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9. ABSTRACT

Covered in this workshop report are a talk on "Food Packaging in the Less Developed Countries"; the topical outline of the workshop, Meeting Food Packaging Needs in Developing Countries; and the four panel reports: Meeting Packaging Equipment Problems, Adapting Packages to Consumer Habits, New Approaches to Least-Cost Packaging, and Storage and Shipping Containers. Although no general recommendations are given, it was felt that implementation of the various suggestions offered would help in: 1) major food saving, 2) improved sanitation and public health, 3) nutrition education, 4) bridging the time lag between food crop harvests, and 4) increasing number and volume of foods for exports and therefore increasing cash income.

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LEAGUE FOR INTERNATIONAL FOOD EDUCATION

Meeting Food Packaging Needs in Developing Countries

WORKSHOP

CONDUCTED BY THE

League for International Food Education

FOR THE

U. S. Agency for International Development

OFFICE OF NUTRITION

BUREAU OF TECHNICAL ASSISTANCE

Washington, D.C. U.S.A.

April 27-30, 1970

MEETING FOOD PACKAGING NEEDS

IN DEVELOPING COUNTRIES

Report of a Workshop

Conducted by the

League for International Food Education

for the

Office of Nutrition
Technical Assistance Bureau
U.S. Agency for International Development

in

Washington, D.C.
U.S.A.

April 27 - 30, 1970

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I. INTRODUCTION

A workshop on meeting food packaging needs in developing countries was convened by the League for International Food Education at the request of the Office of Nutrition, Bureau of Technical Assistance, U.S. Agency for International Development (A.I.D.). Participants were carefully chosen on the basis of their special knowledge of key packaging areas. A list of these experts with their brief biographies is attached to this report (see pages 37-42).

In addition to the Office of Nutrition, Technical Assistance Bureau, A.I.D., the League for International Food Education is most grateful to the Canadian International Development Agency, the Packaging Institute, the Packaging Machinery Manufacturers Institute, and the World Packaging Organization for their participation in this workshop. Appreciation and thanks are also extended to the private companies and government agencies which so generously provided the time of their experts for meeting together and producing valuable recommendations.

The experts were grouped in four panels addressed to the following topics:

A. Meeting Packaging Equipment Problems
B. Adapting Packages to Consumer Habits
C. New Approaches to Least Cost Packaging
D. Storage and Shipping Containers.
(A complete outline is attached; see page 8).

The results of each panel's deliberations are presented in this report, which was essentially prepared by the panels.

The Office of Nutrition, Bureau of Technical Assistance, A.I.D. has expressed a definite intention to implement the panels' recommendations in many of the ways proposed. It is thus hoped that impetus will be given to improved food packaging for developing countries. Progress here can help in many ways, as by helping to assist in

(1) Major food saving;
(2) Improved sanitation and public health;
(3) Nutrition education;
(4) Bridging the time lag between food crop harvests; and
(5) Increasing number and volume of foods for export, therefore increasing cash income.

II. FOOD PACKAGING IN THE LESS DEVELOPED COUNTRIES

(It seems most appropriate to include as the prologue to this workshop report the following address to the group by Dr. William J. Gall.)

Mr. President and fellow "world packagers". May I, on behalf of the World Packaging Organization and the Canadian International Development Agency, thank L.I.F.E. for its invitation to join in these discussions which I feel very timely and vital, and at the same time congratulate U.S. A.I.D. for putting "L.I.F.E." into this area of packaging! Preservation of what man has is being shown to be equally as important as increasing production--and packaging is part of preservation.

These semi-formal comments of mine are only intended to help provide a background and some basis for our discussions. They are not meant to be conclusive or all-embracing and will be brief. Far better than my words will be the 104 slides that follow.

It should be mentioned at the outset that while our attention may generally be focused on food packaging, there are a multitude of other non-food commodities and materials that are important as well to the economic development of the LDC's--and which are also packaged.

World Food Situation

By the turn of the century, 30 years from now, the world population is expected to be above 6,000 million, or twice its present size!

With population rising by more than 2 percent per year the most strenuous efforts have only managed to keep food production rising at about the same rate. Here it has gone up a little faster and there a little slower; some people are eating just a little better and some a little worse; but their diets are mostly ranged around a world average that is inadequate.

Economic progress over the last decade has mainly taken place in the developed areas, thus increasing the gap between the rich and poor countries. People in the less-developed regions consume between 2,000 and 2,500 calories per capita per day, while people in the more developed regions consume more than 3,000 calories per day.

More than half of the world's people who live in the Far East have only about a quarter of the world's total food supplies made up of only 19 percent of world production of foods of animal origin and 44 percent of the total production of vegetable foods. This is in striking contrast with Europe, Oceania and North America, which, with about a third of

the world's population, get almost 60 percent of the total world's food supplies, made up of about 70 percent of the total animal food supplies and about 40 percent of the total vegetable food supplies.

Malnutrition, undernutrition and poverty are, of course, very closely related and the greater part of mankind is poor--very poor. Although 70 percent of the world's people live in less-developed areas, their share of the world's income early in the last decade was less than $100 in most countries in the Far East and Africa, $100-200 in most countries of the Near East, and $100-250 in most countries of Latin America. Against this, per capita income was between $750 and $1,000 in western European countries, about $1,000 in Oceania, and $1,500 to $2,000 in North America. The Far East with, as mentioned, about half of the total population has only 12 percent of the world's income. Africa with 7 percent of the population has 2 percent of the income. Latin America has almost 7 percent of the population but only 4.7 percent of the total income. And North America with not quite 7 percent of the population has almost 40 percent of the income, and Europe with 22 percent, almost 38 percent of the income.

World food supplies per head, though higher than in immediate postwar years, are only slightly above the prewar level.

In 1966 food production in the developing regions increased by little more than one percent. Subsequently, however, one is pleased to note this losing trend has been arrested and there is now some basis for optimism.

But can this increasing volume of food be efficiently and effectively handled, stored, preserved, protected, processed, distributed--so that this improved situation is exploited to the benefit of the greatest number?

Change in Thinking

"Waste not, want not"--and now such phrases as FAO's "war on waste" are common to the policy statements of many of the international and bilateral aid programs. Concurrent with the "green revolution" is growing a revolution in thinking concerning production and preservation. It is now more widely appreciated that the loss and wastage of food is of considerable magnitude--that if it were reduced significantly, hunger in the world could be essentially eliminated--and that, particularly against the background of the situations prevailing in the developing nations, investment in preservation of what one has is a quicker and more economic path to increasing the quantity of food available than an investment in increasing production. There is growing awareness of the interdependence of the food chain elements of production--processing, marketing, and that emphasis on production without commensurate emphasis on the handling, storage, preservation, processing and distribution aspects will partially negate any production gains.

International Activity

The European Packaging Federation (EPF) with the Asian Packaging Federation (APF) and North American Packaging Federation (NAPF), composed of your Packaging Institute and the Packaging Association of Canada, formed the World Packaging Organization (WPO) in September 1968. WPO represents the nationally recognized packaging organizations in 32 countries.

The nine APF member-countries are Australia, China (Taiwan), Hong Kong, India, Japan, Korea, New Zealand, Philippines, and Thailand.

The Latin American Packaging Federation may soon be formed and will add seven member-countries to WPO by virtue of the existing national Packaging Institutes in Mexico and Argentina and those about to be formed or just formed in Brazil, Chile, Colombia, Cuba and Venezuela--for a total WPO membership embracing 39 countries in Asia, Europe, Latin America and North America. The African continent is, of course, conspicuous by its absence; but no doubt there are movements there towards the development of packaging as a discipline and activity in its own right.

L.I.F.E.'s Newsletter of March 1970 has referred to WPO's concern with the problems and needs of the LDC's in packaging and its intent to marshall its resources to assist in meeting these through packaging training and education in other ways.

FAO, UNIDO, UNICEF, WHO, the International Trade Centre of UNCTAD-GATT as well as the regional Economic Commissions of the United Nations for Asia and the Far East, Africa and Latin America are probably the main UN bodies active in or concerned with packaging.

Worthy of mention separately is the UN/FAO/World Food Program (WFP), which is the largest international shipper of food and commodities required in the production of food. It has recently taken on a Packaging Officer from the Tropical Stored Products Centre (TSPC) of the Tropical Products Institute (TPI), Ministry of Overseas Development, United Kingdom. TSPC has a Food Packaging Section and is the technical advisor on packaging to WFP.

CARE must be mentioned, and while I have had personal experience with its excellent work in one LDC--India--I am not knowledgeable as to the magnitudes of its widespread operations. The many non-governmental voluntary bodies such as OXFAM, the Red Cross and others can also speak on the shortcomings and needs of donor packaging.

As to what extent bilateral aid programs, such as U.S. AID's, are involved in packaging it is very difficult to say. The U.K., through its TSPC of the TPI, just mentioned, is the only one to my knowledge giving any concentration on this field of packaging. Certainly, one can periodically find some attention being given to packaging within the scope of aid in the field of agriculture, marketing, food industry development, food technology, etc.

Plan of Attack

The "scene is set", and any action we can stimulate to improve the packaging situation in the LDC's is timely and a vital part of the war on hunger.

The technical solutions or answers to packaging problems in LDC's are known. However--many of these methods, techniques, materials and equipment are beyond their economic means. They cannot yet afford the luxuries and excesses of packaging common to our society. One must have an appreciation of the indigenous packaging materials available and used. There is no point in replacing palm leaves with cellophane if it's not really necessary and increases the cost of the article. On the other hand, there are many situations where improved packaging will more than pay for itself.

In general the consumer purchasing power in the LDC's is low. Further, their needs are different to ours. I was pleased to note U.S. AID/Brazil's accent on adapting to the announcement of this meeting--items that fall under the heading of "relevance". The whole local handling/transportation/marketing/consumption chain must be studied.

You are probably familiar with the fact that jute and cotton bags containing imported materials end up as dresses, shirts and pants. What we need in addition, as one example, are bulk containers that can, when empty, serve as farm level storage containers--hermetic, preferably--for foodgrains.

It is my feeling from reading of the origins of this meeting, the background papers provided and the Agenda that the predominant concern is to find answers to actual immediate packaging problems with goods shipped to LDC's by the developed countries themselves. Provision of information and answers for such problems is simply a matter of organizing access to the vast resources of information that already exist in your own country and elsewhere. A central point in U.S. AID in continuing contact with the Packaging Institute, the Packaging Machinery Manufacturers Institute and the impressive "Packaging Documentation and Information Service" established under the University of California's "Packaging Program," plus the many other sources here and abroad, is to satisfy the short term informational needs required for problems or commercial supply.

This may successfully take care of problems originating in the U.S. or other develcped countries. But I would like to stress the point that providing such answers at a distance to a point in an LDC, where there is not the ability to apply it, or to use the materials or equipment that may later be delivered, calls for person-to-person contact at that point and the development of an awareness of the parameters of packaging and a capability in packaging in the LDC itself.

I was interested when talking with U.S. AID officials in New Delhi in February to hear that it is favouring the "institutional approach"--

working with and through national bodies and organizations in the LDC's. This makes good sense, psychologically and otherwise, and as I've indicated there are a growing number of national packaging bodies in the LDC's through which this could be done. What I am trying to say at this point is that in addition to establishing methods and procedures to take care of the continual short-term problems of packaging in shipping to LDC's, there must be a program of long term, in-depth assistance and support in the LDC's themselves in order that "packaging" develops as an integral part of their economies in internal and export trade.

There are two major areas where action is needed--Packaging Training, Education and Development and Packaging Industry Development. Both these areas are intertwined, but it may help discussion to consider them separately and look at some avenues for action under each.

Packaging Training, Education and Development

a. in the LDC's:

--ad hoc training courses at all levels
--inclusion of packaging courses in existing and planned courses at educational and training institutions in food technology, nutrition, home economics, marketing, etc.
--establishment of regional and national "schools of packaging" where feasible
--fostering the development of "stored (food) products R/D centers" or similar centers where packaging development is being or could be carried out
--transfer of experience in the development and application of laws and regulations concerning packaging.

b. in supplier countries:

--a small mobile expert group supported by the bilateral aid body in the country concerned to work with the packaging industry and supplier companies in that country, the WFP and the recipient governments to ensure the packaging of goods shipped to LDC's meet minimum requirements, with a constant eye to re-use of the packaging material at the receiving end wherever feasible.

Packaging Industry Development

--encouragement of bilateral and multilateral aid projects aimed at increasing the investment in this industry in the LDC's
--encouragement of industry in our western world to explore the investment possibilities in packaging material and equipment plants in the LDC's
--encouragement of industry in the LDC's in similar investment in their own countries--on its own and with foreign collaboration.

In both these areas one must stress that word relevant and the fact that none of our planning can be effective without full knowledge and appreciation of the resources and requirements of the LDC's--and their cooperation.

Their acceptance of the benefits of packaging must be based more on the economic benefits to be derived than on emotional appeal, although the latter can help "sell" the former.

Our whole "cello-wrapped society" is not what needs to be transplanted to the LDC's. Our sophisticated materials and high speed equipment can only slowly be introduced into LDC's just entering or emerging from the "polyethylene age". We must realize also that a certain knowledge and competence in packaging already exists in many LDC's.

Albert Elder

Martin Forman

William Gall

III. MEETING FOOD PACKAGING NEEDS IN DEVELOPING COUNTRIES

Panel A: Meeting Packaging Equipment Problems.

1. Prospects for moderate cost, simple-to-maintain equipment.
2. Training of technicians for servicing packaging equipment.
3. Influence of equipment investment relative to hand labor cost.
4. Limiting factors peculiar to developing countries.
5. Current prototypes of equipment that seem to do the job.

Panel B: Adapting Packages to Consumer Habits.

1. Food purchase habits in the LDC's and how they affect packaging needs.
2. Package reuse and disposal.
3. Current packaging sizes and shapes in LDC's and future needs.
4. Use of package to convey nutrition message to consumers in LDC's.
5. Packages targetted to special needs (infant feeding, institutional child feeding, etc.).
6. Limiting factors, such as ratio of package cost to contained food cost.

Panel C: New Approaches to Least Cost Packaging.

1. Current packaging in the LDC's and its rationale.
2. Potentials of edible film packaging.
3. Formulating foods (as by encapsulation) to simplify packaging needs.
4. Innovative approaches in minimum cost packaging to conserve fuel, preserve food quality, and provide food safety and sanitation. (Example: "retort pouch".)
5. New packaging materials and their potential for LDC's. (Synthetic paper, film, metals, etc.)
6. Recognition of limiting constraints.

Panel D. Storage and Shipping Containers.

1. Advances in rodent and insect repellent packaging.
2. Large minimum cost storage vessels for foods and food ingredients.
3. Rigorous environmental demands and appropriate packaging responses. (Rough roads, extremes of humidity and temperature, etc.)
4. Better packaging for donated foods.
5. Better handling of bags; loading and off loading in foreign ports.
6. Economical upgrading of existing storage facilities.
7. Possible increased use of rigid insect resistant containers.
8. Actual dimensions of the food wastage problem.

IV. PANEL A: MEETING PACKAGING EQUIPMENT PROBLEMS

Panel Members: Kenneth R. Johnson, Chairman; Jesse D. Hill, Grant V. Hoyt, Elwyn Jones

I. Recommendations.

A. The formation of a panel of experts from industry is suggested.

1. Purposes.

a. To review and recommend equipment to meet a particular requirement;
b. To provide floor plans, flow charts, etc.;
c. To provide quotations;
d. To provide after-sale training of operating and maintenance personnel.

2. Sponsored by

a. Trade associations (PMMI, PSSMA, SPI, AMA).
b. Government agency (TA/N, AID).

3. To meet quarterly or as required.

B. The immediate implementation of a training program is suggested.

1. Purposes.

a. To train potential operation and packaging engineering personnel in the efficient operation and maintenance of packaging machines;
b. To advise industry, government or LDC agencies of equipment specifications and functions.

2. Implementation.

a. Supply text books to cooperating LDC schools, institutes, etc., for in-country training.

1) Packaging converting machinery components - Packaging Machinery Manufacturers Institute (PMMI), Washington D.C.
2) Air Force Manual Basic Electricity - U.S. Air Force.
3) Packaging Machinery Directory - PMMI.
4) Modern Packaging Encyclopedia - Modern Packaging.

b. Set up instructors course in U.S.A. or other convenient location.

c. Organize in-plant training on certain key machine types.

1) Pouch forming, filling and sealing - 1970 PMMI Directory, pp. 26-28.
2) Carton forming, filling and sealing - 1970 PMMI Directory, pp. 14-15.
3) Case packaging and sealing - 1970 PMMI Directory, pp. 16-17.
4) Marking and printing - 1970 PMMI Directory, pp 26-28.
5) Tube filling - 1970 PMMI Directory, p. 18

3. Sponsored by

a. Government agencies (USA and foreign).
b. Trade associations (domestic and international).
c. Private industry.
d. Schools, institutes, etc.

II. Topic Discussion.

In meeting the packaging equipment needs of the LDC's, we have focused entirely on in-country needs and how these needs can be met by the participation and assistance of primarily U.S. industry and technology. This would involve the use of existing commercial-type equipment and the training of indigenous technical personnel to operate this equipment in the LDC's as a commercial or government entity whose goal is to package and protect the product to the point of final sale to the consumer. Relative to donated supplies manufactured in the U.S., equipment is available to perform any known task--all that is required is the decision to implement any specific application.

We cannot, of course, look at the package equipment problems independently of all other considerations. Package equipment must be designed, modified, or chosen based on the specific product-type to be packaged, on the specific material to be utilized, and on the package configuration desired. Once these elements of the product-package mix are established, such factors as degree of sophistication, versatility and volume output must be considered. In short, we must adapt the packages to the consumer habits of the LDC, then select the least cost packaging to do the job. These need not be sequential steps but should be co-developed.

In this report we have concerned ourselves with both specific solutions and generalized alternative solutions based on a range of product types, material types and packaging configurations. In the latter part of this report we will outline specific equipment that may solve some of the specific problems posed in several of the letters addressed to L.I.F.E. in connection with this conference. Basically, however, we feel that specific problems will continue to occur and we feel that such problems could be solved by convening a group of experts from trade associations, such as PMMI or similar U.S. or foreign organizations or from individual machinery companies. This group would have to work closely with food

and packaging experts and with those who have a specific knowledge of in-country technology, mores, and political and economic climate.

In general, we do not believe that any of the problems are impossible to overcome. Prospects for moderate cost, simple-to-maintain equipment are excellent. There is in existence a wide range of equipment from semi-automatic type utilizing a higher proportion of unskilled operators to fully automatic integrated equipment utilizing far fewer operators but requiring technically trained personnel.

Packaging equipment is available, either foreign or American, for virtually all types of package configurations which include flexible pouches utilizing preformed bags or integrated form, fill, seal machines; semi-rigid containers that may utilize preformed containers or again form-fill and seal on line; chub type packages that can utilize extruded tubing or flat roll stock; wrapping equipment; and a wide range of cartoning equipment. This equipment can affect a wide range of closures ranging from heat sealing to a metal clip closure or wire tie closure. In addition, the equipment must be selected based on whether the product is granular, powdered, liquid, or individual pieces.

The influence of equipment investment relative to hand labor cost is a complex issue where conflicting ideas relative to the best use of indigenous labor have been presented. Following is a partial list of advantages and disadvantages:

1. Utilization of significant hand labor will create jobs and therefore purchasing power.
2. Higher labor costs would probably be associated with lower equipment costs.
3. Semi-automatic equipment is less expensive and requires less technical and maintenance personnel.
4. As hand labor increases, package integrity and reliability decrease.
5. Fully automatic equipment requires a larger investment and provides larger volume output with resulting lower package cost.
6. Semi-automatic is generally more adaptable and versatile to different products and materials.

We feel that equipment investment and consequently equipment sophistication must be related to the state of the art in the LDC. That is to say that a highly sophisticated piece of equipment should not be placed in a country where nothing existed before; it should evolve as the need arises, from less sophisticated forms. This equipment investment must be dependent on projected volume output. Equipment and hand labor costs must be balanced in such a manner to result in placing the highest quality and the minimum cost package in the hands of the consumer.

It is evident that the placing of equipment in LDC's will necessitate the training of technicians for servicing this equipment. This training could be accomplished in several different manners. Technical personnel

could be sent to the U.S. to be trained in a trade sponsored school-type situation or by the company that is supplying the specific equipment system. Alternatively, U.S. personnel could be sent to the LDC to train the indigenous personnel either at plant site or preferably train instructors in local training centers such as Mysore in India. In either case, training should consist of both specific training with the specific equipment to be used and generalized training to acquaint personnel with the functioning and operation of equipment component parts. Guides such as the PMMI brochure dealing with component parts could be utilized. Financing of such training ventures might be a function of A.I.D.

The limiting factors peculiar to the LDC's must, of course be considered. Some of these considerations have been previously touched upon; however, the following points are re-emphasized:

1. Economic considerations.
2. Availability of technical personnel.
3. Choice of packaging materials available.
4. Auxiliary needs such as electrical power, compressed air, etc.
5. Plant sanitation and conditions; i.e., temperature, humidity.
6. Government regulations and political climate.
7. Company liability.
8. Degree of cost and maintenance.

It is not felt that prototype equipment is desired for LDC's except where redesign or modification may be necessary to accommodate entirely new packaging materials or processes. In general, what is needed is an existing debugged system. Moderate cost, simple-to-maintain equipment is presently available to meet existing packaging problems. It is, however, not possible to recommend specific equipment to accomplish all jobs--equipment must be chosen to fill particular needs. The following specific information is necessary to make a decision:

1. Type of product to be packaged.
2. Type of material to be used.
3. Desired packaging configuration.
4. Desired size and weight of package.
5. Volume output desired.
6. Level of equipment investment that can be financed.
7. Presence of technically trained operators and plant conditions.

With this specific knowledge, a group of machinery experts obtained through companies or trade associations, such as PMMI, could arrive at specific conclusions.

III. Potential Packaging Systems for LDC's.

A. Short Range.

1. <u>Thermoformed plastic containers</u>: The thermoforming process, as one means of producing packages, does lend itself to ful-

filling the packaging requirements of the LDC's. The process provides the capability of producing either lightweight thin-walled or heavyweight versions, depending on the product requirements. Virtually any thermoplastic material can be employed. Naturally, the material selection will be limited to its availability in the particular country.

From an insect standpoint, thin-walled plastic containers may provide an infestation barrier. By heat sealing a suitable closure to the container, the package will provide excellent protection from its environment.

Output rates of this equipment range anywhere from 50-1500 packages/minute, depending on the size of the package as well as the size of the equipment employed. Cost of machinery ranges from $30,000 to $150,000. Naturally, in the majority of the LDC's, for reasons of limited volume requirements, we would be talking in the price area of $30,000 or $90,000. Less expensive equipment may be available depending on container design and extrusion equipment needed.

A specific recommendation which makes sense for these countries is as follows:

Thermoform lightweight, nestable, cup-shaped plastic packages at one central location at a relatively high rate of speed and ship these parts, in a nested state, to various geographical locations. At these locations, they could then be filled with the particular food product (milk, cereal, etc.) and sealed either by way of a snap-on lid (cottage cheese container type package), heat sealed foil cap, or a thermoformed closure spun weld to the package. The latter two capping methods would provide a hermetic seal, if so desired.

Packages produced by this process are lightweight, disposable, and very low-priced. The possibility of container re-use does exist.

This and similar type equipment is available from companies such as Brown Machine Division of Koehring Company and Illig Company (Germany).

2. <u>Filling and sealing of multiwall paper shipping sacks</u>.

   a. Equipment to fill and seal 50# paper shipping sacks is available from such companies as Union Camp, St. Regis and Bemis Bag.
   b. Available equipment is semi-automatic or automatic operating at speeds up to 20 bags per minute.
   c. Closure techniques such as TOS or POM and TIS valve are commonly used.

d. Relatively simple equipment with rates of speed up to 3 bags/minute are priced at approximately $1,000. More sophisticated automatic type of equipment can range to $35,000.
e. Such equipment may be beneficial for packaging of grains for prolonged storage to minimize infestation inherent in bulk open storage bins.
f. The prospect of utilizing cloth or burlap type bags and IRT coating equipment must also be explored.

3. Plastic coated paperboard cartons (Pur Pak or Tetra Pak).

A wide range of packaging equipment is available utilizing wax or plastic-coated paperboard cartons. Equipment for this purpose is generally available on a lease basis with packages ranging in size from 1/2 pint capacity to 1-gallon capacity. Such equipment can be adaptable to a wide range of product types including liquid, semi-liquid, granular and piece type products. Production speeds range up to 100 per minute depending on product and carton size. Such a system would provide product protection and versatility. This and similar equipment is available from companies such as Ex-Cello-O Corporation, Cherry-Burrell Corporation or Bemis Bag.

4. Semi-automatic machines.

a. Pouch forming.
--PMMI 1970 Directory, pp. 80, 114, 123, 169.
b. Pouch filling liquid and dry product.
--PMMI 1970 Directory, pp. 145, 183, 65, 125.
c. Pouch sealing.
--PMMI 1970 Directory, pp. 255, 259, 111, 115, 53.
d. Thermo forming semi-rigid containers.
--PMMI 1970 Directory, pp. 59, 47.
e. Semi-rigid container filling.
--PMMI 1970 Directory, pp. 19-22.
f. Semi-rigid container sealing.
--PMMI 1970 Directory, pp. 45, 109, 145, 217.
g. Carton forming filling closing.
--PMMI 1970 Directory, pp. 14, 15, 16.

5. Automatic machines.

a. Form fill and seal machines.
(1) Pouch - PMMI 1970 Directory, pp. 27-28.
(2) Chub package - PMMI 1970 Directory, pp. 167, 111.
b. Thermoforming machines.
--Brown Machine Company, Beaverton, Michigan 48612, U.S.A. - PMMI 1970 Directory, pp. 47, 59, 179.
c. Filling machines (liquid).
--PMMI 1970 Directory, pp. 20-22.
d. Filling machines (dry products).
--PMMI 1970 Directory, pp. 19-20.

e. Carton form fill and seal machines.
--PMMI 1970 Directory, pp. 14, 15, 127.

f. Case forming packing and sealing.
--PMMI 1970 Directory, pp. 16, 17.

B. Long Range.

1. U.S. Army Natick "Retort Pouch".

2. Autoclaveable pouch or "flex can" (Reynolds Metals or Continental Can Company).

3. "Extruseal" sealed carton (Brown Company).

4. New plastic-coated package (Fibreboard Corporation carton).

5. "Folding can" (Riegel Paper Corporation folding carton).

6. Shrink polypropylene overwrap, e.g., Gaines Dog Food.

IV. References.

A. Associations.

1. Package Machinery Manufacturers Institute.

2. Paper Shipping Sack Manufacturers Association.

3. Society of Plastics Engineers.

4. Society of Plastics Industry, Inc.

B. Manuals, Catalogs, Equipment Brochures, etc.

1. Asian Productivity.
--"Packaging Engineering Training Starts in Japan", February 5, 1970.
--"Packaging Engineering Course Concludes", March 5, 1970.

2. Bartelt Engineering Company, Inc.
--"The Bartelt Directory".
--"Bartelt/Hassia - Model 421 C Liquid Packager".
--"Bulletin 101 - Intermittent Motion Packager".
--"Bulletin 201 - Multiple Packer".
--"Bulletin 401 - Packmaster".
--"Bulletin 502 - Automatic Cartoner".
--"Bulletin 605 - Model D Filler".
--"Wolkogon Pharmapack Pouch Forming and Filling Machine G-PV/U Simplex or Duplex".
--"Wolkogon Pharmapack Sealing Machine E-MS/III".
--"Wolkogon Pharmapack Thermoforming Packager V-100/AI and V-100/AII".

3. Bivans Corporation.
--"VERtuck 7050"(vertical cartoning system).

4. Brown Machine.
--"Brown Thermoplastic Equipment" (second edition).

5. Canadian Packaging.
--"Automation Comes to Milk-Pouch Packaging", March 1970.

6. Compacker, Inc.
--"...new approaches to box sealing".

7. Doughboy Industries.
--"Chain Band Tape-over Sealer".
--"Continuous Glue Sealer".
--"FILLING MACHINES".
--"MEDIUM DUTY SEWING MACHINES".
--"MiniTIE Portable Twistier".
--"MODEL BD BAND SEALER".
--"MUSTANG Wrapper".
--"Power Hand Sealer Continuous Band Model HS-C".

8. Flowtron, Inc.
--"VISCO-FILL" (positive displacement filling machine).

9. Formost Packaging Machines, Inc.
--"Only a Formost can bag'em all."

10. Hayssen Manufacturing Company
--"Series 60 Model LM Expandette" (milk pouch packaging machine).
--"Sales Bulletin-Milk Packaging, August 28, 1969.

11. Kartridg Pak Company.
--"the Kartridg Pak Rigid package luncheon meat packaging machine".
--"the wonderful world of chub packaging".

12. Modern Packaging.
--"Modern Packaging Encyclopedia".

13. National Canners Association.
(Audio Visual Series).
--"Can Handling".
--"Evaluation of Can Double Seams".
--"For the Retort Operator".
--"Guide for Waste Management in the Food Industry".
--"Planned Sanitation".
--"Using SQC".

14. Packaging Machinery Manufacturers Institute.
--"Packaging Converting Machinery Components".
--"1970 Packaging Machinery Directory".

15. Patent Office, London, England.
--Patent 1,154,752: Method and apparatus for Sterilizing.

16. Ray Publishing Company.
--"Packaging Machinery Catalog" (1970 edition).

17. Rennco.
--"Model 101" (film packaging from roll stock).

18. Seffelaar & Looyen N.V.
--"selo-clipper".
--"TOURVAC 120" (fully automatic deepdraw vacuum-packaging machine.

19. Servpak.
--"Servpak Lidder, Model 211".
--"Servpak 114 - Frictionless Powder Filling".

20. St. Regis Paper Company.
--"Air Flotation Palletizer - Model 4".
--"Bag Clamp Coder".
--"Bag Packaging Systems".
--"EASIFLOW I and II PACKERS".
--"EASIFLOW I PACKER FOR FERTILIZER".
--"EASIFLOW I PACKER for Granular Materials".
--"EASIFLOW II PACKER for Powdered Material".
--"FORCE FLOW MODEL J for Fertilizer".
--"FORCE FLOW MODEL J with Air Pad".
--"Force Flow Packer".
--"Gravity Type Valve Bag Packer".
--"Hot Air Pinch Bottom Bag Closer".
--"JETFLOW IMPELLER PACKER".
--"Jetflow Impeller Packer" (Data Sheet 79-E).
--"Junior Force Flow Packer".
--"MODEL 150-FC PACKER".
--"PINCH BOTTOM BAG CLOSER".
--"Pinch Bottom Bag Top Imprinter".
--"PLATEN PRESS".
--"PLATEN PRESS PRINTERS".
--"Volumetric Valve Bag Packer".
--"107 FC VALVE BAG FILLING MACHINE".
--"150-FC Valve Bag Packer".

21. Tipper Tie, Div. of Rheem.
--"Air Powered Tipper Clippers".
--"Versatile Clip Closure Systems".

22. Triangle Package Machinery Company.
--"new triangle 3-side fin seal bag machine".

23. United States Patent Office.
--Patent 3,494,724: Method and apparatus for controlling microorganisms and enzymes.

24. Vertrod Corp.
--"Thermal Impulse Heat Sealing Machinery."

C. Foreign Sources of Equipment Education.

1. Institute of Packaging, Wimbley, England
2. Japan Machinery Manufacturers.
3. Packaging Association of Canada.
4. World Packaging Organization.

None of the above are prepared to give training help in depth. Japan Machinery's people only recently have discussed programs of this type with the PMMI office.

We suggest that the above groups be contacted to cooperate with our efforts.

V. PANEL B: ADAPTING PACKAGES TO CONSUMER HABITS

Panel Members: Allan L. Griff, Chairman; William J. Gall, Frank E. Horan, F. James Levinson, Robert Russ, Stanley Sacharow

I. Basic Outline for Discussion.
--In general, find locus of decision: Who decides on package choice?

A. Purchase Habits.

1. Who does the food purchasing?
Is there choice? Suppose there is no consumer purchasing? (Central buying and/or giveaway.) Does bulk purchasing (e.g., institutions) mean bulk packaging? Do people eat whatever they are given? Or what do they accept or reject?

2. Is the package a sales incentive?
How important are aesthetic features? How effective is advertising? (Barbadoes milk case where advertising encouraged purchase of wrong product.)

3. Is the package a deterrent?
(No inspection, bad appearance, distrust of seller, e.g., Iran milk.) Are consumers worried about adulteration? How can they learn to trust the package? Are their worries justified?

4. Packages are touch-barriers.
Does this deter purchase and use in a touch-oriented society (as are most low-literacy societies where all other communication means are relied on more)?

5. Package cost.
Must the consumer pay extra for packaging? Does a better (more expensive) package indicate prestige and encourage product use? Does "least-cost" packaging denote a poverty image to users (Incaparina)? Can package costs to consumer be reduced or eliminated via tax allowances, subsidies, etc.?

Packaging means the distance from source of control increases. There is often a reluctance to extend dependence, to need things from further away, less-controllable, less predictable sources. Role of local packaging from bulk?

6. Distribution patterns.
For donated, imported, locally-produced foods? Who controls distribution? Distribution as a basis for political, occupation and family authority.

In specific, who would control purchase and movement (and price) of the high-protein foods for preschool children? What do these foods cost? Who pays for them? Does their distribution consider the limited participation of the consumers in the money economy (where is this so?)? Who ends up eating the product?

7. Time factor.
   Short-term vs. long-term purchases...credit...refrigeration...room-temp storage (longlife milk). Consider distance from food source to consumer terms of both space and time. Cost of moving milk, for example, from cow to child. Longlife milk may still be too expensive--need it be?

8. Where can consumer habits be altered?
   Where are they already visibly changing (e.g., supermarkets in Japan, Brazil)? Change is normal everywhere...but the pace and nature of change varies. Change is tradition in many places. All systems have "loopholes" to permit change, otherwise, they don't evolve and meet new challenges and don't survive.

9. Marketing needs and problems.
   Where can packaging fit in? Shouldn't various packages be tried at market-study level, at same time food itself is developed? When are package tests done? Can funds be allotted for this, especially within structure of donor-packaged products?

10. What is function of local institutes, governments, ministries, universities?
    How can they help and how do they hinder? What is their social influence effect?

B. Package Re-Use and Disposal.

1. Re-use concepts--consumed vs. kept-item vs. sold-item.
   Re-use ideas...poly bags as mini-mulch; polypropylene film - candles; foams as soil-aerators, insulation, brick-fill; window material (any clear plastic). Printing re-use instructions on package (or inside), as has been done in the past for cloth bags to be used as farmers' wives' dresses. Re-use as purchase incentive.

   What is real re-use value of sacks...paper vs. cloth vs. plastic-ribbon? Is the sack still a desirable form? Do paper sacks have any substantial re-use value? Re-use of thin, one-use rigid containers such as blown PE bottles or thermoformed PS? Planters for small seedlings?

2. Re-use by retailer.
   Returnable to packer for refill? Fits consumer habit of filling own container. Returnable containers = higher cost, quality = less waste? Eliminate sack (50-lb/25kg) level? Big containers can easily be fumigated? Big con-

tainers prolong state of best protection? How can packages be re-used as packages for other things? Can they be upgraded (e.g., polyethylene liners in jute bags)?

C. Sizes and Shapes.

1. Smaller sizes.
   Reduce reweighing and related costs and losses. May also cut one or more handlers' profits and reduce cost to consumer.

2. Portion control.
   (Iran letter 30 kg sacks). Large as well as small portions. Would unit packaging in small portions actually reduce package costs?

3. Large sizes.
   May need bug-proof reclosables. (refill tins?) and/or development of repacking machinery in user-country...or altered dispensing customs (all on one day).

   Absolute need to use metric units where possible. Avoid unnecessary time, reweighing and loss, confusion and error. No big problem to U.S. industry.

D. Messages Carried On (or in) Packages.

1. Problems of illiteracy.
   Use radio and TV, extension workers, learn-to-read leaflets and school texts. Symbols and pictures.

   Level to which the package reaches should dictate nature of message. Minimum repack and/or portion control keeps donor's message together with food as long as possible. Politician's problems.

2. School children as focus of message.
   After all, it is their lives that are affected most, and they are most willing to learn things (picture of strong child on protein supplement package).

   Package as place for non-nutritional messages.

   Educating sellers, peddlers, etc., in nutritional concepts. Is it possible and is it worthwhile?

3. Where are the loci of belief...whom do people believe in these matters?
   The question of etiology adapting to people's ability to handle it. They can't afford to believe in nutrition, germs, etc. L.I.F.E. Malawi case. Listing nutritive contents. Is it done anywhere now? Government actions and cooperation. Note Iran law. Notice of vitamin and other supplements? (Note Brazil milk, where <u>lack</u> of vitamins encouraged blindness development!)

E. Special Needs.

1. Are there social or cultural functions to certain foods? Status links? How are packages involved?

   When are the major food distribution and eating times, particularly of protein, which can be stored to some degree, and is often eaten in connection with family feasts, such as weddings or religious festivals, etc. How can we adapt packaging to these things?

2. Central packaging for institutions.
   Bulk vs. portion pack. Special problems. Edible film? Portion control? Humidity/storage problems.

F. Costs.

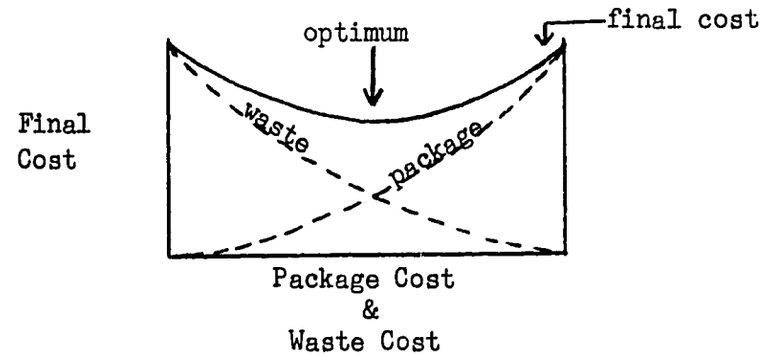
1. Ratio of packaging cost to total cost.
   How important is this, really? What are the components of cost of various foods to the eater (or to the decision maker)?

   Stress on this ratio assumes other components minor or static? Can any components be cut out or reduced to compensate for any increased cost due to the package?

2. How does the buyer perceive product cost?
   Hidden costs. Do national or local tax or subsidy systems favor purchase of packaged (or unpackaged) goods?

3. Preparation of cost analyses of different types of packages.
   Not just how much the package costs here, but the breakdown of its cost to manufacture, at various levels of outputs--to be distributed widely, to give package specifiers and package buyers a real idea of what their packages could and should cost. Include equipment, materials, royalties, etc.

   Concept of optimum package cost:



   Where does the waste go? Is it stolen, used by poor people, or isn't it as high as we think? This is crucial, as increasing package cost to cut waste depends on amount of waste!

II. General Comments.

Knowing the product to be packaged is not enough for deciding upon the best package. We must consider the path of distribution and the place of distribution, for these will then control package choice as well as other things.

The panel was quite concerned with the difference between foodstuffs that were donated and, more generally, institutionally distributed, and foodstuffs which were commercially sold, no matter what their source or destination. These imply different aims: the donated food has the objective of getting undernourished people fed. Commercial ventures have the objective of economic development, expansion, and profit. Both may be worthwhile, but they are not always coincident. We have tried to distinguish between these two paths in this report. For donated food, we concentrate on the point of view of the one who is eating the food. For commercially sold foods, we must also consider the point of view of the seller, whose need must be satisfied as well as those of the consumer.

The body of this report consists of nine projects which we conceived as feasible and useful in the area of food packaging. Most of them are concerned with consumer habits, which was the object of our panel. However, it was inevitable that we should concern ourselves with aspects elsewhere in the chain from producer to consumer.

In considering consumer habits, several projects and recommendations have mentioned the positive and negative aspects of a package which can be a deterrent to use, as well as an encouragement. Even non-packaging (dispensing to consumer from bulk) must be considered in this light, as well as the problems of the consumer himself in storing this food.

III. Proposed Projects.

A. Packaging of PL 480 and similar foodstuffs.
   Study of past experience and application to current and proposed products.

B. Unit packaging in LDC's.
   Economic and other advantages, what it is and who does it.

C. The package as a message carrier.
   Advantages, problems, and some ideas.

D. Packaging on a consumer level in LDC's.
   Field study and preparation of written guidelines for use in local markets.

E. Field requirements for donated and institutional food packaging in LDC's.

Technical and economic information of use here by basic food packers.

F. Market status, response, and development.

Field study to recommend packaging changes and initiation.

G. Waste and losses.

Quantitative study. The magnitude of loss and its justification for package changes.

H. Package reuse and disposal.

Study existing patterns; propose new ones; and consider problems.

I. Economics of protective storage.

At consumer level or at shop and distribution level. Study of economics and trial of suggestions.

IV. Project Elaboration.

A. Packaging of PL 480 and similar foodstuffs.

Coordination and analysis of experience of (a) U.S. shipper and (b) field receivers. Study of distribution system, identification of ultimate users, location of use (e.g., school or home), the acceptance-resistance status of packaging.

Application to current and proposed products, including

(1) Cost components of various types and systems;
(2) Recommendations and specifications for specific products and areas;
(3) Recommendations for continued collection of information from the field; and
(4) Isolation of specific problems.

B. Jnit Packaging in LDC's (Donor).

Study costs of several schemes of unit repack with representative products. Study quantitative aspects of justification--prolonging the message of the package; prolonging the protective value; saving the cost of intermediate packaging; cutting out cost of middle men; increasing product protection against insects, rodents, etc.; discouraging stealing; reducing spillage; and portion control.

Consider elimination of intermediate (sack) level. Consider location of unit packaging--here or there. Availability and problems with machinery. Consider nonpackaging at consumer level--dispensing from bulk, perhaps with home or shop storage. Functional packaging--subunit single use, to control shelf life in home. Consider financing or development of controllable and trustable repacking industries in receiving ports.

C. The package as a message carrier (Donor, mostly).

Consider the ways packaging can so function, solicit ideas, and keep in mind distribution systems and different local belief systems. Show how the package controls the level to which the message reaches. Repackaging can destroy messages. Reuse of packages can provide a lasting message. Investigate political and other problems with messages. Consider illiteracy and the need for pictorial symbols--also, nonverbal abstract "messages", such as shape, opacity, texture, and size. Warnings as messages. Use instructions as messages, disclosure of contents. Messages inside containers put in during packaging operation.

D. Packaging on a consumer level in LDC's.

Field observation and study of existing packaging, package costs and consumer habits, with interviews, full use of local sources, and analysis of culture patterns and trends. Limit to one country or cultural division at a time. Consult and coordinate literature, such as Sacharow book, Modern Packaging Encyclopedia, and individuals. Consider the place, the method, and the extent of dissemination of this information. Keep in touch with efforts that overlap, such as those of the Protein Advisory Group.

Objective: Develop guidelines for consumer packaging in the culture studied--distinguish between positive and negative attributes of packaging (appeal vs. deterrent). Location of packaging costs as component of total cost. (It may not be as much as assumed.)

E. Field requirement for donated and institutional food packaging in LDC's (Donor).

Guide to food packages in LDC's. Cost and function analysis of different types of packages. Concept of optimum packaging cost, where increased package cost may reduce waste more than enough to compensate.

Objective: A useful report to bidders on government donations, the government itself, distribution agencies, and local food industries (especially those themselves interested in export or large shipment).

F. Market status, response, and development (Commercial).

Field study of local needs and habits. Packaging man to recommend packages to local industry for existing and proposed products in a given country. Determining the needs and habits, noting how they respond and change, and showing what we can do to go along with these changes. Consider promotion of functional packaging, where feasible and desirable, such as gaining advantage of sanitation and economy of scale. No assumption of local acceptance of western packaging concepts. Case studies of how consumer habits have been altered and their lessons. Role of local governments and institutions.

G. Waste and losses. Quantitative study (Donor).

1. Case studies of current practices.
   a. How much is lost and where?
   b. Where does this loss go--e.g., destroyed? stolen and sold? stolen and eaten? abandoned and eaten? etc.

2. Determine the magnitude of loss to justify:
   a. Improving package, with costs absorbed by savings;
   b. Efforts to recover and put to use the loss;
   c. Conceiving of AID purchases in terms of food units, actually consumed by hungry people, not just units shipped--and requiring bids in these terms;
   d. Role and costs of insurance.

H. Package reuse and disposal.

Study existing reuse patterns, solicit and generate new ones, locate reuse as a component of total economics of some typical product--considering the entire chain from production to consumer. Consider giveaway containers for re-use as storage. Disposal as a problem: Dangers (fire, infants choking on film); environment deterioration (packaging materials plugging inadequate drains); toxic combustion products.

I. Economics of protective storage (Donor and commercial).

Separate studies might consider (a) consumer level and (b) shop or distribution outlet. Examination of principle--allow larger cheaper packages, easier distribution. Study of available containers and costs. Field observations and interviews. Trials. Consider effects of distribution changes, via protective storage: Is the authority pattern changed? Is food now misused or wasted more? Should the containers be given away or sold?

V. Non-Project Recommendations.

A. Package costs must be considered and understood by the decision makers in food purchasing, whether domestic or abroad.

B. Metric units should be used everywhere, wherever possible. This does not pose major problems to American packagers.

C. Free dissemination of packaging information where financed by public funds. Also, dissemination of <u>sources</u> of packaging information, telling people where to go to learn things. Coordination of AID work with World Food Program--FAO, FDA, World Food Organization. Possible function of L.I.F.E. as liaison point, since it is impartial, nonprofit, and not part-time.

D. Sending of information teams or groups to LDC's as extension or field workers to continually update key local people or institutions with packaging information--also to discover and isolate present and new problems.

E. Commercial packaging problems--don't wait for their inquiries, but seek and anticipate their problems.

F. Test the package along with the product as early as possible--the donor must include testing at the bid level, and the higher cost of this testing, if not already funded by AID or other source, must be economically justified but must not prejudice the bid. In other words, if I spend more money to test my package and I charge the same for my product, I should be, if anything, considered before an apparently lower bid with the same product cost and less testing. However, I should be able to prove and show results of this test, if my cost is to be considered.

G. Consider funding non-profit groups, such as L.I.F.E. or VITA, for certain projects, in addition to industry and consultants. Groups like L.I.F.E. are in a special advantaged position as coordinators of a great amount of expertise.

H. Consider holding future meetings which include representatives of recipient countries--not political representatives but ones willing and able to participate in frank discussion, helping us appreciate what happens there.

I. Recommend independent packaging specialists to advise on continual basis all government organizations concerned with food distribution. The aim is to avoid packaging errors, help make specifications, coordinate liaison with the packaging research work done with government money at corporate or at other level and work done abroad--collect and interpret field data.

J. Consider reconvening of this or similar group.

K. Consider using members of this group to do specific jobs, gather data, and/or lead teams to do the same.

L. Recommend a unit to inspect packages, to reclaim them, and to gather packaging information, located at ports of recipient countries, reporting to and responsible to AID or UN.

M. In funding food development projects, always include funds for package development. And this development must include contact with the field situation. AID or government personnel may be of assistance here. If such package development is funded, its results should be reported and made publicly available. Specifications for packages can and should be based on such early package development.

VI. PANEL C: NEW APPROACHES TO LEAST COST PACKAGING

Panel Members: Denis Robinson, Chairman; Ross A. Easter, Wallace H. Nuttall, Robert Rutherford, Fred B. Shaw

I. Recommendations.

A. Expert advice should be utilized for solving specific packaging problems in the individual LDC's.

B. Influence of food formulation on packaging should be recognized and utilized.

C. Innovative systems should be applied to preserve perishable crops.

D. New manufacturing and fabricating techniques should be introduced to LDC's.

E. Implementation of the recommendations of this panel shall be accomplished in accordance with the procedure outlined herein and funded by U.S. AID.

II. Specifics.

A. Packaging problems in LDC's should be fully analyzed and defined by packaging experts. We recommend that the following factors be considered.

1. Complete listing of indigenous packaging materials, their attributes, availability, costs and the techniques of use.

2. Complete listing of equipment and facilities, such as packaging equipment, available power, and mechanical handling equipment.

3. Complete list of deficiencies in present packaging and systems with respect to:

a. Handling, warehousing, distribution and turnover.
b. Infestation and contamination.
c. Climatic conditions.
d. Spoilage from other sources.
e. Costs.
f. Shelf life.
g. Graphics and labeling (educational value).
h. Repacking and repairing.

i. Closures and reclosures.
j. Disposability and re-use.
k. Availability on continuing basis.
l. Unit size.

B. Formulating foods to simplify packaging needs is an important area in which we recommend the following:

1. Each ingredient should be studied for its physical characteristics and its reactions when combined with others in the formulation with respect to specific packaging requirements.

2. Methods of combining, mixing and processing prior to packaging should be studied by food technologists in the light of their mode of failure. Only when this is known can the true economics be ascertained. Examples are:

a. Encapsulation of fats to control oxidative rancidity.
b. Control of water activity to inhibit microbiological growth--as in semi-moist dogfood.
c. Use of roasting and drying to lower moisture levels and eliminate enzymatic reactions.
d. Use of anti-oxidants, such as BHT.

3. Methods of including ingredients as additives to perform multiple functions. For example, the use of a mixture of tricalcium phosphate and glucose to serve both as a mineral source and as an infestation control. Dr. Walter Ebeling, Professor of Entomology, Department of Agricultural Science, Agricultural Experiment Station at the University of California in Los Angeles (U.S.A.) is an expert in this area.

C. We recommend looking more closely at

1. Presently available systems for processing and packing food --that is, making ready-to-eat-weaning food formulations in individual units, reducing in-home preparation costs.

2. Forming co-operatives, where necessary in the area of perishable crops, justifying use of permanent or portable processing equipment to maintain lowest costs.

3. New techniques, such as flexible retortable packages[1], microwave processing[2], and aseptic packaging[3], are suggested methods.

D. New materials usually mean higher costs; therefore, in the LDC's it is recommended that currently available materials be utilized, but by newer methods. For example, employing the co-extrusion process in lieu of simple extrusion or laminates to obtain the

1-3. See next page.

superior properties of composites at minimum costs. However, the use of new materials, such as non-woven fabrics and sophisticated laminates for the packaging of foods outside of the LDC's for shipment thereto, should be evaluated in individual cases.

Edible films may offer new opportunities; for example, "Ediflex", a new water soluble starch film.[4]

A study should be made of the application of thermoforming and/or extrusion coating to the packaging of consumer units (portion controlled) of compacted foods. This is a means of minimizing packaging materials, cube and costs, accompanied by a maximizing of barrier.

E. The application of computer technology to solving packaging problems should receive attention. Dr. Marcus Karel, Department of Food Science and Nutrition at Massachusetts Institute of Technology, Cambridge, Massachusetts (U.S.A.) is familiar with this application.

F. It is recommended that the Packaging Institute, U.S.A., or an equivalent technical group, be requested to nominate a five-member Ad Hoc Committee to meet bi-monthly to consider individual recommendations of this and other panels, and make recommendations as to appropriate individuals or organizations to investigate and take action on the individual items covered. This Ad Hoc Committee should report to the Executive Director of L.I.F.E., with all expenses being authorized by the Director, Office of Nutrition, U.S. AID.

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[1] "Heat Processing of Flexible Packages". Package Engineering, March 1962.

[2] British Patent 1,154,752, dated June 11, 1969.

[3] U.S. Patent 3,245,200, dated April 12, 1966.
U.S. Patent 3,299,603, dated January 27, 1967
"New System for Asceptic Pouch Packaging". Modern Packaging, October 1967.

[4] "Ediflex". American Maize Products Company, Roby, Indiana 46326 U.S.A.

VII. PANEL D: STORAGE AND SHIPPING CONTAINERS

Panel Members: Roy Landstrom, Chairman; John H. Dively, Walter W. Dykstra, Henry A. Highland, Paul E. Johnson, John King, William H. Schoenherr

I. Introduction.

Very large sums are lost each year as a result of damage to packages of food shipped to the LDC's. These losses may occur at each stage of shipment, where clean and wholesome products from food plants become contaminated and unfit for human consumption by the time they reach their intended destination. The prevention of such losses could save sufficient food to feed many thousands of hungry persons.

II. Recommendations and Suggestions.

A. U.S. AID might fund training programs and demonstrations in LDC's for personnel responsible for cargo handling techniques, warehouse operation storage facilities, and on insect and rodent-control techniques. A training task force of qualified personnel from private industry, government and other agencies should be developed.

B. Develop containers that provide more resistance to physical damage, insect damage, and mold and rodent damage (USDA and industry). Example: Tri-Wall Containers.

C. U.S. AID might fund technical assistance to improve handling equipment, such as pallets, handcarts and cargo slings.

An immediate improvement would be canvas slings and spreader bars. In the longer term, consideration should be given to larger unit loads such as shipping containers which will also provide protection from physical, rodent, bird, and animal damage. The size of the units would depend on the quantity shipped and the handling equipment that is available.

D. Require that all railcars be fumigated after loading to kill all insects and rodents (by ASCS, USDA).

E. Inspect domestic port warehouses and institute more rigid sanitation standards (by ASCS). U.S. AID should assure that agreements of cooperating sponsors with foreign governments and warehousemen provide standards for sanitation and management, with provisions for enforcement.

F. Warehouses should conform to the following:

1. Masonry, or metal construction.
2. Sufficient windows for adequate ventilation with screening against birds and protection against rain.
3. Building to be rodent proof with countersunk doors and rodent-proof wire screening over all other openings.
4. Warehouse design should allow for complete closure so that stored commodities can be fumigated.
5. Stacks should be uniform in size to accommodate tarps for fumigating to eliminate insects.
6. Aisles must be wide enough to provide for good housekeeping practices.
7. It should be emphasized that shipping containers can be designed so as to provide improved final storability in the warehouse.

G. Shipments of voluntary agencies and other cooperating agencies should be consolidated at central warehouses and commodities distributed on a first in, first out basis. Packages should be dated to permit proper rotation and inventory control by allocating foods to the distributing agencies from the central warehouses rather than the manufacturing plants.

Contaminated packages should be removed from warehouses without delay so as to discourage spread of the infestation. Enforcing this provision is difficult, but it should be encouraged. Low-cost portable storage bins such as "Bin Bags" may be of help in this case.

H. Quality control procedures to assure proper construction and closure of packages (by USDA inspectors).

I. Funding by U.S. AID to investigate the development of insect and weather rodent proof tarps (by USDA and USDI).

J. Develop unitized methods of shipment.

K. Form a committee clearing through L.I.F.E. to continue the function of this conference.

III. Problems from Processing Plant to Dockside in U.S.

Packaging problems can develop in bags that are not made according to specifications or in bags with closures improperly formed at the processing plant. Physical damage occurs when the package is moved into the railcar. Since most cars are infested with insects, espe-

cially during warm weather, packages are subject to infestation as soon as they are placed in the car. During movement of the car, physical damage may occur as a result of protrusions, etc., on walls and floors. Constant wear between bags can produce fatigue in the package components. Further damage occurs while unloading the railcar at the port because of pallets that have protruding nails, splinters and loose slats. During storage in the dock warehouse, the packages may be attacked by insects and rodents. Since most ports handle a wide variety of goods and commodities, packaged foods are subjected to the entire spectrum of insect infestations, rodent attack, and damage by careless handling and contamination from other materials stored nearby. Rapid and extreme changes in ambient temperatures can cause moisture to condense on the bags. Such moisture can cause the formation of mold on the exterior of packages.

IV. Problems from U.S. Dockside to Unloading in LDC's.

Cereals and other commodities are commonly shipped in cotton and multiwall paper bags, which are subject to damage by tearing, insect infestation, moisture, mold and rodents. Bags are punctured and torn by dunnage, bulkheads and pallets with splinters, protruding nails, and sharp edges. Similar damage results from the pressure of rope and cable slings on packages during loading and unloading. Damage to the package may not make the product unusable, but it does allow contamination by insects, rodents, mold and moisture.

V. Problems of Storage and Distribution in the LDC's.

Each LDC will have its individual needs. Recommendations will be difficult to implement from this point in the distribution chain. The main problems fall into four categories:

A. Physical damage during handling into and out of the warehouses.

B. Damage from insects, rodents, birds, livestock, and excess moisture in the warehouse.

C. Items being stored for excessive periods of time.

D. Method of distribution to final consumer.

E. Inexpensive insect and rodent resistant properly covered bins can compensate in part for the inadequate warehousing facilities.

F. Plastic inflatables may have potential for storage.

VI. Advances in Packaging and Shipment.

A. Current Packaging.

During the past several years the following package has been developed and is currently being used in U.S. AID overseas distribution programs for blended foods and corn meal. This insect-resistant treated multiwall bag is fabricated from five plys of kraft paper and one ply of 3 mil polyethylene film. The film is stripe laminated to the inner kraft ply facing the commodity. The outer play is 60# wet strength kraft paper with an insect-resistant coating applied to the exterior surface. The remaining plys are 50# kraft paper. End closures and the exterior longitudinal seam are made secure against insect harborage and invasion. A completely enclosed system at the time of packaging would reduce insect infestation later.

B. Current Research and Development.

1. Purpose: To improve resistance to physical damage and overall strength.

   Applicable techniques:

   a. Woven polypropylene - a woven material made from strands of polypropylene that have been oriented in one direction to impart high tensile strength. The woven material is somewhat similar in appearance to woven jute.

   b. Spunbonded polypropylene - for use as outer ply to provide strengthening properties as outlined above.

   c. A specially oriented and laminated composite polyethylene film (Valeron) - this high-strength material is being evaluated as a possible substitute for the 3-mil polyethylene film currently being used.

2. Purpose: To improve resistance to insect infestation.

   Applicable techniques:

   a. Specially coated kraft barrier plys positioned next to the outer insect-resistance treated ply to hold the insect-resistance treatment either on the outer ply or to prevent it from migrating beyond the barrier ply. An effective insect-resistance barrier may make possible the use of a heavier application of the insecticide.

   b. Heat sealing of the inner polyethylene film ply. This will improve resistance to insects that have invaded imperfect end closures.

   c. Mold inhibitor. If other solutions do not confine mold that results from dampness, a mold inhibitor may be required.

It should perhaps be emphasized that whenever possible physical barriers to insects or rodent infestation may deserve priority over chemical procedures from a health and regulatory point of view.

C. Advances in Shipping.

Currently all packaged Food for Peace shipments go as "loose loads"--each bag handled and stacked individually. The packages, whether textile or multiwall paper, are afforded no protection against such things as nail heads, broken slats from pallets at docks, stevedore hooks, other cargo on the ships, and abrasion and other damage in railcars.

The use of unitized and/or containerized shipments has virtually eliminated the types of package damage described above. New, lower cost methods for unitized loads (generally approximately one ton each) are being perfected. One of the newest is the "shrink wrap", a film covering for a stack or pallet load of bags that will contract tightly around the load when it is passed through a heat protection against physical damage for the bags.

Containerization can provide maximum product protection. Containers the size of highway trailers can be loaded at the end of the packing line, then the doors closed and sealed. Normally such containers remain sealed until they are delivered to the customer in foreign ports, or inland if facilities are available for overland delivery. Containerized shipments also lend themselves to fumigation.

U.S. AID has had a number of discussions with USDA to arrange a test shipment of containerized non-fat dry milk to Brazil. While plans have not been finalized, it appears that 600 metric tons of NFD milk will be shipped out of Fergus Falls, Minnesota, in the near future. Thirty 20-foot containers will be shipped via New Orleans to Rio de Janeiro and Santos, Brazil. Results will be made available to interested parties.

VII. References.

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_____, Margaret Secreast and P.H. Merritt. "Polyvinylidene-Coated Kraft Paper as an Insecticide Barrier in Insect-Resistant Packages for Food". Journal of Economic Entomology, Volume 61, Number 5, pp. 1459-1460, October 1968.

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Majumder, S.K., Athia Bano and J.S. Venugopal. "Processing of Foodgrains to Induce Immunity to Insect Attack". Central Food Technological Research Institute.

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Pratt, H.D. "Pictorial Key to Some Common Beetles and Weevils Associated with Stored Foods". U.S. Department of HEW, Communicable Disease Center, July 1958.

VIII. BIOGRAPHICAL SKETCHES OF PARTICIPANTS

John H. Dively
Manager of Planning
Bag Packaging Division
St. Regis Paper Company
West Nyack, New York 10994

St. Regis has as one of its primary objectives the development, testing and successful introduction of packages and packaging equipment that will protect from contamination the quality of food and food products produced and shipped throughout the world. Mr. Dively has been working in the industrial packaging field with St. Regis since 1945. Since 1963 the major part of his time and efforts have been applied to finding solutions to the various problems related to export shipments.

Walter W. Dykstra
Research Staff Specialist for Pesticides and Control Methods
Bur. of Sport Fish. and Wildlife
U.S. Department of Interior
Washington, D.C. 20240

1935-B.S.(Zoology), North Dakota State. Author and co-author of more than 30 papers and leaflets on rodenticides and other pesticides. Member of Committee on Plant and Animal Pests, NAS-NRC, and Federal Committee on Pest Control. Liaison officer between Fish and Wildlife Service and U.S. Department of Agriculture in pest control programs. Honorary member of National Pest Control Association.

Ross A. Easter
Research Associate, Packaging Research
The Pillsbury Company
311 Second Street, S.E.
Minneapolis, Minnesota 55414

1940-BChE, University of Minnesota. 1940-Joined Pillsbury Company. 1946-organized Packaging Department. Presently Corporate Representative for Packaging Institute.

Albert L. Elder
President
League for Intern'l Food Education
612 South Stone Avenue
La Grange, Illinois 60525

1923-A.B., 1925-M.S., 1928-Ph.D., University of Illinois. 1941-War Production Board. Closely associated with the early developments of the Synthetic Rubber Program; Head Chemical Advisor and Coordinator of the Penicillin Program. 1944-Director of Research of Corn Products. 1961-Director of the Institute of Nutrition of Corn Products Retired in 1966. Author of three books and over 50 technical publications. Past president of the Research and Development Associates Food and Container Institute and the American Chemical Society.

Martin J. Forman
Director, Office of Nutrition
Bureau of Technical Assistance
Agency for Intern'l Development
Washington, D.C. 20523

B.A., Temple University; M.A. and Ph.D., University of Pennsylvania. Originated "Operation Ninos" for

Latin America which added 10,000,000 children to our feeding programs in two years. Lived in Taiwan for five years and has visited 61 countries on special assignments.

William J. Gall
Special Adviser (Food Technology)
Liaison and Evaluation Division
Canadian Intern'l Devel. Agency
75 Albert Street
Ottawa, Ontario, Canada

1946-B.A.Sc (ChemEng), University of Toronto; 1950-Doctor of Natural Sciences (PhyChem), Swiss Federal Institute of Technology. Active in establishing packaging material standards with the Packaging Association of Canada (PAC) and Canadian Standards Association. PAC award of merit in 1966. 1964-67-Director, FAO International Food Technology Training Centre, India; 1967-69-Deputy Chief, Food and Agricultural Industries, FAO, Rome. Associated with the World Packaging Organization since 1968.

Allan L. Griff
Consulting Plastics Engineer
Edison Technical Services, Inc.
70 Riverside Drive
New York, New York 10024

Since 1960, has been a consulting engineer to the plastics industry, especially in plastics processing technology, international technical assistance, and information services. Much of this work has been done with plastics in packaging. Some individual projects include: technical specialist for AID in Bolivia; market research on extrusion technology in all South America, market research on extrusion coating in USA. Author of Plastics Extrusion Technology. Correspondent to Argentine Plastics Industry Association. A Research Fellow at Columbia University, his Ph.D. dissertation involves a study of obstacles to industrial/economic development in Latin America.

Henry A. Highland
Stored Product Insects Research and Development Laboratory
Agriculture Research Service
U.S. Department of Agriculture
Post Office Box 5125
Savannah, Georgia 31403

A research entomologist, he conducts and coordinates research on the development of insect-resistant packages. Participated in the development of the insect-resistant multi-wall kraft shipping bag now being used for AID shipments of CSM, WSB, and cornmeal. Participated in inspection trip to Philippines and India to review handling and storage procedures of foreign aid foods. The Stored Product Insects Research and Development Laboratory is the principal agency in the United States for conducting and coordinating research on insect-resistant packaging.

Jesse D. Hill
General Equipment and Packaging Lab
Packaging Division
U.S. Army Natick Laboratories
Natick, Massachusetts 01760

A Packaging Technologist, he has experience in package design and development related to government and military packaging needs throughout the world.

Frank E. Horan
Director of Research
Archer Daniels Midland Company
4666 Faries Parkway
Decatur, Illinois 62526

The ADM Company is very much involved in overseas shipments of commodities for food uses. Dr. Horan has been involved with the introduction of WSB to the Food for Peace officers and those of voluntary agencies in various parts of the world.

Grant V. Hoyt
International Manager
The Kartridg Pak Company
807 West Kimberly Road
Davenport, Iowa 52806

Now engaged in promoting sale of K.P. equipment world-wide, except USA and Canada. Traveling abroad approximately 50% of the time. Responsible for setting up agency and distributor sales outlets. Responsible for training sales and technical personnel within the distributor and agency organizations. Member, Iowa Regional Export Expansion Council; active in export promotion activities of the state of Iowa. Experience in dairy products, manufacturing and in other food processing and packaging operations. Experienced in and now engaged in promoting aerosol food and non-food packaging.

Kenneth R. Johnson
Director of Business Development
Bartelt Engineering
Sub. of Riegel Paper Corporation
1900 Harrison Avenue
Rockford, Illinois 61101

With Bartelt Engeineering for 28 years, Mr. Johnson has held several design positions, including Assistant Chief of Engineering, Technical Assistant to President, Research Director, Director of Engineering, Director of Marketing.

Paul E. Johnson
Chief of Operations
Office of Food for Peace
Agency for International Development
Washington, D.C. 20523

In private industry, worked for paper mills manufacturing kraft paper for bag manufacturers and for food processors packaging flour, breakfast cereals and meat products. Owns and has managed and operated farms in the Middle West and Canada with granaries for storage of soybeans, wheat, corn, and other grains. Was a supply officer, US Army, in World War II, responsible for storage, handling and transportation of grain and processed food for civilian population. In government, Mr. Johnson has been an agricultural economist and Assistant to Administrator of AAA, U.S. Department of Agriculture, working on CCC grain storage programs for AID. Chief, Agriculture Division, USAID/Afghanistan. Has traveled throughout the world with specific assignments on grain and processed food storage and packaging problems.

Elwyn Jones
Director of Market Development
Brown Machine
Division of Koehring Company
Beaverton, Michigan 48612

Currently involved in the further extension of the thermo-forming and thermoform-spin welding processes in the area of packaging, e.g., plastic cans, bottles, jars, and containers. Also directly involved in thermoforming applications on most of the new plastic materials as they are developed by the various chemical companies.

George T. Joyce
Manager
Corporate Marketing Service
St. Regis Paper Company
150 East 42nd Street
New York, New York 10017

Member of National Institute of Packaging, Handling and Logistic Engineers; President of the Packaging Institute; Vice President of North American Packaging Federation; and a Trustee of World Packaging Organization.

John King
Director of Manufacturing
Tri-Wall Containers, Inc.
One Dupont Street
Plainview
Long Island, New York 11803

A chartered engineer, he is presently engaged in an assignment in the U.S. concerned with the manufacture of rodent and fire resistant fibreboard products.

Roy E. Landstrom
Bur. of Sport Fish. and Wildlife
U.S. Department of Interior
Wildlife Research Center
Federal Center Building 16
Denver, Colorado 80225

Currently engaged in the development and testing of rodent repellents. Primary concern has related to protection of conductive cables for use by the U.S. Army Electronics Command. Conducted tests on Biomet 12, a commercial rodent repellent effective at 90% level for two years of field testing at different locations. Recent programs have included the testing of Tri-Wall Laminite, a fire retardent impregnated cardboard for rodent resistance. Future work will be directed, in part, toward the development of rodent-resistant food packaging materials, such as containers, multiwall tarps, and other means of reducing rodent damage.

F. James Levinson
Graduate Student
Cornell University
146 Warren Hall
Ithaca, New York 14850

Chief of the Nutrition Branch, USAID Mission to India, 1967-69. Involved in the packaging of several protein products in India, particularly Bal Ahar and fortified bread and atta.

Wallace H. Nuttall
Project Manager
Corporate Materials
Container Corporation of America
Research Center
Oaks, Pennsylvania 19456

Research chemist in coatings and food technology.

Leif Oxaal
Executive Director
Packaging Machinery Manufacturers Institute
2000 K Street, N.W.
Washington, D.C. 20006

Attended the University of Oslo Social Economics Institute and Ohio State University. Presently an Industry Consultant to HEW; 1968-69, Industry Consultant to the U.S. Information Agency.

Denis Robinson
Project Manager
CPC Food Technology Institute
10 de Angelo Drive
Bedford, Massachusetts 01730

Responsible for introduction and utilization of high lysine corn in Cen-

tral and South America, South Africa and Kenya. Projects include development and distribution of high protein-bearing foods in Brazil (Cerealina), Colombia (Duryea), Mexico, and South Africa.

Robert J. Russ
Account Manager
Dow Chemical Company
Post Office Box 350
Moorestown, New Jersey 08057

Entered packaging in sales with one of the original flexible packaging companies, Dobeckmun, which later became a division of Dow. A 17-year career includes contacts with virtually every type of major industry: food, textile, drugs, etc., concerned with the need--actual or possible--for most types of films, laminations, and rigid plastics.

Robert Rutherford
Packaging Consultant
731 Bobbin Mill Road
Media, Pennsylvania 19063

Working for Sun Oil in 1959, he was responsible for the development of all new and/or improved packaging of all products. Successfully developed the one-quart fibre can for motor oils. 1959-national chairman of the Petroleum Packaging Committee of the Packaging Institute; 1960-national director of the Packaging Institute. Holds the patents for liquid applicator for packaging machines and the like and for conveyor belt and chute mechanisms.

Stanley Sacharow
Project Director, Laminated Products
Packaging Research Division
Reynolds Metals Company
10th and Byrd Streets
Richmond, Virginia 23219

The author of over 200 articles on packaging of food in the international trade press; senior author of Food Packaging (AVI Publishing Company, 1970); and senior author of Principles of Package Development (in preparation). Experience in development of flexible packages for foods ranging from meats to produce to snacks. Works in area of package development (technical).

William H. Schoenherr
Vice President and Director
Biological Control
Lauhoff Grain Company
Post Office Box 571
Danville, Illinois 61832

A producer of cereal-based foods, Lauhoff is interested in the preservation of the quality of these foods, fully realizing the importance of proper packaging and warehousing. Experience in processing, packaging, shipping, and storing have demonstrated the importance of environmental sanitation and control from the producer to the consumer. Observations in Brazil (1965-66), the Philippines (1968-69), and India (1969) has allowed them some insight into some of the problems.

Fred B. Shaw
General Manager, Research & Devel.
Flexible Packaging
Continental Can Company
1200 West 76th Street
Chicago, Illinois 60620

B.S., University of Michigan; M.S. (ChemEng), the Detroit Institute of

of Technology. Plastics research and development at Chrysler Corporation and Libbey-Owens-Ford Corp., prior to World War II. Organized and directed packaging. Numerous publications and patents in the field of plastics and packaging, including several systems for providing sterile flexible packages of foodstuffs and medical items for commerce and the military.

Samuel M. Weisberg
Executive Director
League for Intern'l Food Education
1155 Sixteenth Street, N.W.
Washington, D.C. 20036

Retired in 1968 from Director of the Division of Research and Development of the Kraftco Corporation. Has been granted 30 patents and has published extensively in the areas of dairy by-products utilization, animal feeds, and food technology.

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First Row (l. to r.): Elwyn Jones, Jesse Hill, John King. Frank Horan, Ross Easter, Samuel Weisberg, William Gall, Stanley Sacharow, William Schoenherr.

Second Row (l. to r.): Grant Hoyt, John Dively, Denis Robinson, Kenneth Johnson, Paul Johnson, Roy Landstrom, Robert Rutherford, William Nuttall, James Levinson, Henry Highland, Allan Griff, Fred Shaw.

IX. DIRECTORY

(Organizations listed in this directory are those which were mentioned in the body of this report. There is no intent to recommend any one organization over another or endorse any particular product or approach in connection with packaging problems.)

American Maize Products Company
Roby, Indiana 46326

American Management Association
135 West 50th Street
New York, New York 10020

American Miller & Processor
15 West Huron Street
Chicago, Illinois 60610

Archer Daniels Midland Co. (ADM)
4666 Faries Parkway
Decatur, Illinois 62526

Asian Packaging Federation (APF)
c/o Japan Packaging Institute
Honshu Building
2, 5-chome Ginza-Higashi
Chuo-Ku, Tokyo, Japan

Bartelt Engineering Company
Sub. of Riegel Paper Corporation
1900 Harrison Avenue
Rockford, Illinois 61101

Bemis Bag Packaging Company
800 Northstar Center
Minneapolis, Minnesota 55402

Bin Bag, Inc.
Post Office Box 222
Ft. Dodge, Iowa 50501

Bivans Corporation
2431 Dallas Street
Los Angeles, California 90031

Brown Machine
Div. of Koehring Company
Beaverton, Michigan 48612

Canadian International Development Agency (CIDA)
75 Albert Street
Ottawa, Ontario, Canada

Canadian Packaging
McLeon Hunter Publishing Ltd.
481 University Avenue
Toronto, Canada

CARE, Inc.
660 First Avenue
New York, New York 10016

Castco Poly Products
Div. of Northern Petrochemical Co.
Northern and Willets Point Blvd.
Corona, New York 13368

Central Food Technological Research Institute (CFTRI)
Mysore 2, India

Cherry-Burrell Corporation
1024 South Lopez Street
New Orleans, Louisiana 70125

Compacker, Inc.
720 West River Drive
Davenport, Iowa 52802

Container Corporation of America
Research Center
Oaks, Pennsylvania 19456

Continental Can Company
1200 West 76th Street
Chicago, Illinois 60620

CPC Food Technology Institute
10 de Angelo Drive
Bedford, Massachusetts 012730

Doughboy Industries
869 South Main Avenue
New Richmond, Indiana 54017

Dow Chemical Company
Post Office Box 512
Midland, Michigan 48640

Edison Technical Services
70 Riverside Drive
New York, New York 10024

European Packaging Federation (EPF)
3, rue La Boetie
Paris, 8e, France

Ex-Cell-O Corporation
Post Office Box 386
Detroit, Michigan 48121

Food and Agriculture Organization (FAO)
Via delle Caracalla
Rome, Italy 0100

Fibreboard Corporation
475 Brannan Street
San Francisco, California 94107

Flowtron, Inc.
165 Lower Morrisville Road
Fallsington, Pennsylvania 19054

Formost Packaging Machines
4510 14th Avenue, N.W.
Seattle, Washington 98107

The Institute of Packaging
Malcolm House
Empire Way
Wimbley, Middlesex, England

Japanese Packaging Machinery Manufacturers Association
1-8, 3-chome, Nishi-Shinbashi
Minato-Ku, Tokyo, Japan

Journal of Economic Entomology
4603 Calvert Road
College Park, Maryland 20740

Lauhoff Grain Company
Post Office Box 571
Danville, Illinois 61832

League for International Food Education (L.I.F.E.)
1155 Sixteenth Street, N.W. Rm. 705
Washington, D.C.

Modern Packaging
Post Office Box 809
New York, New York 10036

National Canners Association (NCA)
1950 Sixth Street
Berkeley, California 94710

North American Packaging Federation (NAPF)
c/o Packaging Institute
342 Madison Avenue
New York, New York 10017

The Northwestern Miller
2501 Wayzata Boulevard
Minneapolis, Minnesota 55440

Packaging Association of Canada
45 Charles Street East
Toronto 5, Ontario, Canada

Packaging Document and Information Service
University of California
Davis, California 95616

Packaging Institute
342 Madison Avenue
New York, New York 10017

Packaging Machinery Manufacturers Institute (PMMI)
2000 K Street, N.W.
Washington, D.C. 20006

Paper Shipping Sack Manufacturers Association (PSSMA)
16 East 42nd Street
New York, New York 10017

Patent Office and Industrial Property and Copyright Department
25 South Hampton Buildings
London, WC 2, England

Pillsbury Company
311 Second Street, S.E.
Minneapolis, Minnesota 55414

Ray Publishing Company
5 South Wabash Avenue
Chicago, Illinois 60603

Rennco
111 Redfield Plaza
Marshall, Michigan 49068

Reynolds Metals Company
10th and Byrd Streets
Richmond, Virginia 23219

St. Regis Paper Company
150 East 42nd Street
New York, New York 10017

Seffelaar & Looyen N.V.
Post Office Box 24
Oldenzaal, Switzerland

Servpak
178 Crescent Road
Needham Heights, Massachusetts 02194

Society of Plastics Engineers
West Putnam Avenue
Greenwich, Connecticut 96830

Society of Plastics Industry, Inc.
250 Park Avenue
New York, New York 10017

Tipper Tie, Inc., Div. of Rheem
9501 West Devon Avenue
Rosemont, Illinois 60018

Triangle Package Machinery Company
6655 West Diversey Avenue
Chicago, Illinois 60635

Tri-Wall Containers
One Dupont Street
Plainview
Long Island, New York 11803

Tropical Products Institute
56/62 Gray's Inn Road
London, W.C. 1, England

Union Camp
1600 Valley Road
Wayne, New Jersey 07470

U.S. Agency for International
Development (A.I.D.)
Office of Food for Peace
Office of Nutrition
Bureau of Technical Assistance
Washington, D.C. 20523

U.S. Army Natick Laboratories
Natick, Massachusetts 01760

U.S. Department of Agriculture (USDA)
Agric. Stab. & Con. Service (ASCS)
Agricultural Research Service (ARS)
Washington, D.C. 20250

U.S. Department of Health, Education, and Welfare (HEW)
Communicable Disease Center
Atlanta, Georgia 30396

U.S. Department of Interior (USDI)
Bur. of Sport Fisheries and Wildlife
Washington, D.C. 20240

U.S. Food and Drug Administration (FDA)
Washington, D.C. 20204

U.S. Patent Office
Washington, D.C. 22212

United Nations Industrial Development
Organization (UNIDO)
Post Office Box 837
A-1011 Vienna, Austria

United Nations International Childrens'
Emergency Fund (UNICEF)
United Nations Plaza
New York, New York 10017

Vertrod Corporation
2037 Utica Avenue
Brooklyn, New York 11234

Volunteers for International Technical
Assistance (VITA)
College Campus
Schenectady, New York 12308

World Food Program (WFP)
United Nations Plaza
New York, New York 10017

World Health Program (WHO)
Avenue Appia
1211 Geneva 27, Switzerland

World Packaging Organization (WPO)
1 Vere Street
London W1M 9HQ, England

The League for International Food Education

Created on June 12, 1968, the League for International Food Education, or L.I.F.E., represents a consortium of seven scientific societies whose memberships had previously expressed a desire to aid in the War on Hunger. The societies forming the consortium are:

American Association of Cereal Chemists
American Chemical Society
American Institute of Chemical Engineers
American Institute of Nutrition
American Oil Chemists' Society
Institute of Food Technologists
Volunteers for International Technical Assistance

Presently funded under a grant from the U.S. Agency for International Development, L.I.F.E.'s primary objective is to provide technical assistance and information in answer to specific requests on food technology and nutrition to anyone in the developing countries having need for such information.

For further information about L.I.F.E., please address letters to:

Dr. Samuel M. Weisberg, Executive Director
League for International Food Education
1155 Sixteenth Street, N.W. Room 705
Washington, D.C. 20036 U.S.A.