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Manufacturing Chemists' Association, Inc.

(FOUNDED 1872)

1825 CONNECTICUT AVENUE, N. W.
WASHINGTON, D. C. 20009

MINUTES OF MEETING

PLASTICS COMMITTEE
The Greenbrier
White Sulphur Springs, West Virginia
June 8, 1967

PRESENT:
Messrs. G. L. Pitzer (Chairman), Union Carbide Corporation
T. B. Nantz (Vice Chairman), B. F. Goodrich Chemical Company
C. E. Brown, Sinclair-Koppers Company
W. J. Dugan, General Electric Company
J. W. Ferguson, Hooker Chemical Corporation
D. M. Gallagher, Canadian Industries Limited
W. C. Goggin, The Dow Chemical Company
W. D. Holland, American Cyanamid Company
J. F. Kroeger, Shell Chemical Company
C. M. Neher, Ethyl Corporation
F. M. Norton, Allied Chemical Corporation
W. C. Roher, Gulf Oil Corporation
A. F. Giacco (for J. R. Ryan), Hercules Incorporated
H. C. Wechsler (for E. J. Sullivan), The Borden Chemical Co.
D. C. Williams, Eastman Chemical Products, Inc.
John Brooks (Board Liaison), Celanese Corporation
F. H. Carman (Secretary), MCA

and
F. J. Pizzitola (Guest), Celanese Corporation

In opening the meeting, Chairman Pitzer welcomed new Committee members nominated by the Plastics Committee in its last meeting and appointed by the Board on June 7. In keeping with the Committee's proposal of May 4, 1967, members are appointed to the Committee at this time for a two or three year term for a total membership of 15. This will permit 5 to be replaced each year in compliance with the rotation provisions in the Terms of Reference. As directed by the Committee, the Chairman and Secretary have selected new members to serve as indicated:

3 Years	2 Years
W. D. Holland (American Cyanamid)	C. E. Brown (Sinclair-Koppers)
C. M. Neher (Ethyl)	W. J. Dugan (General Electric)
R. L. Schuyler, Jr. (duPont)	D. M. Gallagher (Canadian Industries)
R. E. Workman (Goodyear)	W. C. Roher (Gulf Oil)

The ninth nominee designated by the Committee has not been available. If it later develops another nominee should be selected, the Committee agreed this should be handled by a letter ballot as soon as practicable.

Plastics Financial Package

Expenditures for the fiscal year just concluded were within $200 of that listed in the report cleared to member representatives with the proposed budget on May 19, 1967. The surplus on June 1 was $20,920.

Weatherability Project

During the month of May, the project was staffed by the two Research Associates, two technicians, and V. E. Gray, director of the project for NBS, who is continuing to devote half his time to the program. Tests on films in controlled atmospheres and on outdoor exposed samples are being continued. Technical representatives have been urged to visit the lab to follow through on the procedure for atmospheric testing, and four have already commented in writing on this new development. One company's representatives are planning to visit the NBS early in July, and it is anticipated others will be following shortly. No firm decision has yet been made, although it is quite possible that one of the Research Associates can be replaced by a technician later in the fiscal year.

In the discussion of this activity, question was raised on future of the program as to whether or not it would be concluded at the end of the new fiscal year or must be continued. It was the consensus that this be given priority attention by the Steering Committee and the Plastics Committee during the coming months. Discussion of this will be started in the Liaison Committee meeting at the Bureau on June 16.

Epidemiologic Investigation - PVC

Twenty companies (two non-members of MCA) have been assessed a total of $80,350 ($78,600 on hand) for this study at the University

of Michigan's Institute of Industrial Health. The program was a little delayed getting under way, and the contract has been extended to August 31, 1967. By the end of June, the Institute representatives will have visited all plants, possibly with the exception of two units out on strike. During July and August, they expect to complete examination of all X-rays and tabulation of the findings. This will be reported through regular channels to the member companies, and it is quite possible a symposium will then be scheduled.

National Industrial Conference Board

This Board's conference on "Plastics: A Management Dilemma" May 18, 1967, included excellent speeches by Robert K. Mueller (Monsanto), Arthur J. Warner (DeBell & Richardson), and Gary C. Hufbauer (University of New Mexico). Some of the highlights of Mr. Mueller's talk were reported by the Secretary. Copies of these speeches are included with these minutes.

U/L - Plastics in Building and Appliances

The Committee was reminded of research sponsored at the U/L on plastic materials in building and electrical appliances. Pertinent reports on this include "Survey of Information on Toxicity of Combustion and Thermal Decomposition Products" (U/L Bulletin Number 53, July, 1963), "Burning, Arching, Ignition, and Tracking of Plastics Used in Electrical Appliances" (U/L Bulletin Number 55, February, 1964), and "Study of Smoke Ratings Developed in Standard Fire Tests" (U/L NC493, May 15, 1964). This research and the contacts of industry technical representatives with the Laboratories' staff have resulted in the U/L having a better set of tests and a new understanding of the qualities of today's plastics which were found to be much better than they had believed prior to these studies.

There has been a distinct improvement in the cooperative relationship between the U/L, the material suppliers, and the end users of plastic products. It is anticipated an industry advisory group (material producer representatives) of the U/L will be convened in the early fall to review and finalize a report on tests and operating procedures.

Members' attention was called to reports emanating from Wayne State University on evolution of HCN during burning of ABS plastics. Professor Irwin Einhorn was reported to be conducting this work. It was agreed the Washington office would consult with technical representatives for further information on the liaison industry is maintaining with this group at Wayne State.

State University of New York

A request for advice on a curriculum on plastics technology was reported by the Secretary. Following a short discussion, it was recommended that this be referred to Dr. Eric Baer, director of the MCA project at Case Institute, for assistance.

Oyster Harbors Arrangements Committee

The Committee suggested that the following individuals serve on the Arrangements Committee for this meeting September 6-9: Richard Fleming (Avisun), A. F. Giacco (Hercules), W. D. Holland (American Cyanamid), A. R. Ludlow, Jr. (U.S. Industrial Chemicals), and A. A. Pavlic (duPont). This group is to elect its own chairman.

During discussion of subject matter for the business meeting, it was suggested this Arrangements Committee consider: (1) A business forecast discussion by Ira Ellis of duPont; and (2) Status of the GATT Negotiations, particularly an analysis of results and probable effects on domestic industry and its foreign operations.

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The dinner meeting was attended by 146 representatives from Plastics Group participating companies and 27 representatives of other MCA members. Among other announcements, the Chairman, in behalf of the Plastics Group, expressed appreciation to R. G. Askew (Phillips), H. H. Bible (Monsanto), E. S. Ebers (Uniroyal), J. W. Ferguson (Hooker), W. C. Goggin (Dow), G. M. Hale (Shawinigan), and F. M. Norton (Allied), who had completed their terms on the Plastics Committee.

Respectfully submitted,

F. H. Carman

F. H. Carman, Secretary
Plastics Committee

FHC/bk
Enclosures (1) NICB Conference Speeches.
(2) Plastics Committee Roster 1967-68.
cc: All Present
Plastics Committee

June 19, 1967

1967

Manufacturing Chemists' Association, Inc.
PLASTICS COMMITTEE ROSTER
1967 - 1968

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Information for the Press

NATIONAL INDUSTRIAL CONFERENCE BOARD

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Area Code 212 PLaza 9-0900

For Release After 9:30 a.m. (EDST) Thursday, May 18, 1967 Conference Release

KEYNOTE ADDRESS

A talk by Robert K. Mueller
Vice President, Monsanto Company
at a special one-day meeting on "Plastics: A Management Dilemma"
conducted by the National Industrial Conference Board
Thursday, May 18, 1967, in The Waldorf-Astoria, New York City

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Thank you, and good morning.

It is good to see that so many are interested in the plastics industry. I guess we all like to hear that others have problems, too. Oscar Wilde once said when asked about his new play -- "The play was a great success but the audience was a failure!" With the fine turn-out this morning and our distinguished panelists we can't help but get a good review of the exciting dilemma that management now faces in the plastics industry.

Last year there were 43 U. S. plastics molding and fabricating company business failures, and 19 mergers resulting from the economic, technical, and market shifts taking place. Mergers were also occurring at a rate of about 80 per year in the chemical industry during 1966. This churning and turmoil has been going on at much this same tempo for some time in the plastics and chemical industry. In fact, 480 U. S. manufacturers of molded and fabricated plastics products have bit the dust in the last 10 years, representing about $50 million liabilities. Despite these business tribulations, the last thirty years of scientific effort in plastics have yielded such sophistication in the disciplines involved - chemistry, physics,

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engineering, styling, and merchandising - that the plastics industry has substantially altered the raw material index of our times. Why then, with these great technical advances, is there a management dilemma facing us today?

Those of us who experienced the nitrate plastics heyday have seen that sector of the industry displaced with entirely new materials, ranging from the improved cellulosics to the vinyl family. Another instance - vinyl resins have nearly supplanted the old jute and linseed oil compositions and rejuvenated the floor covering business. A stream of plastics developments has created new business and new products, in some cases at the expense of other materials. But, more often, entirely new compositions have been developed to add to or enhance the materials of construction available to us. All of this development has taken place, and, yet, there are troubles brewing.

Recently, the London Economist characterized the chemical industry in a manner which can be paraphrased for our plastics industry only too well. It's "like an enchanted forest. Delicious little paths curve away invitingly into charming little glades; the addict wanders on, entranced, unable to resist each fresh delight, until he finds himself lost and starving. Indeed, so vague are the industry's boundaries it is possible to invest in anything and still remain with it!"

The ubiquitous nature of the industry is both its salvation and the source of the management dilemma. And we find ourselves at a number of crosspaths in this wonder woods. Some managements decide to leave the woods. Recently, Distillers Company Ltd., a beverage producer with substantial chemical interests, sold off its plastics and chemical subsidiaries to British Petroleum Company Ltd., and now confines its affairs to the original whiskey business.

But why leave the enchanted forest? Having spent most of my working years in the plastics field, I cannot believe that this was a misspent youth, or that it is an unattractive industry -- for either the investor, the manager, the supplier,

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or the customer. The industry has by and large performed in good style in coping with continual technical advances. What we've got to do now is to learn to manage as well as we make.

A Management Dilemma

It was Aristotle who first used the metaphor "horns of the dilemma" to dramatize the discomfort of decision-making. Today we have improved skills and tools of management to help relieve this discomfort when we make decisions in this fascinating plastics business - if we learn to use them as tools and don't expect them to make our decisions for us. In the scientific end of our business it has taken brains, assisted by all the tools and machines available to give this industry its fantastic growth. Now that we have come of age we certainly have the brains, and certainly, we can also use the new management tools that have become available to the business manager - and I'm not selling computers! I am selling a realistic, common sense management approach to some perplexing problems which call for our best management efforts as distinct from our technical efforts.

Let's face it - the uncertainties in the industry require continual decision-making as to which plastics markets to select for profitable direction of management time and money. Competing in these markets involves not only facing up to consumer caprice but to Free World competition at a turbulence level never before encountered in the plastics business world. Of course, the complexity varies around the world with different economic, political, and cultural settings. These dilemmas, however, present a challenging opportunity for the management-minded to employ the best systems and techniques which are now available.

Some - notably Professor Galbraith - argue that the efficient producer determines what the consumer will have. This is simply not true in the plastics industry. In the all-pervading plastics business the consumer and the market economy are still enthroned. The technically-minded plastics industry must now turn its

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talents to decision-making in the complex commercial area, where the art and science of management is not so well developed as the science of manufacture and research in the physical world of plastics.

The plastics industry has already profited from the science of manufacture. Now it has a mandate to cash in on the science and art of management. Our challenge is to manage as well as we make.

Anatomy of the Industry

The discussion this morning is in two parts - one in which our industry does very well, and one in which our industry needs to do better.

What do we do well? We have an outstanding record of technical achievement and growth -- witness the many dramatic uses of plastics in the Mercury spacecraft nose cones, Detroit's vinyl-covered hardtop auto roofs, artificial aortic, mitral, and tricuspid heart valves, plastic encapsulated transistors, Cadillac's six pound plastic instrument panel, the air-supported plastic greenhouses, the new uncrushable, washable polyproplyene "straw hats," and on and on. We compete with metals, wood, paper, and other materials, yet we haven't stunted their growth. Actually, we have created wholly new markets and invented new products, at a commercial realization rate that is getting shorter and shorter with each new development surge.

A banker friend of mine once defined an invention as something which ruined his investments. While we brag about how well we invent and make plastics, I am afraid that the management of these expanding international investments in plastics can be ruined unless we manage them better in the future. The reason this is of concern is that unless we manage as well as we make, there will not be sufficient future profits in certain segments of the industry to sustain healthy growth. We don't yet have all the answers we need, and we must solve this management dilemma by facing these prospects now.

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To better understand the challenge, let's look briefly at the anatomy of the industry as it is presently constituted.

We retain the classical definition of plastics as man-made organic materials which with pressure, heat, or both, may be formed into almost any shape. Even though they are closely related, we exclude synthetic rubber and man-made fibers - two distinct branches of the high polymer world that have really taken off in recent years.

The United States plastics industry today employs a quarter of a million men and women, and set a production record last year of 6.8 million tons of product. This was up 16 per cent over 1965, and its value was about 6.5 billion dollars. The rate of growth of the worldwide plastics industry is greater than the United States rate. One of our panel speakers has estimated that our United States plastics industry, which had a position of about half the world production ten years ago, will drop to about 35 per cent of the world output by 1970. It is interesting to note that the Soviet Union's plastics business has been estimated at about 7 per cent of the world volume - just short of a million tons last year - but growing very rapidly.

Bill Cruse of the Society of the Plastics Industry tells me there are about 5,700 separate plastics companies in the United States. They can be divided into several groups:

First, the material suppliers who take basic raw materials like acetylene, ethylene, or propylene, and produce a spectrum of plastics in many forms. There are about 150 U. S. firms in this segment of the industry and they require large capital investment and extensive technical manpower. Most material suppliers today are either chemical or petroleum companies.

Plastics materials turned out by these basic suppliers go to other categories of firms. In some cases the basic producers even go downstream to final consumer articles. An interesting example is the forward plunge of Union Carbide into

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the manufacture and sale of the disposable soda pop straw in the form of a poly-ethylene tube "straw."

However, generally, fabrication is a separate operation and there are now about 5,500 such United States companies which perform converting operations solely. They comprise a distinct industry category and have separate dilemmas of their own.

While some firms do cover the entire vertical chain of gathering raw materials and performing processing steps right down to the finished article, others dealing only with the conversion step are content to function in a more limited manner. There are many who make a good living distributing service and plastics products on a regional basis. Competition is sharpening at all levels, with changes in the anatomy of the industry indicated by the many mergers, spin-offs, integration moves, and joint ventures of the day.

Significant Decisions Facing Plastics Industry Management

But perhaps there is a way in which to approach this "enchanted forest" which is planted with challenging business choices. Four decisions seem to be significant in the overall context:

First - the choice of the material - i.e. selection of species of plastics like polyolefins, vinyls, or other families. When dealing with classes of other materials we don't just choose "metals," we select copper or stainless steel or titanium - species which are now well defined - and so it should be in plastics species as these materials become better known. It is interesting to note here that the chief volume markets of the future lie in thermoplastics, forecast to be over three quarters of all plastic types during the next decade. Most thermoplastics will be members of three species - polyolefins, PVC, and polystyrenes. The other quarter portion will be mainly in the thermosetting species - the phenolics, ureas, and melamines. All this doesn't rule out the impact of the polysulfones,

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the polycarbonates, the polyphenylene oxides, just to mention a few of the newer polymers.

The second decision is the route or the technical process by which the plastics product can be made. This is a subject in itself.

The third decision area involves the total market action - how, when, where, why, and to whom are we selling and with whom are we competing? These factors vary tremendously throughout the world, and this aspect will be discussed by our panelists.

The fourth decision area concerns the life cycle of the material or product from infancy through maturity to decline. These cycles force integrations, spin-offs, and so on. The rise and fall of once promising plastics is part of the industry growing up. How many of us who spent time and money on polystyrene wall tile applications, or vinyl draperies, in their shining hours, recognized in time the relative decay of the life cycle of these businesses? duPont recently reviewed the marketing progress in Europe of its acetal resin, Delrin, after six years' effort. 60 per cent of the original applications still hold, 31 per cent had been terminated due to the item no longer being manufactured, and 9 per cent of the applications are now made from other materials.

What we are really talking about is the need for a better system of managing the plastics business, one which is comprehensive enough to embrace all sectors, eliminates emotion and folklore from decision-making, introduces consistency, and is basically an evolutionary process using the experimental method which we so successfully employ in the scientific side of our business. Such a philosophy and system is no more complex than those employed in other business sectors, where corporate decisions are also being made in the face of multiple dilemmas.

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The steel and auto industries set good examples in their use of input-output analysis techniques for long-range economic projections of their business systems. A recent elaborate effort is the one by economist Clopper Almon, Jr., who has worked out growth estimates for 90 industries. Interactions of supplier industries like the coal mines or the steel consuming industries, or the auto or machinery business, are perceivable in these business equations with management science techniques and computer tools. With such analyses, basic business decisions can be soundly made from a host of alternatives. This same management philosophy approach is available for use on the business configurations existing in plastics today.

Hastily, I must say that any plastics industry manager who can be replaced by a computer, or any other tools of the management scientist, should be. However, there is no question in my mind that managers will be more successful in resolving dilemmas, if they will learn to use some of the decision-making tools available to them and their staffs. Outside expertise often is needed in designing a decision-making process, to decide if these management science concepts are justified, and then to actually go about it.

You know, an old Chinese proverb says there are few situations in life that cannot honestly be settled, and with little loss of time, either by suicide, a bag of gold, or by thrusting a despised antagonist over the edge of a precipice on a dark night! With the host of problems facing plastics management today we dare not use these Chinese alternates, but, better, we need to isolate primary decision areas which present us with choices of material, route, market action, or life cycle of the business. Here are five major clusters of these decision areas:

The Major Raw Material Producers

We can begin with a typical one facing the large producer of monomers, those simple unpolymerized forms of certain chemical compounds. Where should he build his next plant? Perhaps when he chose two plant sites a decade ago in Brazil

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or Colombia, to supplement exports of certain monomers from the United States to other South American countries, he probably didn't think this action would create a future dilemma. He had several choices open to him, but it was a manageable number of alternatives. He looked at the locations of customers and raw materials, the supply of labor, the transportation cost, the tariff situation, and the tax loads to have to carry.

If there was much to consider then, look at what's been added. There's the impact of the Latin American Free Trade Area. There's the factor of even longer range plans he must now consider about other prospective plants of his own in Peru, Argentina, Ecuador, and so on. There's the increased impact of foreign producers on U. S. producers. There's an unresolved question of petrochemical feedstock quotas on his own base in the U. S. There are special problems of recovering any investment abroad, and, if that weren't complication enough, the concepts of the mini-plant and the super-plant create the need for a host of new decisions.

I hardly need recite any more complications. The important point is that there are many -- so many that the algebra of combinations begins to work against the decision-maker. It turns out that the maximum number of interrelated variables a person can manipulate is only six or seven. So there are just too many alternatives and, now, too little time for leisurely evaluation. That's why computers must surely be used to help us look at more alternatives than we ever could alone. Methods of analysis of this LAFTA type investment problem have already been developed and published for the benefit of all of us by our friends in Union Carbide.

Another example: Our government, in deciding on what petrochemical feedstock quotas to allow U. S. producers, must consider what will happen to our balance of payments under various assumptions about the construction of plants here and abroad. Each firm in the industry wants to see the effect of legislation on its own profits. Obviously, both government and the firms in the industry would like

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to get some idea of the consequences without having to make an irreversible decisi
The answer: A computer simulation of sorts of the world's petrochemical business.
One such simulation has recently been built by a well-known consulting firm.

Another example of the computer as a tester of alternatives has to do with the construction of a plant, once the site has been chosen. If you will excuse this Monsanto example - in 1961 when we were building our petrochemical complex at Chocolate Bayou, it was a computer using a critical path program which advised us what to do when. Before construction was complete Hurricane Carla hit. We couldn't blame the computer for that! As a matter of fact, we gave it credit for staying cal during a crisis and telling us what to do next. An entirely new sequence of installation steps was undertaken, with no loss in elapsed time to complete. If we seem to imbue the machine with near-human power, we don't mean to. In telling how to schedule our construction, the computer just goes on trying out all sorts of schedules until it finds good ones. It tests lots of alternatives, more and faster than we could without electronic help.

Later in the program today we shall consider finance, tariffs, international trade, each from the point of view of a speaker expert in the field. I have not read their papers, but I will wager they include such phrases as "assuming that," "in the event that," and "of course, if." These, the traditional escape mechanisms used by management facing decision, can be put into the decision-making equation to deal with such eventualities as "if funds are scarce," or "if there's a shortage of skilled manpower," or many other variables which may be encountered.

The Plastics Polymer Producer

Now, let's turn to a second cluster of decision areas - those of the managers of firms producing polymers. Most of these firms are already in monomer production, but the pertinent question arises - "Should I integrate forward towards the consumer, and if so how should I go about it?"

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First of all he must determine the attributes which a plastic must have to displace another material in the marketplace. Of course, the producer of the threatened material - be it paper, metal, or wood - is also glancing sideways at the plastics business and contemplating his own future. Just the other day I was talking to a friend in the plastic pipe business. Plastic pipe - up 30 per cent over last year to $170 million, is expected to hit the one third of a billion dollar market level in 1970, and this may still be less than 5 per cent of the total pipe market! Simulation techniques and model building are useful to the manager faced with these dilemmas. Distribution systems or acquisition decisions can be structured so that sensitivity of all factors can be exposed for the manager to make his decisions. Such exposure forces clarification of objectives. In this example the question is raised - "Do you want to be in the plastics business, the pipe business, or the steel business?" You can be in the first two, or the last two, but not in all of them.

From the viewpoint of the plastic polymer producer, there is the ever-present threat of retaliation by his existing customers if he tries to move into their markets. It is difficult to build new marketing systems and, thanks to Messrs. Sherman and Clayton, there are problems involved in direct acquisitions of operating firms. It takes time to build an enterprise. No matter which approach is selected, there will be a need for patient money, and, most of all, for sophisticated management.

This makes the problem difficult from the point of view of the plastics industry, but, at the same time, equally difficult for companies interacting with the plastics industry.

Here, again, there are common sense considerations and management techniques which can help in taming the dilemma of "go" and "no go." It is possible nowadays to construct models of the most involved situation. duPont's Venture Analysis program on Corfam is a well publicized example of a simulated consumer

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marketing situation in which, by mathematical model, the reactions and effects of other parties in the field can be rapidly estimated, and sales and profitability forecasts made. Customer acceptance or rejection, changes in the national economy, even upheavals in international politics, may be tested on such a model. Publicized examples of such models exist in other industries in the form of simulation techniques, risk and merger analysis, optimization of capital budgeting, and other complex management science approaches which are used to tackle business dilemmas. Well-known companies using these tools in other industries include General Electric, H. J. Heinz, Johnson & Johnson, Proctor & Gamble, just to cite a few.

The Fabricator-Convertor

Let's take a third cluster of problems - those faced by the plastics fabricator and convertor, who may be dependent upon a single firm, or even several firms for raw materials. The fabricator-convertor may or may not have some process know-how invested in his machinery. For sure, he has an established franchise in the marketplace through his distributors and dealers.

In addition to the technical problems peculiar to this operation, he faces continual business decision-making. What should he do about the integrated monomer-polymer firm which is considering going into the conversion end of the business, and may or may not be approaching his distributors with a prospective competitive line? Should he attempt to distribute his plastics products at the retail consumer level? These are realistic questions that must be faced by top management with the same fervor as facing a technical problem, and using all the experience, common sense, and analytical ability that can be mastered, for these problems will not go away.

In the plastics industry's rapid growth, it has often fallen to the raw material producer - representing the capital intensive end of the business - to develop transformation technology and create plastics product markets, and even

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distribution systems, to speed up the pull-through of the basic polymer production. This provision of capital, technology, credit, and market development cannot go on forever in this manner in the plastics business. The fabricating segment of the industry has now developed to a point where these business components need to be shouldered and developed by this sector of the industry.

Many of the operations in converting plastics are headed by managers who have historically operated very successfully through unusual brands of intuition and know-how, and who have had limited experience in a worldwide business environment. We certainly need common sense and business acumen now, but we can also use some machine help, too. True, computers have been adopted in many plastics converting firms' record keeping, inventory control, and the like, but only rarely in the field of business decision-making. Today, thanks to remote access computer technology we find programs applicable to plastics businesses. The convertor has available to him now the most modern business techniques, without a major in-house investment. Perhaps one of the outgrowths of this conference will be to provoke those in this sector of our plastics industry to explore the worth of such a management approach to their problems. Stock programs are now available to all, and I have never seen any figures which indicate a cut-off point for the size of the firm employing them.

The Customer Dilemma

The dilemmas faced by the fabricator of plastics articles have a mirror image in a fourth cluster of dilemmas - those facing the purchaser of these plastics products. This customer-supplier interface, as we all know, is a ticklish one. Should the user of plastics parts integrate into plastics fabrication? The appliance and auto industry have in a big way. Take Admiral Corporation's vacuum forming plant, or Hotpoint, or Kelvinator, or General Electric's mammoth regrigerator liner molding plant at Louisville. Take Ford's new huge blowmolding machine scheduled to

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turn out up to forty-thousand plastic gas tanks for the 1968 T-Bird. Chrysler, GMC, Oldsmobile are not far behind. This is big business. It will take seven railroad cars of plastic resin per day just to keep Ford's fender liner operation going! The new Italian Fiat has revolutionary uses of plastics, up 30 per cent from last year to seventy-five pounds per car. The skills and management needed for such transforming operations are close enough to the talents possessed in their own companies to allow a safe business integration.

The recent move on the part of the government to force safety factors in the design of the automobile gives plastics an opportunity that could not be foreseen two years ago. The lamination of embossed vinyl to steel for some auto tops was so well accepted from an aesthetic standpoint it may move on to the hood and fenders - not as an aesthetic measure, necessarily, but to cut down in specular gloss - one of the safety factors the government is advancing.

But hard goods producers are not the only ones faced with business decisions at the plastics industry interface. Some examples: Take the paper companies, or the packaging industry - which is now the second largest market for plastics, after construction, and which consumed about 2.6 billion pounds. Also, the dairies are another example. Over 500 dairies are moving rapidly now to plastic milk bottles. The "Paxton Story" is a case of a cigarette company seeking a greater market share through improved packaging. The development effort came up with plastics as the material, and a process had to be created for fabricating the new package. These were all business decisions made on whether to be a customer for, or a fabricator of plastics articles. Such problems of complex economics are certainly amenable to business modeling and analysis. We must learn to use these techniques to give us realistic alternates from which we can make a business decision.

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Firms Competing with Plastics

Now, let's wind up with a fifth cluster of problems. The firm selling products that presently compete with plastics faces an extraordinary set of dilemmas all its own. Should the firm get into the plastics business itself, or should it fight back with improved types, models, and grades of its own material? Should a conversion to plastics, or a combination of plastics with other materials be investigated? So-called "atomic wood" is a good example of plastic impregnated irradiated wood making interesting strides in the furniture field. The AEC has been working with 41 different types of wood and 6 different woodworking companies to develop these wood-plastic composites.

Senator Hart's "Truth in Packaging" efforts have shaken up many a nest in the plastics and paper industry by focusing consumer attention on the subject. The supermarkets' problem of bottlenecks at the meat counter was solved by the switch to prepackaged meat cuts which could be prepared at off-peak periods, and the housewife accepted this. However, now, some disgruntled customers are complaining that they can't see the complete cut. The transparent plastic meat tray, which has been struggling in development limbo, for eight years that I know of, is now taking hold with its one hundred per cent visibility contribution, and the plastics industry diffuses itself one step further into a new business.

The choices which the firms competing with plastics must face are concerned not only with market-related problems, but lead them directly into the area of developing new technology, which must be appraised before venturing into this area of competition. However, the plastics business is different from others, not only in its marketing and its technology, but in the fact that the materials it deals with are man-made and man-conceived. In 1966, one chemical compound - tolylene diisocyanate - was used to produce 100 million pounds of an entirely new composition of matter, urethane foam. This moved quickly through 200 U. S.

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manufacturers' plants into the furniture upholstery market. Howard Gans, merchandising director for Ward Furniture Company, of Fort Smith, Arkansas, predicts that within ten years plastics will, in fact, supplant wood in furniture, with the exception of antiques and some of the highest priced furniture.

Last week, when in London, I saw an announcement of a United Kingdom company formed to produce instant furniture out of rigid polyurethanes. The system, tested in Scandinavia, consists of pouring chemicals into molds, with complete frame having attachments for legs or swivel bases formed after 10 minutes curing!

These trends mean, of course, that both commodity and specialty plastics require a great deal of technical research time and development costs, and they face high obsolescence risk factors. For the looker-on industry, to enter the plastics business is easy - everybody's welcome - but to stay in it, profitably, requires patient and astute management, technical capability, time and money.

The attraction of the industry is reflected in the latest U. S. Department of Commerce input-output analyses of twelve basic industries. This, incidentally, is a good example of a management science approach to a complex forecasting problem. The plastics industry leads all others in these projections, with a 183 index of growth for 1970, compared to a 1963 base of 100. These input-output analyses will allow the manager to stand not so lonely and forlorn when business decisions are made. He can have some quantitative evaluations of the choices in his dilemma which can be helpful in deciding whether to bring his firm into the plastics industry.

Conclusion

And now in conclusion, the five clusters of management dilemmas represented by the decision area of the raw material producer, the polymer producer, the fabricator-convertor, the customer, and those competing with plastics, certainly do not exhaust the problems and the challenges in this "enchanted forest" of plastics.

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They are merely illustrative of the fact that managers need every assistance they can get as international competition, technology, economic, political, and cultural factors take further hold.

As an example of an entirely separate decision-making area, we can look at the dilemmas posed by governmental framework, growing daily. These are particularly foreboding but nevertheless must be recognized and dealt with in business decision-making. In addition to coping with overseas governmental postures, we must consider what new constraints will be imposed by the Department of Justice, the Federal Trade Commission, the Food and Drug Administration, the Commerce and Labor Departments, the Bureau of Standards, and so on!

One advantage that the keynote speaker has is the opportunity to raise questions without the obligation of supplying all the answers. And I certainly don't pretend to have all the answers. In this regard we are particularly fortunate in being backstopped by a panel of experts who will explore the avenues leading to the answers, and hopefully deal with your questions.

I would like to close with this thought. Our plastics industry was one of the first of the science-oriented industries. Its present management dilemma derives both from this technical origin and from the industry's astonishing growth around the world. The first order of business is, of course, to get each individual company in fighting form with tight management in all functions, and particularly in its home base environment. Without efficient parent operation, business survival away from home will be short lived. The best management philosophy and systems are essential, and these are available, if the industry will dedicate itself to improving management with the same fervor that it has applied technical expertise to create and manufacture improved products. This is our management challenge.

Thank you for your attention.

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From: Joseph L. Naar, Director

Division of Public Information

THE INTERNATIONAL ASPECTS OF PLASTICS: A MANAGEMENT DILEMMA

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Delivered Before the
National Industrial Conference Board
May 18, 1967

The very success of plastics, as materials of commerce, has brought with it the problems being discussed with you today, and the size and complexity of the industry associated with the production, sales, transformation, and distribution, forces a much closer look as to where we are going, and how we are going to achieve a full realization of the potentialities of the situation.

In his keynote address, Bob Mueller has given you a broad review of the situation as he sees it with a background of the American chemical industry making the basic raw materials and having interests overseas. It is my purpose to attempt briefly to show some of the International ramifications and to highlight the fundamental decisions facing American industry in the context of world competition. To give a brief background for reference purposes, let us recall and amplify some of the data already known to you. Firstly, the growth of all plastics materials used in the U. S. has been, with minor exceptions, strongly upward since 1945. During the period 1944 - 1955, production grew annually at an average rate of nearly 17%. For the period 1955 - 1965, the increase has been at an annual rate of about 12% and a reasonable assumption would be that for the next 10 years we should see an annual rate of increase of some 10%. Based on a 1966 figure of 6,122,400 tons, this should give, by 1975, the really large figure of 17,450,000 tons.

Figure 1 illustrates this point.

For the world as a whole by comparison, the rate of increase in the past few years (1962 - 1966) has been of the order of 15.5% per year which means that the United States has actually been increasing its plastics production at a slower rate than the rest of the world.

As a percentage of total world production, the United States has dropped from 54% in 1955 to 37.4% in 1965 and it is estimated that this will decrease further to 30% by 1975.

Figure 2 illustrates this point.

Should we look at the figures as they relate to the actual breakdown of the overall production numbers into the various types of plastics materials going into them, we get a very interesting situation.

Figure 3 - World Plastics Production by Types

The figures show clearly that all major producers of plastics materials in the world today have determined that the chief markets of the future lie in the area of the thermoplastics, a fact well established in the United States as early as the 1960's when 70% of the production was in this category. Of even greater consequence has been the emergence, at least as far as volume is concerned, of the polyolefins, polystyrene and polyvinyl chloride type materials, as the basic polymers of the industry. For the world overall, even including the Comecon countries, some 90% of all thermoplastics produced are now in what we may call these three basic commodity types. I hasten to use the

term "basic" so that we can include copolymers, derivatives and modifications to cover the detailed grades and types of materials that have been, or will be, developed for specific applications.

Advances in technology have put one material, namely ethylene, as the major raw material for the production of these three basic types, and with the increasing pressure for the lowest production costs, access to a cheap and assured large volume source of ethylene is now an essential to any plastics materials producer who expects to enter, stay in or compete successfully in the largest part of the industry on a long term basis.

Production of plastics materials worldwide has therefore expanded from the classical and traditional chemical companies, Du Pont, Union Carbide and Chemical, Dow, Monsanto, Imperial Chemical Industries, Farbwerke Hoechst, BASF, Montedison, Rhone Poulenc, and so forth, to the petrochemical companies, and finally back to the producers and refiners of crude oil, and even the natural gas (LPG) companies. To the above list of companies, we therefore can add Shell, Standard Oil of New Jersey, Phillips Petroleum, British Petroleum, Gulf, and others.

It can be estimated that in the middle 1970's some 35 million tons of plastics materials based on ethylene will be involved in world commerce. The complex problems raised in determining where this production is to be based are not only of direct concern to the present

producers, but also to others who are exploring the possibility of entering the field and even to National Governments because of the long term potential effect on their economies.

One key to a successful solution is the availability of cheap feedstocks for the plants now under construction or planned for the future. For a period, it appeared that only the United States had the detailed technology and domestic crude oil or natural gas supply necessary, but the rest of the world has rapidly advanced under the stimulus of available knowledge and the drive for an increased standard of living. In addition, certain practices engendered by a long period of world affluence and high standards of living at home are leading to difficult competitive situations for United States management. Later speakers this morning will deal more in depth with the labor problems of the United States, the financing problems, and with the vexing question of tariffs, free trade zones, dutyfree areas, oil quotas and so forth.

In the period just after 1950, large refineries were established in strategic areas in Europe, using principally crude oil from the Middle East. The primary requirement was for heating oil, and the by-product naphtha was either used as a gasoline additive or as a source of chemicals and particularly ethylene and propylene. In the past few years the production of naphtha has been more and more directed towards its use as a feedstock for chemicals and for manufacture of gas for fuel purposes.

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Two years ago it appeared that there might develop a shortage of economic priced naphtha with the soaring demand for the product but the discovery of natural gas in the North Sea has eased this concern. Thus the European producer of plastics materials based on ethylene appears in a very good position to compete on a worldwide basis.

Another area of heavy crude oil production has been the Caribbean and certain areas in the north of South America, whose products have, until recently, been exported more heavily to areas outside of, than to, the United States. The establishment of refineries in Puerto Rico, with the associated chemical plants based on the naphtha produced, has now put a highly competitive manufacturing area in the sphere of the United States with immediate problems for the domestic industry. The skillful moves of Phillips Petroleum, Commonwealth Oil and Hess Chemical in this area are well known to you. Recent representations in Washington on the question of oil import quotas show the heat that has been generated by these moves.

Crude oil supplies from the Black Sea area have had the effect of helping stabilize world crude oil prices, but the growing need for the material for internal consumption in the Comecon countries has kept large quantities from being offered on the open market. This might not necessarily hold in the future.

This concentration of crude oil in the Mid-East and Caribbean areas has led many world oil companies to seek other sources by

exploration to reduce the danger of increase of price by nationalizatio unilateral renegotiation of contracts and so forth. This search has bee highly successful, and at the present time adequate supplies of crude oil are available throughout the world under ever-increasing competitive conditions.

For the basic commodity plastics the key to the future must lie in an ability to compete on a global basis. To do this several factors have to be considered. Firstly there is this question of the size of plant required to economically compete. For ethylene, it is now clear that the minimum size is 350,000 tons per year and preferably 450,000 tons per year. To provide the raw material stock for such a plant, it must be located adjacent to a crude oil refinery of suitable size and this refinery should operate at the highest efficiency, which means it must have outlets for the economic sale of the products, other than naphtha, coming from the refinery operations. In the United States such situations exist for the Houston Ship Channel complexes and the Baton Rouge - Taft Louisiana area.

In Europe, naphtha demand and disposal of non-chemical by-products favor the refiner or an association between a chemical firm and a refiner.

Similarly, Japan has established large petrochemical complexes, and has pioneered in methods for reducing the transport costs of the

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crude oil from the Mid-East. (The Idemitsu Maru recently made its maiden voyage from Kuwait to Japan with a load of 1,500,000 barrels of crude oil) Thus we recently hear of the Phillips - Showa Denko new petrochemical center.

As the size of the ethylene plant has increased, so has the minimum economic size of the polymer plant. For example, it is now considered that for any future production a polyethylene plant should not be smaller than 200,000 tons per year; a polystyrene plant, 100,000 tons per year; and a polyvinyl chloride plant, 100,000 tons per year.

These large plants call for vast capital resources and the reserves needed to sustain them when markets do not absorb the full output of new capacity, and the growing concern of American manufacturers over this situation inside the United States has caused many of them to seek associates or partners, both within the U. S. and without.

This trend is particularly noticeable abroad, and has led to some interesting combinations of companies and approaches to the problem. We have referred to, and this audience will be familiar with, the associated companies forming the refinery-chemical complexes in Puerto Rico and particularly those basing around the Commonwealth Oil facility. You might be interested in the situation in Spain, where the basic olefins plant at the Puertolano complex is Government owned, but no fewer than

(Figure 4)

three major world companies, each from a different country, Phillips (US), ICI (UK) and Montecatini (Italy), have joint agreements for supply of the olefins and have part ownership in the polymer plants themselves. In a separate refinery-chemicals-polymers set up in Tarragona, Esso (US), Dow (US), Shell (UK-Dutch) and Farbwerke-Hoechst (Germany) are involved. (Figure 5)

In Japan, we see a trend away from the anti-trust business approach introduced by General McArthur following World War II, and a return to the more familiar and old style Japanese practice of groupings of industries with interlocking interests and arrangements, the so-called Zaibatsu. Such practices condone and even encourage cartels, permit the division of markets, establish production quotas, fix prices and carry out a whole host of practices considered restrictive of competition in the U.S. The Japanese have long resisted any attempt to establish production facilities in their country by foreign companies, and where permission has been granted for the setting up of a joint company, effective control has always been retained by them. Their aim has been to establish facilities either by a patent or know-how license, or by developing their own technology using technical assistance from wherever it could be obtained. They already have the necessary knowledge for the manufacture of the three main thermoplastics commodity materials, and are currently regrouping their petrochemical complexes and establishing what group will produce which polymer,

obviously aiming for a further aggressive approach to world markets.

We have few details of how the U.S.S.R. and the Comecon nations are proposing to handle their plastics materials production questions, but some details are becoming clearer. They, too, recognize the shift to the three basic commodity type materials, and have agreements for the necessary know-how and the building of plants. Originally it was the hope of the U.S.S.R. that its Council of Mutual Economic Assistance (Comecon) would become the control agency for integrating the economies and the economic planning of the Eastern European states with the Soviet Union itself and Mongolia. Recently, it has become more evident that the individual requirements for large capital spending, and the reluctance of individual states to relinquish decision making power to a central authority has caused the Soviet Union to permit planning to proceed on a less elaborate basis.

Once the immediate surge of demand is satisfied, however, I believe they will return again to a more planned approach to massive primary production facilities and that we can expect them to enter world markets in competition with other nations.

An interesting situation has developed in the Near East, where large amounts of natural gas (LPG) exist, but which have led to be "flared" for lack of sufficient economic incentive to collect and ship all of the material available. The development of the oxychlorination route for vinyl chloride monomer using ethylene as the basic raw material hydrocarbon has encouraged one large U. S. domestic producer whose ability to compete profitably in the absence of a petrochemical base here and with the increasing price competition was becoming under question, to form a joint company with the Iranians, and this vinyl chloride monomer will be used to produce polyvinyl chloride. Since Iran cannot possibly be expected to absorb the full capacity of the plant announced, the material will obviously enter the world market.

Joint companies are not new, but many large U. S. corporations are beginning to wonder whether the classical approach can be maintained when they do not have a controlling interest, especially as they contemplate restrictions on the control they can exercise, renegotiation of original agreements, sometimes under local government pressure, the large capital requirements to stay competitive and the difficulties of foreign exchange. An interesting sidelight on this question is seen in the recent sale by the Distillers Company in the U.K. of their plastics and chemicals interests to the British Petroleum Group, including, as it does, a number of smaller companies set up jointly with

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various partners, including some from the United States.

This growing feeling that some entirely new thinking is necessary in approaching world markets has been highlighted this past year by the announcement of several large companies in the chemicals and plastics areas that they intend in the future to act like, and wish to be considered as, international companies rather than as American companies with international operations. This approach is all the more urgent when we consider that no longer does any one country have a monopoly on raw materials, technology, money resources and skilled personnel, and the successes of today and yesterday are no guarantee of success in the future.

So far we have considered the raw material situation only, but similar problems exist for the fabricator and converter. Although he now has the promise of cheaper basic plastics materials coming from these large plants, will he be able to improve his presently small operating margins of profit, or will he find increasing pressures as companies abroad attempt to bring in finished items based on lower cost raw materials and lower labor costs.

The establishment of plastics processing plants in South Korea, Hong Kong, Taiwan and Thailand, using principally plastics materials manufactured in Japan is indicative of a trend which must affect our domestic manufacturers. It is well known that substantially all of the

plastics artificial flowers and plants sold in the U. S. are manufactured in the Far East. Similarly, with the loss of the majority of transistor radio set manufacture to the Japanese, the production of the plastic cases housing them has been lost also. Many consumer items, presently large users of plastics materials, could be manufactured abroad and imported into the United States at lower cost than the domestic product, and the pressure will intensify. This, of course, is not unique for plastics, but now extends to fabricated steel, textiles and others. Gary Hufbauer will deal with the question of Tariffs as it relates to this problem shortly.

It was the fortunate position of the United States for many years to be a large exporter of plastics raw materials, while at the same time very little material was imported. This position has now changed and I expect that it will not be long now before we will see an actual reversal whereby more plastics raw materials are imported than exported. From the chart (Figure 6) it will be seen that the decline of exports had already stated in 1965. This situation will be, of course, particularly acute when some of the large scale production plants now under construction abroad are brought on stream and the surplus over immediate domestic needs has to be sold. We know, for example, that the Japanese have substantially increased their exports these past few years, and expect by 1970 to export over 100 thousand tons of polyethylene; and 50 thousand tons of polyvinyl chloride. Already this

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pressure is being felt by the low prices being offered, for example, by the Japanese for homopolymer polyvinyl chloride.

Lest we think that our own large production is a shield against importation, let us remember the experience of the United Kingdom, who found itself suddenly turned from a net exporter of polyvinyl chloride to a net importer when the Norwegians made cheaper material available from a low cost operation.

On all sides, American plastics industry is faced with an urgent necessity to plan carefully for the future, not only from the standpoint of the intense internal competition, but also from the growing strength and sophistication of the world producers. Certain end use items are already lost to the American manufacturer.

Unfortunately, not all of the problems are technical in nature, since, in the ultimate analysis, questions of the cost of raw materials using world available sources, and the importation into the United States of either finished goods using plastics materials, or the polymers themselves, involve balance of trade and tariff considerations which are political questions also.

What is certain is that the next five years will probably be the most exciting and important one for the business - statesmen of the plastics industry.

Figure 1

WORLD PLASTICS PRODUCTION
(in metric tons)

Country	1962	1963	1964	1965	1966
U.S.A.	3,673,500	4,063,000	4,580,500	5,298,000	6,122,400
West Germany	1,244,900	1,422,200	1,739,900	1,973,900	2,200,000
Japan	831,300	1,061,600	1,376,000	1,600,500	1,937,300
United Kingdom	664,400	744,700	858,100	957,100	1,036,200
U.S.S.R.	495,700	587,300	721,100	819,000	940,000
Italy	498,900	621,300	716,600	816,300	930,000
France	454,400	507,000	610,900	677,100	780,000
Benelux	182,600	209,500	299,800	368,000	405,000
East Germany	165,800	181,400	198,600	209,500	245,000
Others - Western World	597,600	722,400	868,000	1,020,400	1,286,000
Others - Comecon	158,700	210,500	294,800	419,500	488,000
TOTAL	8,967,800	10,330,900	12,264,300	14,159,300	16,369,900

A. J. Warner
May, 1967

Figure 2

U.S.A. PRODUCTION AS A PERCENTAGE
OF TOTAL WORLD PRODUCTION
PLASTICS RAW MATERIALS

1955	54.0
1958	45.5
1961	43.5
1962	41.0
1963	39.4
1964	38.0
1965	37.4
1966	37.4
1970 (est.)	35.0
1975 (est.)	30.0

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May, 1967

Figure 3

MAJOR WORLD PLASTICS PRODUCTION BY TYPES
(in metric tons)

Type	U.S.A.			U.K.			Japan			U.S.S.R.
	1962	1964	1966	1962	1964	1966	1962	1964	1966	1962
Cellulosics	71,700	73,000	81,600	14,300	15,200	14,200	8,200	12,600	13,600	37,300
Phenolics	262,600	314,300	430,800	57,200	64,600	71,100	55,800	77,800	95,500	93,000
Aminoplastics	194,100	258,400	294,800	92,400	113,300	124,400	199,100	276,400	340,500	102,300
Alkyds	248,500	268,700	317,500	50,500	52,700	58,900	29,900	47,900	59,000	46,800
Polyesters	96,200	143,300	204,100	11,700	17,800	27,900	20,400	33,300	44,800	23,100
Polyvinyl Chloride	551,000	746,900	1,269,800	119,900	180,000	205,700	313,400	473,800	485,400	83,600
Polystyrene	577,800	765,100	1,088,400	68,800	82,000	118,400	42,600	100,400	191,000	24,800
Polyolefins	980,500	1,345,500	1,873,000	174,600	237,000	289,500	142,400	328,900	628,300	31,400
Other Thermosets	274,000	251,000	68,100	21,800	26,800	47,800	7,800	3,500	3,900	28,200
Other Thermoplastics	417,100	414,300	494,300	53,200	68,700	78,300	11,700	21,400	75,300	25,200
TOTAL	3,673,500	4,580,500	6,122,400	664,400	858,100	1,036,200	831,300	1,376,000	1,937,300	495,700
% Thermoplastics	70.7	73.0	78.5	64.8	67.9	68.1	62.3	68.1	71.9	40.8
% Thermosets	29.3	27.0	21.5	35.2	32.1	31.9	37.7	31.9	28.1	59.2
% Three Major Thermoplastics	57.4	62.4	69.1	54.7	58.2	59.2	59.9	65.6	67.3	28.2

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May, 1967

DeBell & Richardson, Inc.

Figure 4

SPAIN

PUERTOLANO COMPLEX

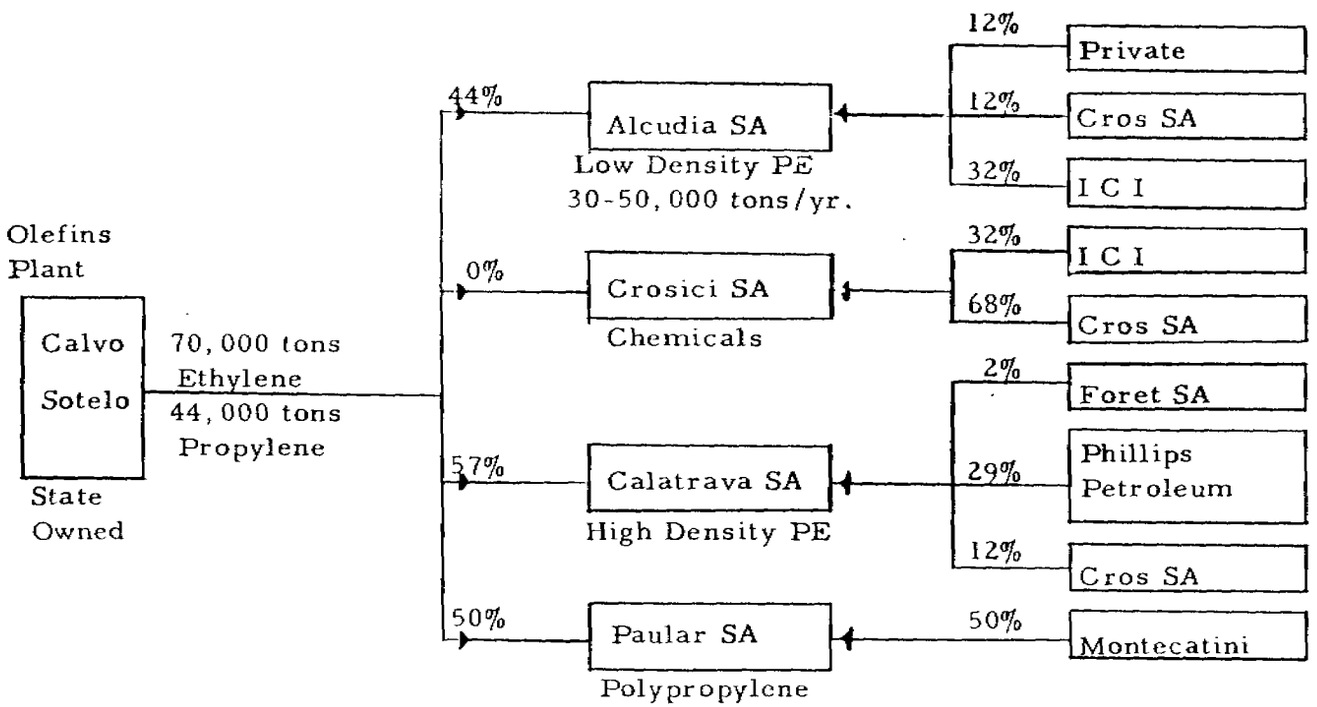

Figure 5

SPAIN

TARRAGONA COMPLEX

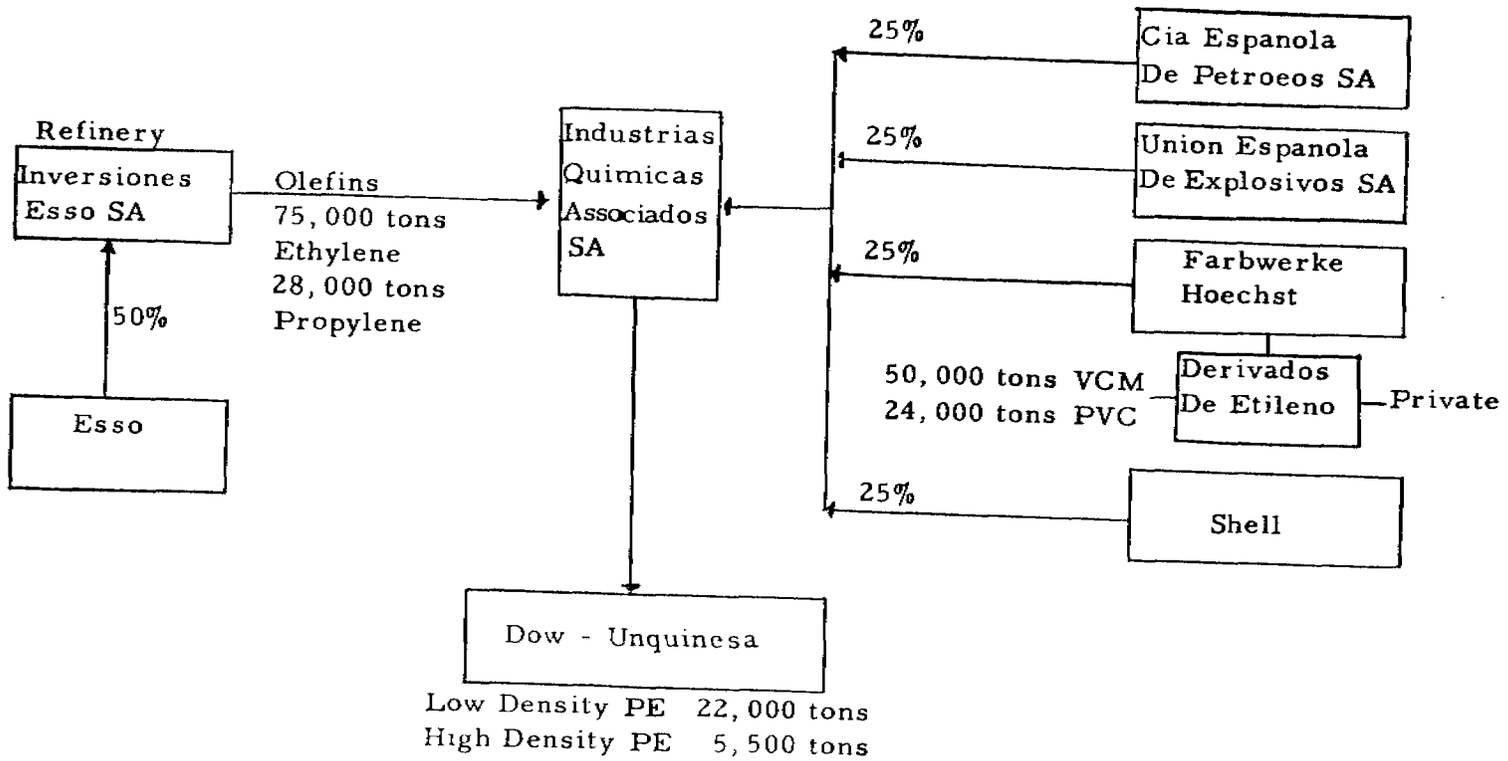

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Figure 6

U. S. EXPORTS OF PLASTICS

Virgin Resin
(in metric tons)

1960	149,700
1961	142,000
1962	263,800
1963	267,200
1964	344,200
1965	303,700
1966	283,400

A. J. Warner
May, 1967

PLASTICS AND THE TARIFF

G. C. Hufbauer
University of New Mexico

Delivered before the

National Industrial Conference Board

May 18, 1967

PLASTICS AND THE TARIFF

G. C. Hufbauer
University of New Mexico

The Dilemma. The typical widget manufacturer's Garden of Eden has, I ..spect, tariff walls of three different heights. The barriers protecting widget ..es at home are very great. By contrast, raw materials and intermediate goods ..sed to make widgets enter duty free. Foreign tariffs on widgets are low, ideally ..n-existent.

Widgets may be a figment of imagination, but the tariff dream just out-..ned seems to be cherished by a great many American industries. When every ..dustry tries to legislate its own version of the dream, however, contradictions ..erge. Most inputs for manufactured goods are themselves manufactured goods; ..rthermore, every country is both a home territory and a foreign market. One ..mpany's tariff dream thus becomes another company's nightmare.[1] Compromises are ..equired.

In making these compromises, an industry really must choose between two ..road strategies. It cannot very well advocate free trade for all products except ..s own. It must either champion protection, and tacitly endure tariffs both for ..s suppliers and foreign competitors, or it must espouse free trade, and vigor-..sly reject all tariffs.

Most American manufacturers have chosen the protectionist course. This ..rategy may be perfectly logical for textiles and leather goods, but whether ..rotection commends itself to the plastics industry is another question. Academic ..conomists, as you know, generally oppose tariffs as contrary to consumer well-..eing.[2] My remarks here, I would like to emphasize, are addressed not to the ..elf-interest of the consumer, but rather to the self-interest of the plastics ..anufacturer.

Tariff Rates. The American plastics industry grew up with protection. Pyroxylin compounds were dutied at rates varying from $1.00 to $0.40 per pound between 1864 and 1900.[3] Beginning with its invention in 1909, phenol formaldehyde was protected by a 20% tariff.[4]

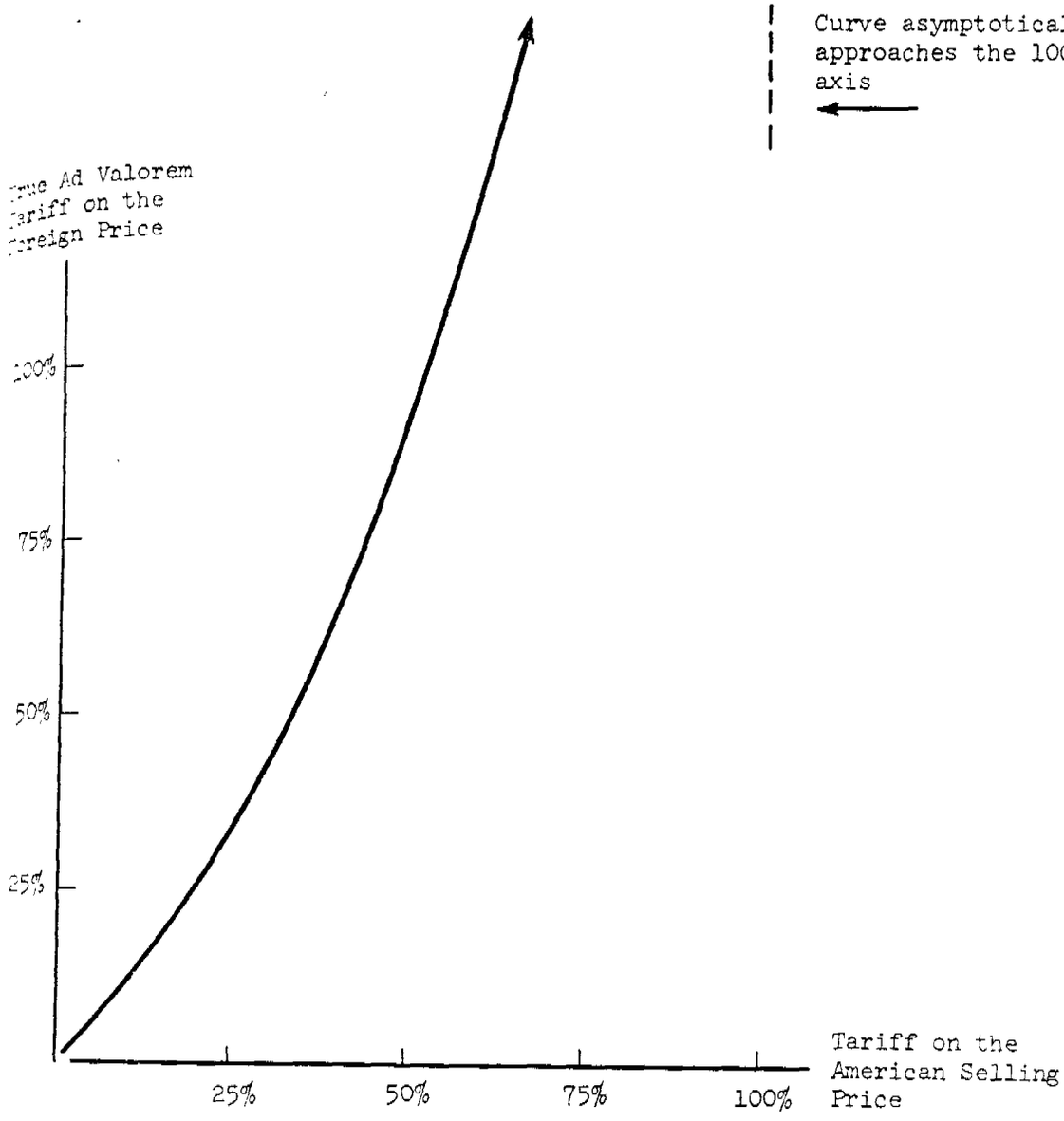
Mindful of the trade threat from Germany, the chemical industry pressured Congress for more protection after the First World War. The Emergency Tariff of 1921 and the Fordney-McCumber Act of 1922 answered these demands. Cellulosic plastics were given 60% ad valorem protection. The duty on synthetic resins was raised to 60% (lowered in 1924 to 45%) plus 7¢ per pound.[5]

In a highly significant departure, the Fordney-McCumber Act based the resin ad valorem duty, along with duties on many coal tars and dyestuffs, on the American selling price rather than on the foreign price. This departure from customary practice was supposedly required to stop the fraudulent invoice habits of importers. In reality, it transformed high nominal rates into prohibitive duties. As explained in the margin, if the American selling price (ASP) tariff is λ, the true ad valorem rate on the foreign price can reach $\frac{\lambda}{1-\lambda}$.[6] Diagram 1 portrays this relationship. An ASP tariff of 50% potentially gives protection of 100%; higher ASP rates become rapidly more prohibitive.[7]

The Hawley-Smoot Tariff of 1930, inspired by the Great Depression, substantially raised most duties over their 1922 levels. Rates on coal-tar synthetic resins, however, stayed at 45% of the American price, plus 7¢ per pound. Cellulosic plastics were tariffed at 80% on the foreign price. Vinyl acetate and the other newly emerging thermoplastics were assigned a duty of 30% on the foreign price, plus 6¢ per pound.[8]

The Hawley-Smoot Tariff was part of a world-wide nationalistic response to the economic collapse. Statesmen in many nations soon realized the foolishness of mutually prohibitive tariff barriers. Over the objections of the Manufacturing Chemists' Association and other trade groups, Congress accordingly passed the firs

Diagram 1



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Reciprocal Trade Agreements Bill in 1934.[9] This act enabled the President to lower American duties by as much as 50%, in exchange for similar concessions abroad. American tariff policy since Roosevelt has been based on extensions of the Reciprocal Trade Bill.

In successive rounds of tariff bargaining, American duties on plastics have been lowered from the Hawley-Smoot levels. Table 1 outlines the present rate structure in the United States and other industrial nations.

The first section of Table 1 sets forth average "nominal" ad valorem rates for the three types of plastics distinguished in the Brussels nomenclature.[10] The condensation group includes phenol formaldehyde, urea formaldehyde, alkyd, polyester, silicone, and similar resins. Virtually all condensation plastics are still tariffed by the United States (though not by other countries) on the domestic selling price basis. Owing to competitive pressures at home, however, this has not noticeably benefitted the industry. The polymerization group includes polyvinyl chloride, polyethylene, polypropylene, acrylics, polystyrene, and other thermoplastics. Of these, only polystyrene receives ASP treatment. The cellulosic group comprises cellulose nitrate, cellulose acetate, and related compounds, none of which are dutied on the ASP basis. Evidently, the United States has a somewhat higher "nominal" tariff structure, especially on the thermosets, than other major industrial nations.

The second section of Table 1, drawn from the work of Professor Balassa, compares "nominal" and "effective" rates for synthetic materials as a group (plastics, synthetic rubbers, and man-made fibers).[11] The "nominal" tariff relates the duty to the foreign price; nominal tariffs correspond to the common concept of ad valorem tariffs. The "effective" tariff, on the other hand, relates the duty to that portion of the foreign price accounted for by value added (wages and profits) in the industry; furthermore, the "effective" tariff makes allowance for the duty on inputs.[12]

Table 1

	United States	Common Market	United Kingdom	Japan	Sweden
Average Nominal Ad Valorem Tariff Rates					
Condensation Plastics	26%[1]	18%	20%	20%	10%
Polymerization Plastics	23%	21%	10%	20%	10%
Cellulosic Plastics	21%	21%	30%	20%	10%
Average Nominal (N) and Effective (E) Rates					
	N E	N E	N E	N E	N E
All Synthetic Materials[2]	19% 34%	12% 18%	13% 17%	19% 32%	7% 13%

Notes: 1. Tariffs on condensation plastics are based on the American selling price. However, internal competition has kept American selling prices beneath the maximum levels they might attain without attracting foreign supplies. Thus, while the highest feasible ad valorem tariff is 35%, the actual rate is about 26%. Cf. U.S. Tariff Commission, Products Subject to Duty on the American Selling Price Basis of Valuation; Conversion of Rates of Duty on Such Products to Rates Based on Values Determined by Conventional Valuation Methods, July 1966 (TC Publication 181).

2. Plastics, synethetic rubbers, and man-made fibers.

Sources: F.K. Topping, Comparative Tariffs and Trade, volume I, 1963 (Committee for Economic Development); B. Balassa, "Tariff Protection in Industrial Countries: An Evaluation", Journal of Political Economy, December 1965.

Suppose, for example, that a finished widget costs $1.00 on the wor
market, that each widget incorporates $0.50 of raw steel and $0.50 of wages an
profits, that the nominal duty on widgets is 10%, and that the nominal duty o
steel is 2%. The effective tariff on widgets is then 18% (10% - .5x2%)/.5 = 18%.
The effective rate on a product exceeds the nominal rate whenever inputs are
tariffed at lower nominal rates than the product in question.[13] A low proportion
of value added enhances effective protection under these circumstances.[14]

Effective rates on synthetic materials are generally higher than nominal
rates. Following the time-honored custom of according greater protection to more
highly processed goods, inputs for synthetic materials are dutied at lower rates
than the materials themselves. Of the three groups making up synthetic materials,
plastics enjoy the highest effective rate, at least in the United States: 42%.[15]
Among industrial countries, the United States has the highest overall effective
rates on synthetic materials (and almost certainly on plastics), though only
marginally higher than Japan. However, quotas on petrochemical feedstocks are
rapidly eroding these high effective rates. Quotas on a key input exercise ap-
proximately the same impact as high tariffs.

The steep effective rates presently imposed by the United States on
plastics are reflected in its low import ratio by comparison with other areas.
America imports about 1.5% of its plastic needs, the Common Market imports about
2.3% of its requirements from areas other than the EEC, Japan imports around 1.7%,
and Britain, about 18.9%.[16] Even without high protection, the United States would
probably have a low import ratio, but not so low as 1.5%.

Almost five years ago, Congress enacted the Trade Expansion Act of 1962,
giving the President authority to cut tariffs up to 50% of their 1962 levels.[17]
The authority granted by this Act expires June 30, 1967.

In a few weeks, the results of five years' negotiations will be known.

Negotiators at Geneva have expressed pessimism, especially over tariff cuts in the chemical field. The Europeans are objecting strenuously to the ASP clause, but the American team has no bargaining authority on this point.[18]

The plastics industry faces a dilemma. In these last crucial weeks of the Kennedy Round, and in the years ahead, should the industry seek to exchange part of its present high protection for lower rates abroad and liberalization on key inputs? Or should it, along with other members of the Synthetic Organic Chemical Manufacturers' Association, staunchly defend the status quo?[19]

Comparative Advantage. The key to this dilemma lies, I think, in David Ricardo's concept of comparative advantage. To illustrate this concept, I will use a simple example. Suppose there are only two countries in the world, the United States and the Common Market, and only two products, plastics and steel. Suppose further that labor is the sole input, that prices are proportional to labor requirements, and that production conditions can be described as follows:

	United States man-years	Common Market man-years
Steel, per ton	1	1
Plastic, per ton	2	3

Under these assumptions, American prices for steel and plastic will be such that 2 tons of steel exchange for 1 ton of plastic (e.g., a ton of steel might cost $100; a ton of plastic, $200). In the Common Market, 3 tons of steel will exchange for 1 ton of plastic (e.g., steel, fr. 100; plastic, fr. 300). Plastic is cheaper, relative to steel, in the United States than in the Common Market. Conversely, steel is cheaper, relative to plastic, in the Common Market than in the United States. The United States has a comparative advantage in plastic; the Common Market has a comparative advantage in steel.[20] Under a free trade regime, the exchange rate between francs and dollars will necessarily adjust so that America exports plastic and the Common Market exports steel.[21] Put very plainly, the U. S. plastic industry and the Common Market plastic industry would both expand

under free trade, while the U. S. steel industry and the Common Market steel industry would both contract.[22] The former two industries are natural allies in the cause of free trade; the latter are natural advocates of protection.

But does the complex real world actually favor the American plastics industry with a comparative advantage? Direct productivity comparisons are hard to obtain.[23] Nevertheless, there are, I submit, at least six indicators of American prowess at manufacturing plastic.

In the first place, the United States exports a larger share of its plastics output than its output of other manufactured goods. Between 1952 and 1965, plastic exports ranged between 6% and 12% of production. By contrast, exports of all manufactures fluctuated around 3.5% of total sales. To be sure, as a given plastic matures and its technology becomes well known American exports may decline as a percentage of output.[24] Despite pessimistic comments from some quarters, however, I detect no reversal of the export prospects for the industry as a whole.[25] As old products decline new products and new processes will take their place.

Secondly, the manufacture of plastic requires a great deal of capital. Equipment and structures per man amount to about $17,600, whereas the average U. S. manufacturing plant utilizes only about $4,500 per man. The lower labor costs enjoyed by competing industrial nations thus count less heavily in the plastics trade than elsewhere, simply because depreciation charges and profits assume greater importance per unit of output.

Third, the plastics industry employs more skilled labor than the average firm. This is indicated by an average wage rate of $7,130 per man, contrasted with a wage of $5,880 for manufacturing taken as a whole. The use of human capital, like the use of physical capital, enhances the industry's position vis-a-vis other American manufactures.[26]

Fourth, the United States enjoys a technical lead in plastics manufacture over virtually all nations save Germany. The frequency of licensing arrangements and joint ventures between U. S. firms and overseas companies attests to American know-how. One quantitative device I have used to measure technical disparity between nations is the "imitation lag." This figure relates average national first production dates for various plastics to average world first production dates. A short lag indicates technical leadership. As of 1962, both the United States and Germany had plastic imitation lags of 2.5 years; Britain had a lag of 8.1 years; all other countries had lags of 10 years or more.

Fifth, economies of scale characterize plastic manufacture, particularly manufacture of the petrochemical thermoplastics. Since American markets are large, the United States firm can more confidently erect a big plant and reap this advantage than his foreign competitor.

Sixth, the trade record of the United Kingdom, the one large industrial nation which most nearly practices free trade in plastics, offers much hope for the United States. In 1965, Britain exported nearly $227 million of plastic material, and imported only $153 million. If the United Kingdom, with various disadvantages when compared to the United States, can achieve a large export surplus under conditions approaching free trade, it seems likely that the United States can accomplish the same feat on a much grander scale.

Looking at these six indicators, I conclude that the United States has a strong comparative advantage in making plastics. If this conclusion is correct, then the typical American plastic firm has more to gain by all around free trade than by universal protection.[27]

Apart from its comparative advantage at home, the American plastics industry has, I think, an international stake in free trade. Through licensing arrangements, joint ventures, and sole ownership, the larger manufacturers are becoming extensively committed to overseas production.[28] This commitment will

prove most rewarding if each new plant can be designed to service a large mar
Costs of production rise rapidly when small, uneconomical plants must be inst
for each product in each country. But the ideal of large markets can be achiev
only when free trade conditions exist in broad geographical areas. The inter-
national chemical firm thus has a general interest in promoting low tariffs.[29]

Some Qualifications. Evidently I believe that free trade commends itself to the U. S. plastics industry. Yet historically this industry has favored high tariffs. Am I to conclude that the industry has mis-judged its own self-interest? Not entirely.

To begin with, the industry's tariff position was really developed in 1922. At that time, plastics were in their infancy; the industry may have been truly disadvantaged in an all-out competitive struggle with Germany. But conditions change in 45 years. The policy response of the 'twenties may no longer be appropriate to the 'seventies and 'eighties.

Secondly, the plastic industry belongs to the chemical industry, more precisely, to the organic chemical industry. In my estimation, free trade commends itself to the chemical industry as a whole, but undoubtedly there are many organic chemicals -- particularly coal-tar intermediates and dyestuffs -- which would suffer under this policy. A firm with far-flung interests in many products cannot very well advocate protection for some, free trade for others. To maximize its effectiveness, it must stand wholly for tariffs, or wholly against them. The same is even more true of industry associations. In deciding which way to turn, most firms and associations have, it seems, paid undue attention both to their own tariff arguments advanced a generation ago and to their less competitive products. But cool economic calculation might, in fact, lead some firms to choose the protective way.[30]

Third, the chemical industry may genuinely believe that it can best ease the American balance of payments distress by maintaining a high tariff wall and

keeping imports at a minimum.[31] The balance of payments problem is too broad for consideration here, but I think American manufacturers have a common interest in urging an exchange rate solution, rather than restrictive measures on imports, capital movements, tourist, or government activity abroad.

Fourth and last, there are probably those who believe that "foreign-trade zones" will answer the tariff dream of the plastics industry. Hence they feel little incentive to lobby for lower tariffs. Under enabling legislation passed in 1934, the Secretaries of the Treasury, Commerce, and Army can designate zones in or adjacent to Ports of Entry.[32] An area with zone status can store, manufacture, and process foreign goods, adding American components to the imported supplies, without paying customs duty. If the goods do subsequently enter the United States, an appropriate duty is then paid on the import content.[33]

Until recently, zones were mostly located in major cities, such as New York, New Orleans, and San Francisco for warehousing purposes. In the past few years, however, zones have been established in Puerto Rico and Bay City, Michigan, and Taft, Louisiana, at the behest of petrochemical firms.[34] Foreign-trade zones offer the petrochemical firm two major advantages.

First, the petrochemical firm can service the export market without initially paying duty on inputs. To be sure, the firm might eventually obtain drawback of duty anyway, but the foreign-trade zone avoids cash outlays to the customs authorities and bypasses red tape. Upon payment of appropriate duties, the zone plant can also sell to the U. S. market. Economies of large scale production can thus be realized just as if the plant were located in American customs territory.

The second major advantage remains in the anticipatory stage. A Presidential proclamation of December 1965 gave the Oil Import Administration power to set oil quotas for foreign-trade zones located in the continental United States. The proclamation, however, did not apply to Puerto Rico; hence the Union

Carbide zone plant in Penuelas can import feedstock unrestricted by quotas. The Oil Import Administration has yet to make its maiden decision on quotas for mainland zones, but petrochemical firms are hoping that the Administration will look favorably upon their feedstock needs. An application from Dow Chemical for Bay City is pending; Union Carbide is apparently awaiting the outcome to submit its own request for the Taft complex.

Needless to say, the domestic oil interests are vigorously resisting any quota liberalization for the foreign-trade zones. Wrapping themselves in both flag and balance of payments, they contend that feedstock allotments would damage the national interest. From an academic viewpoint, the petrochemical firms could, in my opinion, have the better of both these arguments. But the Oil Import Administration can hardly be expected to decide the issue on its academic merits. The domestic oil industry has strong political connections.

While I applaud the foreign-trade zone concept, it is only a partial answer to the needs of the plastic industry. Zones will lose most of their attraction if the petroleum interests have their way on quotas; in any event, zones will do nothing to lower tariffs abroad or to reduce duties on chemical inputs. Despite the allure of zones, therefore, I suggest that the American plastics industry not forget its long-range interest in universal free trade.

Footnotes

1. W. Haynes provides an amusing example: "...the interests of American manufacturers of synthetic aromatic raw materials and of finished cosmetics collided violently and each suggested diametrically opposite remedies. This clash enlivened the dinner of the Perfumery, Soap & Allied Industries at the Hotel Astor, New York City, on March 28, 1923. [The cosmetics industry had appealed] to Washington... for a 50 per cent reduction in the duties on the raw materials of cosmetics... [At the dinner] Dr. S. Isermann of Von Dyk & Company and Dr. L. Jenkel of Denney & Denney fought back bitterly in defense of the duty on raw materials, landing some sarcastic blows on the selfish inconsistency of the highly protected perfumers." American Chemical Industry, volume IV, p. 296, 148.

2. Certain exceptions are made for "infant industry" and "optimal tariff" arguments, but these arguments have more relevance to developing countries than to advanced industrial nations.

3. W. Haynes, American Chemical Industry, volume I, Appendix VI, 1948. The The comparable ad valorem rate was probably about 50%.

4. W. Haynes, op. cit. This rate was levied under the Payne-Aldrich Act.

5. W. Haynes, American Chemical Industry, volume II, Appendix V, 1948. The rates in the Underwood Tariff of 1913 had been 40% on cellulosics and 15% on synthetic resins.

6. Let P_a represent the American price for a given article, and P_f the foreign price for the same article. If the American selling price is governed only by foreign competition, the following relationship must hold, at least approximately, for imports of the good:

$$\text{(i)} \qquad P_f + \lambda P_a = P_a$$

The ad valorem rate on the foreign price, t, is given by the expression:

$$\text{(ii)} \qquad t = (P_a - P_f)/P_f$$

If relationship (i) is solved for P_f, and that solution value is substituted in (ii), it becomes evident that:

$$\text{(iii)} \qquad t = \lambda/(1-\lambda)$$

The ad valorem rate will be lower if domestic competition keeps the American selling price below the maximum level set by potential foreign competition. For an empirical study, see United States Tariff Commission, Products Subject to Duty on the American Selling Price Basis of Valuation; Conversion of Rates Based on Values Determined by Conventional Valuation Methods, July 1966 (TC Publication 181).

7. F. W. Taussig, the noted international economist, resigned from the Tariff Commission over the high rates of the Fordney-McCumber Act. He specifically opposed the generous protection for the dye industry, which largely resulted from the ASP tariff system. Taussig even suggested that German and Swiss firms were better suited to the dye trade than American companies. Events of the past 45 years have not proven him wrong. CF. W. Haynes, American Chemical Industry, volume IV, pp. 266-70, 1948.

8. W. Haynes, American Chemical Industry, Volume IV, Appendix I; volume V, Appendix VI, 1948.

9. W. Haynes, American Chemical Industry, volume V, p. 59, 1948.

10. The difference between "nominal" and "effective" rates is explained below. Most countries employ the Brussels nomenclature to classify their tariff rates.

11. B. Balassa, "Tariff Protection in Industrial Countries: An Evaluation," Journal of Political Economy, December 1965.

12. Let t_i represent the ad valorem nominal rate on product i; a_j, the input of product j per unit of product i; t_j; the nominal rate on product j; and v_i, the proportion of product i accounted for by value added. The effective rate on i, z_i, can then be expressed as:

$$(i) \qquad z_i = \frac{t_i - \sum a_j t_j}{v_i}$$

Cf. B. Balassa, op. cit., p. 577.

13. Conversely, when inputs have higher duties than the product, effective protection will be less than nominal protection. It is quite possible for effective protection to be negative.

14. Effective protection for some processing activities can thus be quite high: with a nominal tariff of 40%, makers of venetian blinds enjoy an effective rate of 107%. G. Basevi, "The United States Tariff Structure," Review of Economics and Statistics, May 1966, p. 155.

15. G. Basevi, op. cit. The estimated effective rate on synthetic rubber is 10%, on cellulosic man-made fibers, 39%, and on synthetic man-made fibers, -2%.

16. These figures are based on data presented in A. J. Warner, "Problems Facing the Plastics Industry," January 5, 1966, and United Nations, Commodity Trade Statistics (Series D), 1964 and 1965. Including imports from the EEC, the Common Market has a ratio of about 12.8%.

17. As bait for Britain and other nations to enter the Common Market, the Act also provided that tariffs could be eliminated on products in which the EEC and the United States together accounted for 80% of free world exports. Since the EEC has not been enlarged, this provision applies to very few items. The United States and the present EEC, for example, account for only 72% of plastic exports. Cf. W. B. Kelly, editor, Studies in United States Commercial Policy, 1963, chapter II. This volume also provides a very readable history of United States tariff legislation.

18. "Mr. Blumenthal [the chief U. S. negotiator] says it's possible there will be little or no reduction of protective tariffs in the chemical field.

" 'This may or may not have implications for the overall prospects of the Kennedy Round,' adds the negotiator, 'but one thing is certain -- the biggest losers, if chemicals remain untouched, will be the chemical industries throughout the world.' " Wall Street Journal, December 16, 1966.

Blumenthal's views are based on the fact that 19% of the chemical industry's direct inputs come from the chemical industry itself. The plastics industry purchases 35% of its inputs from the chemical industry. Cf. "The Transactions Table of the 1958 Input-Output Study," Survey of Current Business, September 1965, Table 2.

An act of Congress would be required to change the ASP clause.

19. For the views of this Association, consult the Oil, Paint, and Drug Reporter, September 12, 1966.

20. As this example illustrates, the term "comparative advantage" refers to two comparisons: first, the cost of the chosen product is related to the cost of another product (or basket of products) within the country; second, the price ratio between products within the country is related to the price ratio between the same products in another country (or the world at large). The country enjoys a comparative advantage in the chosen product if its price ratio for that product is more favorable than price ratios elsewhere; otherwise, the country has a comparative disadvantage.

21. For example, if demand conditions are such that the exchange rate settles at $1 = fr. 0.75, the following prices, all expressed in dollars, will result: U. S. steel, $100 per ton; U. S. plastic, $200; Common Market steel, $75; Common Market plastic, $225. Plastic is cheapest in the United States, while steel is cheapest in the Common Market. The export pattern described will emerge as consumers seek the least expensive source of supply.

22. The extent of expansion and contraction would depend on the precise nature of cost conditions in the two countries.

23. Among other things, qualitative variations between products falling in the same statistical classification, different marketing ability of different firms, and productivity disparities between firms in the same industry within a country, all render meaningful comparisons quite difficult. Nevertheless, G.D.A. MacDougall has broadly confirmed the relevance of comparative advantage theory to trade conditions: "British and American Exports: A Study Suggested by the Theory of Comparative Costs, Part I; Part II," Economic Journal, December 1951; September 1952. Also compare the follow-up articles by R. M. Stern and G. D. A. MacDougall in Oxford Economic Papers, October 1962.

24. I have developed this theme at length in Synthetic Materials and the Theory of International Trade, 1966.

25. Pessimism was expressed, for example, by A. J. Wanrer in "Problems Facing the Plastic Industry," January 21, 1966, pp. 21-23. In 1965, the United States exported some $425 million of plastics; in 1966, the figure rose to about $470 million.

26. H. Y. Waehrer has documented the positive connection -- which would be expected from theoretical considerations -- between high wage rates (implying high levels of labor skill) and U. S. exports. Inter-Industry Skill Differences, Labor Earnings and United States Foreign Trade, 1960 (Columbia University Ph.D. thesis).

27. The attractions of free trade would be magnified if developing countries were permitted to sell a range of light manufactures (textiles, processed foods, etc.) to the United States. If poor nations could solve their foreign exchange difficulties by enlarging exports, they would less readily practice "import substitution" on plastics and other hard-to-make products.

28. International firms should reflect on their own possible participation in larger U. S. imports resulting from lower trade barriers.

29. This interest may be satisfied through the creation of regional free trade areas, rather than through multilateral tariff reduction.

30. It seems doubtful, however, that many firms have rationally calculated an overall tariff position.

31. See the position of the Synthetic Organic Chemical Manufacturers' Association, Oil, Paint, and Drug Reporter, September 12, 1966.

32. R. H. Lake is the very helpful Executive Secretary of the Foreign-Trade Zones Board, located in the Department of Commerce. The literature on foreign-trade zones includes: Foreign Trade Zones Board, Laws, Regulations, and Other Information Relating to Foreign-Trade Zones in the United States, June 1966; Annual Report of Foreign-Trade Zones Board (published each year); W. A. Dymsza, Foreign Trade Zones and International Business, 1964; articles by R. H. Lake in American Import and Export Bulletin, July 1963, International Commerce, July 15, 1964, The Oil Daily, November 8, 1965.

33. Usually raw materials pay lower tariffs than finished goods. Duties levied on "raw" import content are thus lower than the duties which would be collected on the same goods in more highly fabricated form if it came from abroad. Incidentally, when the tariff structure is "inverted" (higher duties on finished goods than on raw products), the Customs authorities have allowed the lower duty to prevail.

34. Oil, Paint, and Drug Reporter, September 19, 1966. Union Carbide, Dow Chemical, and Union Carbide respectively.