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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 ss we all like to hear that others have problems, too. Oscar Wilde once said n asked about his new play -- "The play was a great success but the audience was ilure!" With the fine turn-out this morning and our distinguished panelists we t help but get a good review of the exciting dilemma that management now faces the plastics industry.

Last year there were 43 U. S. plastics molding and fabricating company iness failures, and 19 mergers resulting from the economic, technical, and market rts taking place. Mergers were also occurring at a rate of about 80 per year in chemical industry during 1966. This churning and turmoil has been going on at this same tempo for some time in the plastics and chemical industry. In fact, U. S. manufacturers of molded and fabricated plastics products have bit the dust the last 10 years, representing about $50 million liabilities. Despite these iness tribulations, the last thirty years of scientific effort in plastics have lded 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 technic 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 busines 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 o 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 "li an enchanted forest. Delicious little paths curve away invitingly into charming little glades; the addict wanders on, entranced, unable to resist each fresh delig 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 sour of the management dilemma. And we find ourselves at a number of crosspaths in thi wonder woods. Some managements decide to leave the woods. Recently, Distillers Company Ltd., a beverage producer with substantial chemical interests, sold off it 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 ye in the plastics field, I cannot believe that this was a misspent youth, or that i is an unattractive industry -- for either the investor, the manager, the supplier

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

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

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

Another example: Our government, in deciding on what petrochemical feed- ock quotas to allow U. S. producers, must consider what will happen to our ance of payments under various assumptions about the construction of plants here abroad. Each firm in the industry wants to see the effect of legislation on its 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 decision. 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 chedules 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, internation al 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 lace another material in the marketplace. Of course, the producer of the tened material - be it paper, metal, or wood - is also glancing sideways at the tics business and contemplating his own future. Just the other day I was ing to a friend in the plastic pipe business. Plastic pipe - up 30 per cent over year to $170 million, is expected to hit the one third of a billion dollar mar- level in 1970, and this may still be less than 5 per cent of the total pipe mar- Simulation techniques and model building are useful to the manager faced with dilemmas. Distribution systems or acquisition decisions can be structured so sensitivity of all factors can be exposed for the manager to make his decisions. exposure forces clarification of objectives. In this example the question is ed -"Do you want to be in the plastics business, the pipe business, or the steel ness?" 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- ent threat of retaliation by his existing customers if he tries to move into markets. It is difficult to build new marketing systems and, thanks to . Sherman and Clayton, there are problems involved in direct acquisitions of ting firms. It takes time to build an enterprise. No matter which approach is ted, there will be a need for patient money, and, most of all, for sophisticated ement.

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

Here, again, there are common sense considerations and management tech- s which can help in taming the dilemma of "go" and "no go." It is possible ays to construct models of the most involved situation. duPont's Venture ysis 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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tribution systems, to speed up the pull-through of the basic polymer production. is provision of capital, technology, credit, and market development cannot go on rever in this manner in the plastics business. The fabricating segment of the dustry has now developed to a point where these business components need to be uldered and developed by this sector of the industry.

Many of the operations in converting plastics are headed by managers who e historically operated very successfully through unusual brands of intuition know-how, and who have had limited experience in a worldwide business environ- nt. We certainly need common sense and business acumen now, but we can also use e machine help, too. True, computers have been adopted in many plastics con- rting firms' record keeping, inventory control, and the like, but only rarely in e field of business decision-making. Today, thanks to remote access computer chnology we find programs applicable to plastics businesses. The convertor has ailable to him now the most modern business techniques, without a major in-house vestment. Perhaps one of the outgrowths of this conference will be to provoke ose in this sector of our plastics industry to explore the worth of such a anagement approach to their problems. Stock programs are now available to all, and have never seen any figures which indicate a cut-off point for the size of the m 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 roducts. This customer-supplier interface, as we all know, is a ticklish one. hould the user of plastics parts integrate into plastics fabrication? The appliance nd auto industry have in a big way. Take Admiral Corporation's vacuum forming lant, or Hotpoint, or Kelvinator, or General Electric's mammoth regrigerator liner olding 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 ...cts that presently compete with plastics faces an extraordinary set of dilemmas ...its own. Should the firm get into the plastics business itself, or should it ... back with improved types, models, and grades of its own material? Should a ...rsion to plastics, or a combination of plastics with other materials be ...stigated? So-called "atomic wood" is a good example of plastic impregnated ...diated wood making interesting strides in the furniture field. The AEC has been ...ing with 41 different types of wood and 6 different woodworking companies to ...lop these wood-plastic composites.

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

The choices which the firms competing with plastics must face are con- ...ned not only with market-related problems, but lead them directly into the area ...developing new technology, which must be appraised before venturing into this ...a of competition. However, the plastics business is different from others, not ...ly in its marketing and its technology, but in the fact that the materials it ...ls with are man-made and man-conceived. In 1966, one chemical compound - ...ylene diisocyanate - was used to produce 100 million pounds of an entirely new ...position 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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ndis- ...ey are merely illustrative of the fact that managers need every assistance they can ...t as international competition, technology, economic, political, and cultural ...tors take further hold.

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

One advantage that the keynote speaker has is the opportunity to raise ...uestions 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 ...he 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 ...urvival away from home will be short lived. The best management philosophy and ...ystems are essential, and these are available, if the industry will dedicate itself ...o improving management with the same fervor that it has applied technical expertise ...o 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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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.

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 nationalization, unilateral renegotiation of contracts and so forth. This search has been 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 plan required to economically compete. For ethylene, it is now clear that the minimum size is 350,000 tons per year and preferably 450,000 ton 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 Rou 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 comple and has pioneered in methods for reducing the transport costs of the

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[redacted] of their plastics and chemicals interests to the British Petroleum Gr[redacted] including, as it does, a number of smaller companies set up jointly [redacted]

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

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

A. J. Warner
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

A. J. Warner
May, 1967

Figure 4

SPAIN

PUERTOLANO COMPLEX

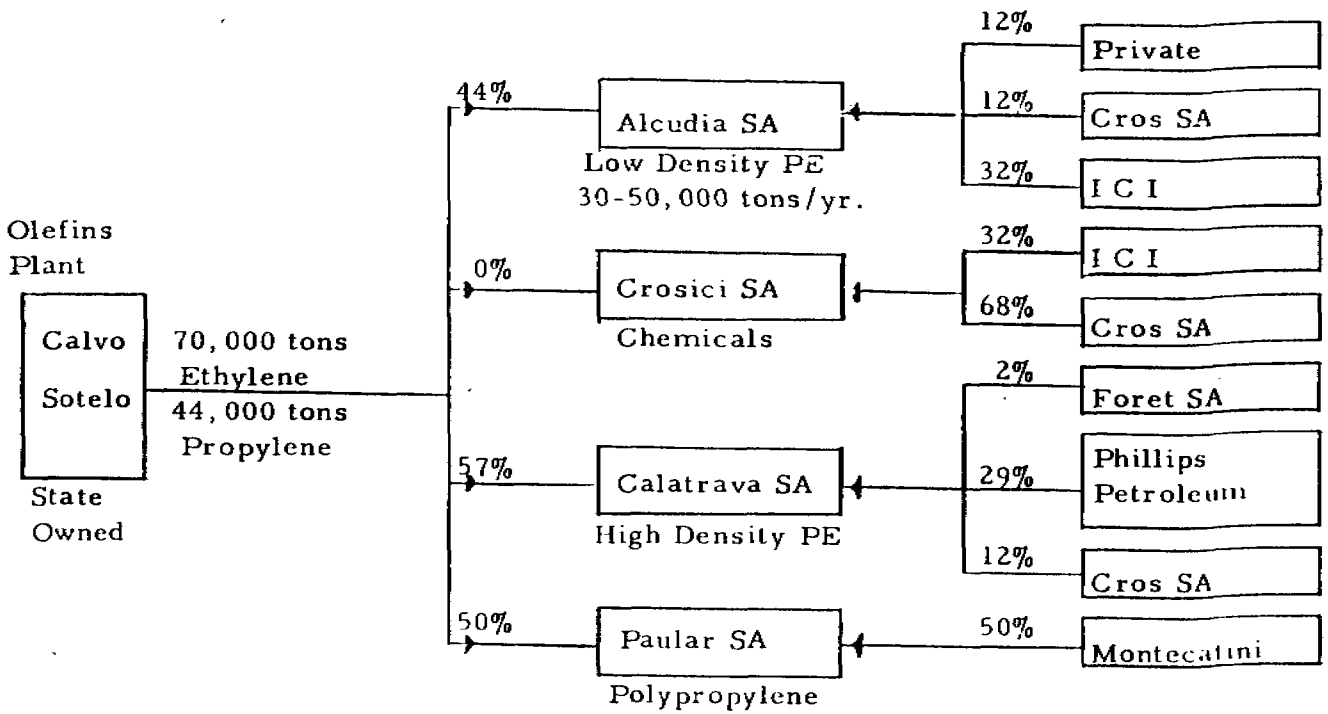

Figure 5

SPAIN

TARRAGONA COMPLEX

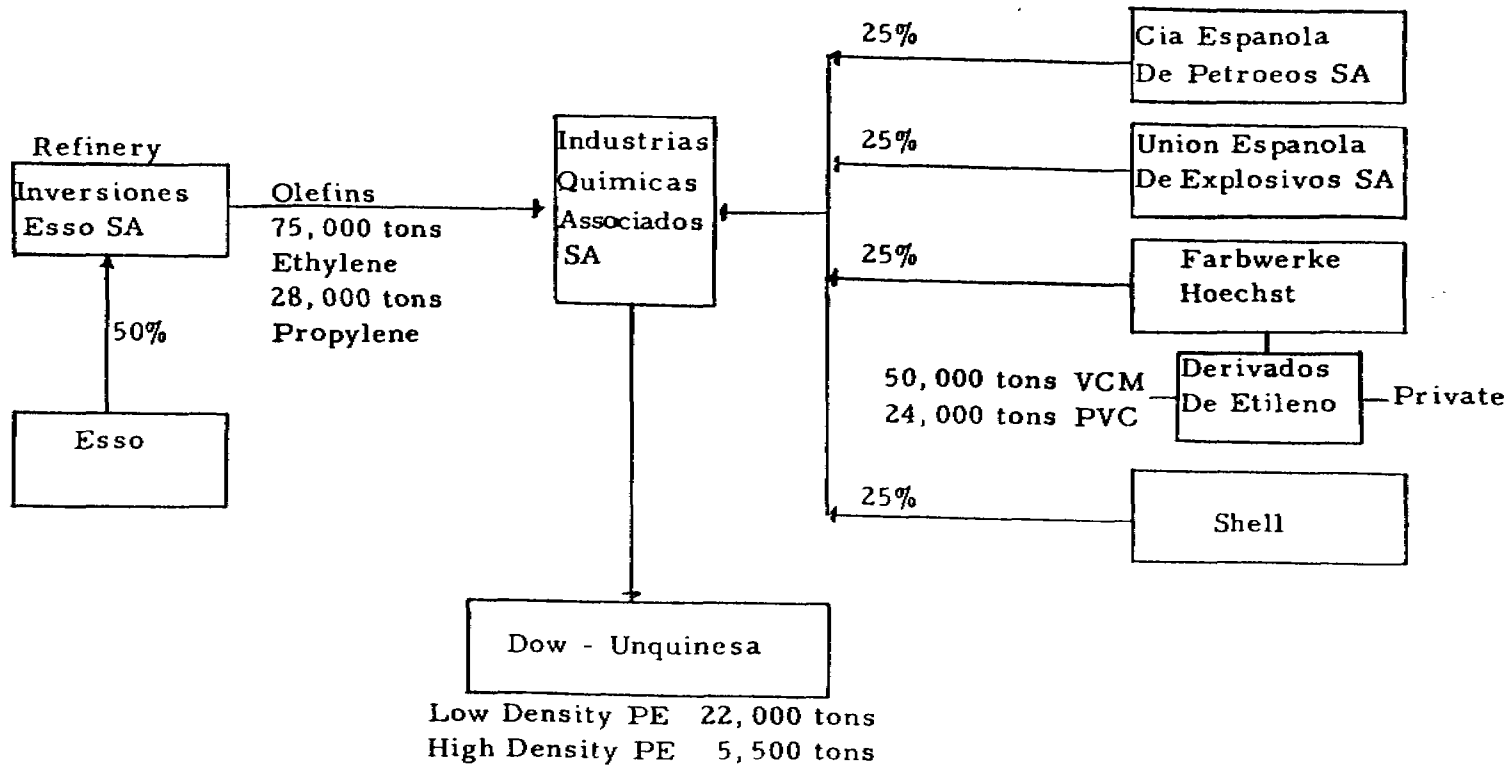

Figure 6

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

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