1 AEROSOL MARKETING CONSIDERATIONS

MARKETING has been defined as the management process responsible for identifying, anticipating and satisfying customer requirements profitably. To do well at marketing, a company must evaluate constantly its resources and match them to the environment in which it operates. Marketing is by no means restricted to those firms whose products are presented to the consumer on the store shelf, by mail order or by the door-to-door salesperson; it is a ubiquitous force, being applied by every successful company as its marketing experts assess the realities and potentials of their customer mix.

The marketing operation may begin with the flash of inspiration that heralds the development of a new or improved product. It acts to regulate and systemize that development through the myriad of steps required to bring the product to the point where the consumer purchases it. Marketing is a very big business. During the last decade, the number of new consumer products increased from 26,000 to 37,000 per year, at research and development costs of over $17.5 billion. As imposing as this dollar figure may seem, it is still only a small part of the capital that U.S.A. companies must lay out during the evolution of new products and packages. The advertising and promotional budget for a full-scale national program normally starts at $10 to $14 million.

New products form an increasingly demanding aspect of corporate decision-making. The high impact and complexities of technical and marketing developments have brought about a virtual condition of sink or swim in the marketplace, and there is less financial room for errors than ever before. The whole world loves a gambler—when he is successful. For a company not to introduce new products, better products, new services or new economies is to be unloved, particularly on Wall Street, and unwanted by talented creative people as the corporate entity withers. New marketing thrusts, then, are essential, even though the cost of failure can be disastrous. (In 1981 the failure of a feminine protec-

TABLE I

U.S.A. Production of Consumer Retail Packages

	Units Produced (Billions)*	
	1971	**1980**
Plastic Bottles	6.0	9.7
Glass Bottles	41.0	47.1
Collapsible Tubes		
Metal	1.44	1.2
Plastic	0.06	0.13
Metal Cans		
General Line	10.0	4.9
Sanitary	31.0	30.0
Beer & Beverage	37.0	54.4
Aerosol	2.8	2.4
Paper, Foil & Composites	177.0	286.0

*Estimates from various sources. Packaging cost $47 billion at the manufacturing level in 1980.

tion product cost $90 million.) In the whole complex maze of product introduction and maintenance no one is more important than the marketing director.

In the larger companies, new product marketing activities are aided by inputs from research, engineering, manufacturing development, packaging and cost accounting. Outside agencies are increasing contributions in such areas as advertising, package design, clinical testing and brandname selection. Smaller roles are played by quality assurance, sales and legal departments. In the smaller company, the marketing executive is often forced to go outside for nearly everything. Historically such firms have often turned to contract fillers, taking advantage of their years of experience in formulation and packaging areas.

For a large, nationally oriented product introduction program, the time for completion will take from one to four years, up significantly from the time frames of a decade ago in the 1970s when things were simpler and less regulated. The longer programs may come about through the need for exhaustive clinical testing, the satisfaction of EPA or FDA requirements, unanticipated complications, or even new developments that may make it necessary to restructure the schedule. In one interesting case, an aerosol pancake batter product was developed during a three year period. During this time, however, the priorities of the marketing department changed. It was realized that a $900,000 batter processing system would have to be installed, and a study of breakfast eating habits showed a steady decline in the consumption of pancakes. The project was killed.

There is nothing small about the consumer packaging market. Packaging costs are now about $49 billion for 1981 at the supplier level, up from $22 billion in 1971. The 1981 figure translates to a retail level close to $85 billion. About 4,600 manufacturers make the containers and employ roughly a million workers in the process. The final package is put together in some 300,000 filling and packaging plants, with a gross output of around 370 billion units per year. A breakdown of the various container types is given in Table I.

Sir Francis Bacon once said, "Figures can be likened to streetlamps: they can serve both to illuminate the written word and provide support for the weary writer." (Market statistics included.) Our purpose in reporting these numbers is to show the truly massive dimensions of the U.S. packaged commodity market, with aerosols showing up as somewhat less than 1%.

An interesting contrast can be shown by examining the toiletries packaging market, which is only about 2% of the total, but where aerosol containers make up the largest category. A comparison of the various container types is given in Table II.

The future advances will be derived from the technical developments now underway. Programs designed

TABLE II

*U.S.A. Production of Toiletries Retail Packages**

	Annual Rate Of Increase (Per Cent)		Dollar Shipments to Mfgrs. (Millions)	
	Units	**Dollars**	**1980**	**1985**
Plastic Blow-Molded Bottles	5	17	212	465
Glass Bottles	0	11	54	91
Collapsible Tubes				
Metal	2	12	27	48
Plastic	5	17	23	50
Aerosol Cans	4	14	302	581
Boxes				
Folding	4.5	14.5	151	294
Set-Up	(2)	8	5	4
Closures	—	15	119	240
Total	—	7.5	893	1773

*Estimates from *Frost & Sullivan, Inc.*

to reduce energy consumption, improve recyclability, produce higher quality and lower cost decoration, improve tube laminations, provide easier opening and dispensing closures, improve gas barrier resins for plastic bottles and so forth will all help determine the upward pace of the market. Many improvements for aerosol cans and valves are in progress and are described in later chapters.

Scheduling A Product Introduction

These days the introduction of a new product involves thousands of individual steps taken by hundreds of people. A central master plan must be evolved to schedule and control this myriad of steps and operations, so that they can be completed in a minimum of time and at the least expense. The PERT (Project Evaluation and Review Technique) is used by many firms to achieve these objectives.

Although PERT was designed originally as a computer system and used by the Navy to develop the Polaris missile, the method can be described in such simplified terms that it can be understood and administered without the need for either a computer or extra personnel.

In the simplified PERT system, a series of circles, squares or rectangles is used to designate a specific operation which is a part of the overall program. The job description is written inside. The diagram normally flows from left to right, using a backbone of key operations to build upon. A series of such key points would be, for example:

a. Marketing motivation (The beginning of it all.)
b. Marketing plan
c. Creation of the package
d. Development of final formula and specifications.
e. Test market approval
f. National program approval
g. Full production
h. Consumer purchase

The accentuated key operation points are connected up by means of a large number of secondary operations. For instance, test market approval starts a sequential chain of events involving:

a. Elaborate test market planning.
b. Placement of advertising in various local media.
c. Personal contact with test stores.
d. Ordering chemicals and packaging.
e. Production and shipment to test stores.
f. Package performance evaluation.
g. Evaluation of test market results.
h. Possible revision of product according to marketing analysis.
i. Final production costs established.

The objective of this program: that a national marketing program can be established. In some diagrams, the above chain will not necessarily be sequential. If a delay is anticipated with the production operation, supplies can be purchased for the run even before test market plans are finalized. In some cases this may lead to back-up production, or an excess of merchandise, but the time saved will often be worth the risk.

Arrows are used to link up sequential operations, and proposed time to complete each step is posted above the arrows. It is convenient to indicate time in weeks and decimal fractions of weeks, but some PERT networks are timed in days. A few PERT diagrams are drawn with strict attention to time as the X-axis, or abscissa; thus keeping time coordination between operations on an easily viewed basis. The various circles or squares are often circled in red as they are completed. Auxiliary PERT diagrams, which can be looked upon as insets on the primary one, are made usually where more detailed development is needed for a particular situation, such as the purchase of all the chemicals and packaging components for the test market product. An outstanding example of a marketing type PERT diagram is given in *Modern Packaging Encyclopedia,* 1971 issue; page 47.

Network planning is rapidly becoming popular with marketing directors and package development executives, since it tells them exactly where the project stands. The chart indicates the time schedule, shows what may have gone wrong (if anything), and provides the necessary interrelationships — who has to do what before something else can be done. The primary benefits are avoidance of unnecessary delays and expenses. Another benefit is that minor contributory points will not be overlooked. Two pitfalls, both minor, have come to light: if the timing on the chart is too generous, no one will finish ahead of schedule, and if the network is all nicely drawn and organized, few people will risk antagonism by proposing meaningful improvements. Both can be minimized by an alert marketing executive.

Any good product introduction program will benefit from the creation of a Packaging Committee as the central organizational feature. The committee should be composed of experts on construction, graphics, scheduling and so forth, and should have the power to make approvals in the absence of top managers. Committee activities also help cut snags in communications and lessen the need for lengthy report writing. The key people, working with the project day by day, attend these meetings. They will surely note things of interest. The interplay between these packaging experts often results in significant improvement of the final product.

Marketing people must keep in mind the thought that every new product must start and finish with the consumer. Here, regardless of all else, it must be able to stand on its merits. The finest marketing program, the best package, the most effective formula, will all go down in ruin if the soverign consumer remains unimpressed. New product ideas must be encouraged constantly from all sources, particularly suppliers. Speed is vital in product introduction. Be first if at all possible. *Nielsen* has made a 15 year study of the sales record of "pioneer brand" versus that of followers. The first follower gained only 51% of the sales volume of the first brand after three years, while the second follower managed only 25%. It is also essential to work within clearly defined corporate objectives and business realities. The new product must have the hearty sanction of top management. There are too many cases where middle executives have worked many months on a new product, only to have it killed during a Board of Directors meeting.

Many new products are carried to the market on three waves of activity, each more costly than the last. In the first stage, sometimes called the initial assessment, the idea is submitted to a generalized scanning process, aimed mainly at deciding whether the project should be subjected to further and more intensive study. A PERT diagram or a simple listing of requirements will suffice at this stage. Some typical check points are:

a. Is the product consistent with consumer needs or desires?
b. What precisely is the new product concept and how does it perform?
c. What type of customer would likely purchase?
d. What is the marketing platform in relation to:
    i. Population of probable consumers.
    ii. Market statistics.
    iii. Market experience of other firms with similar products.
    iv. Competitive position.
    v. Price policy.
    vi. Cost of advertising.
    vii. Rate of product obsolescence.
e. Do distributional channels pose any problems to the company?
f. Can the sales force effectively sell the product?
g. Is the formula available?
    i. Is the formula free of patents, royalties or other encumbrances?
    ii. Is the formula well tested for compatibility and safety?
    iii. Is the formula exclusive in any way?
h. Do production requirements pose any problems?
i. Are there any legal or registrational difficulties?
j. Is the development program capital intensive?
k. Does the development and marketing of the product conform to broad corporate objectives?

If the proposed new product passes muster at this level, then it is generally qualified for second stage assessment — a much more searching scrutiny over a broader field. At this stage, the inquiry must become strongly consumer oriented. Sequential check points can be listed as:

a. Organize the facts by preparing a brief covering:
    i. Rationale for introduction.
    ii. Proposed brandname(s).
    iii. Description of quality requirements.
    iv. Estimated cost structure.
    v. Anticipated problems, if any.
b. Examine advertising concepts, aided by small-scale panel testing.
c. Survey all existing information concerning the desired market area, consumer buying habits and important product attributes. Conduct market surveys to fill in any missing data.
d. From the above, determine the approximate consumer rating of the proposed product versus competition.

e. Define as accurately as possible the estimated market size and value.
f. Estimate competitive brand shares.
g. Estimate competitive expenditures (both present and future) compared with those of the new product.
h. Determine marketing position.
   i. Is the brand aimed at becoming a leader?
   ii. Is the pricing to be highly competitive?
   iii. Is the product designed to fill an unfilled marketing need?
   iv. At what level should the sales estimate and advertising budget be set?
   v. What is the laboratory's assessment of the advantages of the product over competition. Can they be dramatized?
   vi. What is the consumer's assessment, based on small panel tests?
   vii. What is the pull of the proposed brand-name?
   viii. What have been the results of any similar introductions either in the U.S.A. or abroad?
   ix. What is the strength of competition? What are the weaknesses?
   x. Are distributional networks available?
   xi. Are trade margins favorable?
i. Check availability of packaging components and chemicals.
j. Outline a complete quality assurance program.
k. Check production methods; possible problems.
l. Ascertain preliminary direct costs, delivered to warehouses.

The final stage involves the decision to launch, with all the attendant complexities.

A PERT network becomes essential from this point on. Nearly always, a test market will precede initiation of a full national program. A test market is justifiable if:

a. More than a "slight risk" is attached to the introduction.
b. The test will assist in finalizing certain details of label, advertising, container size, pricing, distribution and so forth.
c. By selecting certain test areas, a true indication of the national market can be obtained.
d. There are many uncertainties about the product, advertising, distribution, etc. that should be finalized.

Presuming that a test market strategy is integrated into the program, typical check points are about as follows:

a. Prepare the PERT diagram, or launch timetable.
b. Finalize the product formulation.
   i. Are the color, odor, viscosity and other physical attributes acceptable to consumer panels?
   ii. Has the product demonstrated compatibility with the least expensive practical container? (At least nine months.)
   iii. Have all clinical safety tests been completed?
   iv. Can all label claims be justified to the FTC if necessary?
   v. Does the product do a highly acceptable job for the intended use?
   vi. Are all registrations, new drug applications and similar tasks well along or completed?
c. Finalize the packaging components.
   i. Has the package been tested with the formulation?
   ii. Does the package conform to applicable regulations; such as use of FDA approved materials for foods and drugs, use of child-resistant closures, etc.?
   iii. Have suitable packaging suppliers been selected?
d. Describe the initial brand marketing strategy which will serve as a guide to all future agency actions.
e. Write the copy strategy.
f. Prepare the label, using "b(iv.)" generalities as a guide.
   i. Is copy acceptable to the laboratory?
   ii. Is copy acceptable to legal department?
   iii. Produce final package art work.
g. Prepare the creative material. Test it in panel groups.
h. Finalize all market, sales and advertising estimates.

i. Send revised advertising figures to agency for final media budgets.

j. Supply accounting, planning, buying, and production with final figures and develop a final overall cost.

k. Prepare the final profit statement and make budgetary revisions as needed.

l. Plan for the test market.

m. Prepare final media strategy and submit to agency.

n. Order all components and chemicals for test market.

o. Produce and ship product to designated warehouses.

p. Establish final production costs based on experience generated in "o".

q. Analyze test market results.

r. Revise art, designs, package specifications, formula, etc. as dictated by test market results.

s. Establish full national program.

t. Plan production on national scale.

   i. Obtain bids from contract fillers in different locations.

   ii. Make sure components and chemicals can be produced at needed rates.

   iii. Consider alternate packaging sources and supplies.

   iv. Design and produce introductory special displays, etc.

u. Consider danger of competition.

   i. May get into full distribution before you do.

   ii. May establish deals, price incentives and so forth to eat up available shelf space.

   iii. May revise copy, advertising methods, even formula to "improved" type.

v. Set ad promotional budget.

w. Hold national sales meetings and notify trade.

   i. Distribute salesmen's samples and other selling materials.

   ii. Inform salesmen about product and strategy.

x. Produce and ship product to distribution points.

y. Ship to outlets.

z. Check consumer purchases in selected stores.

It is very important to evaluate continuously the product itself at various stages of development, including systematic consumer testing. Consumer evaluation is necessary to determine what they want from a product, and the value they place on specific attributes. Laboratory evaluations must be meshed into this program, in order to determine how these objectives can best be accomplished. Consumer and laboratory tests can be considered equally important in any development program, since one will rarely provide meaningful answers without the other.

Although there is certainly a greater degree of control built into laboratory testing, the procedures are set up usually to test only one attribute at a time. Research people should not be expected to estimate the relative importance of these attributes to the marketing success of the product. In contrast, consumer testing provides a rough estimate of all the factors considered at one time. It is concerned with overall satisfaction or rejection based on subjective factors.

Unfortunately, people are often conditioned to expect certain characteristics in a product. One of the pitfalls of consumer testing is that they will fault a product if it does not provide the expected characteristics, even though the attribute may have little or no beneficial effect. (A furniture polish without a lemon odor will probably not sell very well these days, although the citrus fragrance contributes nothing to the polishing effect whatever.) Sometimes the laboratory methods can suffer from over-expertise, since the technical people are well aware of the product and container parameters. In consumer use testing it must be remembered that people do not read "use directions" and do not always use products as intended by the manufacturer. As an example, when a new aerosol valve was introduced, about 1958, a large production of bug killer spray was produced and thoroughly checked by many experts before being released to the market. A week or two later complaints started coming in by the hundreds. The cause? Customers were sometimes tilting the valve during actuation, instead of pressing the button straight down as did the experts. Under this new and unplanned for stress, the gasket allowed secondary sprays of product to spurt out from the base of the stem. Most of the production was recalled, at great expense, and the valve housing fitted with a special press-fitted cap which prevented sideways movements of the stem and button. The design was incorporated into the valve cup a short while later and remains there to this date.

Other well known limitations of consumer testing are: over-response (people are all too willing to criticize), too short a trial period, as reaction may vary with extended use, lack of specificity, since people tend to generalize, and the possibility that dislike of one product characteristic will be carried over by the consumer to the product's other characteristics.

Consumer Profiles

A sound marketing program should recognize always the changing market demands for products and services. Demographic surveys show that, while the largest U.S.A. markets are still in the East and Midwest, the greatest percentage gains during the 1980s will be in the sunbelt areas. This will affect package sales of many products, and influence design in favor of stronger colors and more vibrant graphics—a change already noted for outdoor products and those aimed at the large "60-plus" and retiree market.

With the huge youth market of the late 1960s and 1970s now blossoming into a booming young adult market of the 1980s some of the current emphasis on teenage needs will subside. During the 1980s there will be a 42% growth in the number of people aged 35 to 44; both this market and the rapidly increasing market for financially secure older people should cause profound changes in the orientation of many products.

In 1960, women accounted for 32.3% of the U.S.A. labor force. This rose to 36.8% in 1970 and to almost 42% in 1980. This is a significant statistic for marketers since working women have very different buying needs and patterns than the homemaker, particularly in the amount of available discretionary money. They can indulge themselves in items of higher quality if they elect to do so. In 1980, over 55% of all U.S.A. households contained two or fewer people, compared with 46% in 1960; this trend is expected to continue. Also in 1980, single persons made up 30% of the total population, compared with half that level in 1960. With the obvious increase in households, the sale of household products has been advancing at a very fast pace.

During the 1980s, an increasing amount of attention will be given to minority needs. In 1980, there were an estimated 25 million Blacks (11%) in the U.S.A. with a buying power of $96 billion. About 1.0% of this is spent on health and beauty aids. The average Black is 21, in contrast to the White median of 29, and they will account for one-fifth of the population gain during the 1980s.

The formal complaints received by marketers represented about one in every fifty significant problems during 1978-79, and was perhaps as high as one in twenty-five in 1980-1981. Other complaint routes involved reports by retail stores regarding returned merchandise and contacts by attorneys seeking restitution for furniture damage and other losses suffered by their clients.

Another increasingly important racial group is the Hispanics, with a market of 21 million consumers in 1980. They have a purchasing clout of some $32 billion. Government estimates indicate that by 1985 they will have the largest population of any minority. The median age for the Hispanic consumer is 21.5 years old. With an average household income of $15,000 per year in 1980, they tend to be conservative and family oriented.

All these statistics have an important place in any quantitative market analysis. Distribution of income affects the market for many products, and particularly aerosol products. With the "income pyramid" turning upside down during the last 25 years or so, it is essential to recognize family expenditure patterns and predict them into the future.

Consumer Attitudes

The aerosol package has been extolled as convenient, profitable, clean and soft, easily controlled by the consumer, dependable, easy to use, efficient, having good identity and so forth. These attributes are probably more useful as a palliative to the anxious marketer than as anything highly visible to the consumer. To the buyer, aerosols have been around "forever," always in essentially the same packaging style, and they have little or no novelty. Their advantages are taken for granted; but their presumed or actual disadvantages are treated with less tolerance than ever before.

Starting in the 1978-79 period, consumers began to indicate their displeasure with aerosols by means of a significant escalation of written complaints to the marketer. A typical summary of complaints for a shaving cream is shown in Table III.

The aerosol package has been increasingly regarded by consumers as a relatively high priced commodity. This is especially the case where the high costs of essentially anhydrous formulations have forced marketers into smaller packages or higher price levels. In 1981, virtually all anhydrous solvent/propellent compositions cost fillers at least $0.30 per pound on a bulk purchase

TABLE III

Aerosol Shaving Cream

Summary of Customer Complaints
(Third Quarter of 1978 - 1980)

Notation	Complaint Level 1978	1979	1980
Poor foam consistency	17	24	23
Will not release product	18	24	28
Pressure problem	1	0	1
Will not stop flowing	33	48	65
"Dries on Face"	0	1	1
Defective valve	1	1	2
Particles in Lather	0	0	1
Developed rash	0	1	0
Can became rusty	1	0	1
Bad Odor	0	0	1
Clogs Razor	0	1	2
Total	71	100	127

Notes:

Approximate sales volume in each period: 3,000,000 units.

Complaints for the "brushless" counterpart: 1 in 1978, 4 in 1979 and 12 in 1980 based on sales figures adjusted to aerosol level.

The "will not stop flowing" was generally assigned to occasional faulty mis-centering of the lever section of the spout, now corrected by a design change. This problem is readily corrected by the consumer.

basis. During the year the list price of the largest tinplate can reached the $0.50 per can level for some variables, as purchased by fillers from canmakers in good volume. The competitive pressures between fillers and in the marketplace during the 1980-81 "stagflationary" period were such that many large-category products were offered in discount stores at very slightly above the marketer's cost; for example, a 1981 sale of three cans of 17-oz. bathroom cleaner, 19-oz. window cleaner or 15-oz. starch was $2.00 total.

During the recessionary year of 1980, aerosol sales dropped from a 7% growth rate in 1979 to a -11% growth rate. Similarly, the sale of plastic bottles for chemical specialties went from an 11% growth rate in 1979 to -7.5%. The spread of each category is about the same, indicating that both suffered the same decline and that aerosol and liquid specialty products were treated the same by the consumer in 1980.

The aerosol package is no longer viewed as a virtual necessity by consumers, except perhaps in a few unique areas. During the low point of the recession in May and June of 1980, aerosol productions were down 26% from a year earlier. Some of this was due to forced inventory reduction by some major marketers, and to slow sales and tight money; but it would seem that the consumer can get along rather easily with at least 20% fewer aerosols if he finds more attractive outlets for his disposable income. During the past ten years the sales of aerosol containers to fillers never dipped below about 152 million units in any one month, and some analysts have used this to suggest a minimum or basal trend line to separate normal from deprivation sales levels. Manufacturer's sales of metal and glass aerosols during 1980 are compared with 1979 sales in Figure 1 to illustrate the effect of the recession.

Consumer attitudes toward products have changed significantly during the past several years. Buyers have become more pragmatic, seeking products which are economical, efficient and serve real needs. There is a strong interest in personal safety, health and security, as witness the growth in the civilian sales of aerosol stun products of the "Mace" type, which rose from almost zero in the 1970s to a $40 million retail market in 1981.

With the very high cost of skilled labor, many consumers have become talented home and car repairmen. As a result, the polyurethane foam insulation aerosol became a $10 million retail item in 1980, and caulking compounds in aerosol form developed the same sales volume in 1982. Automotive aerosols grew by 9.8% in 1979, and increased by almost as much in 1980. Many of these products provide the consumer with energy savings, thus making them doubly attractive.

There are certain consumer traits that have encouraged marketers to put their efforts into revitalizing existing products, rather than developing new ones.

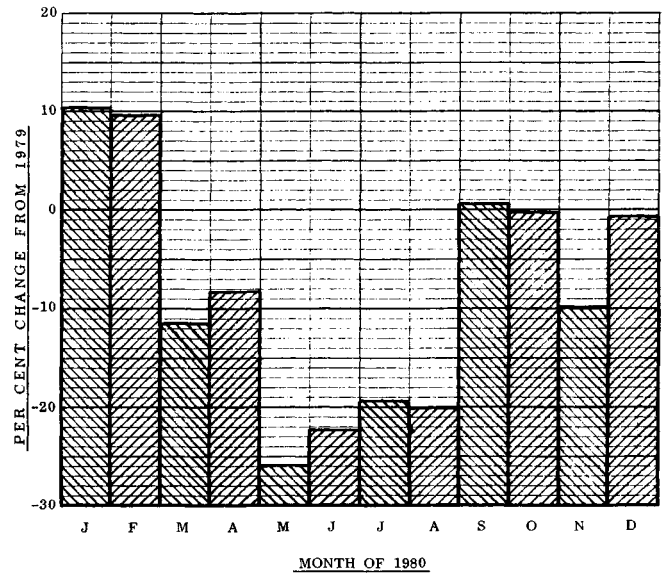

Figure 1. Aerosol Container Sales in 1980 vs 1979

Time constraints now often limit shopping time, causing people to buy familiar brands. There is an increasing tendency toward avoidance of risk, perhaps in part due to lurid television and newspaper stories that have made "chemicals", "aerosols" and even "new" bad words; this steers people away from new or untried brands. The public is less attentive, less keyed to new things. Finally, there is continued interest in the genuine original, the authentic tried-and-true, which they may never leave unless some dramatic or emotional issue arises, such as a disappointment or a compelling sale of a competitive product.

In general, marketers are far happier to count on continued support of existing products. It is a less expensive, surer way to conduct business. Relatively minor improvements: a new valve, or a revised propellent composition, can be incorporated for as little as $50,000 in research, consumer tests and other routines. The success rate is better than 98%, compared with a recent *Benton & Bowles'* figure of only 67% for new products unveiled during the 1975-1980 period. Even if the revision fails, the marketer has the obvious option of returning to the original.

Many marketers simply feel it is too expensive to launch new products. They keep their customers loyal by extending existing lines or making stronger efforts to lift established brands into new product categories. Special incentives are fast becoming a vital ingredient when a marketer considers a new product possibility. There must be a patent, a uniquely effective formulation, a magic ingredient or some other factor — and even then, many marketers will not stray very far away from fields in which they have strength and expertise.

Marketing Strategies

Every marketer approaches product introductions or improvements from a different standpoint. There are a few who are interested only in high volume routine products: 5 to 10 million units per year or more. Obviously these are restricted to well recognized and popular items. Others aim for the specialties market, where relatively small sales can still generate interesting profits because of the higher prices that can be charged per unit. Many firms are quite satisfied to capture a very small share of one or more major markets. For instance, it is estimated that there are now about 4800 brands and formulas of aerosol hair sprays. In 1977, and again in 1980, only 19 firms shipped over $100,000 at wholesale prices, but well over 4000 hair sprays had sales volume of a mere several thousand units per year. Many were sold to more than 200,000 beauty salons in the U.S.A.

A review of a number of specific aerosol market areas should be of interest in providing information on volume sales, market profile and opportunities that may be available.

Shaving Cream

This important aerosol category accounted for 93.8% of the $205,000,000 retail market for shaving preparations in 1980. Product use is 94% male oriented and this segment represented 17% of the $970,000,000 retail men's toiletries market for that year. According to *Packaged Facts, Inc.*, the dollar growth of the aerosol shaving cream market went from $181,000,000 in 1979 to $192,000,000 in 1980; from this they predict about a 5% continuing growth to 1986.

This is a difficult growth figure to handle, since shaving creams advanced in price from $1.24 (retail supermarket) to $1.38 during 1980, for a gain of 11.4%. Thus a 5% dollar growth would reflect a sales decline of about 6.4% per year. As a matter of record, unit sale of shaving cream has been increasing at an average rate of 3.8% per year for the 1976-1980 period, and this hardly seems likely to reverse. Explanations could lie in the selection of can size or intensity of price-cutting, but these are hardy sufficient to cover the proposed difference.

The market profile in terms of unit volume is given for shaving cream aerosols as follows:

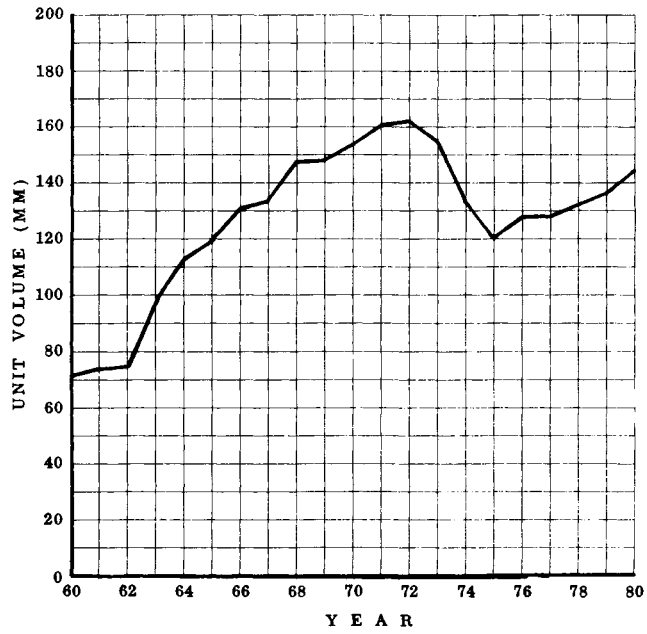

Figure 2. Aerosol Shaving Cream Market Volume

In 1971, a *Gillette R&D* report stated that 71% of all U.S. shavers were "wet" shavers and 73% of this group were users of aerosol shaving creams. The average user consumed 26 ounces of aerosol shaving cream per year at an average cost of $0.11 per ounce, thus accounting for a market of $111,000,000 per year. During 1981, a decade later, one can suggest that about 94% of "wet" shavers use aerosol shaving cream; another 5% of sales volume should accrue to increasing use of shaving cream by women. Thus the market should have increased by about 36%. Instead, unit volume was down by 5.0%. This might suggest that circumstances are ripe for a significant regrowth in this product category, and indeed there are many encouraging signs of marketer interest and good sales reports.

Rather surprisingly, shaving cream sales are somewhat seasonal: the highest sales develop during August, September and October, when they trend about 10% above average. The lowest sales volume occurs in January, at 12% below average.

There are three major formulation types:

a. Standard ambient temperature foam.
   i. Standard formula for men. (Menthol, regular and lemon-lime.)
   ii. Gentle formula for women. (No sodium or potassium salts present.)
   iii. Special formula for blacks. (Urea and sodium sulfite usually present.)
b. Hot foam.
   i. Thermogenic or self-heating. (Co-dispensing package with peroxide.)
   ii. Appliance for external heating. (Electrical or hot-water type.)
c. Gelated, post-foaming.
   i. S.C. Johnson & Son, Inc. "Edge" type. (Patented.)
   ii. Other varieties, as Carter-Wallace, Inc. type.

At least 97% of the volume is marketed in three-piece tinplate (or C/CO plate) cans. Some high-margin specialty items are sold in two-piece "Spra-tainers" and "Peerasol" aluminum cans in the nominal 6-oz. size. A growing market area has developed recently in the 1 to 1½-oz. travel-size package, using an aluminum container.

The usual formulation contains about 8% sodium and potassium stearates (80%)/cocoates(20%), 10% triethanolamine stearate(80%)/cocoate(20%) or some mixture of the two. Foam stabilizers such as sodium lauryl sulfate, diglycol stearate, polysorbate 80 and certain amphoterics are then added, along with propylene glycol or glycerin humectants, fragrances and sometimes some special items. In the early 1970s it seemed fashionable to market formulas with as many as 22 ingredients, but later on as many as half were discarded as probably worthless or because they were possible skin sensitizers, or because of the need to report all of them on the label in accordance with a new FDA requirement.

The usual propellent selection is a blend of isobutane/propane or mixed-butanes/propane having a pressure of between 40 to 52 psig at 70°F (276 to 359 kPa-gage at 21.1°C), and being used at about 3.2 to 3.6% of the total formulation. Nitrous oxide, at about 0.9%, has been looked at because it provides dense foams of exceptional surface luster or pearliness. There are some disadvantages of a technical nature, however, such as a growing "soupiness" as the can is emptied, and a more difficult gas injection procedure.

Shaving creams typically contain 76 to 79% water and are considered non-flammable under both warehouse storage and consumer use conditions. The freshly dispensed foam can be lit momentarily with a match, but this academic fact has no real significance. The few serious consumer complaints against shaving creams have generally related to the use of steaming hot tap water, poured onto the can for an extended period, with the individual hoping to get a hot shave. In some of these thermal insults the pressure build-up has been so intense as to cause eversion and rupture of the dispenser.

While most women use standard men's shaving creams, a number of products are available formulated especially for feminine use. They do not contain the harsh sodium stearate soaps, but tend toward combinations of potassium and triethanolamine soaps, and ideally to the pure triethanolamine (diethanolamine-free) stearate/cocoates, if the expense can be tolerated. This is unimportant for shaving the legs, but mildness is of primary concern when shaving the underarm areas.

The hot lathers of the early 1970s are now largely a thing of the past, due to packaging deficiencies and expense. The thermogenic types used combinations of hydrogen peroxide and either sulfite, thiosulfate, thioureas or pyrimidines to react and produce heat.

The temperature rise could be adjusted by the amounts of thermal ingredients used, and the rate of heating by the use of sodium molybdate or other catalysts. The peroxide was contained in a plastic or laminated bag attached to the valve body, so that upon actuation both it and the product were co-dispensed, mixing and warming up in the process. Problems involved the maintenance of a reasonably close ratio of the two liquid phases during the life of the package. For several products the peroxide concentration exceeded 10% and it was thus capable of permanently opacifying the eye lens, if it were to be "spritzed out" as the last bit in the can and somehow contacted the eye. Nearly all the co-dispensing valves were sensitive to throttling actions by the cautious consumer, losing their ability to maintain the correct ratio of phases when this happened. Other difficulties involved production of slightly malodorous reaction by-products, plus the production expense of having to fill separately polyethylene tubes in a special filler, join them to the valve, and then hand-insert the special valve into the aerosol can.

During the 1967-1973 period a significant number of thermal products were marketed. "The Hot One", "Rise-Hot" and "Hot Lather" captured an estimated 6.5% of the total shaving cream business, with retail sales of about $6.7 million. Other products included hot windshield de-icers, hot beauty oils, hot facial cleaner foam and an experimental hot pre-surgical scrub. These products have nearly vanished today, and the business climate does not seem propitious for their return.

Shaving cream cans may be fitted with an appliance for achieving a hot foam. The earliest one (circa. 1963) consisted of a vaned metal chamber, preheated by passing hot water over the exterior, after which the shaving cream was forced through the device so that it emerged in a moderately warm condition. Since then, a large number of hot water heaters have come and gone, with an indifferent response in the marketplace. One shortcoming is that most of them are limited to use with just one aerosol valve design.

A more effective but vastly more expensive appliance is the electrical type. The can is often fitted inside this heater, and used routinely until it is empty. The unit is plugged in and activated, with an amber light coming on when the heating step is complete. The formulas for these units are best made with thickeners, such as gels and cetyl alcohol, so that they will not be too loose when heated to 180°F (82°C) or higher. Also, the ingredients must be thermally stable at such temperatures, without changing color, texture or fragrance. Although heating to such high temperatures may seem excessive, actually it is not; the foam structure has such a low thermal transfer rate that it can be placed on the skin at literally 212°F (100°C) without discomfort — provided it remains a stable foam, without weeping. The "Hot Lather Machine" is the most popular of the electrical types, although sales are slowly declining. The device will accept only the 6-oz "Schick Hot Lather" "Spratainer" can, fitted with a long-stemmed aerosol valve.

About 1966, S.C. Johnson & Son, Inc. brought out their "Edge" shaving cream, and with it a new dimension to the aerosol shaving lather business. Packaged as a light green gel in a "Sepro" can, the product contained a dispersed P-114/pentane propellent (now isopentane) which became gaseous when the gel was rubbed across warm skin, causing the appearance of a foam structure. The novelty and heavy advertising brought the product up to an 8.4% market share in 1970, after which something of a sales slump took place. An improved formula with superior lubricity was then developed and promoted in the media as "To cut yourself you almost have to try!" The lubricity resulted from the use of certain diethanolamides and other special ingredients. By 1977, the product had slowly captured a 13.5% market share, and by 1981 this reached about 16%. At this time it was emulated by products in "Sepro" cans marketed by Carter-Wallace, Inc., makers of "Rise" shaving cream, the overall brand leader for many years. It is hard to predict the future of these unusual shaving creams, but it seems likely they will carve out even larger market shares in the forthcoming years.

Other innovations in the shaving cream market have included a formula with "all natural" ingredients, one designed to actively inhibit the corrosion of razor blades and one based entirely upon non-ionic detergents. During 1981, Jasco Products, Inc. introduced "Brush-On", an actuator fitment ending in a large brush of imported boar's bristles. The first shaving creams to use designer perfumes were test marketed in 1980, with "Burley" and "Aramis" fragrances, breaking away from the traditional, nondescript, menthol and lemon-lime types. Still further marketing ploys include the use of shaving cream as one of a number of men's toiletries in lines with highly similar labels, such as the "Yardley of London Spice" grouping. All in all, the aerosol shaving cream market looks healthy and certainly capable of significant additional growth.

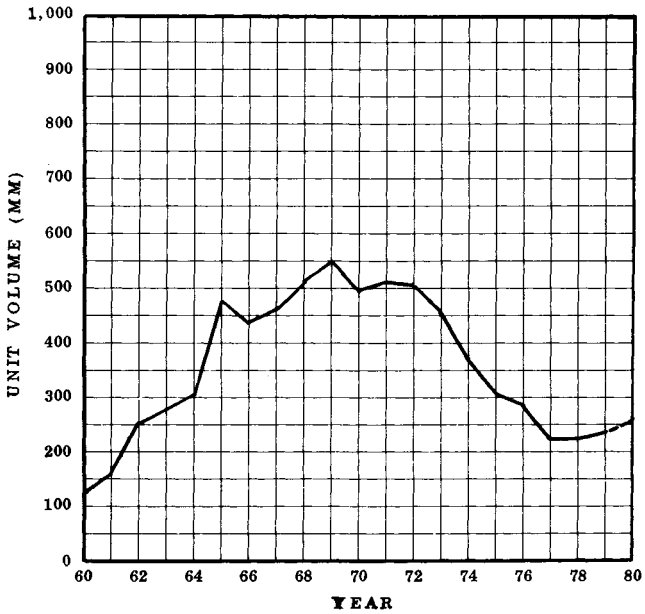

Figure 3. Aerosol Hair Spray Market Volume

Hair Sprays

Hair spray is one of the most fascinating of all the aerosol markets. At one time it was the acknowledged leading category, with sales of 548 million units in 1969, some 22.2% of the total U.S.A. volume in that year. But with the onslaught of the CFC environmental problem, changes in hair styles, the growth of pump-spray alternatives and so forth, sales dwindled to a mere 255 million units in 1980, only about 12.0% of the volume of sales of all aerosols. The unit sales profile of aerosol hair sprays is shown in Figure 3.

The phenominal decline in the market share of the aerosol form can be shown by a review of published *Towne-Oller* data during the CFC/ozone reactionary period, when millions of consumers forsook the product in favor of the pump-spray, as shown in Table IV.

This and confirming data by the A.C. Nielsen Co. show that the aerosol market stabilized at about

TABLE IV

Unit Market Shares of the Aerosol Hair Spray

Year	Quarter	Aerosol Market Share (Per Cent)
1974	1	97
	2	97
	3	96
	4	94
1975	1	91
	2	89
	3	86
	4	83
1976	1	81
	2	79
	3	80
	4	75
1977	1	73
	2	72
	3	70
	4	69
1978	1	67
	2	65
	3	66
	4	65
1979	1	64
	2	63
	3	63
	4	63
1980	1	63
	2	61
	3	62
	4	62

TABLE V

Unit Hair Spray Market in England; 1972 - 1980

Year	Unit Sale (Millions)	Population (Millions)	Units Per Capita
1972	117	55.80	2.10
1973	133	55.93	2.38
1974	146	56.05	2.61
1975	132	55.96	2.36
1976	139	55.94	2.48
1977	123	55.90	2.20
1978	127	55.87	2.27
1979	104*	55.93	1.86*
1980	98	55.98	1.75

*The apparent decrease is explained in that, from 1978 to 1979 total aerosol production decreased 7.4% (to 522,000,000 units) and manufacturers increased can sizes from 120 g to 200 g. Aerosols held 91.4% of market in 1979.

TABLE VI

Unit Hair Spray Market in Japan; 1972 - 1980

Year	Unit Sale of Hair Spray (Millions)	Unit Sale of All Aerosols (Millions)	Per Cent Hair Spray	Units Per Capita
1972	57	207	27.5	0.54
1973	63	243	25.9	0.59
1974	55	230	23.9	0.50
1975	57	220	25.9	0.52
1976	62	252	24.6	0.55
1977	53	269	19.7	0.47
1978	51	301	16.9	0.44
1979	52	341	15.2	0.45
1980	53	311	17.0	0.46

TABLE VII

Total Unit Hair Spray Market in The U.S.A.

(Expressed as number of aerosol hair spray can equivalents; 1973 - 1980.)

	Market Share (Per Cent)			Actual Units (MM)		Equivalent Units (MM)				
Year	Aerosols	Pump Sprays	Other (as dips)	Aerosols	Pumps (etc.)	Aerosols		Aerosol Equiv.*		Total
1973	97	3	0	453	14	453	+	25	=	478
1974	96	4	0	376	16	376	+	29	=	405
1975	87	13	0	308	44	308	+	79	=	387
1976	79	19	0	285	76	285	+	137	=	422
1977	71	28	1	223	89	223	+	160	=	383
1978	66	33	1	224	115	224	+	207	=	431
1979	63	36	1	238	140	238	+	252	=	490
1980	62	37	1	252	154	252	+	277	=	529

*Expressed as the actual number of pump-sprays, dips and other non-aerosols, multiplied by a factor of 1.8.

63 ± 1% during 1979 and 1980, after losing some 34% to the pump-spray packaging form. During this period the pump-sprays were advertised at greater than ten times the expenditure for the aerosol form, and virtually every marketer promoted the aerosol merely as an "also ran", if at all.

An interesting comparison can be made in the case of the aerosol hair spray market in England, where the chlorofluorocarbon/ozone theory never achieved much publicity until about 1979 (Table V).

A second comparison can be made with the aerosol hair spray market in Japan, a case in which the total aerosol consumption rose rapidly during the 1972-1980 period (Table VI).

Data in the U.S.A. and England show that women use aerosol hair sprays at 7.5 ± 2.5 g per application and men use them at 4.0 ± 0.9 g. In the case of domestic pump-sprays, the use rate by women is 3.2 ± 0.7 g per application. The ranges represent the difference between light and heavy users. The comparison between female users of both product types is not surprising, since the pump-sprays contain an average of about 1.9 times as much film-forming resin as the aerosol hair spray, the usual ranges are about 3.4 to 7.0% vs. 1.2 to 2.8%, respectively.

These data can be adjusted to consider relative dispenser size and used to develop a tabulation of total hair spray usage, based upon "aerosol hair spray can equivalents", as shown in Table VII.

The total column in Table VII shows the number of aerosol hair sprays that would be used in the absence of other packaging forms. The production dip in the 1974-1978 period is probably due mainly to an overall consumer reaction against all forms of hair spray, due to the ozone controversy. The increases following 1978 may be attributed to the increased numbers of women entering the work force, different hair styles and a dulling of consumer recollections regarding the controversy. Nearly one-third of all young girls (about 4,000,000 in the age 12 to 18 category) used hair spray in 1979, twice as frequently as in 1976.

During 1979 and 1980 there was an increasing trend toward the extra-soft, soft, and gentle hold hair sprays, as well as an increase in the hard-to-hold and extra firm types, all at the expense of the regular category. The soft holding sprays were positioned toward the fast-growing teen-age market, while the growing market of older people increasingly preferred the firm holding formulas to prevent fly-away hair. The overall market profile in 1980 is shown in Table VIII.

Use of hair sprays exhibits very little seasonality; sales in the months of March and April are about 5% above average, with the other ten months not varying

TABLE VIII

U.S.A. Hair Spray Market Profile - 1980

Product Type	Share of Category (Per Cent)	Resin* (Per Cent)
Pump Spray		
Regular	25.5	3.8
Hard-to-Hold	4.6	7.0
Super Hard-to-Hold	7.0	8.2
Aerosol Spray		
Extra Soft	0.8	1.2
Soft	3.1	1.6
Regular	23.1	2.0
Hard-to-Hold	15.3	2.3
Super Hard-to-Hold	19.7	2.6
All Others (as dips)	0.9	(Diverse.)

*Will vary somewhat according to type of resin used.

more than about ± 3% from the average. "Final Net" is the leading non-aerosol hair spray, and in fact leads the entire category in dollars. The leading aerosol product is "AquaNet" followed closely by "VO-5", "Miss Breck" and the five Toni Division-Gillette products, such as "Adorn" and "White Rain". "Rave", introduced in 1979 to cater to the teen-age soft-hold market, has made surprising gains and was followed in 1980 by "Adorn Soft Hold" and others. The current problem with soft-hold sprays is that while they promise hold, over 33 to 63% of the users (depending on the product) find that the level is unsatisfactory. In 1980, a typical 10-oz. hair spray could be purchased at discount center sales for as low as $0.79, and this price advanced 8.5% during the following year. For comparison, the cost of a typical 10-oz. non-aerosol hair spray on the same basis was $1.09 in 1980 and $1.18 in 1981. The *Marketing Focus* newsletter reported the total hair spray market as $352,000,000 for 1980. Despite the fluorocarbon/ozone controversy, the recession, and other factors, the dollar volume of hair sprays has advanced each year for at least the last ten years.

Formulation of aerosol hair sprays is an interesting subject. During the early 1970s, nearly all U.S.A. products contained about 45 to 50% of a propellent blend averaging about 55% P-11, 35% P-12 and 10% A-31 (isobutane). The rest was anhydrous ethanol plus resins, neutralizer and perfume, except that sometimes up to about 10% methylene chloride was added to reduce cost, enhance resin solubility, and lower relative flammability. After the fluorocarbon/ozone controversy, products were pressurized with hydrocarbon propellents, typically A-31, A-40, and A-46, all used in the 20 to 25% range. (Carbon dioxide was tried, at 5% or so, but the product was always delivered with too much force due to the 100 psig initial pressure at 70°F and the inability of the limited amount of propellent to adequately break up the spray. These formulas were abandoned after about two years; e.g., 1979.)

Because the apolar hydrocarbons limited the solubility of most resins in the ethanol/propellent system, many marketers added modest levels of methylene chloride to prevent the resins from separating at storage temperatures below about 55°F. The usual levels were 8 to 21% of the total formula. The addition of water was found to accomplish the same purpose, and more cheaply, although not more than about 10% could be added without incurring phase separation. Other problems involved can corrosion and changes in the drying ratio. In general, can corrosion could be controlled by using an amine based resin neutralizer in conjunction with extremely pure water and a double lined can, preferably one with an "Organosol" dome lining. The drying ratio problem, a measure of the distortion of the set-

TABLE IX

Unit Shares of Major Hair Spray Brands in the U.S.A.

Marketer	Brand Name	Unit Share of Category (%) 1971 All Outlets	1981 All Outlets	1981 Food Stores
Clairol Division	Final-Net*	2	15	12
Shulton Division	Miss Breck, etc.	10	10	12
Chesebrough-Ponds	Rave	0	9	
Alberto-Culver	VO-5, etc.	5	7	
Gillette (Toni Div.)	White Rain**	7	7.8	
	Mink Difference***	0	2	
	Adorn	7	6.5	
Rayette-Faberge	Aqua-Net**	19	5	19
	Caryl Richards	6	1	
Whitehall Lab's.	Sudden Beauty	6	1	
Others		38	36	

*Pump-action spray. (Introduced as aerosol spray in 1982.)
**Lower cost entries.
***Introduced Sept. 1981.

fixed coiffure upon application the spray, assumed minor importance at the 5% water level, and was still quite modest at 8 to 10%.

Around 1976, La Maur, Inc. introduced a hydrocarbon version of their "Style" and other professional use hair sprays. A 211 × 713 can was used, labeled 20 fl. oz. (16 av.oz. or 1 lb.). In order to fit both label declarations, and also into the can, the company used methylene chloride at about 18% of the total formula to gain the needed increase in product density. Other marketers of institutional hair sprays, such as Faberge, Inc. and Bonat, Inc., were quick to follow, setting a labeling trend for these hair sprays that remained strong in 1981.

In the quest for reduced flammability, several marketers are now experimenting with hair sprays based on the use of dimethylether (DME). This propellent was produced only in Japan and Europe, but it is now also made by E.I. Du Pont de Nemours & Co., Inc. (for non-captive uses) in 1982, and by Conn Chem Div. Canada in 1983. A major impediment is the current U.S.A. price of about $0.57/lb. (1982), which is only slightly less than the imported cost of bulk "tank-tainers" of DME from Germany. This is about three times the price of most hydrocarbon blends and well above the European price of about $0.25/lb.

Data are given in Table X showing proposed formulations in both the U.S.A. and Europe, where DME functions as the primary propellent.

The use of so much water in the proposed U.S.A. formula does not contribute as much toward the relaxation of waved hair as might be imagined. Droop is minimized by the azeotropic removal of much of the water by the dissolved DME. There still remains a problem with product cost, but this is partly compensated by the much reduced flammability level of the product.

The selection of film-forming resin is critical for hair sprays and sets. Some require plasticizers and others do not. The original aerosol hair spray was "Liquinet", in 1948, which used shellac. In 1950 PVP (polyvinylpyrrolidone) was found to be a better choice, but it had low curl resistance to high humidity droop. During the early 1950s, copolymers such as P(VP/VA) 70:30 were introduced by GAF Corp., in which the vinyl acetate part acted to reduce sensitivity to humidity and improved holding power. Further improvements came in the 1960s, when National Starch & Chemical Corp. developed "Resyn 28-1310," a vinyl acetate/crotonic resin, to be followed by GAF Corp.'s "Gantrez ES-225", monoethyl ester of polyvinylmaleate/maleic anhydride copolymer, and "Gantrez ES-425", the slightly less polar monobutyl ester. Still later National Starch & Chemical Corp. brought out the first public offering of a terpolymer, with their "Resyn 28-2930" (vinyl acetate/crotonic acid/vinyl neodecanoate polymer) and "Amphomer" (an octyl acrylamide/arcylates/butylaminothylmethacrylate polymer). The state of the art rested at this point until 1980, when Stepan Chemical Co. introduced its "Stepanhold R-1" terpolymer resin, and 1981, when the Amerchol Corp. began offering "Amphoset" terpolymer, equivalent to the leading hair spray resin of Japan.

The resins must give adequate hold, even in high humidity conditions, but they must also provide high lustre, easy comb-out, minimum stiffening or boardiness, no flaking, no yellowing or darkening, and be removed readily by shampooing in warm water. Add-

TABLE X

Hair Spray Formulations Using Dimethyl Ether

Ingredients	U.S.A.	England	France	France	Germany	Germany	Italy
Fixative Resin*	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Neutralizer	0.1	—	—	—	0.1	—	—
Perfume, etc.	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ethanol (anhydrous)	31.8	15.0	5.0	5.0	3.0	3.0	5.0
Isopropanol**	—	—	—	—	7.0	7.0	—
Methylene Chloride	—	15.0	—	—	35.0	35.0	35.0
De-ionized Water	30.0	—	—	—	—	—	—
P-11 (CCl_3F)	—	36.8	66.9		26.9		31.9
P-113 ($CCl_2F \cdot CClF_2$)	—	—	—	51.9	—	16.8	—
Dimethylether	35.0	30.0	25.0	40.0	25.0	35.0	25.0

*Indicated on a 100% solids basis, although some are marketed as the 50% solution in ethanol and in similar forms.

**Used because of government taxes on ethanol.

ing plasticizers will partly neutralize and soften most resins, rendering them more water dispersible and more polar in their solubility relationships. Excess use of plasticizers will cause tackiness (reduction of coherent bonding) and flakiness (reduction of adherent bonding). The hair will also pick up dirt faster. Certain plasticizers may migrate to the surface of the film and cause changes in "tackifier" properties. This can be an important factor when the plasticizer ratio is high, as in certain "soft-feel/good-hold" formulas using "Gantrez" resins, where the plasticizer is increased from the usual 12% (of the resin level) to 18 to 20%. One major formula avoids higher plasticizer problems by using a Resyn neutralized with AMP at 7.5%; another uses "Stepanhold R-1", which does not require an external plasticizer.

There are a number of aerosol hair products. The hair set is a strong-hold formula, designed for application after shampooing and conditioning. Various hair sheens are available which seem to be particularly popular with Blacks, based upon myristyl lactate lauryl laurate and similar hair substantive ingredients that adhere to the hair and give it shine and substance. Hair sprays with built-in conditioning action have been developed recently, using the GAF Corp.'s "Gafquat 755N" polymer. In fact, the combination of "Gafquat 755N" and copolymer "8-45" is useful for soft-hold, conditioning type hair sprays.

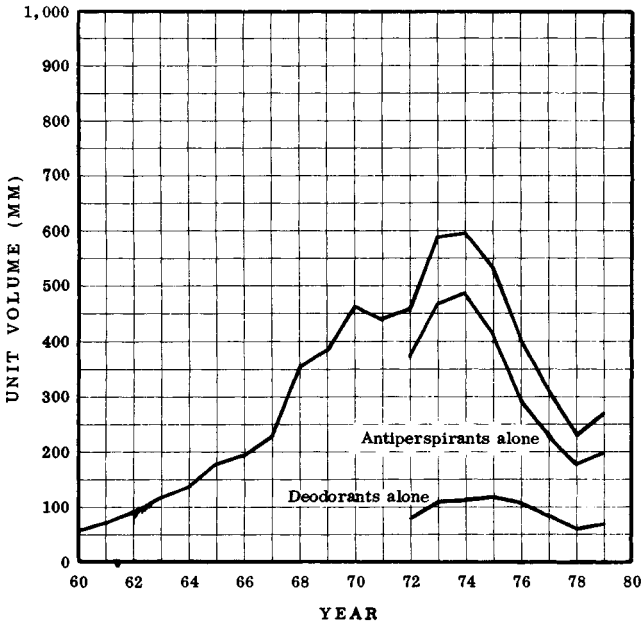

Figure 4. Aerosol Antiperspirant/Deodorant Market

Antiperspirant Sprays

Of all the major aerosol categories, the antiperspirant spray was the one affected most severely by the impact of the fluorocarbon/ozone controversy on marketer activities and consumer buying practices. (The colognes/perfumes and frypan lubricant sprays were stricken even more, but were not major product lines.)

There are two distinctly different types of underarm sprays: the antiperspirant, which controls both wetness and odor, and the personal deodorant, which minimizes odor by germicidal action. The antiperspirant always contains aluminum chlorhydroxide powder, suspended temporarily by shaking in a solution of predominantly hydrocarbon propellent. It must reduce underarm sweat levels by at least 20%, averaged across a one day period, in order to be legally called an antiperspirant. If the product is declared to be an extra-strength antiperspirant, then it must produce at least a 30% reduction. The aluminum chlorhydrate complex first acts to reduce perspiration by dissolving in the ever-present film of underarm moisture, forming an astringent, mildly acidic salt solution that closes the axillary sweat pores to varying degress. Meanwhile, the acidic solution (pH = 4.0 ± 0.5 as a rule) causes bacteriostasis, so that the resident skin bacteria which catabolically produce the characteristic underarm odors are unable to function. In the past, a few marketers added germicides to antiperspirants, but this approach has been found superfluous and is no longer done.

As a general rule, the aerosol underarm products run about 80% antiperspirants and 20% personal deodorants in unit volume. The deodorant came first, being developed about 1957, and it represented a new application for a simple ethanol/fluorocarbon type formulation. When the more complex antiperspirant came along two years later ("Princess Val", developed by Don Virzi at Chase Products Co.) it caught hold rather quickly, pushed past the deodorant and ran ahead to achieve a unit volume estimated at some 480,000,000 units in 1974. This same situation is now being experienced in the young and fast-growing stick market, where personal deodorants held 60% in 1980 but less than 50% in 1981, as antiperspirants took the lead.

Underarm aerosol products are often lumped together as deodorants, or as antiperspirants in marketing reports and other non-technical literature. The *SAMI* (Selling Areas Marketing, Inc.), *Nielsen* (A.C. Nielsen Co.), *CSMA* and other market surveys all consider these two products as one category, and no

further breakdowns are given. On the other hand, some published *Towne-Oller* reports do quantify the component product sales figures.

The unit sales profile of the aerosol antiperspirant and personal deodorant products is shown in Figure 4.

The dramatic decline in the market share of the aerosol antiperspirant/deodorant spray can be illustrated by Table XI.

These and other data show that the aerosol form has lost a 52% market share during the seven year period of 1974-1981. The burgeoning sales of the antiperspirant stick, scheduled to increase strongly during 1981, with three large marketers set to launch these products, shows that the slide of the aerosol forms is still continuing. Aerosols will be surpassed by roll-ons during 1981, and both of these will be overtaken by the stick form by 1983-1985.

Marketers have several concerns with antiperspirant aerosols. In order to get the benefit of about a quarter ounce of aluminum chlorhydrate the consumer must purchase a relatively expensive can, as well as a large amount of hydrocarbon propellent. The propellent averages about 70% of the formula. The can may contain a half ounce of alluminum salt, but only about 55% is actually transferred to the underarm area; the rest is lost to the air during spraying and the potential long-term toxicological effects of breathing this dust is the subject of intensive study by both the FDA and several marketers. In the old fluorocarbon antiperspirants the transference efficiency averaged about 86%. Although

TABLE XI

Unit Market Shares of Antiperspirants and Deodorants - All Types

	Aerosol Products				Non-Aerosol Products				
Year	A.P.	P.Deod.	Powder A.P.	Total Aerosol	A.P. Roll-On	AP&PD Sticks	A.P. Creams	A.P. Pumps	Pads & Sq. Bottles
1974 1				90	4	1	4	0	1
2				89	5	1	4	0	1
3	60	15	13	88	6	2	4	0	1
4	55	16	12	83	10	2	4	0	1
1975 1	54	16	12	82	12	2	4	0	1
2	54	16	11	81	11	3	4	0	1
3	51	16	9	76	16	3	4	0	1
4	48	18	8	74	16	4	4	1	1
1976 1	45	18	7	70	18	5	4	2	1
2	41	18	6	65	19	7	4	4	1
3	40	18	6	62	20	7	3	5	1
4	38	16	6	60	22	8	4	5	1
1977 1	36	14	6	56	26	9	4	4	1
2	32	12	5	49	30	10	4	7	0
3	33	13	5	51	27	10	3	8	1
4	34	13	5	52	27	10	4	7	0
1978 1	33	13	5	51	28	10	4	7	0
2	33	12	5	50	29	12	4	5	0
3	33	13	4	50	29	12	4	5	0
4	31	12	4	47	32	13	4	4	0
1979 1	31	12	4	47	32	13	4	4	0
2	29	12	4	45	34	14	4	3	0
3	29	12	4	45	34	14	4	3	0
4	28	11	4	43	34	16	4	3	0
1980 1	27	11	4	42	35	18	3	3	0
2	25	11	4	40	35	20*	3	2	0
3	24	11	4	39					
4	24	10	4	38					

*Gillette claims the total stick solid segment increased from a 19.1% unit share in 1980 to a 23.5% unit share in 1981. Of the total segment, antiperspirant stick solids went from a 6.9% unit share in 1980 to a 10.5% unit share in 1981.

the technology for doing almost this well with hydrocarbon formulas is available, it has yet to be applied commercially. The alternative packaging forms generally contain more active ingredients than the aerosol, as shown in Table XII.

TABLE XII

Level of Antiperspirant Salt in Various Product Forms

Product Type	Percentage of Aluminum Chlorhydrate Average	Range
Aerosol		
Standard Formulas	11	5 to 14
Water-Based Formulas	17	15 to 21
Light Powder Formulas	5	4 to 7
Roll-On	20	18 to 23
Stick	21	18 to 25
Cream or Lotion	15	12 to 16
Pump	16	12 to 20
Pad	25	25
Squeeze Bottle	9	6 to 12

Except for the pad (which has a negligible market share) they deliver practically all of their astringent salt to the underarm area during normal use. In some instances they use antiperspirants that are more biologically active than those permitted for use in aerosols, e.g. aluminum zirconium tetrachlorohydrex-glycine.

Despite the concerns about economics, toxicology and relative efficacy, the aerosol antiperspirant remains an exceptionally easy, quick, clean and decisive way to treat the underarm area. There is no stickiness; no sensation of "something" having been laid down on the skin. The aerosol is also versatile to the extent that more can readily be sprayed on, perhaps to compensate for a hot day, exercise or other activities. One aerosol can may be used hygienically by the whole family. To compensate for this, the roll-ons and sticks have now been positioned as personal (not family) products.

An interesting comparison can be made between the antiperspirant market in the U.S.A. and in England, where the chlorofluorocarbon/ozone issue did not receive much publicity until about 1979, and where nearly all antiperspirants are still formulated with chlorofluorocarbon propellents. In mid-1980, the aerosol sector of the total English market accounted for 64%, compared with 40% in the U.S.A. The roll-on is the major alternate. In England, stick antiperspirants suffered from severe dry-out and weight-loss problems, which were solved in 1979. But this factor acted to depress the category strongly until then.

The antiperspirant aerosol market was about $92,000,000 in England during 1980, and in that year the brand leader, Elida Gibbs (Sure), with about a 19% share, spent about $1,900,000 in heavily TV-weighted advertising. Such advertising commitments are totally missing from the U.S.A. market.

The antiperspirant aerosol market in England is shown in Table XIII:

In mainland Europe, the popularity of the underarm aerosol products has been maintained all through the 1970s, but with a distinct shift toward the deodorant-cologne side of the market. Rather interestingly, this perfume-enhanced deodorant was not available in the U.S.A., until 1982, but it comprises by far the strongest sales in West Germany and to a lesser extent in Switzerland. The popularity of this item may explain why the 1979 per capita use of underarm aerosols was 2.09 in West Germany, but only 1.25 in the U.S.A. The second largest per capita use of underarm aerosols in Europe was in Switzerland, at 1.80.

A final comparison can be made with the aerosol antiperspirant/deodorant market in Japan, where total aerosol consumption increased rapidly during the 1970-1979 period. This is given in Table XIV.

Unit sales increased every year of the decade. They advanced from a factor equal to 4.0% of hair spray sales in 1970 to 33.5% in 1979, and still increasing in 1981.

Data developed in the U.S.A. and England show that hydrocarbon-based antiperspirants and deodorants are used at about 1.9 g per application, whereas the

TABLE XIII

Unit Antiperspirant/Deodorant Aerosol Market in England; 1972 - 1980

Year	Unit Sale* (Millions)	Population (Millions)	Units Per Capita
1972	48	55.80	0.86
1973	62	55.93	1.10
1974	70	56.05	1.25
1975	51	55.96	0.91
1976	59	55.94	1.05
1977	61	55.90	1.09
1978	45**	55.87	0.81
1979	53**	55.93	0.94
1980	61***	55.98	1.08

*Figures do not include feminine hygiene sprays and food deodorants, two categories often lumped into European surveys of antiperspirants and deodorants.

**The decrease is due mainly to competition from roll-ons on economic grounds.

***Unexplained sales surge in all forms of antiperspirants and deodorants.

TABLE XIV

Unit Antiperspirant/Deodorant Aerosol Market in Japan; 1970 - 1980

Year	Unit Sales of A.P. Deod (MM)	Unit Sales of All Aerosols (MM)	Per Cent A.P./Deod.	Units Per Capita
1970	2.1	174	1.21	0.020
1971	2.6	191	1.36	0.025
1972	4.4	207	2.13	0.042
1973	4.4	243	1.81	0.041
1974	8.7	230	3.78	0.079
1975	9.0	220	4.10	0.082
1976	11.5	252	4.56	0.102
1977	12.6	269	4.68	0.111
1978	17.9	301	5.95	0.156
1979	19.1	342	5.58	0.164
1980	22.0	311	7.07	0.190

fluorocarbon counterparts are used at 3.6 g. Some of these products contain mixtures, such as those with about 25% isobutane as the true propellent, and 60% P-11 as the solvent/carrier component. (These are also popular in Australia and in Canada, where they are sometimes referred to as "the Gillette formula".) Figures on amount per application vary, but about 3.0 g is probably a good average. In sharp contrast, the average application rate for roll-ons runs about 0.63 g while sticks are about 0.58 g. These low usage levels explain the rather small package size of these alternate formulations. Using the 1979 retail prices, a cost effectiveness study shows that aerosols average about 1.8 times the application cost of the other two types, although formula types, product sizes and other factors have led to the development of a surprisingly large cost of application range for all three packaging forms. This economic disadvantage does not bode well for the aerosol, despite its many advantages as a delivery system.

Formulation of antiperspirants is a complex subject. Almost without exception they contain about 12% aluminum chlorhydrate complex (shortened to aluminum chlorhydrex for labeling purposes), having the formula $[Al_2Cl_x(OH)_{6-x}]_n$, where x = about 1.0 to 1.6 and n is a very large number. As the amount of Cl (chloride) increases, efficacy rises, but problems of dermal and nasal irritation may also increase, especially in the case of sensitive people, typically the older, overweight woman who shaves the underarm area.

About 0.06 g of aluminum salt (for women) is required per underarm to produce sweat reductions comfortably above the 20% minimum FDA requirement. For men, this escalates to about 0.08 g, simply due to scale up. A two-second spray time under each arm is stipulated in the FDA test protocol; using this it follows that the spray can must deliver 0.03 g/s (for women) or 0.04 g/s (for men) to the underarm surface.

Considering the more rigorous case which applies to men, and assuming the transfer efficiency of the hydrocarbon-based aerosol spray is only 60%, then 0.067 g/s at 70°F (21.1°C) of aluminum salt must be sprayed to achieve the desired result. Valve delivery rates will vary depending upon selection, and the delivery rate will also fall off somewhat near the end of the can, since a vapor-tap valve is required for a relatively slow spray rate, while still using large enough valve orifices so that they will not become plugged by the powdered product. A spray rate of about 0.55 g/s at 70°F (21.1°C) is considered a practical minimum. From this the percentage of aluminum salt can be calculated from the expression:

$$\frac{\text{Spray rate of aluminum salt (g/s at 70 °F) (21.1 °C)}}{\text{Spray rate of aerosol can (g/s at 70 °F) (21.1 °C)}} = \frac{0.067}{0.55} \times 100\% = 12.2\% \text{ Aluminum Salt}$$

In practice, a 12.2% aerosol antiperspirant will give about a 28% average level of sweat reduction for a panel of equal numbers of men and women. For men, as a sub-group, the estimate would be 24.5%, and for women about 32.2%. Around the half-full area, the level of antiperspirancy will rise a few points, due to the progressive depletion of propellent and increase in transference index, counterbalanced only slightly by a decrease in delivery rate. And at the point of near emptiness, antiperspirancy will dwindle a few points, due principally to the decrease in delivery rate.

Lest these figures appear to give an overly precise picture of the relationship of sweat reduction to aluminum salt level, it is appropriate to say that this is far from the case. Variations of 20% or more are not uncommon. In fact, experimental formulations have sometimes been found to include antiperspirant blocking ingredients that cause surprising reductions below anticipated efficacy.

The particle size of the aluminum chlorhydrate is extremely important from both a toxicological and valve operation standpoint. As a general rule, particles

with a mean diameter of about 0.5 to 6.0 microns stand a good chance of being retained in the deep, sub-cilial alveolae of the lung if inhaled. Those above about 6 microns will impact in the cilial region and be removed from the lungs by automatic body functions. Because of this, the makers of aluminum clorhydrate have made the product available in a "macrospherical" form, where about 99.7% of the material is present in the form of roundels having a mean diameter of at least 6 microns. The upper particle size range of a typical product: "Macrospherical 95F" is about 55 microns (0.002"), and this has been shown to still be compatible with valve systems of the powder-tolerant type — although not by a particularly large margin. A more detailed discussion of the toxicological aspects is given in the chapter on toxicology.

Personal deodorants are relatively simple formulations. Typically they consist of about 30% hydrocarbon propellent, such as A-70, about 68% anhydrous ethanol, and small amounts of benzthionium chloride or other germicidal agents. One firm uses three related parabens. Perfume is included at up to about 1%, and a bit of glycol, isopropyl myristate/palmitate or other oily vehicle is put in to help cause the germicide to adhere to the skin while providing a lubricious film.

Nearly all antiperspirants and deodorants are sold in 202-diameter cans, up to the 509 height. The outlet breakdown was 51.2% in food stores, 31.0% in drug stores, and 17.8% mass merchandising stores during 1980. The heaviest advertiser was Procter & Gamble Co., with about a 16% share; they were probably also the market leader for that year.

The brand share of major products within the three aerosol spray sub-categories is shown for the years 1977 and 1978 in Table XV.

During these years the leading marketer was Procter & Gamble Co., with a 32-35% market share, and the leading single product was "Right Guard", available in roughly 65 items. The greatest loser in the period was "Arm & Hammer", with a -92% change.

Perfumes and Colognes

This dual category is interesting in that it was the hardest hit of all aerosol areas by the CFC/ozone problem, decreasing from 169 million to a mere 11 million units in the U.S.A. in four years. In contrast, sales in other countries were virtually unaffected. The unit sales profile of perfumes and colognes is shown in Figure 5.

The U.S.A. is the largest consumer of fragrance products in the world, yet the rate of use of aerosol perfumes and colognes is less than that of England, West Germany, Saudi Arabia and several other countries. Also in the U.S.A. the men's fragrance market is well developed and grew 1.9 times the rate of the women's component during 1980 and 1981. Despite this, aerosol fragrances for men are virtually unknown. A comparison between the U.S.A., English and Japanese aerosol markets is given in Table XVI.

TABLE XV

Dollar Volume Brand Share of Major Antiperspirant/Deodorant Aerosol Products; 1977 - 1978

	1978 (Per Cent)				1978 (Per Cent)			
Brand Name	**Deod.**	**A.P.**	**A.P.P.***	**Total**	**Deod.**	**A.P.**	**A.P.P.**	**Total**
Sure	0	20.12	0	20.1	0	21.34	0	21.3
Secret	5.16	6.62	0	11.8	5.90	7.86	0	13.8
Right Guard	12.80	7.32	2.50	22.6	14.63	5.95	2.40	23.0
Soft 'n Dri	0	5.76	0.97	6.7	0	6.41	1.17	7.6
Arrid	0.04	12.00	5.29	17.3	0.02	12.48	4.74	17.2
Dial**	Negl.	5.70	Negl.	5.7	Negl.	5.37	Negl.	5.4
Ultraban	0	4.62	0.04	4.7	0	3.24	0.02	3.3
Dry Ban	0	Negl.	0	Negl.	0	Negl.	0	Negl.
Brut	1.80	2.16	0.45	4.4	2.25	2.36	0.33	4.9
Old Spice	0.86	0.2	0	0.9	1.12	Negl.	0	1.1
Mennen	0.78	Negl.	0	0.8	0.90	Negl.	0	0.9
Arm & Hammer	2.61	0	0	2.6	0.20	0	0	0.2
Others	1.05	0.99	0.41	1.5	0.47	0.76	0.15	1.3
Total:	25.10	65.21	9.66	100.0	25.39	65.39	8.81	100.0

*Antiperspirant powder sprays. These products typically contain 2.0% talcum powder.

**Includes Dial Very Dry.

TABLE XVI

Unit Volume of Aerosol Perfumes and Colognes in the U.S.A. and Japan, 1970 - 1979

	Millions of Units		
Year	U.S.A.	England	Japan
1970	90		2.6
1971	96		2.5
1972	158		2.1
1973	169		3.3
1974	134	46.3	1.6
1975	80	51.0*	1.2
1976	63	57.3	0.7
1977	11	64.6	1.7
1978	24	59.8	1.3
1979	29	64.5**	1.2
1980	30***	51.0	0.5

*48% of the total $84 million market.

**40% of the total $88 million market.

***With 43% in aluminum tubes, up from 29.3% in 1978.

In the U.S.A., as aerosols rapidly lost market share starting about Oct. 1973, marketers began to realize the implications of the CFC/ozone controversy. Eventually they might have to use flammable hydrocarbon propellents, where odor was somewhat variable and where certain low-level impurities (as isobutylene, 1,3-budatiene and acetylene) could damage sensitive fragrance components. Other problems soon surfaced. The usual fluorocarbon type perfumes and colognes were formulated completely by the filler, including propellent, and allowed to remain in a loosely closed tank at about 20°F (-7°C) until the incompatible resins and substantives finally precipitated and could be filtered out. The resulting clear product was cold-filled into tubes or bottles, which were then sealed by clinching the valve in place. Because of the problem of flammability, this method could not be used when a switch to hydrocarbon propellents was forced by the government ban on use of fluorocarbons. Fillers would have to add a filtered concentrate to the container, attach the valve and pressure fill the propellent. Under such conditions, the apolar hydrocarbons were found to cause precipitation of portions of the essential oil in the aerosol unit itself. This was unsightly in a clear bottle, and could also cause staining when unshaken bottles were sprayed. A final problem was the possibility of bottle breakage. During 1977, there were at least four product liability cases in which persons were struck with shards of flying glass. The most costly of these was settled for about $200,000. With the addition of hydrocarbon propellent, a breakage situation could result in a significant flammability hazard as well. Actually, a typical 1-oz. glass aerosol with 13% hydrocarbon will instantly release about 3.1 g of vapor upon breakage. This will produce about 17 gallons of (LEL-basis) flammable gas/air mixture, capable of forming about 25 gallons of flame if ignited by a bathroom hot water heater flame or other source. The possibility of product liability suits was thus seen as significantly increased by the use of hydrocarbon propellents.

Faced with all these uncertainties, marketers ceased their promotion of glass aerosol and aluminum tube aerosol fragrance products after about 1974, and directed their research people to concentrate on developing pump-spray alternates. New non-throttling pumps were perfected that eliminated the effects of varying finger speed and gave finer sprays. The outstanding success of firms such as Jovan, Inc. (100% pumps), versus the static performance of firms such as Revlon, Inc. (mixture of pumps and aerosols), gave further impetus to the move toward pump-sprays in the late 1970s.

To help salvage the aerosol fragrance market, some marketers developed concentrates that were more compatible with the hydrocarbon propellents, sometimes adding up to 18% water to help separate components that were likewise insoluble in the butanes. The propellent firms developed hydrocarbons that were extremely low in unsaturates content, either by hydrogenation or by employing a special molecular sieving

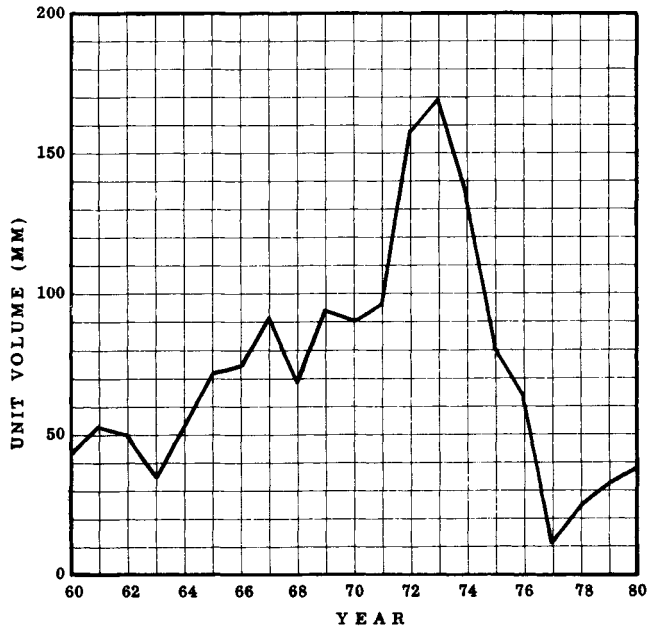

Figure 5. Aerosol Perfume & Cologne Market Volume

process. These premium priced "Cosmetic Grade" gases were found to be satisfactory by most perfumers. And finally, the Wheaton Industries Co. advocated the use of a special, triple-coated "Lamisol" bottle (adhesive/Rigisol-PVC/Plastisol-PVC) that could be produced on their "E-machine" at rates of 105,000 to 120,000 units per day. They proposed such bottles for aerosols over ½-oz. (15 ml) in capacity, except for low pressure formulas in bottles up to 1-oz. (30 ml) in volume; especially if the amount of gas was low or from 10 to 20% water was present in the formula. The Lamisol bottles were suggested to fill up to at least 4-oz. (180 ml) bottle capacity and pressures to 40 psig at 70°F (21.1°C).

With these innovations in place and tested for both hydrocarbon and P-152a ($CH_3 \cdot CHF_2$) propelled formulations, by about 1979 the aerosol fragrance industry was again ready for expansion. A total of twelve contract filler lines were available, nine in the east, two in the midwest and one in the Los Angeles area. Most of these lines could produce at 60 to 80 bottles per minute. Marketers include Chesebrough-Ponds, Inc., Revlon, Inc., Avon Products, Inc., Coty, Inc., Faberge, Inc., Estee Lauder, Inc. and others, but all are moving into the area with considerable caution.

During 1978, one of these firms indicated that their target volume was 35 million units per year within five years. Volumes of this magnitude (if coated) could not be produced on the Wheaton aerosol bottle line, and a second line would cost about $1.4 million in 1978 dollars. It would be 157 feet long and take slightly over a year to build. A substantial portion of the present line is used in the production of pharmaceutical aerosol bottles, such as about 6 million bronchodilators for Riker Laboratories, Inc., in 1978.

The aerosol cologne formulations have been extended into a number of other products that are not normally thought of in the same context as straight fragance items. One is the perfumed, after-bath talcum powder spray, where Avon Products, Inc. is the undisputed leader. They offer perhaps twenty fragrances in a mini-market, totalling around 18 million units per year in 1981. A 4-oz. fill in a 202 × 406 can size is typical. Another is a sachet spray, with about 2 or 3% perfume oil, ethanol and hydrocarbon propellent, packed in a 202 × 406 can. It is designed for spraying clothes, either when folding them after washing and drying, or for spraying lingerie and other articles while in the drawer. Many body mists are nothing more than cologne products, although some also contain some rather complicated formulas high in moisturizing ingredients such as squalane and glycerine/volatile-silicone combinations. These products are packed in aluminum tubes (typically 3-oz.) or 202 × 314 to 202 × 406 cans. Finally, the after shave, skin bracing formulation contains at least 0.4% perfume in a 50:50 (wt.) water-ethanol mixture, to which a bit of glycol, menthol and higher pressure hydrocarbon propellent are added. The suggested can size is the 202 × 509. The aerosol approach has not been a popular one, since it involves spraying onto the fingertips, then patting down the face, underarm or legs. The application can be made in the same way and almost as easily using the regular glass or plastic bottle forms.

Skin Care Aerosols

With the growing sunbelt population, the increased interest in skin care and sun care products by health and beauty editors in the consumer press, and the burgeoning number of older people, sales of skin protective products have suddenly shot up to Brobdingnagian levels. Typical data on sun care products alone are indicated in Table XVII.

The "Coppertone" products are estimated to have more than 31% of the total market and about 50% of the aerosol sector. An indication of the lustiness of this business is the introduction of the "Mmm! What a Tan!" line of lotions and oils in 1980 with a $2 million advertising budget.

Product formulas vary widely, but the major sunscreen is homomenthyl salicylate, with about 1.4 million pounds used in 1979 in over half of all units sold. PABA esters, on the other hand, enjoy the largest share of dollar sales. Greasy ingredients, such as coconut oil, cocoa butter (theobroma oil, USP natural)

TABLE XVII.

Market Performance of Sun Care Products

Year	$ Volume Total Market	$ Increase Total Market	% of Population Using Sun Care Products	$ Volume Aerosol Segment
1974	93MM	4%	18	—
1975	99MM	7%	20	—
1976	118MM	19%	23	9.5MM
1977	143MM	21%	26	11.0MM
1978	154MM	6%	29	13MM
1979	161MM	4%	32	16MM
1980	166MM	3%	33	—
1981	171MM*	3%	34	—

*Sunscreens grew from 30% to 37%. Plough, Inc. brands, led by the Coppertone line, remained stable at 40% share.

Next Page