MATERIAL HANDING FOR SUBSISTENCE SUPPLIES IN A UNIVERSITY RESIDENCE HALL

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY

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1962

Snyder, Ruth M. Dickey

Material Handling for Subsistence
M.S. 1962 FCE

MATERIAL HANDLING FOR SUBSISTENCE SUPPLIES IN A UNIVERSITY RESIDENCE HALL

By

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A PROBLEM

Submitted to the Dean of the College of Home Economics of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Institution Administration

1962

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INTRODUCTION

Material handling is an almost universal business function. It affects the cost of making, distributing, and selling every kind of product. Modern material handling methods are directed at accomplishing the needed movement with a minimum of time, labor, waste, and cost.

White(51) explained that material handling is the picking up and moving of things. It applies to the movement of raw materials, parts-in-process, and finished products. Material handling goes on all the time in every plant. In some plants it accounts for as much as 50 percent of the manufacturing cost. The plant layout engineer considers material handling essential to any cost reduction program.

The major objectives of a study of material handling are to reduce handling costs, to increase the capacity of production, to improve working conditions, and to improve distribtuion of materials. All areas of an operation need to be considered when studying material handling. These include the methods of handling used, the plant layout, the equipment, the working conditions, and the training of the personnel.

Food production managers are learning to apply many of the principles developed by engineers for the solution of food service problems. Management has recognized the need for efficient equipment layout. More consideration has been

accorded mobile equipment for food preparation and storage in an effort to reduce handling.

With approximately 50 percent of the on-campus college and university students housed in residence halls, management is confronted with the myriad problems involved in the material handling of subsistence supplies, work production loads, and clean and soiled table service.

A good program for material handling can result in a reduction of man hours, better utilization of cubic storage space, reduction in handling of materials and parts, minimum salvage and scrap handling, better material inventory control, and less chance for injury to employees. This paper discusses the material handling procedure for subsistence supplies at Brody Residence Hall, Michigan State University for the period April 9-15, 1962, and summarizes the information.

REVIEW OF RELATED LITERATURE

Industry, business, and government agencies recognize the necessity for continually improving methods which will assure profitable operation. This means there must be creative thinking. There must be teamwork between management and labor assuring high performance of both parties. Because of increasing competition as well as unparalleled expansion in this country, only the most progressive businesses can expect to continue profitable operation.

Time and Motion Study

Time and motion study has steadily improved since 1930 until today it is recognized as a necessary tool for effective operation of business and industry. Neibel (37) stated that the far reaching possibilities of time study and work simplification were tremendous. Government agencies, department stores, retail stores, and the transportation industry offer fertile fields for its application.

Dr. Frederick W. Taylor (43), the father of time study in the United States, started his work at the Midvale Steel Company in Philadelphia in 1881. His emphasis was on time study in relation to material, tools, and equipment. Barnes (4) gave credit to the Gilbreths (14,15) for the next important steps in time and motion study. Frank Gilbreth had an engineering and construction background with a talent for

analyzing the motions made by workmen. Lillian Gilbreth was a psychologist, who emphasized the need for understanding the attitude of the worker. Frank and Lillian Gilbreth developed techniques of studying work, fatigue, monotony, transfer of skill, and work for the handicapped. Barnes (4) felt that the fundamental character of their work was indicated by the fact that the principles and techniques which they developed about 1911 are being studied and adapted by present day industry as a basic tool of operation. Today most specialists in the field of work simplification are students of students of the Gilbreths.

The uses of time and motion study are not limited to industry; they are also utilized by offices, retailing, homes, farms, food service organizations, hospitals, and even dentistry and surgery. Apple(3) included in the applications of motion and time study the planning of new methods, the simplifying of work to be done, improving present methods, comparing methods, establishing work standards, determining the number of workers and machines required, and establishing bases for scheduling and for wage payment.

Current specialists (3,4,33,34,35,37) in the field of time and motion study have recommended that to do this type of work a person should have an open mind, a questioning attitude, and training in the use of the various analytical techniques. These techniques include the process symbols; therbligs; charts such as operation process, flow process,

man and machine process, gang process, and operator process; principles of motion economy; micromotion study; memo-motion study; and synthetic motion times.

The procedure universally (3,4,33,34,35,37,) recommended to the analyst for making a time and motion study involves five steps.

(1) Pick a job. Choose one that needs to be improved; e.g., one which is very time consuming, is a bottleneck in the operation, requires much chasing around, has a high turnover rate, is not safe, is a monotonous task, is costly of materials, or is too diversified.

(2) Break the job down into detail. This is done by means of a process chart. Neibel(37) defined the process chart as a graphic presentation of any manufacturing process. In methods analysis one of five types of charts is used: operation process, flow process, man and machine process, gang process, and operator process.

The operation process chart as explained by Neibel(37) shows all operations, inspections, time allowances, and materials used. The completed chart helps visualize the present method with all its details so that a new and better procedure may be developed.

The flow process chart contains more detail than the operation process chart. The former gives a graphic description of all operations, transportations, inspections, delays, and storage occurring during a procedure.

Man and machine process charts are described by Neibel (37) for use in studying, analyzing, and improving one work station. An analysis of the chart information should indicate the best relation between the working cycle of the man and the operating cycle of his machine.

The gang process chart was cited by Neibel(37) as a useful tool for determining the exact number of operators needed to service a machine or process effectively.

The operator process chart is sometimes called the left and right hand chart. Neibel(37) pointed out that the operator process chart clearly reveals the work done by each hand in performing an operation and shows the relative time and relationships of all motions performed by the hands.

In breaking a job down the analyst will need to become familiar with these charts and the specific function of each one.

(3) Question every detail. Kipling's saying:

> I keep six honest serving men
> (They taught me all I knew);
> Their names are WHAT and WHY and WHEN
> and HOW and WHERE and WHO.

is very appropriate to the attitude needed in approaching methods improvement. Maynard and Stegemerten(31) suggested a sequence of exhaustive questions for the analyst. WHAT is done? WHAT is the purpose of the operation? WHY is the work done? WHAT would happen if it were not done? Is every part of the job necessary? WHO could do it better? Can

changes be made to permit a person with less skill and training do the work? WHERE is the work done? Could it be done somewhere else more economically? WHEN is the work done? Would it be better to do it at some other time? HOW is the work done? When the analyst is satisfied that there are no other answers to his questions he is ready for the next step.

(4) Develop a new methos. It is generally(14,15,34,35, 37) accepted that this is done by eliminating a job or part of it, combining jobs, changing the sequence of job elements, or applying the principles of motion economy. Barnes (5) has divided the principles of motion economy into three sections: those related to the use of human body, those related to the arrangement of the work place, and those related to the design of tools and equipment.

(5) Install the new method. The new method is tried out for effectiveness. Neibel(37) declared that it is human to resist change regardless of the level in the organization. In order to overcome this natural resistance Lillian Gilbreth(15) recommended that the employee involved in the change be approached with genuine sincerity. Everyone associated with the method should participate in the improvement and be helped to understand the necessity for it. Fundamentally if the employee can be made to see the need for a change and works it out he is proud of his accomplishment. The new method can mean increased production, less fatigue for the worker, and imoroved employee morale.

Material Handling

Neibel(37) stressed the fact that one of the primary approaches to operation analysis is material handling. Today, material handling has developed into a full science of methods and equipment, which ties together sequential operations and develops them into a large production unit. The American Material Handling Society(37) defines material handling as being the art and science involving the movement, packaging, and storing of substances in any form. This definition includes all substances from the tiniest particle to the largest unit. Material handling adds nothing to a product but cost; the more this cost can be decreased, the lower will be the price of the finished product.

The flow of materials

Apple(3) explained that material handling begins with the flow of materials. The flow pattern is the path, or paths, which materials follow in moving through a series of steps or operations in a process. The objective of a flow pattern should be to facilitate the orderly flow of materials through the process, from receiving through shipping. A logical flow pattern will facilitate the manufacturing process and will minimize handling by reducing the distances materials will have to be moved. More economical use can be made of the operator's time. Overhead costs will be lowered through more effective movements of materials through

the process. Product cost will be lower as a consequence of the savings indicated above.

Apple(3) declared that the factors affecting the flow pattern include external transportation facilities, the number of parts in the product, the number of operations on each part, the sequence of operations on each part, the number of sub-assemblies, the number of units to be produced, the necessary flow between work areas, the amount and shape of space available, and the storage requirements.

In planning the flow pattern Apple(3) suggested that the three areas to be considered are the receiving and storage, the in-process, and the packing and shipping. In each of these areas the scope, the factors, and the space required should be considered.

Dernberger and Rice(10) maintained that application should be made of the principles of material handling and consideration given the tools used to determine the pattern. The tools for planning flow patterns are the assembly chart, the operation process chart, the flow process chart, and the flow diagram. The basic flow patterns are the straight line, the serpentine or zigzag, the U-shaped, the circular, and the odd angle. In planning the flow pattern each individual operation is considered in the overall picture.

Objectives of material handling

Apple(3) declared the objectives of material handling are to lower the unit cost, reduce production time, reduce overhead, conserve floor space, prevent strains and accidents to workers, and improve employee morale.

Lowering unit cost. Through proper planning unit costs can be lowered by eliminating unnecessary handling. As many pieces as possible should be handled in one unit. Rehandling time can be reduced to a minimum by completing movement of materials in one trip; delivering material to the right place the first time; using unit packages such as sectional cars; using skids, pallets, gondolas, and racks; and building assemblies on skids used for shipping. Existing material handling equipment can be replaced with a better type whenever the new equipment will yield greater efficiency or savings.

Reducing production time. Apple(3) indicated that material handling equipment will avoid delays of machine operators; maintain a continuous, uniform, maximum rate of movement of work; and provide for automatic processing of parts. To avoid bottlenecks and to assist in keeping work continuous, the capacity of material handling equipment must as nearly as possible equal that of machines and men. Assembly lines with variable speed drives permit adherence to schedules

since they may be regulated. Conveyors to carry parts to and from workplaces help to increase production.

Reducing overhead. By coordinated handling, overhead can be reduced(3). This will cut down the need for stock chasers, stock boys, and expediters. Other reductions can be made by installing material handling equipment to permit workers to spend full time on production. Accident damage can be prevented to parts in transit by using the right kind of equipment, thus avoiding scrapping or reclaiming which adds to the cost of the product. Reduction in cost may be done effectively and efficiently if all material handling is coordinated into a system. If it is planned, the various systems may be integrated to operate in synchronization wherever possible and to aid or supplement each other. When equipment is purchased it should be as near standard as possible to permit use for purposes other than those for which it was originally intended, but at the same time provide variety intended, but at the same time provide variety in use in order to meet all situations.

Conserving floor space. Floor space can be saved if there is enough equipment to correlate material handling with production schedules and so prevent excessive stock storage in production areas (3). Floor space can also be saved if equipment is used such as conveyor racks and up-enders which

carry materials in an upright position. The use of overhead systems and industrial trucks lessens the need for fixed floor space. By studying all material handling problems in relation to plant layout and vice-versa unnecessary use of floor space can be eliminated.

Preventing strains and accidents to workers. Mechanical equipment can replace heavy physical labor in the movement of material. Apple(3) outlined the basic rules employed by one plant to safeguard worker's health and safety were to use mechanical equipment:

1. Whenever a man has to lift anything from his feet to a point above his head.

2. Whenever a man has to lift more than 40 pounds from his feet to his shoulder.

3. Whenever a man has to lift more than 60 pounds from his feet to his waist.

4. Whenever a man has to lift more than 75 pounds from his feet to his knees.

5. Whenever a man has to stand in one place steadily moving material for more than 30 minutes.

6. Whenever a man has to move material more than six feet, which is approximately two steps.

7. Whenever a man or group of men, although moving around in a small radius, must move more than ten tons of material per hour.

Improving employee morale. Apple(3) stated that material handling equipment can help improve employee morale because it replaces effort with machinery. Mechanization assures a constant rate of production and thereby adds to a worker's sense of security about his job. Properly planned material handling equipment places a fair share of work on each employee.

Principles of material handling

The principles of material handling can be divided into those affecting methods, plant layout, and equipment.

Methods of production. The rules of material handling as outlined by Dernberger and Rice (10) for methods of production are:

1. Perform only necessary operations.
2. Determine the best methods.
3. Reduce the amount of handling by production workers.
4. Synchronize related production operations.
5. Avoid transfers.
6. Avoid sorting.
7. Utilize packaging, containers, and unit loading.
8. Use mechanical aids.
9. Utilize men and equipment fully.
10. Schedule and control.

Plant layout. The principles of material handling that are concerned with plant layout stress these directives: keep the over-all problem in mind, plan straight line routes, and combine handling with processing wherever possible.

When laying out shipping and receiving the following factors need to be considered: adequate area, location of area, building limitations, unloading layout, capacity and facilities, material handling equipment utilization, checking, weighing, receiving, inspection, local containerization, distribution facilities, distribution arrangements, and accessibility, provision for schedule changes, overloads, underloads, and fluctuations(10).

Dernberger and Rice(10) emphasized that when storage areas were planned the following considerations are important: dimensions of storage areas, building limitations, location with regard to receiving, shipping, and production, warehouse arrangement, rate of stock turnover, maximum-minimum capacity, first-in first-out plan, ease of identification and inventory, accessibility of fast moving items, local containerization, standardization of containers and unit loads, utilization of material handling equipment, safe storage to highest point, provision for schedule changes, overloads, underloads, and fluctuations.

Layout planning for the production area involves these basic applications according to Dernberger and Rice(10): least amount of handling, best possible flow of material,

reduced work in process, intake and discharge points at processing and assembly areas, adequate aisles, proper use of material handling equipment, positioning material at work level, inspection needs, scrap removal and handling facilities, local containerization and standardization of containers, identification and material quantity, schedule changes, overloads, underloads, fluctuations, and alternate methods of handling.

Equipment. Dernberger and Rice (10) stated that the rules for choosing equipment for material handling were:

1. Use mechanical equipment.
2. Utilize present equipment.
3. Select standard equipment.
4. Integrate the equipment.
5. Provide alternate methods.
6. Provide suitable building conditions.
7. Consider the unit cost.
8. Plan for the future.
9. Do not overlook maintenance.

When selecting material handling aids that affect working conditions the rules as emphasized by Dernberger and Rice (10) included mechanizing handling to decrease fatigue, and making the equipment safe.

Indicators of material handling problems

Apple(3) reported specific indicators of material handling problems included high overhead cost, high indirect labor payroll, unexplainable delays, idle time, damaged materials, accumulating demurrage charges, truck tie-ups, and stock control difficulties. Another group of indicators listed were excessive injuries due to material handling, decreased production in an area, unexplainable cost increases, employee complaints, crowded conditions, large numbers of men moving materials, and hard, hazardous work performed by hand.

Additional operating difficulties noted were handling by skilled labor, bottlenecks in production, back-tracking, excessive material handling equipment repairs, excessive temporary storage, materials being piled directly on the floor, and unnecessary handling. The last series of problem indicators reported were obstacles in material flow, scheduling difficulties, safety hazards, excessive scrap, long hauls, and wasted "cube" or third dimension.

Analysis of material handling problems

Dernberger and Rice(10) maintained that in material handling as in any engineering, the problem must first be defined. These authors considered that material handling problems in themselves were usually not too difficult, but were often surrounded by so many variable factors that the

solutions were not readily apparent. If production is materials in motion, then applying motion study and process analysis to material handling problems should give the answer. The four questions asked in work simplification can also be used for material handling. These are: can the job be simplified? can the job be combined with another? can the job be eliminated? can the sequence be changed to advantage.

Factors in material handling planning

In planning material handling Apple(3) contended the factors to be considered are the material, the move, and the method.

In studying the first factor consideration must be given to the type of material, whether liquid or gas, as well as how it is packaged. The characteristics of volume, size, weight, shape, and nature affect how the material will be handled.

The type of move is contingent on whether there is a fixed path or a variable path and the distance the material is moved. The characteristics of the move are decided by the distance involved, the source and destination of the material, the quantities per move, the rate or time allowed, the nature of the route, building factors, the flow pattern, and the cross traffic.

The building factors that need to be considered are the

floor load capacity; the aisle width; bay size, the ceiling height; whether or not there are elevators, ramps, or columns; the kinds and sizes of doors; and the number of floors.

The method of handling materials may be manual, mechanical, or a combination of the two.

Equipment selection procedure

A preliminary determination of the type of equipment to be used for material handling will be based on a knowledge of equipment, a study of the items to be handled, an analysis of the path the item is to travel, and the flow pattern.

Harrington(17) recommended that the general type of equipment selected for heavy industry should come from one of three major groups: conveyors, cranes, or industrial trucks. Conveyors may be selected when the unit loads are relatively uniform; when the rate of movement, unit loads, and location of route are not likely to vary; where cross traffic can be by-passed by the conveyor; where there is a fixed path; and for point-to-point movement.

Cranes or hoists may be selected for intermittent movements within a fixed area; for materials of variable size or weight; for movement of materials regardless of cross traffic or uniformity of load.

Industrial trucks may be selected where materials must

be picked up and moved intermittently over various routes; where materials are either of mixed size and weight or of uniform size; where distances are moderate; when cross traffic exists; where there are suitable running surfaces and clearances; where the operation is primarily handling, not transporting; and where unit loads are applicable.

The tentative selection of equipment can be facilitated by such aids as the Check List of Material Handling (22), the Conveyor Selector(22), the Industrial Truck Selector(36), the Flow Directory (13), and the Production Handbook(1).

After studying the equipment available Apple(3) believed an evaluation of alternative methods should be made. Consideration should be given to the intangible factors, the cost factors, and the unit material handling costs. Intangible factors to considered include the possible future expansion or contraction of productions plans or variations in production, the flexibility or adaptability of equipment to other uses, the safety considerations, and the estimated length of time equipment will be used. Other intangible factors to consider are the percent of time the equipment will be in operation, the availability of the selected equipment, the manufacturers' reputation, the availability of repair parts, and the complexity of the equipment.

Stocker(45) stated that the cost factors to be considered besides the purchase price were the depreciation rate, the maintenance costs, the taxes and interest, the labor

costs for operators, the power costs, the operating efficiency, the amortization time, the possible savings over and above another method, and the operating cost per unit handled.

Fields of study for improvement

Fields for future study of material handling as outlined by Apple(3) included the raw and component part stocks; delivery to processing; handling to and from workplaces; movement between workplaces, between departments, and to finished stock; finished goods; controls; and organization. In raw and component part stocks the storeroom layout, the material handling methods, the assembly of orders for processing, the inventory and purchasing may offer possibilities for improvement. When studying delivery to processing methods and equipment, scheduling and dispatching are fields to consider. Review of handling to and from workplace should include methods and equipment, and also identification and controls.

Improvements for finished goods may be found for packing and unitizing, layout of storage area, methods and equipment into storage, assembly of orders for shipping, inventory control, and methods and equipment to shipping. Controls of methods and equipment for processing paperwork, labor, and communications offer fertile fields for study. Scrutiny of the organization should include development of

material handling department, cost accumulation and analysis, and the relation of material handling to the rest of the organization.

A good program for material handling can result in a reduction of man hours, better utilization of cubic storage space, reduction in handling of materials and parts, minimum salvage and scrap handling, better material inventory control, and less chance for injury to employees.

A UNIVERSITY RESIDENCE HALL ORGANIZATION FOR MATERIAL HANDLING

Since World War II colleges and universities have expanded housing facilities for rapidly increasing student enrollments. At the time of this study Michigan State University provided housing and food service for approximately twelve thousand students in the fourteen residence halls for men and women.

Housing and food service activities at Michigan State University were directed by the Manager of the Division of Dormitories and Food Services. Under his supervision were the respective managers of Kellogg Center, the Union Building, Married Housing, the Residence Halls for Men and Women, and the Food Stores.

Food Stores

A central Food Stores which was established in 1948 served as the nerve center for all residence hall food services. The manager of Food Stores was responsible to the University Vice President for Business and Finance for purchasing procedures and accounting methods and to the Manager of the Division of Dormitories and Food Services for management of the operation.

Organization and physical plant

The organization of the department is shown in Figure 1. Each department head was responsible to the Food Stores manager for quotations, purchasing, receiving, and delivery of merchandise for his particular department.

The Food Stores building which consisted of three floors and a basement was located on the south side of the campus within a one mile radius of all food service units and was adjacent to a railroad siding to speed receiving and unloading of carload lots of merchandise. The facilities in the warehouse included dry storage for staples, refrigerated storage for meat and fresh produce, and frozen storage for fruits, vegetables, juices, meats, and fish. In addition to these areas a cool room for meat fabrication, offices, a conference room, and dry storage for paper goods and dishes were provided.

Material handling facilities

Food Stores was planned to incorporate modern material handling equipment. The building had an elevator directly opposite the freight siding that opened both onto a dock for five trucks and the main corridor of the building.

Merchandise was handled on platform skids(Figure 2) or pallets(Figure 3) by either a fork lift truck(Figure 4) or by hand operated lever-lift trucks(Figure 5). Carcass meat was received at the truck dock and moved into refrigeration

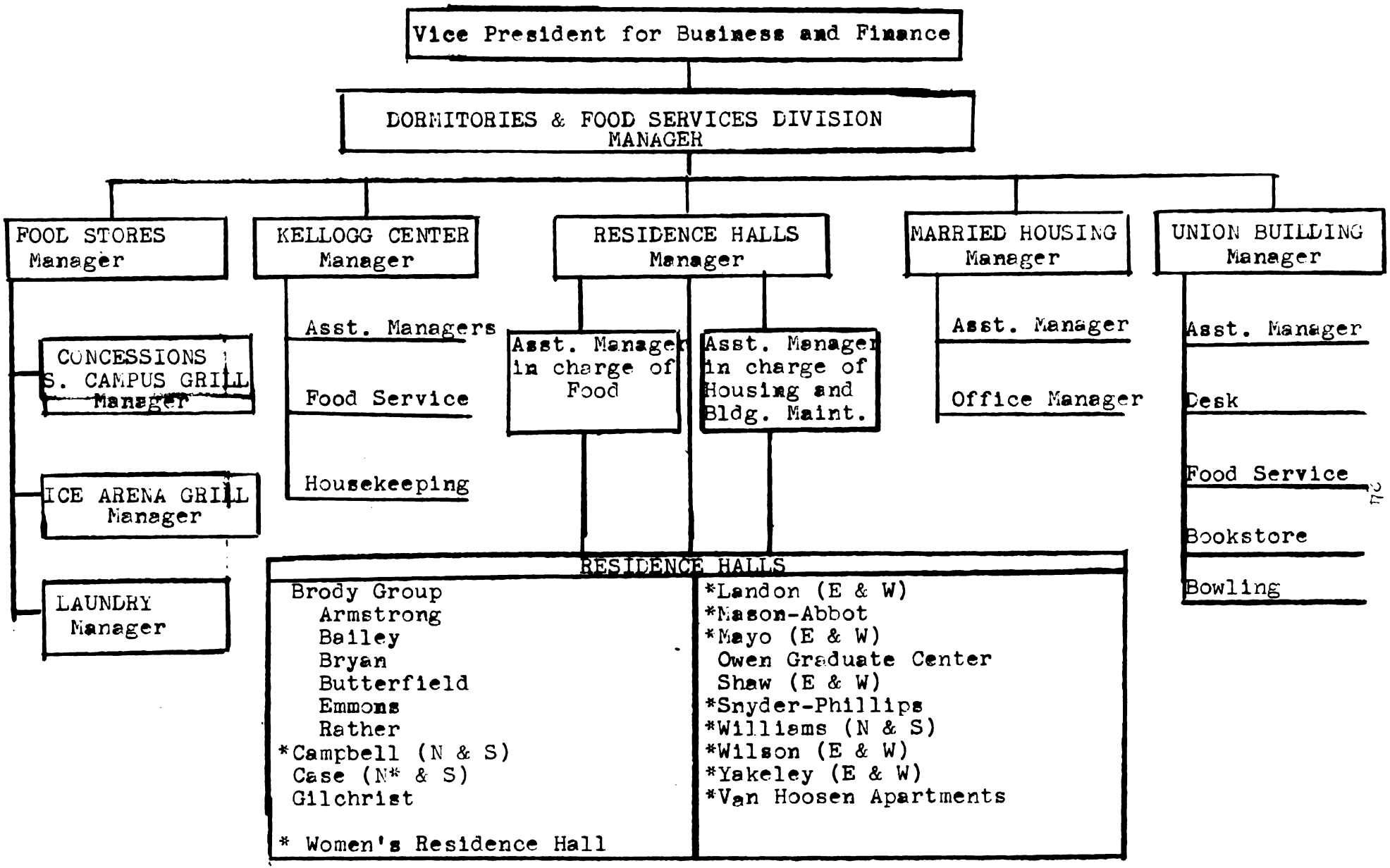

Figure 1. Organization of the Division of Dormitories and Food Services

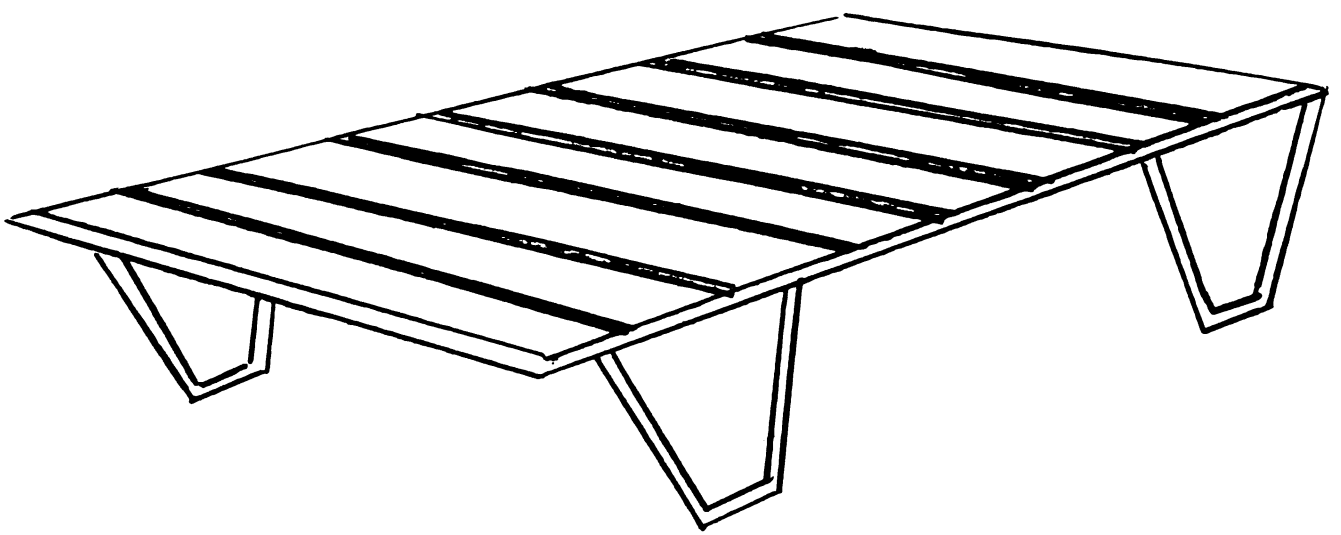

Figure 2. Platform Skid

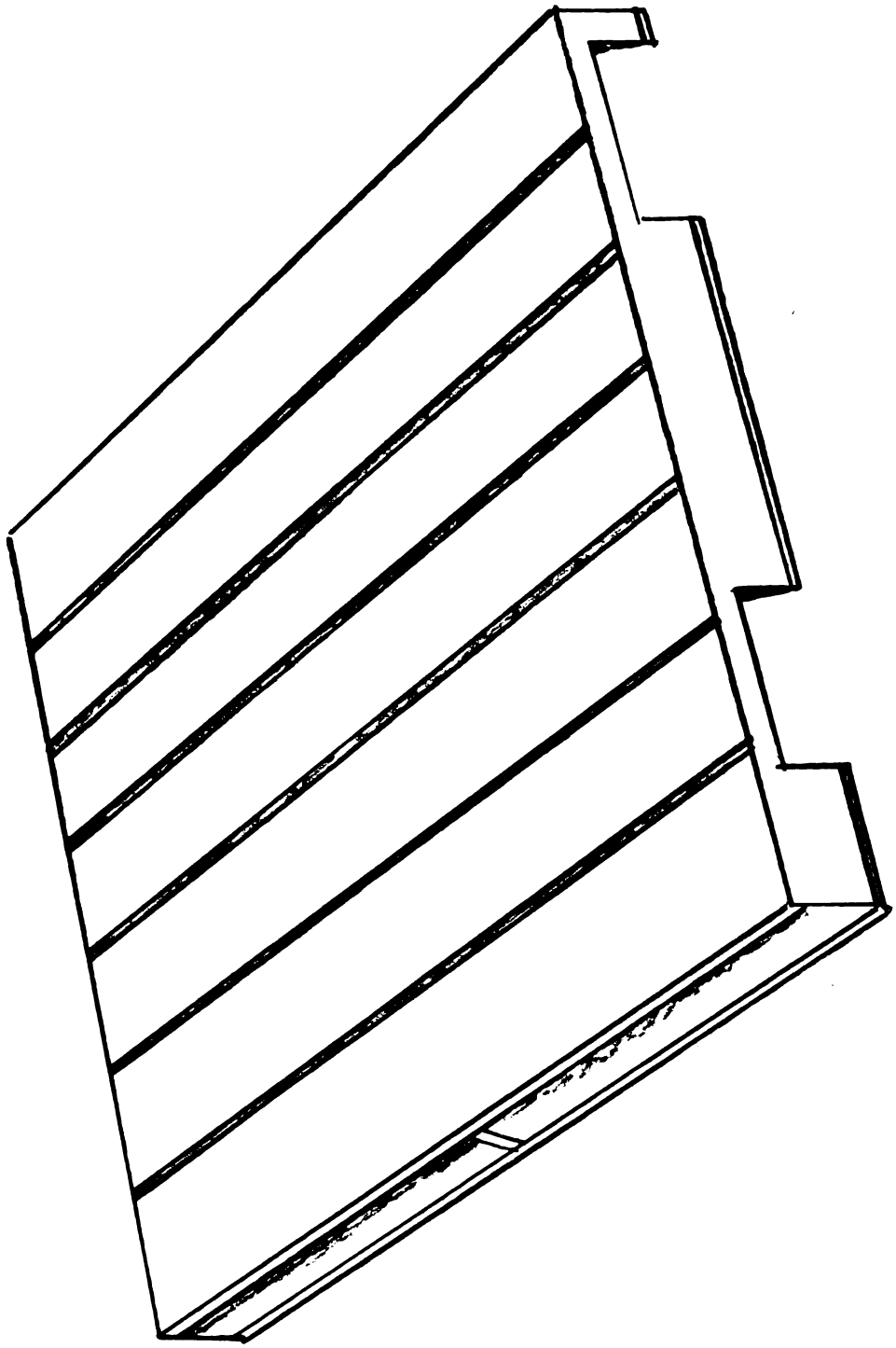

Figure 3. Pallet

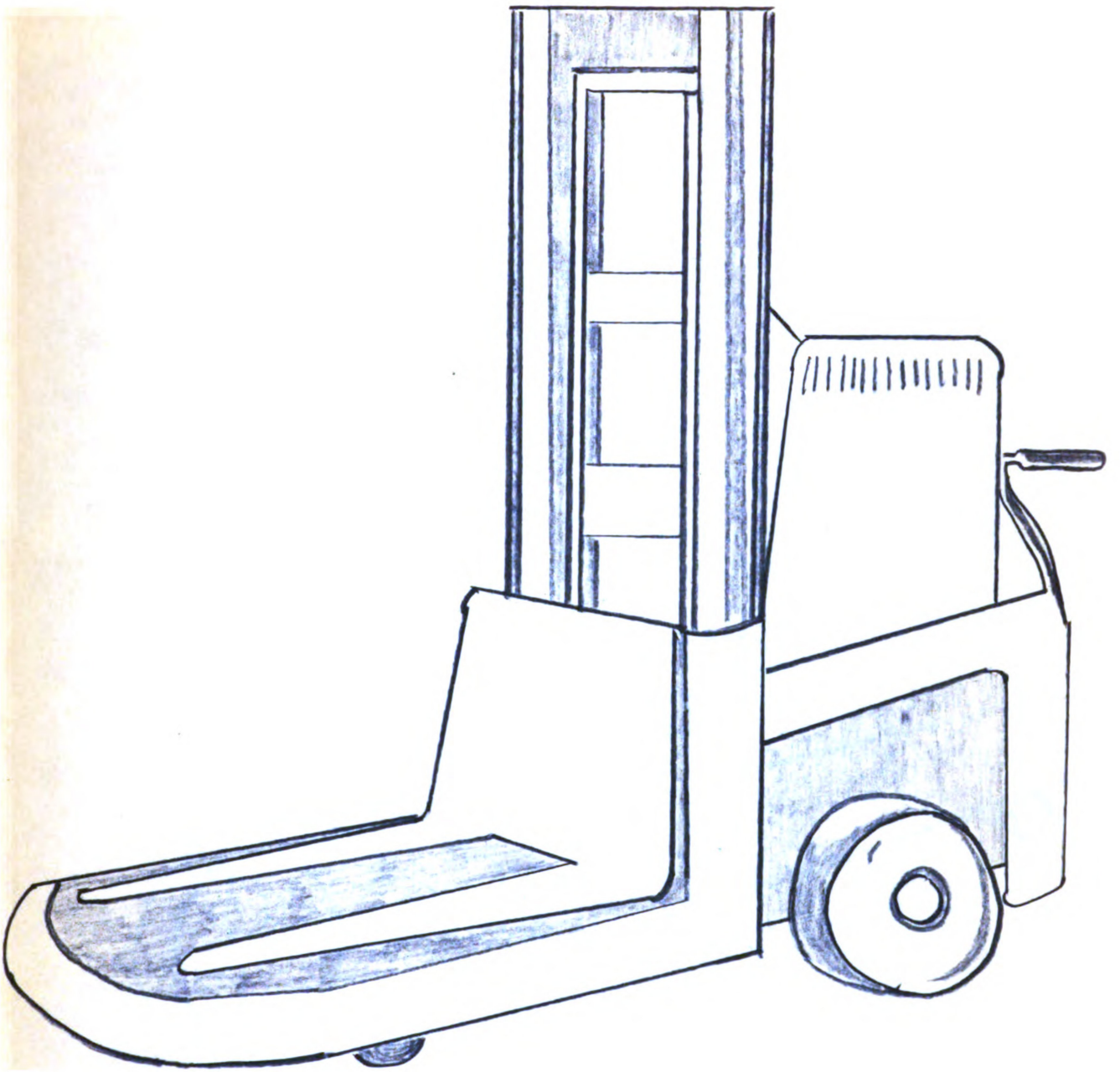

Figure 4. Fork Lift Truck

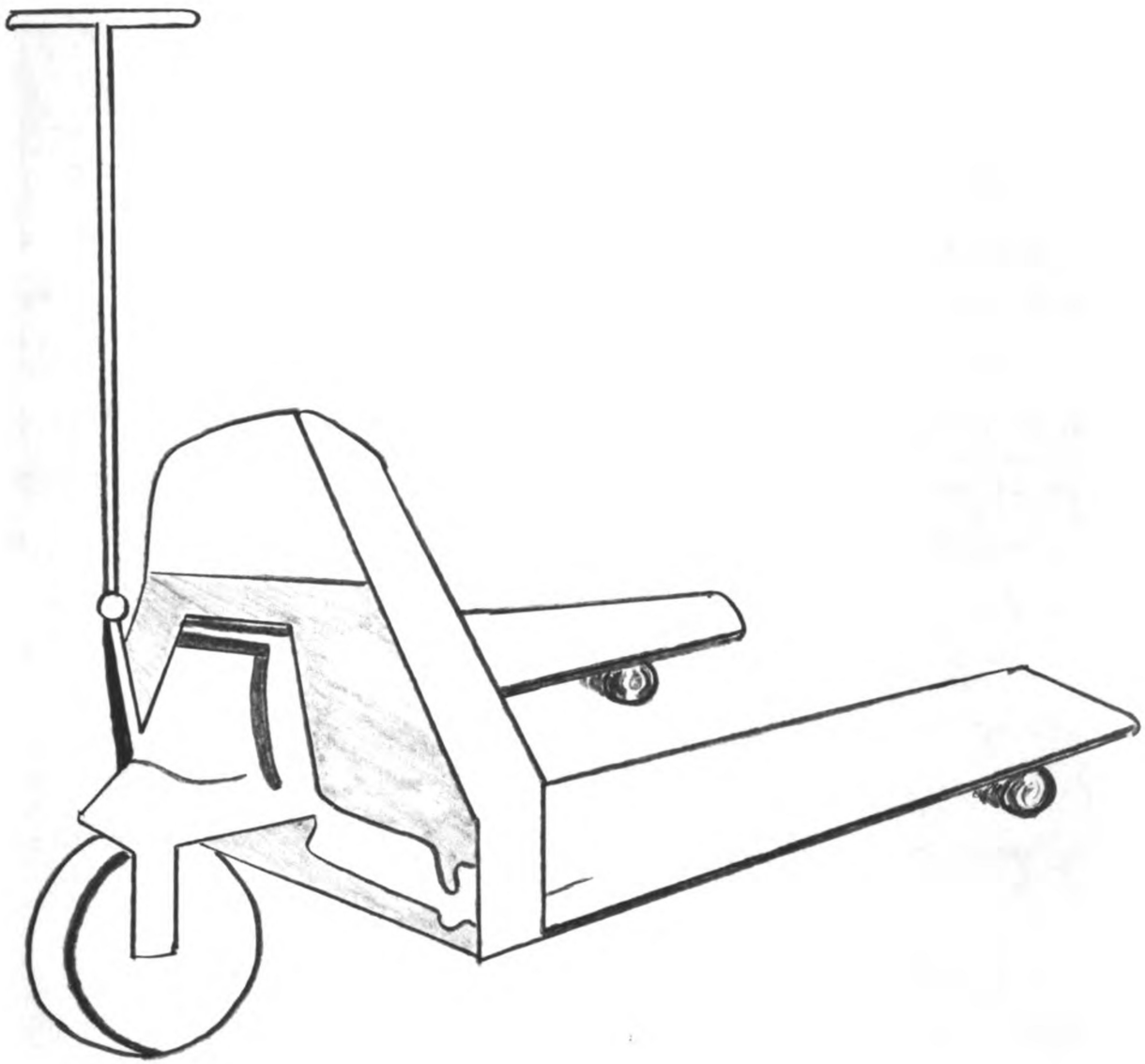

Figure 5. Lever-lift truck

or the fabricating room on a monorail. Produce was moved to the basement on a roller conveyor(Figure 6) directly from the dock trap door.

Production activities

All subsistence supplies for University food services except dairy products and bread were handled through the Food Stores. Ordering for each department of Food Stores was done by the respective department head. Staples, frozen fruits and vegetables, and meat were purchased by specification from quotations submitted. Fresh produce was purchased four times weekly at either the Terminal Market or the Farmer's Eastern Market in Detroit and transported to East Lansing in University owned trucks.

Receiving operations were directed by the head of the department for whom the merchandise was ordered. He checked specifications for goods, directed unloading and authorized the location of storage.

Warehouse storage was divided according to the type of merchandise and the temperature required. Staples were generally received in freight cars and unloaded from the railroad siding. Canned goods were purchased once a year since there was adequate space to store these commodities.

Meat was purchased in the carcass or primal cuts on a weekly basis and delivered in purveyor owned trucks to the dock where it was unloaded to the monorail which ran into

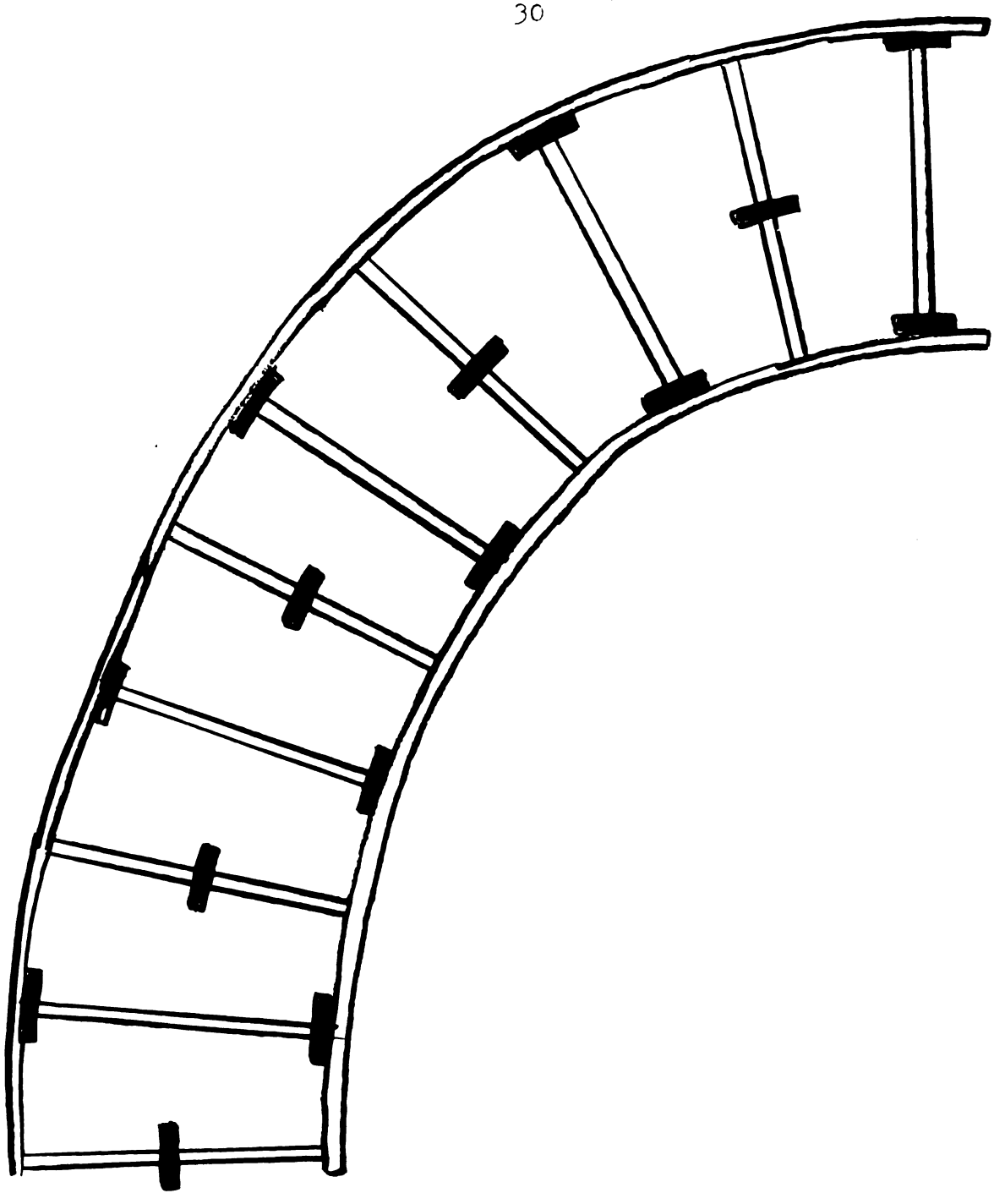

Figure 6. Roller Conveyor

refrigeration or the fabricating room. In the fabricating room meat was cut into portion sizes and stored in stainless steel pans which were placed on skids. From this point the skids could be moved to the holding room or to the delivery truck.

Frozen foods were purchased in lots for one year directly from the processor. There was adequate frozen storage space to receive the entire shipment at one time.

The distribution of the various commodities was the responsibility of the respective department heads. All goods were handled on platform skids as much as possible and moved onto University owned trucks for delivery to the various University food service units.

Brody Hall

The Brody Residence Group was completed in the fall of 1956. This project consisted of six residence halls to house three thousand students with Brody Hall as a central building designed for food service and recreation facilities for these students. The main floor of Brody Hall was planned for recreation rooms, lounges, a soda bar, valet services, upholstery shop, and office space for the administrative staff of the residence halls.

Organization and physical plant of food service

Brody Hall food service organization was headed by a manager. See Figure 7. Menu Planning was done by a committee of residence hall managers or their representatives with the Assistant Manager in charge of Food Service. All residence halls used a three weeks cycle selective menu.

The food preparation area was located approximately in the center of the second floor. Seven serving counters and dining rooms, one for each of the six residence hall units and one for employees were on the periphery of the kitchen as shown in Figure 8. The preparation areas included a range section, a bake shop, a salad and vegetable preparation space, and storage. The storage available included dry, refrigerated, and freezer space. In dry storage 1288 square feet was utilized for staples, cereals, canned goods, and laundry; refrigerated storage included 247 square feet for dairy products, 228 square feet for fresh meats, 208 square feet for fresh produce, and 146½ square feet for left-over foods; 160 square feet of potato storage space were available; 341½ square feet were allocated for freezer space.

Material handling equipment

The material handling aids used in receiving included a steel plate bridge (Figure 9), an elevator, numerous platform skids, and three lever lift trucks.

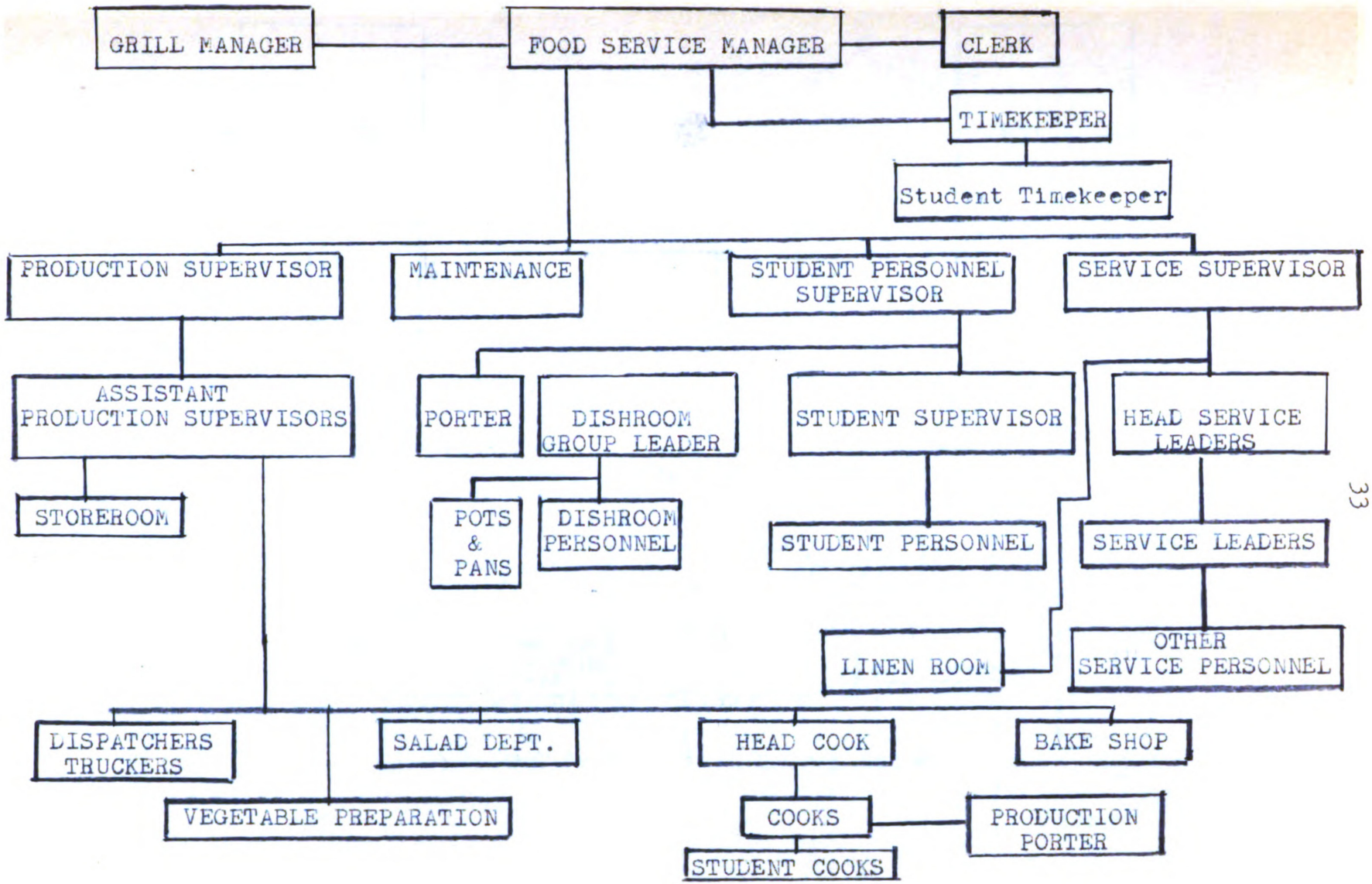

Figure 7. Brody Hall Food Service Organization

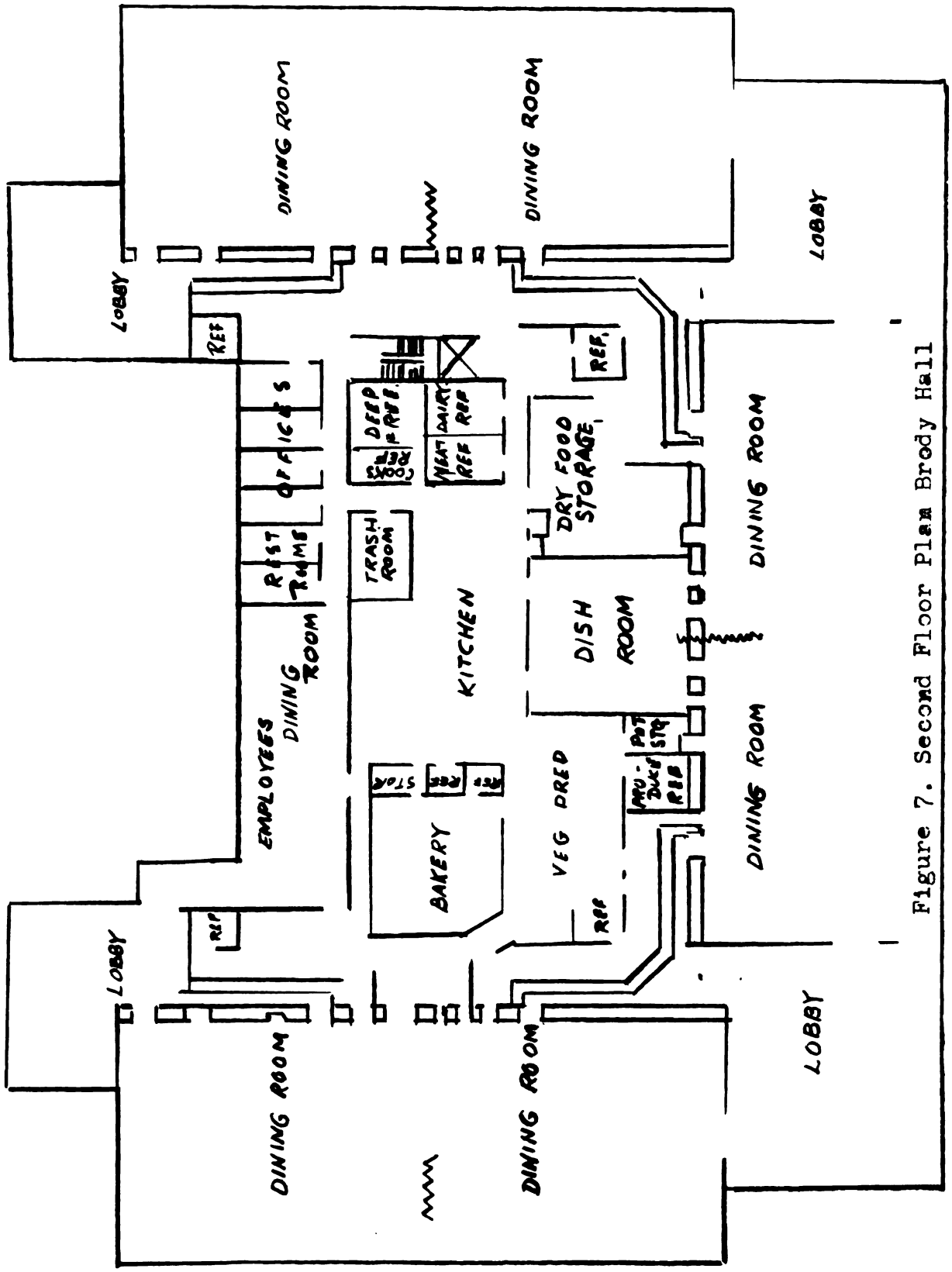

Figure 7. Second Floor Plan Brody Hall

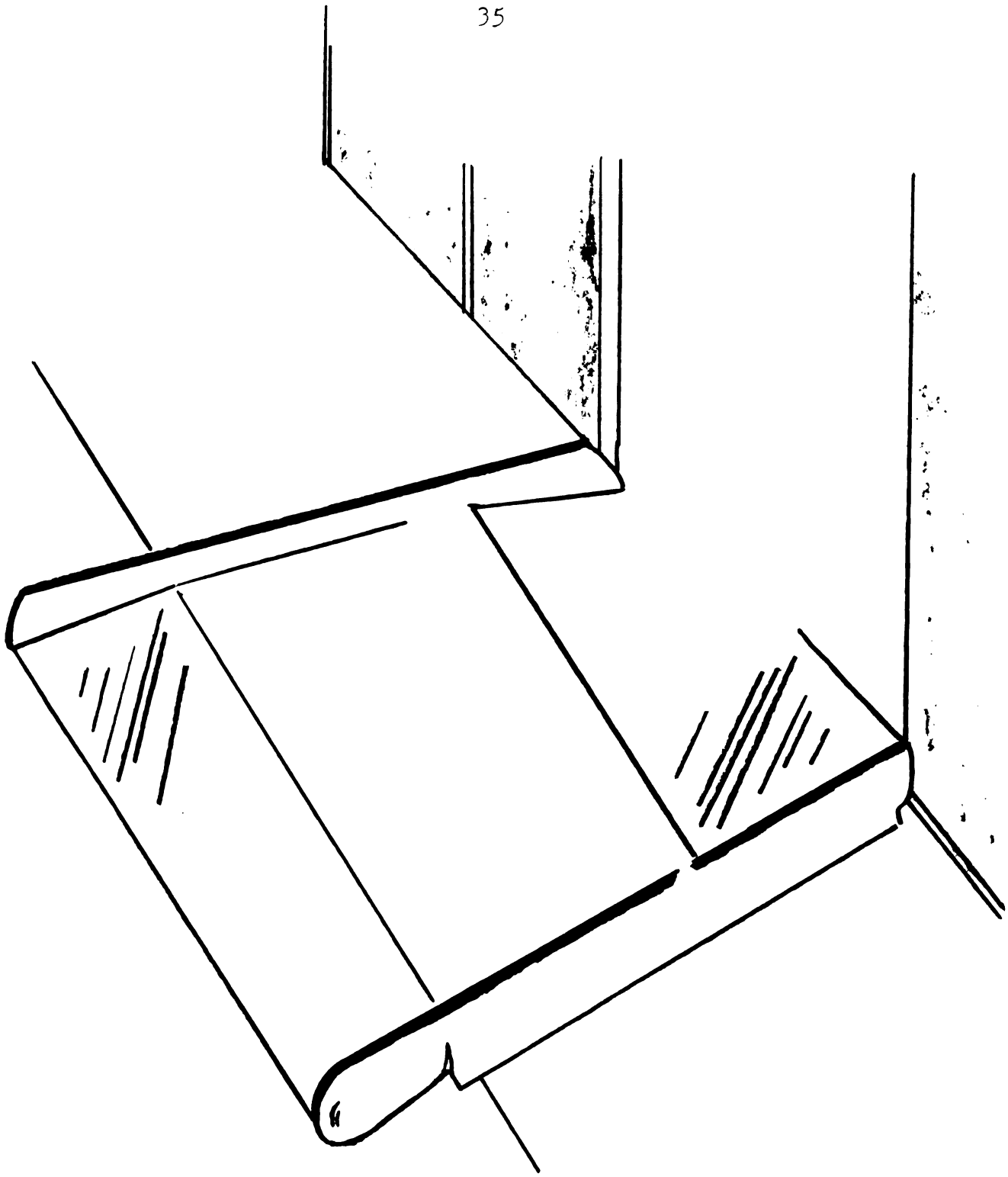

Figure 9. Steel Plate Bridge

Merchandise received from Food Stores came on platform skids and was removed from the truck by use of the lever-lift truck. The goods were moved to the elevator by the lever-lifts and transported to the second floor. The items were delivered to their various storage places in the kitchen area by the storeroom men.

material handling activities

Ordering food supplies was the responsibility of one assistant food production supervisor. Cleaning and paper supplies were kept at par stock and reordered by the storeroom men as needed.

Two full time men were employed for the storeroom. They had copies of all requisitions and were responsible for receiving and inventory. Drivers of delivery trucks signalled by means of a bell when they arrived at the receiving dock. A storeroom man reported to the dock to check the merchandise and signed the delivery slips. He transferred the good to productions or to storage on the second floor. Before unloading the goods, the assistant food service supervisor in charge of ordering rechecked the goods against his requisition. During the week of April 9-15, 1962, with the material handling aids available at Brody Hall the two storeroom men moved all provisions for an average of 5,000 meals daily (see Table 1) for a selective cycle menu(Appendix Exhibit 2).

Table 1. MEALS SERVED TO STUDENTS AND EMPLOYEES BRODY HALL
APRIL 9-15, 1962

DAY AND DATE	BREAKFAST	LUNCH	DINNER	TOTAL FOR DAY
Monday, April 9	1371	2152	2325	5848
Tuesday, April 10	1430	2252	2231	5913
Wednesday, April 11	1397	2216	2390	6003
Thursday, April 12	1318	2255	2319	5892
Friday, April 13	1336	2129	1843	5308
Saturday, April 14	449	1599	1696	3744
Sunday, April 15	568		1771	2339
TOTALS	7,869	12,603	14,575	35,047

In this seven day period two men transported from the dock to the point of production 10,708 pounds of staples, 9,650 pounds of fruits and juices, 12,595 pounds of vegetables, 8,328 pounds of meat, and 34,339 pounds of dairy products for a total of 75,620 pounds of subsistence supplies. See Table 2.

Meat was delivered to Brody Hall in stainless steel pans. These pans were stacked on skids and moved from the dock to the meat refrigerator for storage until time for preparation.

Flour, sugar, and salt were stored on a platform skid in the dry storage room and moved to the bake shop on the skid when they were needed. If space permitted, these items were delivered directly to the bake shop when received in the building.

Frozen goods were transported to the second floor on platform skids and moved by hand to the floor of the freezer.

The delivery schedule for produce was three times weekly, for staples and frozen commodities twice weekly, and for meat four times weekly. Daily supplies for production were requisitioned from the storeroom by each department. The storeroom men filled a skid by hand from supplies in stock and delivered the merchandise to the various production areas on a platform skid by use of the lever-lift truck.

The methods engineer uses various types of process charts for analyzing problems. For this study the author used the Flow Process Chart (Exhibit 1) for studying the

Table 2. SUBSISTENCE SUPPLIES FOR BRODY HALL, APRIL 9-15,1962

(Pounds of Food)

COMMODITY	TYPE OF STORAGE				TOTAL
	DRY	ROOT VEG	REFRID-ERATED	FROZEN	
STAPLES	10,708				10,708
FRUITS & JUICES	6,906		899	1845	9,650
VEGE-TABLES	2,523	2,200	3,042	4,830	12,595
MEAT	257		7,951	120	8,328
DAIRY	400		31,327	2,612	34,339
TOTALS	20,794	2,200	43,219	9,407	75,620

Exhibit 1. # FLOW PROCESS CHART

40

PART NAME Milk

PROCESS DESCRIPTION Delivery

DEPARTMENT Food Service

PLANT Brody Hall

RECORDED BY R. Snyder DATE 4/11/62

SUMMARY	NO.
○ OPERATIONS	3
⇨ TRANSPORTATIONS	10
□ INSPECTIONS	2
D DELAYS	1
▽ STORAGES	9
TOTAL STEPS	25
DISTANCE TRAVELED	

STEP	Operations Transport Inspect Delay Storage	DESCRIPTION OF _____ METHOD	Dist. Moved	Method of movmt.
1	○⇨□D▽	lift to dock from truck	1'	hand lift truck
2	○⇨□D▽	on dock		
3	○⇨□D▽	roll on dock to lever lift truck	3'	hand truck
4	○⇨□D▽	on dock		
5	○⇨□D▽	count cans		
6	○⇨□D▽	check requisition		
7	○⇨□D▽	lift to skid		by hand
8	○⇨□D▽	on skid		
9	○⇨□D▽	to elevator	25'	lever-lift
10	○⇨□D▽	on elevator		
11	○⇨□D▽	to second floor	one floor	elevator
12	○⇨□D▽	to milk refrigerator	50'	lever-lift
13	○⇨□D▽	move old supply of milk		
14	○⇨□D▽	on skid		
15	○⇨□D▽	remove to floor of refrigerator		by hand
16	○⇨□D▽	refrigerator		
17	○⇨□D▽	pick up with dairy truck		two wheeled dairy truck
18	○⇨□D▽	on two wheeled truck		
19	○⇨□D▽	to serving line	75'	
20	○⇨□D▽	on dairy truck		
21	○⇨□D▽	to salad refrigerator		
22	○⇨□D▽	on floor		

Exhibit 1.
(continued)

FLOW PROCESS CHART

41

SUMMARY	NO.
○ OPERATIONS	
⇨ TRANSPORTATIONS	
□ INSPECTIONS	
D DELAYS	
▽ STORAGES	
TOTAL STEPS	
DISTANCE TRAVELED	

PART NAME Milk

PROCESS DESCRIPTION Delivery

DEPARTMENT Food Service

PLANT Brody Hall

RECORDED BY R. Snyder DATE 4/11/62

STEP	Operations Transport Inspect Delay Storage	DESCRIPTION OF ________ METHOD				
23	○⇨□D▽	by hand	15'			
24	○⇨□D▽	to milk dispenser				
25	○⇨□D▽	hook up tubing				
	○⇨□D▽					
	○⇨□D▽					
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	○⇨□D▽					

handling of one subsistence item, milk. By the American Society of Mechanical Engineers standard definition(37) the flow process chart is a "graphic representation of all operations, transportations, inspections, delays, and storages occuring during a process or procedure, and insludes information considered desirable for analysis such as time required and distance moved."

From the data obtained in the Flow Process Chart a Flow Chart was constructed (Figure 10) which shows the path followed in the delivery of milk from the elevator to the point of consumption.

All fresh milk was delivered from the University Dairy in ten gallon cans for use in bulk milk dispensers. The cans were moved from the delivery truck to platform skids. After reaching the second floor the containers were removed from the platform skids and stored directly on the floor of the dairy refrigerator. The milk cans were delivered to the various lines by supply boys who used a two wheeled truck designed for dairies. The can was lifted by hand into the bulk dispenser.

Efficient plant layout eliminated back-tracking in moving one subsistence item, milk, from receiving to the point of consumption. Basic material handling equipment was also essential for controlling and minimizing man hours. Ordering and delivery schedules frequently made it possible to move materials directly to production without storage.

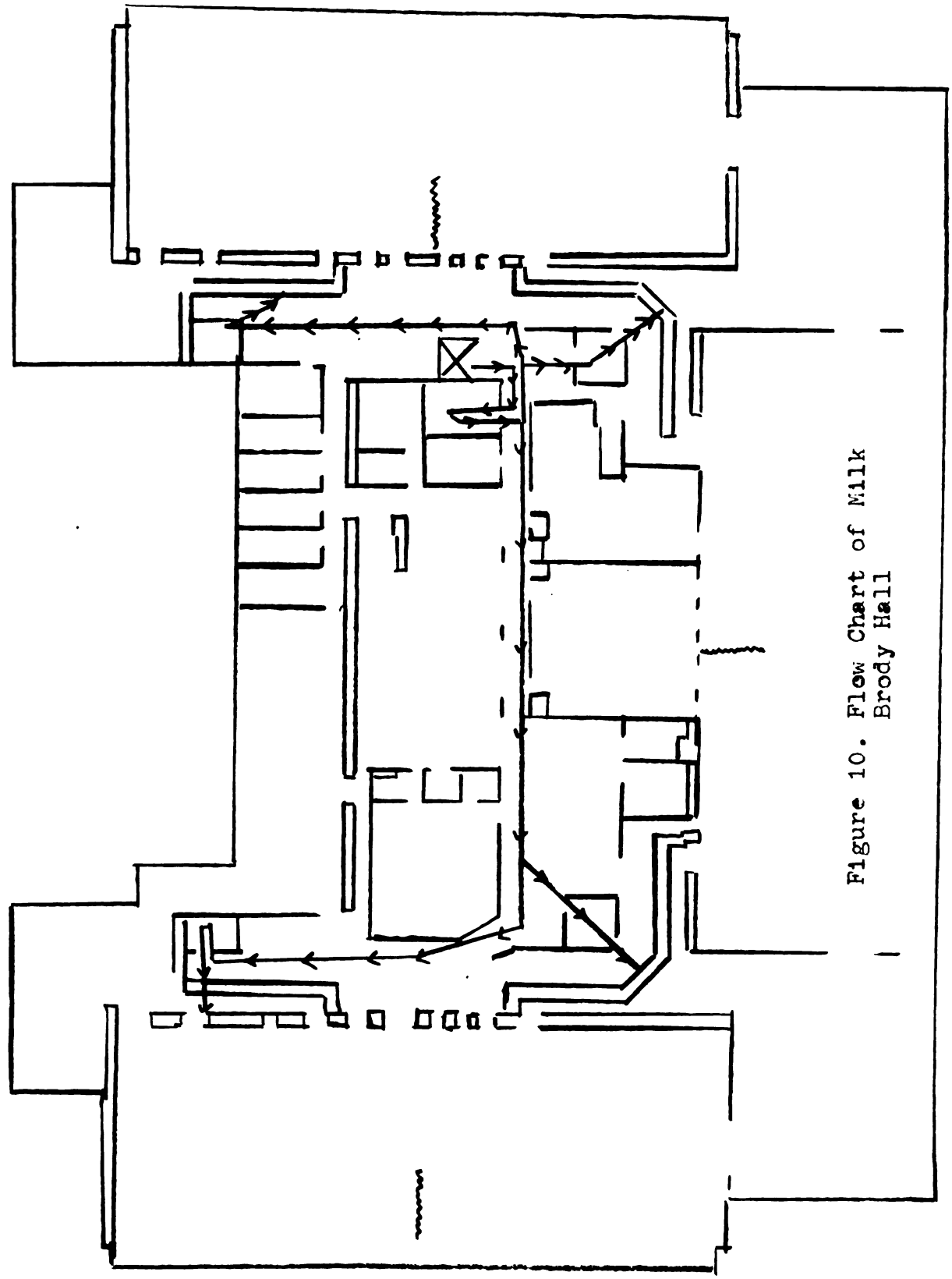

Figure 10. Flow Chart of Milk
Brody Hall

Material handling affects the cost of making, distributing and selling every kind of product. A study of material handling can reduce handling costs, increase the capacity of production, improve working conditions, and improve the distribution of materials. Such a study will include methods of handling, the plant layout, the equipment, the working conditions and the training of the personnel. By means of much of the same mechanical equipment in both Food Stores and Brody Hall this study shows that 75,620 pounds of subsistence supplies were moved by two men for the period of April 9-15,1962 from the receiving dock to the point of production for 35,047 meals.

LITERATURE CITED

1. Alford, L. P. Production handbook. New York, The Ronald Press. 1948.

2. Allegri, T. H. and Herrick, J. F. Materials handling in public refrigerated warehouses. Marketing Research Report No. 145. United States Department of Agriculture. 1957.

3. Apple, J. M. Plant layout and materials handling. New York, The Ronald Press. 1950.

4. Barnes, R. M. Motion and time study. 3rd. ed. New York, John Wiley and Sons, Inc. 1949.

5. ----------Work methods manual. New York, John Wiley and Sons, Inc. 1950.

6. ---------- Work methods training manual. 3rd ed. Dubuque, Iowa. Wm. C. Brown and Co. 1950.

7. Brown, R. E. Methods improvement is management's job. Modern Hospital. 83:71. Aug., 1954.

8. Carlson, J. G. Planning easier work. Jour. Am. Diet. Assn. 30:133-137. 1954.

9. Current trends in industrial psychology. Pittsburgh, University of Pittsburgh Press. 1949.

10. Dernberger, W. J. and Rice, R. S. Material handling, Booklet #2 of Know How. Pittsburgh, The Material Handling Institute, Inc. 1952.

11. England, Arthur O. Who, me? New London, Conn., The National Foremen's Institute. 1950.

12. Fitzsimmons, C., Goble, E., and Monhaut, G. Easy ways. Purdue Agr. Ext. Serv. Bull. 391. 1953.

13. Flow directory of material handling equipment. Flow Magazine. Cleveland, Ohio. 1956.

14. Gilbreth, Frank B. Primer of scientific management. New York, D. Van Nostrand Co. 1914.

15. Gilbreth, Lillian M. The psychology of management. New York, The McMillan Co. 1919.

16. Gomberg, W. A trade union analysis of time study. 2nd ed. New York, Prentice-Hall. 1955.

17. Harrington, Carl C. Materials handling manual. New York, Conover-Mast Publications, Inc. 1952.

18. Harrington, M. M. Work simplification at work. Jour. Am. Diet. Assn. 29:796. 1953.

19. Hatch, L. A practical approach to work simplification. Their application to the dietary department. Hospitals. 29:127. Oct., 1955.

20. Hendry, J. W. A manual of time and motion study. London, Sir Isaac Pitman & Sons, Ltd. 1946.

21. Holmes, W. G. Applied time and motion study. New York, The Ronald Press. 1938.

22. How to analyze and solve materials handling problems. Factory Management and Maintenance. 106:88-98. Jan., 1948.

23. Kemler, C. L. You can be your own efficiency expert. Hospitals. 30:33. Mar. 1, 1956.

24. Lawrence, A. and Menard, M. Motion and time study in clearing dishes and handling trays. Jour. Am. Diet. Assn. 31:604-608. 1955.

25. Lesperance, J. P. Economics and techniques of motion and time study. Dubuque, Iowa, Wm. C. Brown Co. 1953.

26. Lowry, S., Maynard, H., and Stegemerten, G. J. Time and motion study. New York, McGraw-Hill Book Co., Inc. 1940.

27. Lundberg, D. E. Personnel management in hotels and restaurants. Minneapolis, Burgess Publishing Co. 1948.

28. Maier, Norman. Psychology in industry. 2nd ed. Boston, Houghton Mifflin Co. 1955.

29. Mattos, E. R. A practical approach to work simplification. The principles and tools. Hospitals. 29:126. Oct., 1955.

30. Maynard, H. B. and Stegemerten, G. J. Guide to methods improvement. New York, McGraw-Hill Book Co., Inc. 1944.

31. Maynard, H. B., Stegemerten, G. J., and Schwab, J. L. Methods-time measurement. New York, McGraw-Hill Book Co., Inc. 1948.

32. Miller, J. C. This suggestion system sparks work simplification. Food Eng. 26:59-60. Jan., 1955.

33. Morrow, R. E. Motion economy and work measurement. 2nd ed. New York. The Ronald Press. 1957.

34. Mundel, M. E. Motion and time study. New York, Prentice-Hall, Inc. 1950.

35. Nadler, Gerald. Motion and time study. New York, Mc Graw-Hill Book Co., Inc. 1955.

36. Nadler, G. and Holtzman, A. O. Pick the right materials handling equipment. Mill and Factory. 58:92. June, 1956.

37. Niebel, B. W. Motion and time study. Homewood, Ill., Richard Irwin, Inc. 1955.

38. Northrup, N. W. Modernization erases 20 year old errors. Institutions. 39:130. July, 1956.

39. Rosa, Ercole, Jr. Work simplification--a tool for reducing food costs. Jour. Am. Diet. Assn. 27:952. 1951.

40. Schmid, M. D. Work simplification, making the job easier. Jour. Am. Diet. Assn. 24:1062. 1948.

41. Simons, A. M. and Dutton, H. P. Production management. Chicago, American Technical Society. 1951.

42. Smith, H. C. Psychology of industrial behavior. New York, McGraw-Hill Book Co., Inc. 1955.

43. Speckler, J. C. Work simplification as a tool of management. Jour. Am. Diet. Assn. 24:598. 1948.

44. Spriegel, W. R. and Myers, C. The writings of the Gilbreths. Homewood, Ill., Richard Irwin, Inc. 1953.

45. Stocker, H. E. Materials handling. 2nd. ed. New York, Prentice-Hall, Inc. 1951.

46. Stokes, J. W. Simplify job, aid morale. Institutions. 35:170. Sept., 1954.

47. Suggestion plan pays dividends. Institutions. 37:107. Oct., 1955.

48. Taylor, F. W. The principles of scientific management. New York, Harper and Bros. 1911.

49. Thomas, O. M. Job analysis in institutional kitchens. Jour. Am. Diet. Assn. 23:505. 1947.

50. U. S. Bureau of the Budget. Work simplification. Publ. 91. Public Administration Service, Chicago. 1945.

51. White, W. L. Improving materials handling in small plants. Small Business Management Series No. 4. Small Business Administration. 1954.

APPENDIX

BREAKFAST

Bananas Orange Juice Apple Juice

Farina Assorted Cereals

French Toast Fried Apples & Ham Eggs any Style

Sweet Rolls Toast Butter Jelly

Coffee Tea Milk Cocoa

LUNCHEON

Cream of Tomato Soup, Crackers

Beef Stew with Vegetables on Rice Grilled Cheese Sandwich

Pear and Cream Cheese Salad Sliced Tomato Salad

Molded Crushed Pineapple Salad

Assorted Breads Butter

Gold Cake Vanilla Pudding Fruit Cocktail with Bananas

Coffee Tea Milk

DINNER

Fried Chicken Corned Beef

Mashed Potatoes Rice

New Cabbage Buttered Carrots

Relish Plate Head Lettuce Peach Pinwheel

Cherry Squares Chocolate & White Layer Cake Frozen Apples

Coffee Tea Milk

Exhibit 2: Men's Residence Hall Menu for April 9, Spring Term, 1962

BREAKFAST

Whole Orange Orange Juice Tomato Juice

Ralston Assorted Cereals

Fried Potatoes Bacon Blueberry Hot Cakes Eggs any style

Cinnamon Rolls Toast Butter Marmalade

Coffee Tea Milk Cocoa

LUNCHEON

Chili Con Carne Crackers Chicken Tetrazinni

Creole Eggs

Chopped Buttered Spinach

Grapefruit Juice Gracie's Cole Slaw Citrus Pinwheel Salad

Assorted Breads Peanut Butter and Jelly

Gingerbread, Lemon Sauce Jello Cubes Fruit

Coffee Tea Milk

DINNER

Beef Loaf Liver and Onions

French Fried Potatoes Rice

Green Beans with Bacon Crumbs Buttered Green Beans

Carrot and Raisin Salad Celery Cabbage Molded Fruit Cocktail

Assorted Breads Hot Rolls Butter

Pineapple Upside Down Cake Grapefruit Melon
Orange Sherbet

Coffee Tea Milk

Exhibit 2 (continued): Men's Residence Hall Menu for April 10, Spring Term, 1962

BREAKFAST

Apricots Orange Juice Pineapple Juice

Malt-O-Meal Assorted Cereals

Brown and Serve Sausage Buckwheat Cakes Eggs any style

Fried Cakes Banana Muffins Toast Butter Jelly

Coffee Tea Milk Cocoa

LUNCHEON

Meat Pie-Potato Topping Egg Salad Sandwiches, Pickles

Buttered Mixed Vegetables

Peach and Cream Cheese Salad Relish Plate Spring Salad

Assorted Breads Butter

Chocolate Ice Cream Slice Pineapple Fluff Blue Plums

Coffee Tea Milk

DINNER

Veal Cutlets, Wisconsin Roast Leg of Lamb

Creamed New Potatoes Rice

Whole Grain Corn

Molded Banana Salad Sliced Cucumber and Onions in Vinegar

Applesauce

Assorted Breads Orange Bread Butter

Peach Blossom Pie Frozen Strawberries Jelly Roll

Coffee Tea Milk

Exhibit 2 (continued): Men's Residene Hall Menu for April 11, Spring Term, 1962

BREAKFAST

Prunes Orange Juice Grapefruit Juice

Farina Assorted Cereals

Griddle Cakes Link Sausage Regular Bacon Eggs any style

Apple Turnovers Bran Muffins Coffee Cake Toast

Coffee Tea Milk Cocoa

LUNCHEON

Beef Noodle Soup, Crackers

Barbecued Beef on Bun Hero Sandwiches Tuna Salad on Bun

Molded Strawberry and Crushed Pineapple Salad

Tomato and Cucumber Salad Orange and Apricot Juice

Glorified Bread Pudding Pineapple Chunks Cookie

Coffee Tea Milk

DINNER

Baked Ham, Sauce Meat Balls

Potatoes Rice

Buttered Green Peas

Russian Salad Grapefruit Molds Mixed Fruit

Malted Milk Cake Frozen Peaches Ice Cream Slice

Coffee Tea Milk

Exhibit 2 (continued): Men's Residence Hall Menu for April 12, Spring Term, 1962

BREAKFAST

Sliced Pineapple Orange Juice Apple Juice

Oatmeal Assorted Cereals

Fried Potatoes Canadian Bacon Hot Cakes

Sweet Rolls Toast Butter Marmalade

Coffee Tea Milk Cocoa

LUNCHEON

Cream of Potato Soup, Crackers

Macaroni and Cheese Spanish Rice

Cottage Cheese Tomato Wedge Molded Sliced Peach Sl. Orange

Assorted Breads Butter

Chinese Chews Fruit Cup Chocolate Pudding

Coffee Tea Milk

DINNER

Fried Smelt Turkey Pie Veal Cutlet

Mashed Potato Rice

Buttered Squash

Rhubarb Banana and Crushed Pineapple Lettuce Wedge

Assorted Breads Bran Muffin Butter

Lemon Pie Lime Sherbet Royal Ann Cherries

Coffee Tea Milk

Exhibit 2(continued): Men's Residence Hall Menu for April 13, Spring Term, 1962

BREAKFAST

Fruit Orange Juice Assorted Juices

Hominy Sausage Eggs, H.C. or S.C. Cereal

Grilled Cinnamon Rolls Toast Butter Jam

Coffee Tea Milk Cocoa

LUNCHEON

Liverwurst on Rye, Pickles Cheese Sandwich

Hot Meat Sandwich with Gravy

French Fried Potatoes

Creamy Cole Slaw Fruit Punch Pear and Cheese Salad

Cherry Cobbler Jello Cubes Sheet Cake

Coffee Tea Milk

DINNER

Spaghetti-Meat Sauce Pork Cutlets-Apple Ring

Potatoes Rice

Buttered Wax Beans

Spring Salad Jellied Citrus Fruit Spiced Apple Ring and Grapefruit

Assorted Breads Vienna Bread Butter

Coffee Tea Milk

Exhibit 2(continued): Men's Residence Hall Menu for April 14, Spring Term, 1962

BREAKFAST

Half Grapefruit Orange Juice

Assorted Cereals

Fried Egg Fried Ham

Coffee Cake Toast Jelly Butter

Coffee Tea Milk Cocoa

DINNER

Tomato Juice

Roast Sirloin of Beef French Fried Shrimp

Mashed Potatoes

Buttered Asparagus French Cut Green Beans

Head Lettuce Molded Red Cherry Salad

Hot Rolls Assorted Bread Butter

Fudge Sundae Fruit Cup

Coffee Tea Milk

Exhibit 2(continued): Men's Residence Hall Menu for April 15, Spring Term, 1962

Problem, M. S. 1962

Snyder, Ruth M. Dickey

Material Handling for Subsistence Supplies in a University Residence Hall