Recent Developments in the Toilet-Bar Market

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Abstract

During recent years consumers have shown an increasing willingness to purchase more expensive toilet soaps. Two types of toilet bars in particular, surfactant formula bars and antibacterial bars, have shown steady growth.

Surfactant formula bars have gained acceptance because of their excellent lathering properties and the lack of soap scum, which eliminates the unsightly "bathtub ring."

Antibacterial bars have gained acceptance because of their ability to reduce the number of resident bacteria on the skin. This reduces the incidence of superficial cutaneous infection and slows down the development of objectionable body odors attributable to the bacterial decomposition of sweat.

Introduction

According to trade estimates, annual retail purchases of toilet soaps are about $300,000,000. Perhaps three-quarters of these sales are made in grocery stores, and to the supermarket manager toilet bars are an important profit-producing center. But perhaps more important than size, the toilet-bar market is a growing market. Between 1955 and 1965 retail purchases increased from $178,000,000 to $300,000,000, a 68% increase in the number of dollars spent on toilet soap (12). This paper explores the various factors which have contributed to this growth.

Growth Factors

Population

The number of households in the United States increased from 48 million in 1955 to 57 million in 1965. This 19% increase in the number of households thus accounts for about one-third of the growth in the size of the toilet-bar market.

Inflation

Between 1955 and 1965 the index of consumer prices increased 18%. The extent to which this overall trend has affected the retail price of toilet soaps can be studied by examining the trends in the retail price of Procter and Gamble's Ivory Soap, the most widely used toilet soap brand throughout this 10-year period. In 1955 the average price of personal-size Ivory was four bars for 24¢. In 1965 the average price was four bars for 28¢. This amounts to an increase of about 17%, or just about the same as the increase in the overall consumer price index. The price pattern for Ivory is typical of most other toilet soap brands; that is, trends in the cost of toilet soap tend to be closely related to trends in the overall consumer price index. This is particularly noteworthy in view of the number of technical improvements in the quality of toilet soaps which have been made during these 10 years. For example, Ivory Soap is now wrapped in a high-gloss plastic wrapper which seals more tightly and keeps the bar fresher, reducing the tendency to pick up scuff-marks on the store shelf. Other brands can point to similar quality improvements: metal foil wrappers, more convenient opening devices, more popular perfumes, and more effective deodorant ingredients. Virtually every toilet-soap brand contains more built-in consumer value than it had 10 years ago.

So another third of the growth in the dollar value of the toilet-bar market is due to the higher cost of everything, but a significant portion of this increase has been passed back to the consumer in the form of better quality and better performance.

Personal Washing Practices

After the effects of population growth and inflation are taken into account, there is still a clear indication that the average housewife spends about 20% more on toilet soap than she did 10 years ago. Why is this?

One hypothesis is that people wash more. It might be postulated that steadily increasing standards of living lead to steadily increasing standards of personal cleanliness. Estimates of the per-household consumption of soap for personal washing can be developed from production figures in the reports of the United States Census of Manufactures or from statistics published by the Soap and Detergent Association and similar sources; then an estimate of the amount of toilet soap used for nontoilet purposes (such as washing dishes, washing painted woodwork, etc.) may be subtracted. An analysis of this type shows that the average household in the United States uses about 13.7 pounds of toilet soap a year for personal washing purposes. This is equivalent to about one complexion-size bar of toilet soap a week. Further, analysis of these data on a year-by-year basis shows that this consumption estimate has remained constant for the last 20 years.

Thus, if there has been some increase in consumption owing to an improvement in the standard of living, it must have been balanced by a reduction in consumption from other causes: more showers and fewer baths, more use of shampoos instead of toilet soap for hair washing, and so on. So increased consumption is not the explanation for increased dollar sales.

Shifts in Brand Preference

Another possible explanation for the steady increase in dollar sales is that housewives are buying more expensive brands. That is to say, consumers have convinced themselves that some toilet soaps which cost more are worth more, and they are willing to spend the additional money for the additional value.

This is what appears to be happening. The brands which have been growing are the brands which are above average in cost. These premium-priced brands which have been winning new friends in recent years fall into two categories, the surfactant toilet bars and the antibacterial toilet bars. So the technical characteristics of these two categories of toilet bars deserve more detailed consideration.

Surfactant Toilet Bars

In 1955 surfactant bars accounted for less than 1% of the toilet soap market; today they account for close to 20%. Many different synthetic detergent

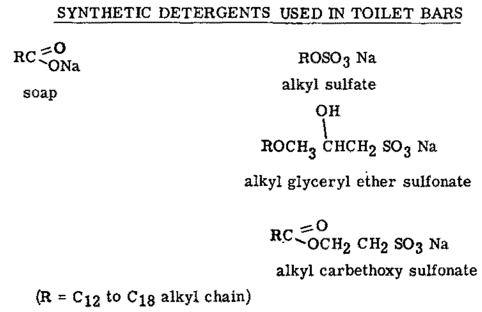

FIG. 1. Synthetic detergents used in toilet bars.

actives have been tried, but only a few have proved satisfactory. Fig. 1 shows the chemical structure of the three most important synthetic detergents used in toilet bars. All three are fully biodegradable so the problems of conversion to biodegradable materials which were faced by the soap industry several years ago did not involve synthetic toilet bars to any great extent.

The important performance benefit which synthetic detergents provide is freedom from lime-soap scum. In hard-water areas this lime-soap precipitate deposits as an unsightly ring around the bathtub. The calcium and magnesium salts of these synthetic detergents are soluble in water so no insoluble residue forms. Further, since none of the active ingredient precipitates out, more is available for bubble formation. Consequently consumers find that surfactant bars lather well, particularly in hard water. In most other performance characteristics (mildness to skin, feel in use, color, odor, shape) detergent bars are competitive with soap bars (8).

Thus the surprising thing is not that synthetic detergent bars have captured 20% of the toilet soap market, but that they account for only 20% of the market. For most other household-cleaning tasks, synthetic detergent products have largely supplanted soap products. For example, in the case of laundry products, more than 90% of laundry loads are washed with detergents rather than soap. In the case of dishwashing, the entire liquid dishwashing product category exists only because of synthetic detergents. In the case of shampoos, all but one of the major market brands are based on the use of a synthetic detergent formulation.

There are probably two reasons why the "detergent revolution" has been less successful with toilet bars. First, there is the unique and unusual viscosity characteristic of soap/water systems which is not found in present-day synthetic detergent/water systems. Fig. 2 illustrates in a schematic manner how the viscosity of soap and the viscosity of synthetic detergents change as water is added. The left side of the chart shows the situation which exists when an individual unwraps a fresh toilet bar; the only moisture present is the 5 to 10% equilibrium moisture in the bar. When he picks up a bar of soap, holds it under the faucet and starts to wash with it or rubs it over a wet washcloth, he adds water to the system. The move is along this curve to the right. In the case of a soap bar, the viscosity of the soap/water mixture on the surface of the bar drops and then increases as the viscous "middle-soap" phase forms. But if he keeps rubbing, the viscosity starts to drop again until it reaches the viscosity of soap lather and eventually the viscosity of water.

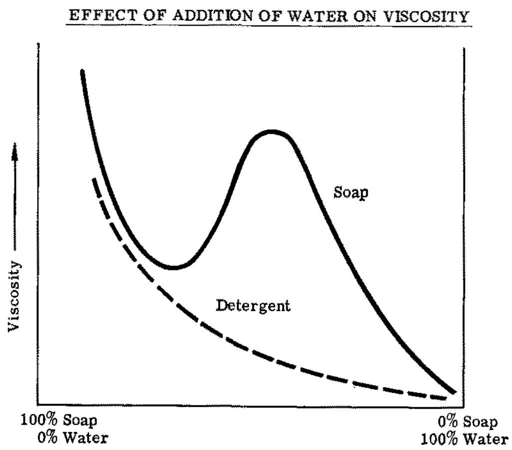

FIG. 2. Effect of addition of water on viscosity.

When this wet bar is placed in a soap dish containing water however, something different happens. Now, as water penetrates the surface of the bar (in effect, moving along the curve to the right), the viscosity again starts to climb, but there is no mechanical action and abrasion to break up the viscous "gum-soap" phase. As a result, penetration of water into the bar slows down and the bar itself, except for the outside surface, remains firm and hard.

Synthetic detergents do not possess this peak-in-the-viscosity-curve property. While they behave much as ordinary soap does when used in the hands or on a washcloth, they behave quite differently in a wet soap dish. The middle-soap phase is not viscous enough to slow down the penetration of water into the bar itself; as a result, under extreme conditions, a detergent bar can become soft and slimy. Some manufacturers have developed surfactant-bar formulations containing an appreciable quantity of soap, and this helps reduce the severity of this problem, but there is still room for improvement in the smear characteristics of synthetic detergent bars (3).

Another reason why surfactant bars have not grown faster is that the basic advantage of detergents over soap, freedom from lime soap scum, is probably not as important in personal washing as it is in the laundry or in dishwashing. The trend toward showering rather than tub bathing, for example, has lessened the importance of bath-tub ring. The growth in municipal and household water softeners, which remove calcium and magnesium salts from the water supply, has also contributed. So also has the growth in the use of bubble baths, for these products keep the bathtub-ring compounds in suspension so they flush down the drain easily.

In summary, surfactant toilet bars have carved out an important place for themselves in today's market because they offer real performance advantage for certain people under certain conditions. But surfactant bars are not likely to supplant soap bars in the way that laundry and dishwashing detergents have done.

Antibacterial Toilet Soaps

The key performance characteristic which antibacterial soaps offer is a reduction in the number of bacteria residing on the skin. Nearly all Americans have been brought up in a culture in which the importance of cleanliness is stressed from earliest childhood. Mothers repeatedly admonish children to wash their hands before eating, after going to the bathroom, before practicing the piano, after playing with the neighbor's dog. Children are repeatedly told that the reason for this is that dirty hands contain germs and germs cause sickness. But the concept of disease transmission by hand contacts is actually not very old.

In 1848 Dr. Ignaz Semmelweiss first propounded the modern theory of the role of personal contact in transmitting disease. In a study at the Vienna Lying-In hospital, Dr. Semmelweiss found that medical students and physicians would perform autopsies in the dissecting room and then rush from the dissecting room to perform a pelvic examination on a woman in labor without even taking time to wash their hands (10). Today, with the hindsight of 119 years, it is not surprising that, in this particular hospital, the mortality rate among new mothers rose as high as 30%, 10 times the mortality rate for other hospitals of that era.

In 1890 Dr. William Halsted of Johns Hopkins Medical College initiated another practice which helped to break the chain of infection at the carrier link. He introduced the use of rubber gloves in the operating room, thus providing a mechanical barrier to cross-infection of the open wound by bacteria on the hands of the attending physician.

In 1938 Dr. Philip Price of Johns Hopkins carried out the first carefully controlled studies of the numbers of bacteria on hands and the effect of soap-and-water washing in removing them. Dr. Price developed the "successive-basin" technique for studying the number of bacteria on the skin, and this test, or modifications of it, has become the standard technique for evaluating the degerming effectiveness of antibacterial soap formulations (9).

A test subject is asked to wash his hands in a basin of sterile water for exactly 60 seconds, transfer to a second basin of sterile water and wash for another 60 seconds, then transfer to a third basin and wash for another 60 seconds, and so on. Next a sample of wash water is taken from each basin and added to an agar medium. After incubation, the colonies are counted; from the count the total number of bacteria removed in each basin can be calculated.

Fig. 3 shows Price handwashing data, published by Pohle and Stewart (7). The counts in the first several basins vary widely from one individual to another and from one experiment to another. But after this initial wobble the data smooth out and show a steady decrease in the number of bacteria removed from one basin to the next.

The bacteria removed in the first several basins are part of the superficial soil picked up in the course of daily living. Price referred to these as transient bacteria. With further washing, the resident bacteria which live and propagate in the deeper layers of the skin are dislodged and removed, but this requires 10 or 15 minutes of washing.

The straight-line relationship on semilog paper shows that bacteria removal from the skin follows the classical exponential decay-rate function and that the number of bacteria removed in any one basin is proportional to the number of bacteria remaining on the skin. The data show that it takes about six minutes to reduce the number of bacteria removed per basin by half, and therefore it takes six minutes of washing to reduce the number of resident bacteria on the skin to half of their original value. From the dotted line it is evident that about 3½ million resident bacteria were removed in the first minute, about 3 million in the second minute, about 2.6 million in the third, 2.3 in the fourth, 1.9 in the fifth, and 1.7 in the sixth. This adds up to 15 million resident bacteria removed in six minutes. Since half of the original bacteria are removed in six minutes, it follows that the resident bacteria count prior to washing was approximately 30 million.

The difference between the dotted line and the solid line represents the number of transient bacteria (with these data, about 4 million). Thus, in this particular experiment, the subjects had an average of 34 million bacteria on their hands, and 30 million, or about 90%, were of the resident or "hard-to-remove" variety. Handwashing for one minute removed about 2½ million transient bacteria and ½ million resident bacteria, or less than 10% of the bacteria population. And who spends even 60 seconds washing his hands?

In 1944 a phenolic compound, hexachlorophene, was found which exhibited unusual bacteriological properties and which could be readily incorporated into soap. During washing a small amount of hexachlorophene is adsorbed on the surface of the skin and inhibits the reproduction of the bacteria. Over several days of use these inhibited bacteria gradually slough off along with the dead skin cells. Since no new bacteria are forming, the bacterial population gradually drops to a fraction of its previous value (11).

Fig. 4 shows successive basin test results (1), illustrating the value of hexachlorophene in reducing the bacteria population on the skin. It can be seen that regular washing with hexachlorophene soap will greatly reduce the starting level of resident bacteria. It takes about 20 minutes of washing with ordinary soap to get down to the resident bacteria level of a regular user of hexachlorophene soap.

As with the previous study, about six minutes of washing are required in order to reduce the bacteria level by half. Therefore the original level of resident bacteria can again be estimated by totalling the bacteria removed in the first six basins and multiplying by two. This chart shows that the subjects who used ordinary soap therefore started with an average count of about 22 million bacteria whereas the subjects who used hexachlorophene soap started with an average count of about 2 million. In other words, regular use of hexachlorophene soap reduced the resident bacteria population of the skin to less than one-tenth its normal value.

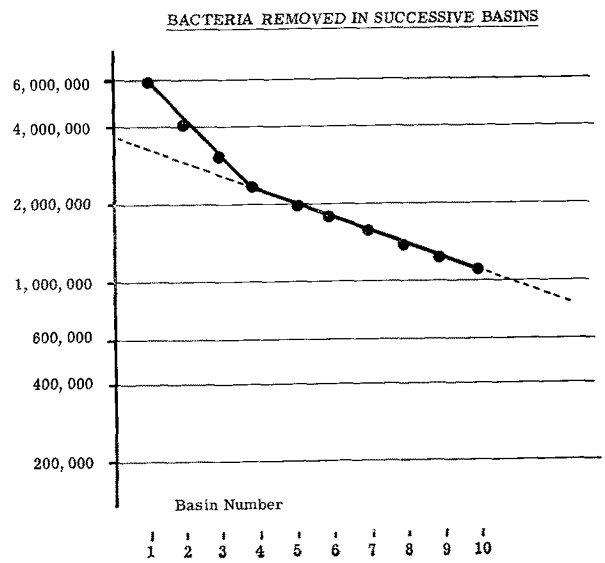

FIG. 3. Bacteria removed in successive basins.

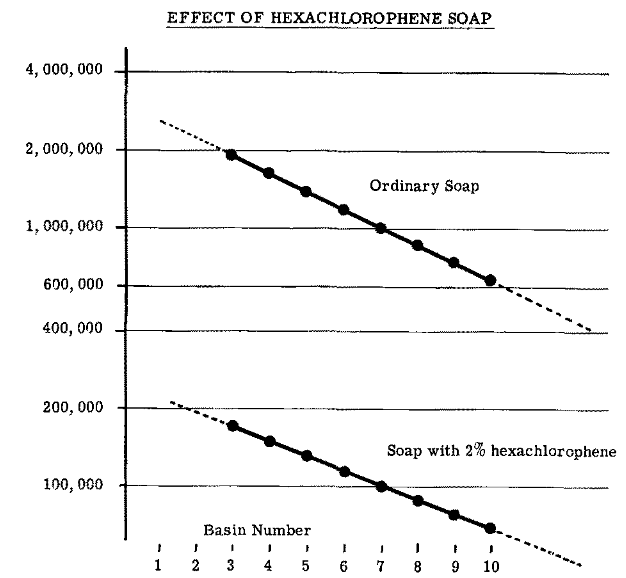

FIG. 4. Effect of hexachlorophene soap.

TABLE I

Effectiveness of Antibacterial Cleansing Products

	Bacteria removed in fifth basin	Estimated total resident bacteria[a]
Ordinary soap	1,300,000	19,000,000
Liquid surgical scrub	12,000	175,000
Antibacterial soaps:		
2% hexachlorophene	115,000	1,700,000
1.5% hexachlorophene, trichlorocarbanilide	65,000	950,000
2% tribromosalicylanilide, trichlorocarbanilide, trifluoromethylcarbanilide	5,700	84,000

[a] Derived from figures in the first column in the following manner: If x represents the proportion of the original resident bacterial population remaining after one minute of washing, then $x \cdot x$ is the proportion remaining after two minutes, x^3 after three minutes, and so on.
Since half of the original resident bacterial population remains after six minutes of washing, $x^6 = 0.5$. Solving, $x = .891$. In other words, after one minute of washing, 89.1% of the original resident bacterial population remains; after two minutes 79.4% remains, after three minutes 70.7%, after four minutes 62.8%, after five minutes 56.0%.
Since the resident bacterial population decreased from 62.8% to 56.0% during the fifth minute, 6.8% of the original resident population was removed in the fifth wash. Therefore the total resident bacteria on the hands prior to washing can be estimated by dividing the fifth basin results by 0.068.

The value of hexachlorophene in surgery was quickly realized. A number of different methods of putting hexachlorophene on the skin were tried; it appeared that a liquid detergent in which an alkyl aryl polyether sulfonate was the active cleansing ingredient was a particularly effective vehicle. Regular use of such a product, containing 3% hexachlorophene, will reduce the resident bacteria count to less than 1% of its ordinary level. For this reason, liquid detergent products containing hexachlorophene are widely used by surgeons to reduce the risk of cross-infection.

To the average consumer the bar form is more appealing, so a significant amount of research effort has been devoted to the search for antibacterial materials with degerming properties as good as hexachlorophene but with greater compatibility with soap. Fig. 5 shows the chemical structure of the antibacterial materials which are most widely used in toilet soaps today.

Mixtures of antibacterial materials are sometimes more effective than single compounds. In 1957 a soap based on the use of a mixture of two antibacterial materials was introduced. In 1963 a soap based on the use of three antibacterial materials was introduced. Table I summarizes the results of numerous successive basin tests of these products conducted in Procter and Gamble laboratories (4).

It is evident that steady progress has been made in improving the effectiveness of antibacterial soaps and that today the American housewife has the opportunity to protect her family with a product with the effectiveness of a surgical scrub liquid, together with the mildness to skin and cosmetic appeal of a high quality of toilet soap.

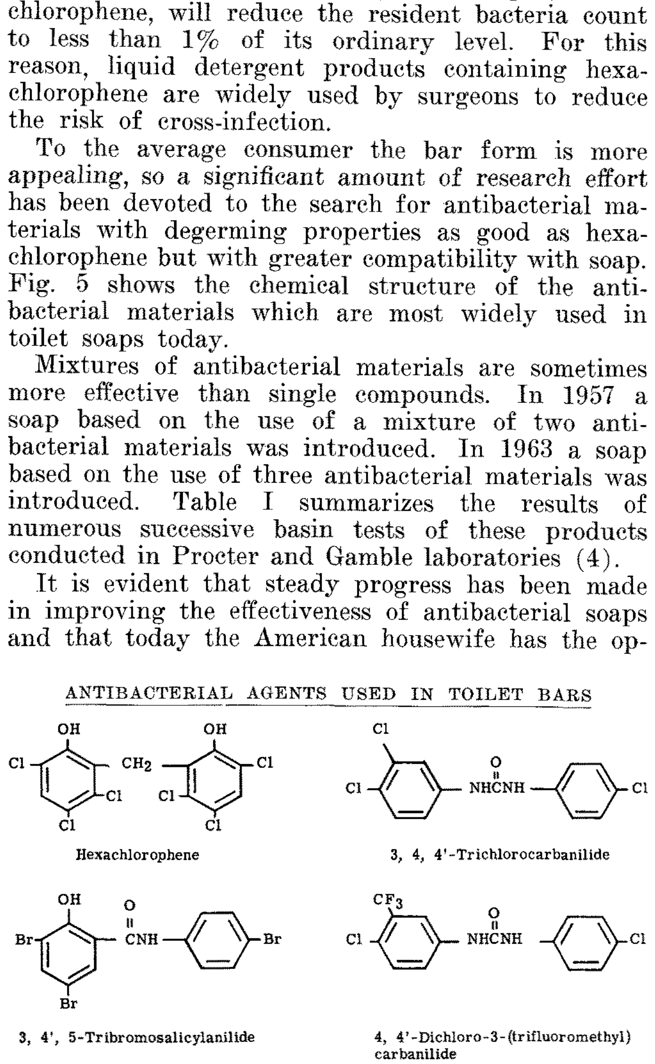

FIG. 5. Antibacterial agents used in toilet bars.

The value of antibacterial soap in preventing skin infections was recently studied at the United States Military Academy at West Point (5). Each entering "plebe" class spends the summer months in an orientation program which involves a considerable amount of physical activity: close order drill, obstacle courses, overnight bivouacs, and the like. An appreciable number of boils, infected blisters, infected poison ivy rashes develop. A nine-week study was conducted, during which time half of the cadets used an antibacterial soap for all personal hygiene while the other half used the same soap without the antibacterial ingredients. The double-blind test technique was used so that neither the cadets nor the examining physician knew the identity of the test soaps. Cadets with suspected infections were examined by a physician for diagnosis. The results of this study showed that the nine-week infection rate among cadets who used the control bar was 64 per 1,000 cadets. The infection rate among cadets who used the three-component antibacterial bar shown in Table I was 36 per 1,000 cadets, a 44% reduction in the incidence of infection.

Another value of antibacterial soap lies in its ability to inhibit the development of perspiration odor. Fresh perspiration is virtually odorless, but the organic materials in perspiration are attacked by the resident bacteria on the skin and the decomposition products so formed have an objectionable odor. Reducing the number of resident bacteria on the skin slows down this decomposition process and thus slows down odor formation.

The value of antibacterial soap in controlling body odor can be measured by having test subjects wash regularly with two soaps, using one bar under one arm and the other bar under the other arm, and then sniffing each armpit to discover which product provided better odor control.

In one test of this sort two antibacterial soaps, one containing 1.5% hexachlorophene/trichlorocarbanilide, the other containing 2% tribromosalicylanilide / trichlorocarbanilide / trifluoromethylcarbanilide, were compared. The test involved 247 subjects and lasted two weeks. During this period the subjects used no underarm deodorant but washed twice a day, lathering under each arm for 75 seconds at each washing. These exaggerated conditions were purposely used in order to give each test soap the maximum opportunity to attain its full potential performance.

Since the key question is how noticeable underarm odor is to other people rather than to the subject himself, the test subjects did not grade their own odor. Instead four different individuals made this right/left comparison on each test subject 24 hours after washing. The results showed that, for 49% of the subjects, there was less odor build-up in the axilla washed with the three-component soap and, for 32% of the subjects, there was less odor build-up in the axilla washed with the two-component soap; for 19% of the subjects there was no right/left difference. It is evident that appreciable differences may exist between various antibacterial formulations and that these differences can be readily measured by appropriate sensory techniques.

Future Developments

Safety

For many years manufacturers in the soap industry worked with a relatively small number of raw materials. Coconut oil, tallow, grease, phosphate builders, alkyl benzene, perfumes have been the building blocks from which soaps and detergents have been constructed. But times have changed. A comprehensive list of commercially available surface-active agents, detergents, and emulsifiers published in 1947 listed 500 materials. The 1964 revision, 17 years later, included more than 4,000 items. Every substance that comes in contact with the body has some potential for affecting health. For this reason, careful study of the biological properties of every new material is essential. This is particularly true of antibacterial compounds since by their very nature they must be biologically active. Thus it is reasonable to expect a steady growth in the amount of time and effort spent on the safety evaluation of cleaning products.

This growing effort on safety testing can be expected to lead to the development of more sophisticated methods of safety testing. More realistic methods for evaluating irritation, sensitivity, and toxicity will come along, particularly in distinguishing between toxicity and hazard. Toxicity is the inherent capacity of a substance to produce injury; hazard is the likelihood that substantial injury will occur under practical usage conditions (2).

Effectiveness

When it comes to predicting the future in terms of the effectiveness of toilet soaps, a guess becomes harder. In most cases, better effectiveness requires an invention, and it is hard to predict when an invention will occur. But there is a reasonable probability that improvements will occur. Considering the advanced state of knowledge of the chemistry of synthetic detergents and the magnitude of the research effort under way in a number of laboratories in many countries, it seems reasonable to look forward to the development of new and better detergents for toilet-bar use. Such detergents can be expected to demonstrate new levels of mildness to skin, perhaps even to the extent of making chapped and rough skin feel soft and smooth again!

In the antibacterial area a broadening of the spectrum of control, an extension of the number of different kinds of organisms against which antibacterial soaps are effective, can be anticipated. Materials may be found which can be added to soap to provide protection against ringworm, athlete's foot and dandruff. The experience of American military forces in Viet Nam has demonstrated the need for better methods of protection against fungus and yeast infections (6).

Essentially every person in the entire United States washes with soap every day. There are few consumer products which have such widespread use. With such a broad base, continuing effort will be directed toward finding ways to provide a better product for the American housewife.

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