table VI on page 32 will give an indication as to the size of the paperboard industry in 1937.[22]

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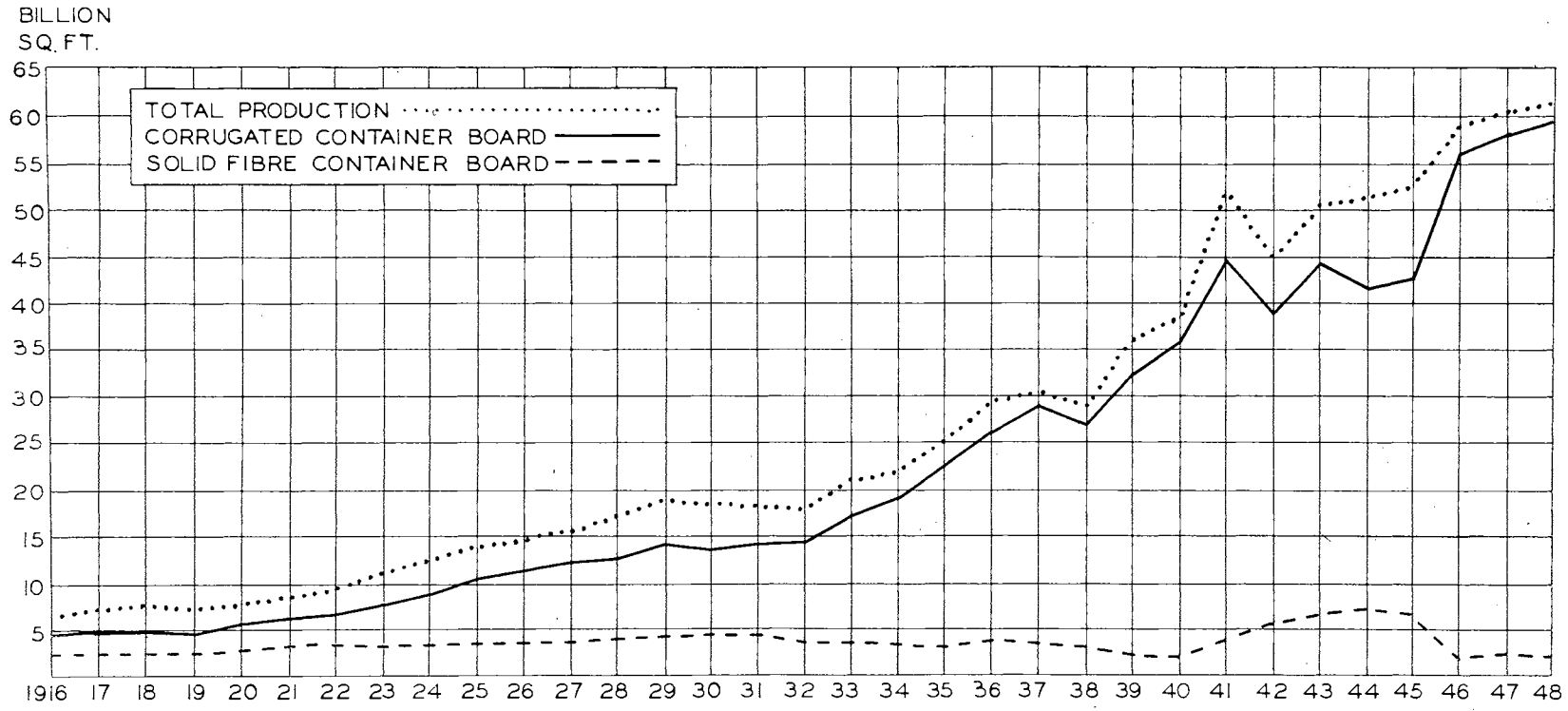
[22]Kennicke, op. cit., p. 2.

PAPERBOARD CONTAINER PRODUCTION



HOWELL & FIBRE CONTAINERS

FIGURE 3

TABLE VI

Size of the Paperboard Industry in 1937

Number of paperboard mills companies in the United States	138
Number of paperboard plants in the United States	224
Number of paperboard machines in the United States	372
Paperboard manufactured in tons	5,646,500
Sale Value of paperboard	$334,000,000
Number of persons employed	31,000
Total pay roll in 1937	$ 34,200,000*
Waste paper consumption--tons	3,700,000*
Pulp consumption--tons	2,080,000*
Coal consumption--tons	4,160,000*

*Estimated

New opportunities for the use of paperboard shipping containers have been developed since 1937. The food industry has expanded its utilization of paperboard boxes and is perhaps one of the largest potential users of paperboard shipping containers. Paperboard containers have not been satisfactorily used as yet in the shipment of lettuce, citrus fruits, tomatoes, pears, etc., but research engineers are working on this problem, and it is only a matter of time until many of these products will be transported regularly in paperboard containers.

The United States ships about 800,000 freight cars of fresh fruits and vegetables annually. Each freight car requires from 200 to 600 shipping containers, so that this constitutes an important consumption of paperboard shipping containers. Export shipment is another large outlet for paperboard containers. Due to research developments, more and more merchandise is being

sent abroad in paperboard shipping containers.[23]

Large markets have recently been developed for corrugated materials, other than shipping containers. They are used in counter display, in insulation, in interior decoration and in many kinds of applications.

Although it is impossible to predict the future development of the industry, for a comparatively long period at least the stability of the shipping container industry seems assured by the ample supply of available and inexpensive raw materials.[24] With a constantly expanding market for the finished product and an adequate supply of raw materials available at a reasonable cost, the outlook for the paperboard industry is optomistic.

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[23]Howell, op. cit., p. 49.

[24]Ibid., p. 49.

CHAPTER III

MANUFACTURE OF WOOD PULP AND KRAFT PAPER

The process of manufacturing wood pulp is an old art. Only recently have scientific methods enabled the paper industry to produce papers and paperboards on the present scale. Therefore, the manufacture of paperboard containers on a huge commercial scale, as we know it today, is a recent development.

The raw material for the manufacture of wood pulp, kraft paper and paperboard, the same as the raw material for any other manufactured product, goes back to the natural resources of the earth. Thus, it is worth while to consider these basic sources of the raw material.

Relative Importance of the Forest Resources

Wood pulp is the basic raw material for paper, and this ingredient is naturally a product of the forest. The increasing demands for paper and paper products are creating a greater need for pulpwood, and this need for pulpwood in turn is related back to its original source, the forest.

The average natural growth of our forests for pulpwood is exceedingly slow, perhaps one-eighth to one-fourth cord per acre per year in the Northwest to about one-half cord per acre in the South where growth is more rapid, but this is not an average figure.[1]

There are 460 million acres of commercial forest lands in the United States and of this amount 74 percent or 340 million acres are privately owned,

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[1]C. Brown Nelson, "Contributions of the Forest to the Pulp and Paper Industry," Paper Industry, (December, 1946), p. 1343.

and the remaining 120 million acres are in public ownership.[2]

There are several other forest areas from which the United States can draw additional pulpwood supplies. Alaska's great Tongass National Forest, which has an estimated annual pulp potential of 800,000 tons, offers a possible source. However, the cost of getting pulpwood from this source would be high. Labrador's spruce forests are too remote for exploitation at this time. Western Canada, near Prince Rupert, is one of the largest pulp producers in Canada. There is one enormous source of pulpwood that has scarcely been tapped, that of the hardwoods of the tropics, which includes approximately two-thirds of the trees of the world. In 1946, hardwoods accounted for 13 percent of the United States pulp production. If chemists can cheapen the hardwood pulping process and strengthen the papers made from these short fibered pulps, the United States could draw on the great hardwood forests of South America, Africa, and South Asia.[3]

The Southern United States has grown very rapidly in pulp production and now constitutes one of the major sources of pulpwood in the country. This new pulp making capacity in the South has been used for the production of kraft paperboard consumed in the manufacture of shipping containers.

There are two chief ways the United States can increase its domestic supply of pulpwood. The first is by growing more timber. The second is by utilizing more completely and more effectively the pulpwood that is now produced in the United States.

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[2] Ibid., p. 1344.

[3] Harry J. Bettendorf, Paperboard and Paperboard Containers, A History, p. 129.

Comparison of Softwood and Hardwood for Pulp Production

Pulp can be made from anything containing cellulose. In the last eighty years of pulp making nothing has proved better, and until recently cheaper, than pulp made from softwood trees. With an increase in pulp production, and consequently a decrease in the softwood forests, pulp companies have begun experimenting with hardwoods as a source of pulpwood. These experiments have proven to be successful, although there are certain difficulties to be overcome. In 1946, hardwoods accounted for thirteen percent of the United States pulp production.

A limited amount of hardwoods was used as a raw material for pulp manufacture as early as 1900. Pulp manufacture from hardwoods was restricted at first to the softer hardwoods such as aspen, basswood, and cottonwood. The use of hardwoods as pulp material has grown until now it includes most of the hardwood species.

Softwoods still are the most important source of pulpwood, and constitute a major source of all pulpwood. Softwood has a number of advantages over hardwood as a source of raw material for the pulp industry. The advantages will be brought out in the following discussion of the two types of wood used in the wood pulp industry.

Hardwood, although it has several disadvantages, has some advantages that are important in causing it to become a source of pulpwood. They are as follows:[4]

1. Many hardwoods give a high pulp yield due to their specific gravity.
2. Many hardwoods are favorably located with respect to transportation

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[4]H. M. Collet, "Utilization of Hardwoods in the Pulp and Paper Industry," Journal of Forestry, Vol. 45, (June, 1947), p. 445.

to the mill in pulpwood production areas.

3. Small-sized and low-grade hardwoods are ignored by most of the competitive forest-products industries. Therefore, there is less competition from other lumber industries for such hardwoods than for conifers.
4. A sizeable market for hardwoods would enable the small and large land owners to dispose of excess trees, thereby affording opportunity to improve residual stand conditions.

The utilization of hardwoods involves a number of problems, some of which tend to off-set any advantages, as follows:[5]

1. Hardwoods produce short-fibre wood pulp, (1.0 mm. to 1.85 mm. in length) in contrast to long-fibre pulps, (2.8 mm. to 3.7 mm. in length) produced by conifers. On the current market, paper products must contain a fairly high percentage of long fibres to give necessary strength to the paper products.
2. Generally, it is more difficult and costly to log hardwoods than coniferous pulpwood.
3. Hardwoods are usually poorer in quality than conifers, and therefore furnish a lower solid cubic volume of wood per cord.
4. Hardwoods often have a greater bark volume than conifers, and the bark of hardwoods is more difficult to remove.
5. There are a greater number of hardwood species than conifers, and in many pulping processes hardwoods must be separated and grouped by species before cooking.
6. Harvesting, handling and transportation will be more difficult to

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[5] Ibid., p. 445.

mechanize in the case of hardwoods than with conifers.

An increased use of hardwoods by the pulp industry involves certain disadvantages, but quantity and variety of hardwoods utilized by the industry at the present time have reached significant proportions. It is believed by most authorities that the quantity will increase in the future.

The nine species of hardwoods that show the greatest promise for use as pulpwood are as follows:[6]

	Scientific Name	Common Name
1.	Quercus shumardii	Swamp red oak
2.	Quercus pagoda	Swamp Spanish oak
3.	Halesia carolina	Wild olive tree
4.	Quercus coccinea	Scarlet oak
5.	Ilex vomitoria	Yaupon
6.	Quercus nigra	Pin oak
7.	Quercus rubra	Southern red oak
8.	Gordonia lasianthus	Loblolly bay
9.	Quercus laurifolia	Laurel oak

Pulpwood consumption in the United States is about 16,400,000 cords annually;[7] a cord is the unit of measurement for pulpwood and contains 160 cubic feet of wood. However, the 1950 consumption is expected to be between eighteen and twenty million cords. If this increase continues, the industry must take steps to insure the future supply.

For many years, the United States has imported about one-third of its pulp from Europe and Canada. Sweden and Finland are the most important European sources. The other two-thirds is domestic pulp which is consumed for the most part by mills operating in conjunction with pulp plants.[8]

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[6] L. V. Forman, D. D. Niemeyer, "Pulpwood Stands Procurement and Utilization," Technical Association of the Pulp and Paper Industry (1947), p. 167.

[7] Nelson, op. cit., p. 1343.

[8] Rennicke, op. cit., p. 13.

Practically any commercial wood can be used as a source of raw material for kraft pulp, the chief substance from which paperboard is made. The jack pine and hemlock are the most commonly used trees in the North, while the loblolly, short and long leaf pines are the usual species used in the South.

Importance of Waste Paper

Baled newspapers, mixed papers, used corrugated containers, box clippings, old kraft paper, Manila paper, envelope paper, white book paper shavings and white envelope cuttings form important sources for waste paper.[9]

Waste paper has been the most important raw material in the past for the paperboard industry as a whole, representing 35 percent or more of the fibrous raw material used in manufacture. However, since 1948 this situation is no longer true. In 1948, waste paper accounted for only 46.7 percent of the paperboard while wood pulp accounted for 48.9 percent.[10]

The basic reason for the decrease in waste paper consumption in the paperboard field has been the advance in the building and operation of kraft board mills in the South, where production is mostly from virgin pine. Significant production from these Southern mills began in 1947. It is reasonable to conclude that the demands for waste paper will be decreased further as a result of the recent kraft mill additions in the region.

However, other data appears to indicate that the lessening demand for waste paper in paperboard manufacture may be only a temporary condition. The reasons are that there is a likelihood of less availability of pulpwood supplies for new virgin forest pulp operations. Supplies of raw straw and chest-

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[9] Ibid., p. 33.

[10] Fibre Containers, op. cit., p. 107.

nut wood are reported to be declining and hardwoods are being introduced into the paperboard industry. This data leads to the conclusion that some of the future expansion of board production capacity is apt to be based on waste paper consumption.

The three major uses of waste paper are for the manufacture of paperboard, roofing material and paper. Table VII shows waste paper consumption for the years 1928 to 1948.[11]

Wood Processing

The South West Box Company at Sand Springs, Oklahoma, receives a major portion of its kraft paper for manufacture of corrugated shipping containers from Southern Kraft Division of International Paper Company, located at Springhill, Louisiana.[12] The following discussion of the manufacture of pulp and kraft paper is based on the process used by the Southern Kraft Division of International Paper Company.[13]

Young pine trees are used in the manufacture of kraft paper. The most suitable logs are six to ten inches in diameter and five feet in length. This means about eight to twelve years, under ideal conditions, is required to grow ideal tree size for use in this process.[14] The wood is received at the mill in open rack cars and to a less extent in box cars. It is unloaded and stored in the yard or conveyed by a conveyor to the barking drums.

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[11] Ibid., p. 108.

[12] F. C. Baker, Office Manager, South West Box Company, Personal Interview, (March 16, 1950).

[13] Special Report, The Manufacture of Pulp and Paper, Southern Kraft Division of International Paper Company, Springhill, Louisiana, pp. 1-7.

[14] Ibid., p. 1.

TABLE VII

Waste Paper Consumption (in Tons)

Year	For Paperboard	For Roofing	For Paper	Total
1929	3,310,000*	-------	531,900*	3,841,900
1930	3,005,000*	-------	485,000*	3,490,000*
1931	2,793,000*	-------	445,000*	3,238,000*
1932	2,347,000*	-------	378,000*	2,725,000*
1933	2,725,000*	-------	435,000*	3,160,000*
1934	2,715,000*	-------	432,000*	3,147,000*
1935	3,097,000*	-------	490,400	3,587,400*
1936	3,590,000*	-------	660,000*	4,250,000*
1937	3,683,000*	-------	677,000*	4,360,000*
1938	3,098,000*	-------	572,000*	3,670,000*
1939	3,678,400	174,500	513,400	4,366,200
1940	3,883,800	210,600	573,100	4,667,500
1941	4,820,300	289,500	965,300	6,075,100
1942	4,423,300	324,100	747,600	5,495,000
1943	5,272,300	357,400	738,200	6,367,900
1944	5,459,600	365,500	1,034,200	6,859,300
1945	5,413,500	372,900	1,013,300	6,799,700
1946	5,739,300	431,700	1,108,600	7,279,600
1947	6,173,800	525,100	1,146,100	7,845,000
1948	5,896,600	559,400	1,128,500	7,584,500

Source: U. S. Bureau of Census *Estimates

Note: Consumption of waste for roofing prior to 1939 is included with paper.

Preparation of Pulpwood

Removal of the bark is the first step in the preparation of the wood. The barking drums are horizontal cylinders about twelve feet in diameter and about forty-five feet long. The bark is removed simply by the rubbing and pounding action of the logs upon each other as the drum revolves. The barked logs fall out of the drum onto a conveyor and are then carried to the chippers.

The barked logs enter the chippers where they are reduced to chips. The log is held against a revolving disc through which knife edges protrude at right angles to the axis of the disc. The chips pass over a screen which rejects the oversized chips for recrushing and allows the proper sized chips to pass through. The ideal chip size is from one-half inch to one inch in length along the grain of the wood. The chips are cut at an angle of less than 45° to the grain of the wood which permits penetration of the cooking chemicals. The screened chips are next moved by a conveyor to a chip storage bin above the digestor room.[15]

Manufacture of Chemical Wood Pulp

There are several processes of manufacturing wood pulp, but only the sulphate or kraft process will be discussed.

The sulphate process is the most popular technique of pulp extraction and was introduced by C. F. Dahl in 1879 at Danzig, Germany. The process was brought to North America by Olaf Bache-Wigg in 1907.[16] The process uses an alkaline cooking liquor, and it replaces the alkali lost by reactionary influences brought about in the process itself. In other words, this continuous process produces the very substances that are lost during another part of the process through the addition of a third chemical, sodium sulphate. It is from the use of this ingredient that the process gets its name.[17]

The wood chips are fed into upright cylindrical digesters along with an alkaline cooking liquor, consisting principally of caustic soda (NaOH) and

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[15] Ibid., p. 3.

[16] A. W. Werner, The Manufacture of Fiber Shipping Containers, p. 17.

[17] Ibid., p. 17.

sodium sulphide (Na_2S).[18] The chips are then heated to 345° F. and under 110 pounds of steam pressure until the "non-cellulose" material is dissolved out of the wood. The principal constituent dissolved out is lignin, along with other so-called carbohydrate material. At the end of the cooking period, the length of time depending on the degree of delignification desired, the contents of the digestor are "blown." This process is accomplished by opening a valve at the bottom of the digestor and allowing the contents, which consist of pulp and spent liquor, to be blown into a blow tank. The pressure with which the steam forces the digested contents out serves to tear the fibres apart by literally exploding them as a result of suddenly reducing the pressure from about 100 pounds per square inch to atmospheric pressure.

The pulp is then washed. This process consists in diluting the stock with liquor and pumping it into a vat containing a revolving horizontal drum. The pulp forms a thick mat on the revolving drum, and at the same time, the liquor solution is pulled through the pulp mat to liquor tanks. This process is repeated several times, and each time the diluting liquor is progressively weaker. For the final washing, water is sprayed on the pulp mat.

The pulp is then discharged into a chest from where it is pumped to the screen room. Here the pulp is diluted with water and passed through revolving screens which remove the partially cooked pieces of wood and undigested knots. The holes in the screen are of such size that the pulp fibres pass through and the larger uncooked materials are retained. The pulp is now thickened or de-watered. Then it is ready to be pumped to the paper mill.[19]

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[18]The presence of the sulphide accounts for the unusual strength (kraft) possesed by pulps made by this process.

[19]Special Report, The Manufacture of Pulp and Paper, op. cit., p. 4.

The Manufacture of Kraft Paper

The product of the above process is the brown unbleached kraft pulp which is used to make paperboard for shipping containers. The brown pulp is prepared for the paper machine by passing through Sutherland Refiners. The Sutherland Refiners separate the individual fibres, brush them and prepare their surfaces to be bonded into a sheet of paper. Rosin is added, followed by alum, in order to make the sheet resistant to water. This treatment, called "sizing," also contributes to the desired type of surface necessary for printing labels and advertising.

The pulp is diluted and pumped to the paper machine. It flows onto a moving endless bronze screen which permits the water to drain off, leaving a sheet of pulp upon the screen surface. As the sheet moves along, more water is removed by suction. It then travels over drying cylinders. These steam heated cylinders progressively drive more moisture out of the sheet until it is practically dry. Next, the sheet passes through calenders which iron it out. Then it is wound on a reel as finished paper, except for re-winding into smaller rolls or cutting into sheets.[20]

A large percentage of the kraft board production in the South is manufactured on the Fourdrinier type of machine.[21] The Fourdrinier machine produces kraft board in thicknesses from .009 inch for corrugating materials up to .032 inch for use as shipping container liners and specialties.

The pulp that is required for the above process, according to I. Y. East is

> ... kraft from pine wood and is known as hard pulp; i.e., incomplete removal of non-cellulose incrustants, resulting in fibres having

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[20] Ibid., p. 7.

[21] Werner, op. cit., p. 33.

> considerable stiffness, necessary for bulk of sheet of heavy paper, otherwise known in the trade as container board. This board must resist puncture and bursting; also be able to be properly glued as a face onto the corrugations of sheets of corrugated medium.[22]

There is some confusion in the use of the terms "sulphate" and "kraft" as applied to the process and the products produced. Sulphate may be considered as a general term applying to any cooking process in which the loss of alkali is made up by the addition of sodium sulphate. The term sulphate was originally used to designate all pulp made by the sulphate process. More recently it is being restricted to special grades, as bleachable, light and strong sulphate pulps. "The word 'Kraft' is now used only to designate that particular quality of unbleached sulphate which has been cooked to produce high yield and exceptional strength."[23] This development came about by the fact that when the process was introduced by Dahl in 1879, the resulting pulps possessed such high strength that they came to be known as kraft pulps.[24] The use of the word "kraft" is justified by the fact that it is the strongest form of pulp known.[25] The chief characteristics of kraft paperboard are its yellowish brown color, its long fibres and its resistance to tear and rupture.

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[22]I. Y. East, Manager, Southern Kraft Division of International Paper Company, Personal Letter, (February 17, 1950).

[23]Werner, op. cit., p. 17.

[24]Special Report, The Manufacture of Pulp and Paper, op. cit., p. 1.

[25]Werner, op. cit., p. 17.

CHAPTER IV

MANUFACTURE OF CORRUGATED BOXES AT SOUTH WEST BOX COMPANY

The South West Box Company, the largest producer of corrugated boxes in Oklahoma, was established at Sand Springs during 1928 in order to serve the needs of the Kerr Glass Company which was located there. The first box was manufactured in February 4th, of that year. The Kerr Glass Company still purchases approximately 20 to 25 percent of the boxes produced by the box factory. Before the establishment of this plant, customers in Oklahoma were supplied by the parent plant, the Iowa Fiber Box Company of Keokuk, Iowa.[1]

Manufacturing Process

The kraft paper used at the South West Box Company in its manufacturing of corrugated boxes is obtained from the Southern Kraft Division of International Paper Company, Springhill, Louisiana.[2] Paper is received from the Southern Kraft Paper mills by railroad. The rolls of paper are transferred from the railroad box car to an unloading dock. It is so constructed that the floor height is the same as the deck level of a box car and the platform level also fits flush with the box car which facilitates handling.

Paper is shipped in rolls varying in weight from 2400 pounds to 2800 pounds. An average roll is approximately four to five feet wide and about three to four feet in diameter. The rolls of paper are classified according to weight, grade of paper, thickness of the roll, and the amount of acid

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[1] On the Job at South West Box Company, op. cit., p. 4.

[2] F. C. Baker, Office Manager, South West Box Company, Personal Interview, (March 16, 1950).

contained in the paper. Two grades of paper used in the manufacture of corrugated boxes are: (1) a standard weight paper that tests two-hundred pounds per square inch, and (2) a heavy weight paper that tests four-hundred pounds per square inch. The heavier grade is called "heavy cut" and is used for the outside covering or liner of the box and in making boxes where extra strength is needed. The standard weight paper is used for the corrugating medium.[3] This material used in corrugating is made from cheaper cuts of wood than that used in the manufacture of kraft paper and contains about 30 percent straw and 70 percent wood pulp.[4]

The paper is moved from the loading dock by a forked truck and stored in the stock room until it is needed. As the paper is required, it is transported from the stock room by a forked truck and put on a large roller which is located in front of the corrugating machine.

In the first manufacturing process, a roll of paper is passed through the corrugator which forms the corrugated sheets.[5] As it emerges from the corrugator it goes through the single facer where a second roll of paper, which is called the liner, is glued to the corrugated sheet by an adhesive.[6] At this stage the product consists of the corrugated medium and a flat sheet of paper, or liner, glued to it. It is called a single-faced sheet (See Figure 1).

The single-faced sheet now passes by means of a conveyor belt to another machine called the "second paster" or "double facer." As the sheet goes into

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[3]The corrugated medium is the corrugated sheet between the two liners.

[4]F. C. Baker, Personal Interview, (March 16, 1950).

[5]A machine that forms the corrugations on a sheet of paper.

[6]A machine that glues the liner to the corrugated sheet.

the machine, a layer of paper is glued to the rough side of the single-faced sheet, forming the complete double-faced corrugated board.

The corrugated board then goes through the hot table process. This machine passes the freshly glued corrugated board over a hot table, heated by steam, which dries the glue and makes the corrugated board stiff.

The dried corrugated board is conveyed to the scorer, and at this stage the outline of the box is well defined.[7] The board then passes to the cutter where it is sheared to the specific size, depending on the individual order. The pieces of scored and cut corrugated board are removed by hand from the conveyor belt, at the same time being inspected for culls or defective panels.

The good panels are stacked near the slotter-printer for further processing. The slotter-printer performs two functions; (1) it cut slots in the corrugated board at the proper place, depending on the specific order, and (2) prints the design on the box.[8]

The design includes any information and advertising the customer desires, besides government required information. The printer-slotter resembles a rotary printer and can print two different colors simultaneously. The most popular colors are red and blue. Any design is acceptable and the South West Box Company will assist in designing the proper style of box for its customers and also will help in choosing the printing dye.[9] The customer's

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[7] A machine that forms an impression or a crease in corrugated or solid fibreboard to facilitate folding.

[8] Cuts in the corrugated board at the proper place for fastening the ends together and for forming the box flaps.

[9] E. E. Boyd, Time Study Engineer and Safety Director, South West Box Company, Personal Interview, (March 2, 1950).

design also includes shipping instructions, precautions in handling, warning of inflammable properties, etc., in compliance with state laws regarding the products being shipped. A second dye gives the name of the box maker, information regarding test strength of the box, and the capacity of the box. The dyes for printing are supplied by and are the property of the customer.

From the slotter-printer, the panels are taken to the stapling machine that joins the two cut edges. The stapling machine has a capacity of 1440 to 1500 boxes per hour. Instead of using staples, some boxes are fastened together with a paper type, depending on box design and size, or the customer's request. The boxes are then stacked by hand in bundles and tied together.

In a separate department, the box fillers or partitions are assembled. Material that otherwise might be wasted is utilized for this purpose. The processes may be mechanical or manual, according to the specifications and size of the order.

Throughout the entire manufacturing process, the boxes are inspected at various stages of completion. After the final inspection, the boxes are packed flat or in a "knocked-down" condition to conserve space, and any accessories such as partitions, dividers, or trays are added. The boxes are now ready for shipment.

Figure 4 shows the flow, or the route followed by the materials, from the original rolls of paper to the completed box. The materials follow a U-shaped pattern from the receiving docks through the manufacturing process to the shipping dock. At no time does the flow of materials cross. This assembly method is considered ideal within practical limitations.

FLOW CHART OF THE SOUTH WEST BOX CO.

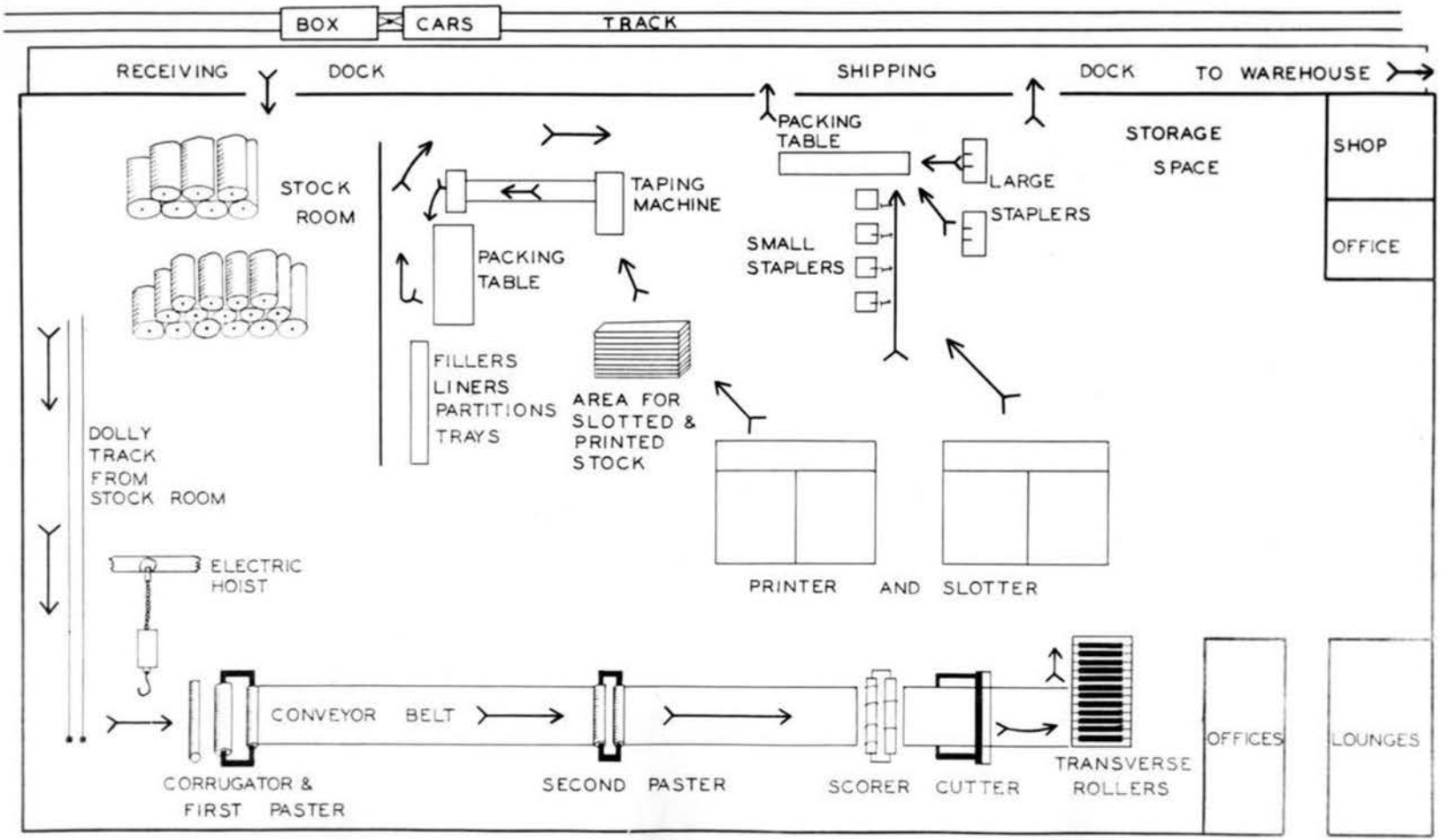

FIGURE 4

Box Styles

Commonly used styles of corrugated and solid fiber boxes may be classified into five categories. They are as follows:[10]

1. Regular slotted box: Outer flaps meet; inner and outer flaps are the same length.
2. Center special slotted box: Inner and outer flaps are the same length.
3. Full telescope box: Cover depth usually equals over-all outside body height. Body slotting is at right angles to cover slotting.
4. Full overlap box: Outer flaps have full overflap; inner and outer flaps are the same.
5. Special full-flap slotted box: The outer flaps have a full overlap while the inner flaps meet in the center.

The regular slotted box, or category 1, accounts for about 90 percent of all paperboard boxes used in the United States. The South West Box Company finds that the regular slotted box is the most popular type of box, however it manufactures all five of the commonly used styles listed above. The remainder of the United States production is distributed more or less equally among the other four box styles, although there are many variations from these categories.

There are many other styles which are adapted to special purposes. Some of these include furniture boxes, textile boxes, textile boxes, combination shipping-display boxes, returnable beverage boxes, egg cases, etc. The importance of such exceptions is clearly brought out by the fact that, during

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[10]Lurhs, op. cit., p. 778.

the last two years, the South West Box Company has designed over 3,900 different box styles for its customers.

The paperboard box has become more than ever a custom industry in that it now can produce a box to meet the requirements of practically any manufactured product. Patent rights are usually not requested. This flexibility has been a decided advantage in competition with wooden and metal containers.

Designing New Boxes

To meet the customers' demands, it is quite often necessary for the South West Box Company to design a new type or style of box. This is because no definite rule or pattern can be followed since many different types of merchandise are being shipped in corrugated boxes. Then too, the industry is relatively new and must meet new demands. It is necessary that the box be sufficiently strong to adequately protect the kind of merchandise being shipped and also to comply with all freight regulations, beside answering the normal requirements of the purchaser.

When the plant is requested to design a new box, the buyer usually sends a rough diagram of the type of box he wants, giving the necessary dimensions and specifications. The order is then taken to the designing department where a box is made by hand according to the customers' wishes. When a small box is desired, sometimes the purchaser will send a sample of his product and the box can be made to fit the product.

The customer usually includes the design he wants on his box. The design he submits is almost always a rough drawn diagram. The design must then be drawn to scale, as specified, so that it will be in the proper proportions when printed on the finished box. A finished, hand-made box is sent back to the buyer for his approval. If the box is reported satisfactory by

the customer, a work order is filled out at the factory for the required number and kind of boxes. In some cases, where a special type of box is made to meet specific needs, it is thought worth while to apply for a patent.

Shipping Boxes

During World War II most shipments were made by rail from the South West Box Company, but now about 60 percent of all shipments are made by rail and the remainder by truck. Boxes are delivered to the Kerr Glass Company, located only one hundred yards away from the plant, on "live skids."[11,12]

When the boxes are shipped in freight cars, the box company usually meets the minimum weight requirement of 24,000 pounds per car to save on shipping costs. The "knocked-down" boxes are bound together with twine into a bundle. An attached bottom of stiff board forms a pallet, weighing between 650 to 700 pounds.

Storage of Boxes

After the boxes are made, they are usually stored in the back of the plant ready for shipment (Figure 4). A warehouse, forty feet by two hundred feet, furnishes additional storage. It is located on the west side adjacent to the corrugating plant. Boxes of the sizes numbered 1, 2, and 10 are made during slack periods and stored in this warehouse because there is always a demand for this size. Other materials are also kept in the plant storage space and in this warehouse.

Since a small inventory of boxes is usually carried by most customers orders are ordinarily filled within two weeks after the initial request is

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[11] A small sled with wheels.

[12] B. B. Boyd, Personal Interview, (March 2, 1950).

received. This results in only a small number of boxes being held in storage at the factory, except for a few days after manufacture. In case of an emergency or rush order, the plant will meet the request as quickly as possible. During the rush season, the plant operates on a heavier production basis.

Types of Boxes Made

The South West Box Company makes boxes of all sizes and descriptions, ranging from those three or four inches in outside dimensions to those that are so large that they are assembled in separate pieces rather than one piece. Examples of some boxes made by this company which meet certain purposes are (1) for small books, (2) for fire extinguishers, (3) for all types of canned foods, (4) for petroleum products, (5) for chairs, (6) for beds, (7) for mattresses and for many other uses.

Labor at South West Box Company

The South West Box Company regularly hires approximately one hundred people. The employees have a semi-skilled rating with the exception of administrative and executive personnel. Approximately 25 percent of the employees are engaged in clerical work. The workers have the option of being affiliated with the International Paper Union, a branch of the Congress of Industrial Organization, or working as independent employees. In either case, the employee works under the same regulations and receives the same pay.

The factory laborers are paid under a dual payment plan. Each employee gets a base pay, computed on the wage scale for that particular type of job performed, and also a bonus calculated on his production over the standard production rate.

The standard production rate is determined by the management. This is best illustrated by the following example. Suppose the standard production for a certain operation was 1,000 units and the employee produced 1,200 units. This is 200 units above the 1,000 unit standard set by the company and the employee would get a 20 percent bonus for that particular unit of production.

This incentive payment plan enables the company to operate more efficiently and results in a greater income for the employees. The employees at the South West Box Company average a 30 percent bonus plus their base pay. In case a worker fails to produce the standard production, he still receives his base pay.

Generally speaking the cost of production of the South West Box Company is a little under the other plants controlled by the Hoerner Corporation.

Wastage

In the manufacture of corrugated boxes, the paper is the main material cost. During the month of December, 1949, the South West Box Company consumed 2,700,000 pounds of paper, and of that amount, 200,000 pounds or 7.6 percent were wasted. Paper costs the company one hundred dollars a ton, therefore the loss due to waste alone was 200,000 pounds and was equivalent to a loss of $10,000. It is obvious from these figures that the maximum utilization must be made of the paper to keep down excessive losses. The waste paper is run through a shredder and is either used for packing or sold to papermills for reprocessing.

Testing and Specifications of Corrugated Boxes

There are various tests to which the corrugated box should be subjected. Only the most important of these will be described here. First of all, the

materials should pass certain tests. Both the liners and the corrugated sheet must come up to or exceed caliper specifications.[13] The corrugations in the corrugated sheet should be perfectly formed, being of a uniform height and uncrushed. The liners should be uniform and strongly glued to the corrugated sheet. The printing dyes should not crush or damage the liners or corrugated sheet, and the scores and slots should be perfectly formed.

After the materials have been checked, the finished corrugated box must be tested. However, boxes manufactured from the best materials may not be of superior strength.[14] No test or set of tests can be made on corrugated boxes which will answer all purposes. By fitting the tests to the box and keeping in mind the particular requirements of the product, a box can be developed, at a minimum cost which will safely transport the merchandise.[15]

Listed below are the most important quality tests pertaining to the testing and specifications of corrugated boxes.[16]

1. Rules: The Association of American Railroads has established general regulations covering the shipment of freight and express by a set of specifications known as "Rule 41--The Consolidated Freight Classification." The purpose of these regulations is to protect

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[13]The thickness of a sheet measured under specific conditions, expressed in thousandths of an inch.

[14]Edward Dahill, "Standard of Quality for Shipping Containers, and Closures," American Management Association, Series Number 104 (November, 1937), p. 16.

[15]Hinde and Dauch, "How to Test Corrugated Boxes," Little Packaging Library No. 11 (1949), p. 5.

[16]Ibid., p. 6.

both shipper and carrier. This rule determines the maximum weight of the box and its contents, maximum inside dimensions, minimum thickness of paperboard, minimum tests per square inch, and other regulations pertaining to different types of boxes. Other transportation regulations are Motor Truck Classification. Rule 5, Official Express Classification--Rule 18, Bureau of Explosives--Tariff 4, Postal Laws and Regulations, and Air Express Agency Regulations.

2. Mullen Test: For measuring the bursting strength of corrugated board, the Mullen Test is the accepted standard for the industry.

3. The Drum Test: A revolving drum subjects a packed corrugated box to severe treatment similar to what it may receive in ordinary handling during transportation. A packed box is placed in a hexagonal drum, which revolves at a constant rate of speed, tumbling the box on its ends, sides and corners. The number of times the box drops in the drum and remains unbroken is its durability.

4. The Drop Test: Releasing of a loaded box from a known height onto a metal or concrete floor is designated as the Drop Test. The height and position of the box can be varied so the box will fall on any desired part. The required minimum number of drops depends upon the nature of the contents. This test determines if the corners or sides will break open and spill the contents.

5. The Compression Test: The test for compression strength simulates conditions similar to those encountered when a box is stacked in freight cars or stored in a warehouse. The purpose of this test is to uncover any weaknesses in the box, for example to determine

the stress points at which leakage may occur, or to determine the stress point at which inner boxes may become distorted beyond use as display units.

6. Inclined Impact Test: This test simulates a load shift in a box car or truck which often throws boxes against the walls. Sudden thrusts of the carrier jam the boxes together and any box not prepared for this treatment will be crushed.

7. The Puncture Test: If the item to be shipped has sharp edges or an irregular shape there is danger of puncturing the box from within, while if the box is stored against some sharp or irregular object there is danger of puncture from without. The puncture resistance of corrugated board is determined by using the General Electric Puncture Tester. The Puncture Test measures the abrasion resistance of the corrugated board, its stiffness and its general fabrication quality.

Other equipment and tests used in testing corrugated boxes are: the humidity room, drying oven, balances, viscosimeter, caliper, Riehle-Quinn Compression Tester, Blum Crush Tester, hydrometer, Elmendorf Tear Tester, Cobb Size Tester, Immersion Number Test, Penescope Penetration Tester, Tensil Tester, bond strength testing equipment, ink fading testing apparatus, and pH testing equipment.[17]

Not all corrugated boxes may be subjected to all the different tests, but certain tests, depending on the type of box and its intended uses, are applied to most corrugated boxes. These tests enable the customer to know in advance the limitations of the container.

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[17] A. W. Werner, The Manufacture of Fibre Shipping Containers, p. 24.

CHAPTER V

A TYPICAL CORRUGATED CONTAINER MANUFACTURING PLANT GROUP IN CENTRAL UNITED STATES

In this study of the paperboard container industry in Oklahoma, a typical corrugating paperboard container industry group was chosen that embraces this state and others in the Central United States. The organization selected for this study was the Hoerner Corporation. This corporation is composed of eight plants, each of which will be discussed later. The South West Box Company, a member of the Hoerner Corporation, located at Sand Springs, Oklahoma, will be used as a model plant in this study.

Questionnaires were sent to each of the eight plants in the group requesting the following general information: the type of product made, either the completed corrugated box or corrugated sheets; where the company gets its raw materials; reasons for establishing the plant at its present location; trade territory of the plant; approximate production of the plant; and the number of people employed.

History of the Hoerner Corporation

The Iowa Fiber Box Company, the first plant of the Hoerner Corporation had its inception in 1920 when the corrugated box industry was in its early stages of development in the Middle West. Only a few years previously, the railroads had adopted a rule whereby commodities could be shipped by rail in certain types of boxes.

At this time C. M. Rich, President of the Purity Oats Company, whose business at that time was quite sizeable, decided that he needed a box company near his original plant at Keokuk, Iowa. Hence, he founded the

Iowa Fiber Box Company to supply shipping containers for his products. He soon discovered, however, that the Purity Oats Company could not use the total production of boxes being manufactured, making it necessary for him to find other outlets for the surplus boxes. To accomplish this, he employed J. O. Hoerner to expand the trade area of the Iowa Fiber Box Company by an intensified sales effort within an area of 250 miles from Keokuk.[1]

An early ideal that was developed was to carefully serve customers in the immediate districts surrounding Keokuk with a shipping container made of materials that would more than protect the commodities being shipped. To carry out this ideal of service, it was necessary to place properly trained men in the sales territory. By necessity, these men had to be packaging engineers who could design proper types of shipping containers for the customers they served. Part of the salesman's training, which was early emphasized, was that he must fulfill the purchaser's needs. He was advised to obtain access to the packing and shipping department of the buyers to analyze the process of packing and then to design a container that would properly fit the commodity. Thus safe transit was provided for the commodity being shipped. As a result, there was a rapid growth of satisfied customers.

As the business grew, this policy of service began to yield other favorable benefits. For illustration, the Kerr Glass Company, located at Sand Springs, Oklahoma, was just getting started in the early 1920's. By 1927, it required a large amount of boxes. Hence it was decided that another box plant should be built and operated by the Iowa Fiber Box Company. It was to be near the Kerr Glass Company to adequately supply its needs and those of other purchasers

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[1]The Company Digest, Iowa Fiber and Associated Box Co., General Information, Index A-025, pp. 1-5.

in the territory. At this time there were no other box plants in Oklahoma.

The South West Box Company was established in 1927 on the south side of Sand Springs, Oklahoma. Again the policy of careful servicing was applied, and its business has grown steadily ever since. During its history the South West Box Company gradually extended its trade territory into the surrounding states, especially Texas. By 1939 its business had grown to the point where it was evident that another box factory would be needed in Texas to adequately service the customers developed in that area.

Again, an additional unit was organized in November, 1940, beginning operations as the Southwest Corrugated Box Company and situated at Fort Worth, Texas. One of the major accounts which this plant serves is Armour and Company. With its main offices at Chicago, Illinois, and with branches scattered throughout the country, Armour and Company had been one of the early customers of the South West Box Company. It was largely due to their meat packing operations at Fort Worth that the Southwest Corrugated Box Company was established there.

Divisions of the Group and Reasons for such Divisions

Freight rates have always played an important role in the paperboard container industry. The farther away a consuming plant might be from the box factory, the greater would be the cost of shipping the containers. This spread of the affiliated units of the Iowa Fiber Box Company, therefore, was made necessary partly by the freight rate factor and partly by the factor of quick delivery to the customer. The theory of being near the customer was that his shipping container needs could be more properly and adequately supplied.

The three plants--Iowa Fiber Box Company, South West Box Company, and

Southwest Corrugated Box Company--are so called one-unit plants. Each plant has a corrugator and the supplementary equipment necessary to completely manufacture corrugated shipping containers.

In certain large cities within the trade area there was a great problem of quick service where packaging and delivery could not be adequately met by the box companies themselves. As a result of this demand, so-called sheet plants were established in Minneapolis, Minnesota; Des Moines, Iowa; and Fort Smith, Arkansas. These sheet plants are supplied corrugated sheets by the complete one-unit plants. The sheet plants are equipped with fabricating machinery so that they can fill orders from the corrugated sheet stock, and serve local companies quickly and adequately. These three sheet plants are: ABC Corrugated Box Company, Minneapolis, Minnesota; Arkansas Box Company, Fort Smith, Arkansas; and Des Moines Container Company, Des Moines, Iowa. It appears that freight rates also influenced the location of these plants.

These three sheet plants perform a dual purpose. In the first place, they are able to quickly service customers in the immediate trade territory of their location, and especially within the city environs. In the second place, the function of these sheet plants is that they take carloads of corrugated sheets from the complete one-unit box plants. The manufacture of corrugated sheets is a simple operation in that only one machine, namely the corrugator is involved. Since the corrugators in these complete one-unit plants can produce more corrugated board than can be properly fabricated into boxes in the individual corrugated box unit, the sheet plants are an outlet for the corrugated board which keeps the corrugator busy and balances the production program of the two plants involved in this supply.

The Iowa Fiber Box Company supplies its own two sheet plant branches,

the ABC Corrugated Box Company and the Des Moines Container Company. In addition, the Iowa Fiber Box Company supplies an independent sheet plant, the Ottumwa Box Company at Ottumwa, Iowa. The South West Box Company serves the Arkansas Box Company, and in addition, a privately owned sheet plant, the Love Box plant at Wichita, Kansas.

It is important to note at this point that the relative distances between these various plants, both the complete one-unit plants and the sheet plants, is only a maximum of a few hundred miles and that these plants are so distributed that they completely cover the trade area west of the Mississippi River from St. Paul, Minnesota, to Fort Worth, Texas. It is also important to note that the plants have been established near the market outlets for their finished products. Freight rates are kept at a minimum and the customer is given rapid and efficient service.

Organization Units of the Hoerner Corporation

It has been pointed out that the Hoerner Corporation is composed of a group of six corrugating box companies, a sheet plant and a plant in Mexico. The Hoerner Corporation serves as the general office of the group and is located at 600 Morgan Street, Keokuk, Iowa. Its purpose is to furnish management services, advice and supervision in connection with production, sales, personnel, purchasing, traffic, accounting, engineering, advertising and other management functions. The general office performs similar services for all companies of the Hoerner Corporation.[2] Each plant in the corporation pays a fee for this service.

The Hoerner Corporation is divided into a northern and southern group.

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[2] *On the Job at South West Box*, (January, 1950), p. 5.

The northern group is composed of the Iowa Fiber Box Company and its two subsidiaries, the ABC Corrugated Box Company and the Des Moines Container Company. The Iowa Fiber Box Company at Keokuk, Iowa, was the first and parent company, having been organized in 1920. The ABC Corrugated Box Company was originally a sheet plant, but was enlarged into a corrugating unit early in 1947. The Des Moines Container Company is a sheet plant. A sales manager located at each of the three plants is responsible for the operation of the company.[3]

The South West Box Company at Sand Springs, Oklahoma, is the parent plant of the southern group of plants. It has two subsidiaries, the Arkansas Box Company and the Southwest Corrugated Box Company. The Southwest Corrugated Box Company. The Southwest Corrugated Box Company is a complete one-unit plant, while the Arkansas Box Company is a sheet plant. Each company has a sales manager who is responsible for the operation of the company, the same as in the northern group.

Significance of This Corporation in Total United States Production

Figure 2 gives the number of converting plants and the number of sheet plants in the United States. There are 314 converting plants and 223 sheet plants, a total of 537 plants in the United States in 1949, and of this number the Hoerner Corporation has four complete one-unit or converting plants and three sheet plants, a total of seven plants in operation. Figure 3 shows the total production of corrugated board in the United States. The Hoerner Corporation produces about one percent of the total amount of corrugated board.

The paperboard container industry is a highly competitive industry.

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[3]The Company Digest, op. cit., p. 4.

The Hoerner Corporation is interested in the area west of the Mississippi River. Table VIII lists those companies that compete with the Hoerner corporation in the area supplied by it. These percentages indicate the amount of business done by each company. It must be kept in mind that the corrugated box industry has grown on the average of eight percent per year. Each percentage, therefore, indicates a different square foot or tonnage.

Although there may be other companies selling corrugated boxes in this area, only the companies listed below are considered by the Hoerner Corporation as competitors.

TABLE VIII

Comparison of Production by Competitive Companies

Name	1932 Percent	1940 Percent	1941 Percent	1942 Percent
Hinde and Dauch	5.77	5.14	4.83	4.69
Downing Box Co.	1.67	1.54	1.29	1.38
General Box Co.	.47	.44	.46	.36
Kieckhefer-Eddy	5.10	4.95	4.87	4.29
Love Box Co.	.08	.09	.09	.09
Loy Lange Box Co.	.38	.28	.33	.27
Scharff Koken Mfg. Co.	1.36	1.23	1.10	.95
A. George Schultz Co.	.60	.52	.56	.61
Waldorf Paper Products Co.	1.59	1.57	1.48	1.50
Other Companies*	(10) 13.95	(10) 14.38	(14)16.90	(14) 18.32
Iowa Fiber & Associates (Hoerner Corporation)	1.40	1.50	1.41	1.58

*"Other Companies" includes fourteen others in 1942, only three of which are competitors in the area covered by the Hoerner Corporation. The figure in parenthesis shows the number of box companies participating in the percentage figure of each year.

Table IX gives the production of the complete one-unit plants of the

Hoerner Corporation for the years 1932, 1940, 1941, and 1942.[4]

TABLE IX

Production for Selected Years

Plant	1932	1940	1941	1942
Iowa Fiber Box--Tons	11,432	12,242	12,437	10,815
Iowa Fiber Box--M. Sq. Ft.	143,094	153,431	155,952	139,123
South West Box--Tons	11,355	11,859	11,612	11,188
South West Box--M. Sq. Ft.	142,045	152,899	148,306	146,310
Southwest Corg. Box.--Tons	----	----	6,481	6,651
Southwest Corg. Box.--M. Sq. Ft.	----	----	86,404	86,523

A Brief Discussion of Each Company in the Hoerner Corporation

South West Box Company

The South West Box Company located at Sand Springs, Oklahoma, is a complete one-unit plant producing corrugated sheets and the completed corrugated box.

The trade territory includes Oklahoma, Kansas, Texas Panhandle, Colorado, New Mexico, and eastern Utah and Arizona.

The production of the South West Box Company is about one-million square feet per day or about twenty-two or twenty-three million square feet of corrugated board per month.

Approximately 100 people are employed by the South West Box Company.[5]

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[4]Ibid., p. 2.

[5]E. E. Boyd, Time Study Engineer and Safety Director, South West Box Company, Personal Interview, (March 2, 1950).

ABC Corrugated Box Company

The ABC Corrugated Box Company, situated at Minneapolis, Minnesota, is a complete one-unit plant. The company supplies corrugated sheets to several sheet plants located in the trade territory and also corrugated boxes for some 500 customers located in their trade territory.

The corrugated boxes are made from jute paper and kraft paper. The jute paper is purchased in St. Paul, Minnesota; the kraft paper is obtained from Georgia and Louisiana.

The ABC Corrugated Box Company is located in Minneapolis because of the concentration of industries in the twin cities and in Wisconsin. There is usually good transportation service to all sections of the trade territory and it is the natural location for this box company.

The volume of business of the ABC Corrugated Box Company is in excess of $1,000,000 each year. This company hires between 80 and 85 people, the number varying somewhat with conditions.[6]

Arkansas Box Company

The Arkansas Box Company was established at Fort Smith, Arkansas, in 1939. The plant purchases its corrugated sheets from the South West Box Company at Sand Springs, Oklahoma.

The trade territory of the Arkansas Box Company includes the state of Arkansas and the southern half of Missouri. However, the largest volume of business is in the Fort Smith area. The large number of furniture manufacturers and canned food processors located in this area influenced the

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[6]C. M. Carson, Vice President and Sales Manager, ABC Corrugated Box Company, Personal Letter, (March 10, 1950).

Hoerner Corporation to choose Fort Smith as the location for this plant.

Present production averages approximately 4,000,000 square feet per month, or about 50,000,000 square feet per year.

Eighteen people are employed by the Arkansas Box Company.[7]

Southwest Corrugated Box Company

The Southwest Corrugated Box Company, located at Fort Worth, Texas, is a complete one-unit plant. The plant manufactures corrugated shipping containers and related corrugated products. The principal source of raw materials is the kraft mills located in northern Louisiana, and in Tennessee.

The Southwest Corrugated Box Company was established at Fort Worth because of the extensive meat packing, food processing and manufacturing activities in the territory surrounding Fort Worth. The production of the Southwest Corrugated Box Company for 1949 was approximately 1,000 carloads. Approximately 105 people are employed by this company.[8]

Ottumwa Shipping Containers

Ottumwa Shipping Containers is a division of Iowa Fiber Box Company, which is a member of the Hoerner Corporation. It is a sheet plant producing corrugated shipping containers and inner packings. Its corrugated sheets are obtained from the Iowa Fiber Box Company, Keokuk, Iowa.

The plant was established in May, 1939, at Ottumwa, Iowa, principally to serve a large meat packing firm in the city as well as its branch plant in Sioux Falls, South Dakota, and Topeka, Kansas. The trade territory of

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[7]W. J. Ross, Sales Department, Arkansas Box Company, Personal Letter, (March 8, 1950).

[8]J. L. LaGrone, Time Study Engineer, Southwest Corrugated Box Company, Personal Letter, (May 6, 1950).

this company covers the city of Ottumwa and the surrounding area, as well as the accounts previously mentioned in Sioux Falls and Topeka.

The current production of this plant averages approximately five million square feet per month. The company employes nineteen people, two of whom are classified as skilled, two semi-skilled, and the balance unskilled.[9]

Iowa Fiber Box Company

The Iowa Fiber Box Company at Keokuk, Iowa, is a corrugated plant and manufacturers corrugated sheets and the completed boxes. The paper stock is purchased from Southern Kraft Division of International Paper Company, Chicago, Illinois, and Central Fiber Products Company, St. Paul, Minnesota. The plant was established June 12, 1920. It was formerly the Iowa Can Company, located at Keokuk. The trade territory includes Iowa, southern Wisconsin, and the northern half of Missouri and Illinois.

The approximate production of this company averages between twenty million and twenty-five million square feet per month. Ninety people are employed by the Iowa Fiber Box Company. Most of the employees are classified as semi-skilled or non-skilled; however, there are a few jobs classified as skilled.[10]

The other two companies of the Hoerner Corporation did not return the questionnaire sent to them.

Geographic Distribution of the Hoerner Corporation Group of Plants

Figure 5 shows the distribution of the various box plants in the Hoerner

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[9]Glen A. Ware, Ottumwa Shipping Container, Personal Letter, (June 12, 1950).

[10]M. P. MacDougall, Vice President and General Manager of the Hoerner Corporation, Personal Letter, (June 14, 1950).

Corporation and also the trade territory of each plant. The plants are located so that the Hoerner Corporation can effectively serve the central part of the United States from Canada to the Gulf of Mexico.

Freight rates are an important factor in the shipping of corrugated boxes and were considered in the distribution of the plants. It is difficult for a company to ship boxes at a profit further than 250 to 300 miles. In a few cases the trade territory extends further than 250 miles from a plant, but few boxes are actually sold outside of the 250 mile radius. Hence, the freight rate factor restricts the tendency of a manufacturer to establish a central plant and ship boxes out in all directions for a considerable distance.

Also by being near their potential customers, the box companies can give more efficient service. For example, the need for different box styles varys throughout the country. This is illustrated by the fact that during the past two years the South West Box Company at Sand Springs has designed approximately 3,900 new box styles for its customers. It is logical to expect that the other plants in the corporation have designed a like number of new box styles. Other problems differ likewise within the distinct areas as designated by the Hoerner Corporation.

Trade Territory of the South West Box Co.

Area One is composed of Oklahoma, Kansas, Colorado, New Mexico, Texas Panhandle and the eastern part of Utah and Arizona. (See Figure 5). It covers approximately 483,000 square miles. The South West Box Company at Sand Springs, Oklahoma, is the parent plant for this division. There are five salesmen located in the trade territory; they are distributed as follows: two at Tulsa, one at Oklahoma City, Muskogee, and Santa Fe,

TRADE TERRITORY OF THE HOERNER CORPORATION

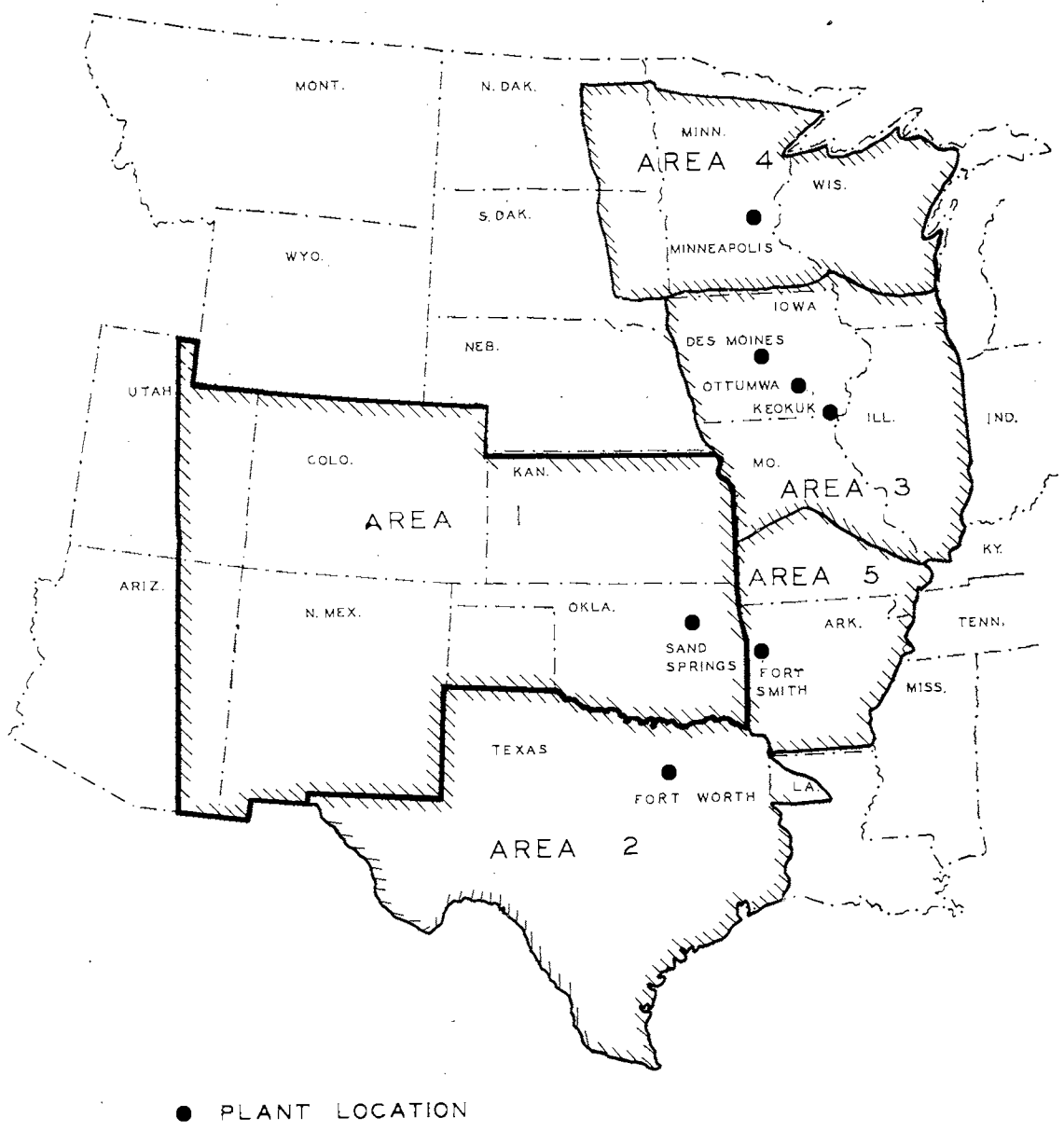

FIGURE 5

New Mexico. The salesmen sell directly to the customers, but in a few cases corrugated boxes are sold through jobbers.[11]

The trade territory extends in an east-west direction in order to serve the sparsely settled areas of New Mexico, Colorado, and the eastern third of Utah and Arizona. The railroad systems also run east and west, which provides good rail transportation in area I.

Shipping cost is an important factor in the manufacture of corrugated boxes. It is difficult for the South West Box Company to compete outside a 250 mile radius from Sand Springs because of the freight rates. Likewise, competitors are limited because of such costs.

Trade Territory of the Southwest Corrugated Box Co.

The Fort Worth division, shown as Area Two, includes all of Texas except the Panhandle and a small section of northwest Louisiana, and covers approximately 242,000 square miles. Seven salesmen are located in this area.

The center of production in this area is the South West Corrugated Box Company at Fort Worth, Texas. The large meat packing concerns in Fort Worth, especially, offer an outlet for many of the boxes manufactured by this plant.

Trade Territory of the Iowa Fiber Box Co.

Composing Area Three are the states of Iowa, Illinois and the extreme southern part of Wisconsin and the northern half of Missouri. The trade territory embraced by this division is approximately 167,000 square miles. Five salesmen serve this territory.

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[11]F. C. Baker, Personal Interview, (March 16, 1950).

Three box plants of the Hoerner Corporation are located within this area. They are as follows: (1) the Iowa Fiber Box Company, Keokuk, Iowa; (2) the Ottumwa Shipping Containers, Ottumwa, Iowa; and (3) Des Moines Container Company at Des Moines, Iowa. Inception of the Hoerner Corporation in this section has given it a long period of market growth. Local availability of cheap power was also a factor.

In the early days, Burlington, Iowa, was the center of the basket and reed container industry. Many of those containers were used to ship fruits, wines and wine bottles from the Mississippi River Valley; so naturally, after the introduction of the corrugated box, they would turn to this container for shipment of their products. A large concentration of industries is located in eastern Iowa, northern Missouri and western Illinois which accounts for the substantial demand for fibreboard box plants in this area, especially in Illinois.

Trade Territory of the ABC Corrugated Box Co.

The fourth area includes the states of Minnesota, the northern two-thirds of Wisconsin, and the eastern third of the Dakotas. The trade territory covered by this area is approximately 143,000 square miles. Six salesmen are located here. The parent plant is the ABC Corrugated Box Company at Minneapolis, Minnesota.

The division is similar to other areas in that it extends in an east-west direction. This may be explained in part by the fact that the railroads run in an east-west direction. Efficient transportation is available to serve the eastern parts of North and South Dakota.

The concentration of industries in Minneapolis-St. Paul and in Wisconsin is responsible for this plant being located in Minneapolis. Local power

from St. Anthony Falls is also an economic consideration. The management of this plant believes that this is one section of the Northwest that will continue to grow.[12]

Trade Territory of the Arkansas Box Co.

The smallest division of the Hoerner Corporation is Area Five which includes Arkansas and the southern half of Missouri, embracing approximately 76,000 square miles. The plant for this area is the Arkansas Box Company. This area is represented by three salesmen. This plant was located at Fort Smith because of the large number of furniture manufactures and canned food processors located in this area.

Most large manufacturing concerns are located near a source of cheap power. Industrial concentration in the Mississippi River Valley is a good example of this. The corrugated box plant locations were chosen with the intention of receiving business from these industries, as well as availing themselves of power and transportation facilities.

The two sheet plants in the Hoerner Corporation are located close to their source of basic material, the corrugated sheets. The Arkansas Box Company is 133 miles from its source of supply, the South West Box Company, while the Ottumwa Shipping Containers is only sixty-eight miles away from the Iowa Fiber Box Company, who supplies it with corrugated sheets.

The affiliated box company group of the Hoerner Corporation are so located that they are able to supply corrugated boxes to any concern throughout the central United States within two weeks, the usual period allowable before the consumer's supplies would be exhausted.

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[12]C. M. Carson, Vice President and Sales Manager, ABC Corrugated Box Company, Personal Letter, (March 10, 1950).

CHAPTER VI

MUSKOGEE BRANCH OF THE CONTAINER CORPORATION OF AMERICA

The sheet plant located at Muskogee, Oklahoma, is the second most important producer of corrugated boxes in the state. It is a branch manufacturer of the Container Corporation of America, which consists of a number of plants whose main offices are at Chicago, Illinois.

This plant at Muskogee has been recently established, starting its operations in November, 1949.[1] The plant representatives report successful operations, and are planning to install a corrugator in the near future.

The Container Corporation of America picked Muskogee, Oklahoma, as the location of this sheet plant because of the numerous glass companies located in Oklahoma. About two-thirds of the plant production goes to these glass factories. Forty to forty-eight canning plants that require boxes surround Muskogee. The company desired to locate a plant in an area where it had previously not been represented. Muskogee was chosen because it is situated in a rapidly developing manufacturing and industrial area. Geographic location and its natural resources were given due consideration. Power costs, however, were high enough to be considered a negative influence in the location. The good labor supply was also taken into account.

The plant is situated about three miles south of downtown Muskogee on Highway No. 64. The inside dimensions of the building are 100 x 225 feet; the plant therefore occupies more than 22,500 square feet of floor space. The grounds contain thirteen acres so that there is considerable room for

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[1] M. D. Wrenn, OfficeManager, Muskogee branch of Container Corporation of America, Personal Interview, (June 2, 1950).

FIGURE 6

Container Corporation of America

Muskogee Plant

Note the truck loading dock on the left side of the plant in the upper picture.

Railroad loading dock is located on the right side of the plant in the lower picture.

(Courtesy of Easton Studio, Muskogee, Oklahoma)


CONTAINER CORPORATION
OF AMERICA
CONTAINER CORPORATION OF AMERICA MUSKOGEE PLANT


MUSKOGEE PLANT

expansion in the future. The establishment has a capital value of $250,000.

The Industrial Foundation of Muskogee, Oklahoma,[2] played a significant roll in the attraction and location of this plant. The Foundation bought the land and paid for the construction of the building. After completion, the Container Corporation of America paid the Foundation for the land and improvements.[3]

Products Produced

At present, this is a sheet plant, using corrugated material for the manufacture of its boxes. The company gets its sheets from the Container Corporation of America plant at Fort Worth, Texas. The sheets of corrugated board are chiefly transported to Muskogee by the Missouri, Kansas and Texas Railroad. To a lesser extent, hauling is done by company-owned trucks, each having a capacity of 110,000 square feet of corrugated board. However, plans are for the installation of a corrugator in the near future. The plant will then be a complete one-unit corrugating factory without dependence upon the Forth Worth source for materials.

The approximate production of the Muskogee plant is six million square feet of sheet per month, and of this amount about three percent is waste in the form of box trimmings. This waste is baled and sent back to Fort Worth where it is sold to paper mills and is reprocessed into paper.

Since this plant, at present, is not a complete one-unit plant, the

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[2]An organization, consisting of $100,000 whose purpose is to attract and help establish new businesses in Muskogee. Since its inception, the Foundation has had over three and one-half million dollars worth of contracts or inquiries concerning Muskogee as a potential industrial location. This organization is a function of the Muskogee Chamber of Commerce.

[3]W. D. McCauley, Muskogee Chamber of Commerce, Personal Interview, (June 2, 1950).

Muskogee office orders the specific type of corrugated board to be used in the processing of each customer's order from the Fort Worth plant. Most box designing is done at the Muskogee plant, but the artistic designs for printing purposes are done at Fort Worth. When the corrugated sheets arrive they are run through the printer-slotter, where the design is printed on the box and slots made at the proper place in the corrugated board. Then the sheets pass through the stapler where the ends of the box are fastened together. Tape also is used to fasten the ends.

The boxes are shipped in a flat or "knocked-down" condition; these are tied into bundles ready for shipment. Each bundle contains an even number of boxes, usually twenty-five to thirty, and weighs between thirty and thirty-five pounds. Corrugated board is also made into box pads and partitions which are shipped with the boxes. The plant has facilities for loading and unloading the boxes; the sheets by rail on the south side and by truck on the north side. Over one-half of the boxes are shipped by company-owned trucks and the remainder are shipped by rail.

Employees are classified according to hourly or salary pay. Thirty people are employed in the plant proper and these employees are classified as hourly paid, while ten are employed in the office and they are classified as salary paid. A piece work incentive plan will be put into operation in the plant proper at a later date. A total of forty people are employed by the company.

Trade Territory

Figure 7 shows the trade territory of the Muskogee branch of the Container Corporation of America, and included in this area is also the trade territory of the corrugating plant at Fort Worth, Texas. This trade

TRADE TERRITORY
OF THE
CONTAINER CORPORATION OF AMERICA

MUSKOGEE AND FT. WORTH BRANCH

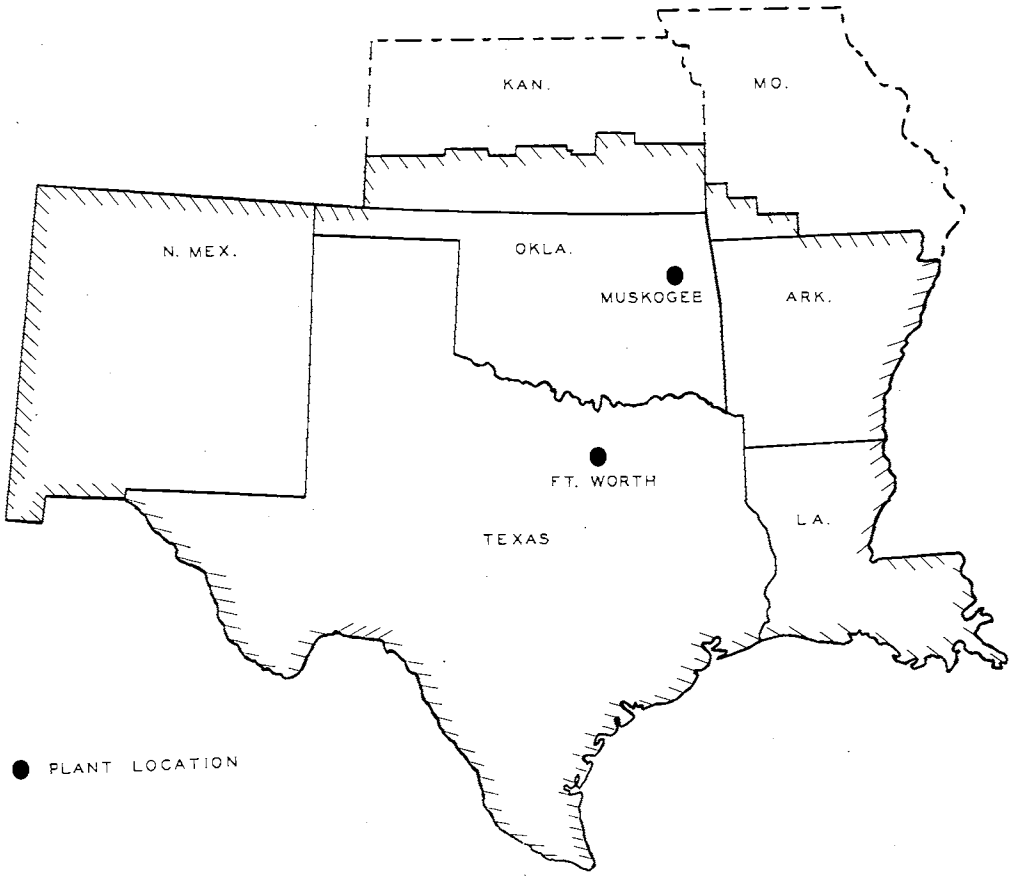

FIGURE 7

area includes Oklahoma, New Mexico, Texas, Arkansas, Louisiana, and all counties south of and including Hamilton, Kearney, Finney, Hodgeman, Pawnee, Stanfford, Rice, McPherson, Marion, Chase, Lyor, Anderson and Linn counties in Kansas and all counties west of and including Barton, Dade, Green, Christian and Taney in Missouri. A sales manager and two salesmen cover this territory for the two plants.

Future Possibilities

The management of this company expects a continued increase in business for the Muskogee plant due to the glass works, the food processing plants and the other manufacturing industries in the surrounding area.

This expected future expansion is borne out by the fact that the company has found the business to be such that it can afford to put in a corrugator in the near future. Such growth was anticipated when the company initially purchased enough land to allow for any reasonable enlargement in the size of the plant.

CHAPTER VII

CLARKSBURG PAPER COMPANY

The third factory, in order of its importance in paper box yields, is a branch plant, situated in Ada, Oklahoma, of the Clarksburg Paper Company. It is a complete one-unit corrugated box producer, manufacturing boxes for the Hazel Atlas Glass Company factories at Ada and Blackwell, Oklahoma. This paper box branch is owned by the Clarksburg Paper Company of Pittsburgh, Pennsylvania.

The factory was established by the Hazel Atlas Glass Company at Ada in 1930. In 1937 the plant was purchased by the Clarksburg Paper Company and has continued to operate under its proprietorship. The box company remained in the same group of buildings as occupied previously by the Hazel Atlas Glass Company, and from all outward appearances is an integral part of the glass plant in spite of its changed business status.

The plant produces the complete corrugated box, box pads, partitions and dividers. The manufacturing process is almost identical with that of the South West Box Company at Sand Springs, Oklahoma. The paper is received from various sources, but the most important are Dallas, Texas, and Chillicothe, Ohio. Kraft paper is the main manufacturing material. The Clarksburg Paper Company produces approximately five million square feet of corrugated board per month.

Thirty people are employed by the Clarksburg Paper Company. The employees are classified as semi-skilled, except for a few administrative personnel. Workers are paid according to an incentive pay scale, which functions similar to that used by the South West Box Company. The employee receives a base pay and a bonus for any production over a minimum standard set by the company.

The company is unique in that it supplies only corrugated boxes to the Hazel Atlas Glass Company at Ada and Blackwell, Oklahoma. Since this company only serves this one customer, it does not enter into competition with other corrugated box companies.

The problem of transportation, which is a very important cost item in the corrugated box industry, is reduced to a minimum at Ada. As previously stated, the box plant is located within the same group of buildings occupied by the Hazel Atlas Glass Company. Therefore, after the boxes are made, they are transported by small power-driven trucks to another building where they are used by the glass plant. Shipment to Blackwell is likewise cheap and easy, being a haul of about 175 miles by commercial trucks. The Ada glass plant uses approximately two-thirds and the Blackwell plant one-third of the total boxes produced, but this proportion varies somewhat according to demands and relative production of the two glass plants. At present, the Clarksburg Paper Company does not plan to enlarge the size of its plant or expand its trade territory.[1]

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[1]William J. Kiethley, Supervisor, Clarksburg Paper Company, Personal Interview, (June 26, 1950)

CHAPTER VIII

SOONER CORRUGATED BOX COMPANY

The Sooner Corrugated Box Company, located at 819 North Harvey Street, Oklahoma City, Oklahoma, is a branch plant of the Lawrence Paper Company of Lawrence, Kansas. The Sooner Corrugated Box Company operates as a sheet plant and produces completed corrugated boxes. It is the smallest producer of the four plants in the state. The corrugated sheets are supplied by the Lawrence Paper Company.

In 1934, Dr. E. C. Harlow, of Oklahoma City, established the Pioneer Box Company which was a year later to become the Sooner Corrugated Box Company. Dr. Harlow had become interested in such a business because he had acquired papermaking equipment that locally had been used to make cross-word puzzles. His business venture proved unprofitable and he sold out his interest to the Lawrence Paper Company in 1935.

The Lawrence Paper Company purchased the Pioneer Box Company in order to expand their trade territory and to establish a corrugated box plant in Oklahoma. Since 1935 the company has been known as the Sooner Corrugated Box Company. The company was especially named to show that it was a local concern.

The present plant is limited to 7,500 square feet of floor space, which houses all the machinery, an office and also serves as storage room for the corrugated sheets and the finished boxes. There is the standard equipment for a sheet plant, namely the scorer, slotter-printer, and stapling machine. The plant in addition has a smaller slotter and scorer which are used for making partitions and dividers.

Products Produced

The Sooner Corrugated Box Company is a sheet plant and produces the complete corrugated box. The corrugated sheets are shipped in under contract by privately owned trucks which run between the Lawrence Paper Company and Oklahoma City. They haul the corrugated sheets to Oklahoma City and waste paper back to Lawrence, Kansas. This Oklahoma plant produces a few different standard sized boxes. It does not market a large variety of box styles and shapes like the other larger box plants in the state. The exception to this rule is that the plant does sell some baby chicken boxes, but they are made by the Lawrence Ppaer Company, being distributed, in part, from Oklahoma City.

The production of the Sooner Corrugated Box Company requires approximately 400,000 square feet of corrugated board per month. Seven people are employed by the company, five men and two women. The employees are paid on an hourly basis.

Trade Territory

The trade territory of the Sooner Corrugated Box Company includes Oklahoma and part of the Texas Panhandle, however the overall trade territory of the Lawrence Paper Company includes all the United States west of the Mississippi River.

At present, the most important problem faced by the company is obtaining the corrugated sheets from Lawrence, Kansas, so as to make prompt deliveries to their customers. The present plant is not on a railroad line so that all materials, both those shipped in and out, must be handled by truck. The plant does not operate its own trucks, but hires an independent trucking company, operating under contract.

FIGURE 8

Sooner Corrugated Box Company

(Courtesy Mr. Floyd L. Shields)


SOONER CORRUGATED BOX CO.
SOONER CORRUGATED BOX CO.

When a customer places an order, the plant has to obtain the corrugated sheets from the Lawrence Paper Company; delivery of these to Oklahoma City may take two or three weeks. After the corrugated sheets arrive they have to be processed into the completed corrugated box which requires several more days. Therefore, a total of three to four weeks are needed from the time the order is placed by the customer until the corrugated box is ready for delivery. Since most customers only stock about a two weeks supply, they cannot meet regular market demands. It is thought that when the new plant is built near a railroad the problem will be solved.

Future Possibilities

The company plans to construct a new establishment at 2400 South Main in Oklahoma City to be occupied before September 1, 1950, when the present lease ends. The building will have 15,000 square feet of floor space. The capital of the building and grounds will be $50,000. In addition, the equipment is valued at another $40,000. This plant will be constructed by the side of the Frisco Railraod tracks, giving the company access to rail transportation. Railway shipment will enable the company to get its corrugated sheets more quickly from Lawrence, Kansas, thus giving better service to its customers. The Oklahoma plant will also be able to store more corrugated sheets, reducing the number of required deliveries from Lawrence. If business continues to increase, as the company expects it to do, a corrugator will be installed sometime later.[1]

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[1]Floyd L. Shields, Manager, Sooner Corrugated Box Company, Personal Interview, (June 14, 1950).

CHAPTER IX

SUMMARY, WITH PARTICULAR CONSIDERATION ON THE INDUSTRY IN OKLAHOMA

Most of the paper developments occurred outside of the United States, while most all of the significant paperboard and corrugated box developments were a product of United States industry. The development of paperboard was the first big step in the development of the fibreboard box of today. The development of paperboard led finally to the introduction of corrugated sheets which were first used as a packing material and later were developed into the corrugated boxes of today.

The corrugated box offers a cheap, mass production shipping container that is so designed as to adequately protect the merchandise being shipped. It is necessary to have a shipping container that can be produced cheaply and in quantity to meet the needs of mass production. Manufacturing close to the market keeps down transportation costs and makes it possible to meet the demands of the customers.

Figure 9 shows the distribution of the four corrugated box plants in Oklahoma. These four are located in the eastern half of Oklahoma, and were first established at their present locations primarily to serve the glass manufactures and glass container packers located in this section of the state. Approximately two-thirds of the total production of corrugated boxes manufactured in Oklahoma still are utilized by the glass industry here. The remaining one-third is distributed among the many different types of merchandise being shipped throughout the trade territory of the respective plants.

The South West Box Company at Sand Springs is the largest corrugated box manufacturer in Oklahoma. Its average production is approximately twenty-two to twenty-three million square feet of corrugated board per month. About 25 percent of the corrugated boxes produced by the plant is consumed by the Kerr Glass Company also located at Sand Springs. The South West Box Company is a complete one-unit plant. The plant has the capacity to produce considerably in excess of its present average production of corrugated board. Hence, it does not expect to increase in size in the near future.

The Muskogee branch of the Container Corporation of America ranks second in production of boxes in Oklahoma, with an average yield of approximately six million square feet of corrugated board per month. Two-thirds of this amount is utilized by the glass companies surrounding Muskogee. The remaining one-third is consumed by the numerous food processing plants and other industries located in the surrounding territory. At present it operates as a sheet plant, obtaining its corrugated sheets from the Container Corporation of America unit at Fort Worth, Texas. The Oklahoma plant was established with the idea of expanding its local market. Business has been such that the management expects to install a corrugator in the near future.

The Clarksburg Paper Company at Ada, a branch plant of the Clarksburg Paper Company of Pittsburgh, Pennsylvania, is the third largest corrugated box manufacturer in the state. It is a complete one-unit plant with an average production of approximately five million square feet of corrugated board per month. This box company is unique in the fact that it only supplies one customer, the Hazel Atlas Glass Company plants at Ada and at Blackwell, Oklahoma. Due to its proximity to the glass company, transportation costs are reduced to a minimum, except for small transporting charges

CORRUGATED BOX PLANTS

IN OKLAHOMA

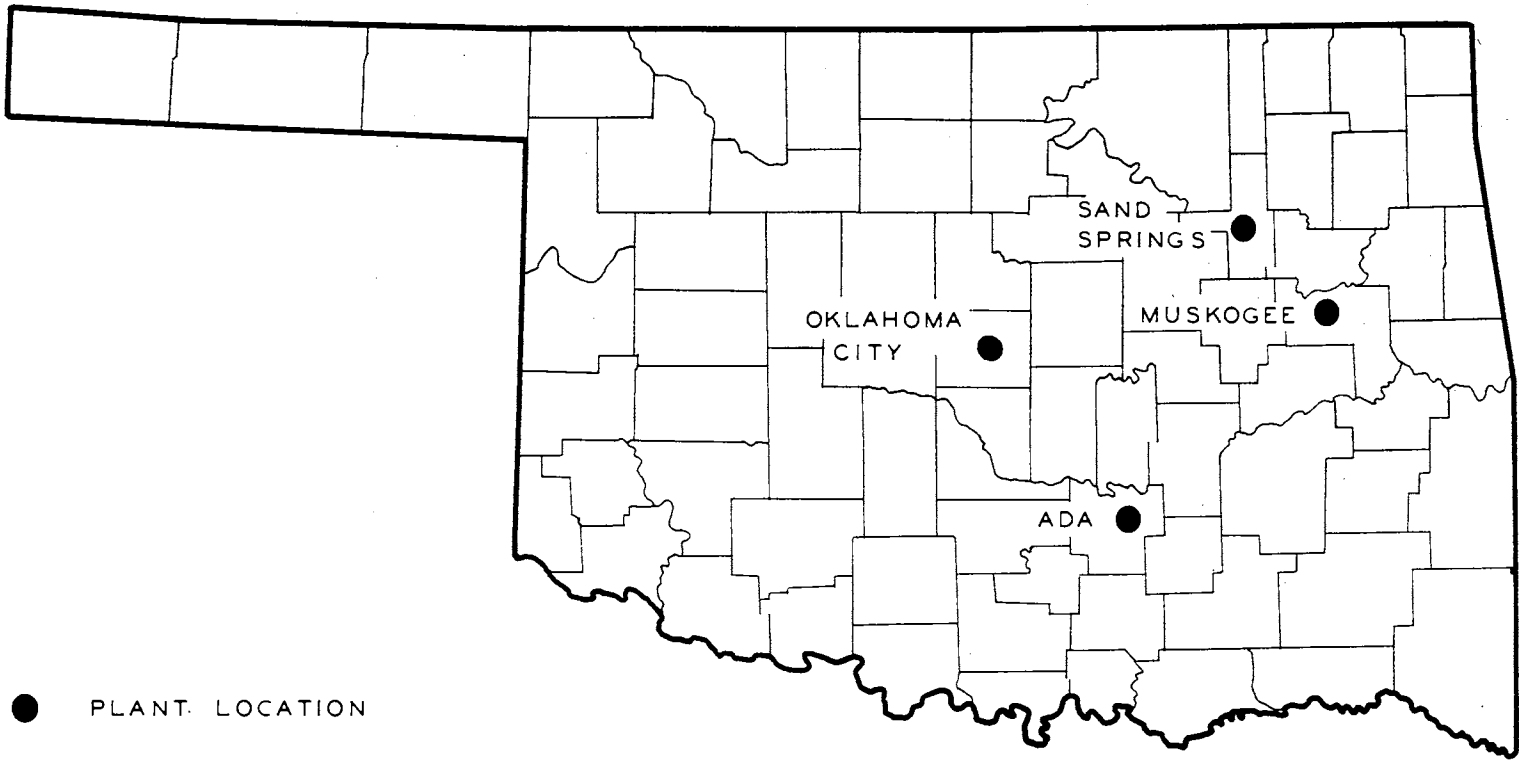

FIGURE 9

to Blackwell. The Clarksburg Paper Company does not plan to expand its production in the near future. The plant has the necessary equipment to exceed its production of five million square feet of corrugated board per month, should the glass company need more boxes.

The smallest of the manufactures in Oklahoma is the Sooner Corrugated Box Company located in Oklahoma City. The average production of this plant is approximately 400,000 square feet of corrugated board per month. This plant operates as a sheet plant, obtaining its corrugated materials from the Lawrence Paper Company at Lawrence, Kansas. Although the smallest corrugated box producer at present, the Sooner Corrugated Box Company anticipates a greater relative expansion program than any of the other three box plants in the state. The company expects to construct a new building having approximately 15,000 square feet of floor space and if business continues to increase, as the company expects it to do, a corrugator will be installed later. However, after the company has expanded it will still be the smallest corrugated box plant in Oklahoma, with respect to size of plant and production, although its output of corrugated board is expected to increase.

Three of the four corrugated box plants in Oklahoma were first attracted to Oklahoma primarily to supply the numerous glass factories located throughout the state. The other one, the Sooner Corrugated Box Company, developed from a cross word puzzle factory and is the least significant box plant in the state.

The four corrugated box plants in Oklahoma represent two different stages of development. The South West Box Company and the Clarksburg Paper Company could be classified as mature in their evolution. That is,

they are both complete one-unit plants, and they do not anticipate any immediate expansion either in plant size or trade territory. The Muskogee branch of the Container Corporation of America expects soon to install a corrugator, while the Sooner Corrugated Box Company is now constructing a new complete one-unit plant, but at present they may be classified as youthful in their stage of development. After corrugators are added to the two sheet plants, and the markets adjusted, all four corrugated box plants in Oklahoma will be complete one-unit box plants. Then, they may be all considered as mature, or stabilized in their development. The fact that all of these companies are anticipating enlargement of their market or continuation of present demands is reasonable evidence that they expect the manufacturing industries in Oklahoma to continue to grow in the future.

The four corrugated box plants in Oklahoma employ approximately 177 people, and the average total production for these four plants is about 34,400,000 square feet of corrugated board per month. The combined capital value of the four corrugated box plants in Oklahoma is approximately $1,500,000. Each of the four corrugated box plants in Oklahoma are subsidiary plants of larger box organizations located outside the state.

It should be emphasized that, in every case, the box company established its plant in an area where there was a large demand for corrugated shipping containers. It was necessary for the plants to locate themselves near established and potential customers in order to give satisfactory service, and have a low transportation cost, which are considered necessary requirements in the successful operation of the corrugated box industry.

These four corrugated box plants have the capacity to supply most of the manufacturers and shippers located throughout Oklahoma and limited areas outside with corrugated boxes for the handling and shipment of their

merchandise. These factories, likewise, can expand their rate of output to meet any reasonable demands. In the immediate future, there appears little likelihood that any new plants will be located here, and that is as it should be from an economic point of view, because the present producers meet the needs of the state.

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