The Army's Soap and Detergent Problems

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IN World War I the Army used only commercial products available in the civilian market. From a military standpoint these products were only partially satisfactory, but a warfare of fixed position, carried on in a relatively small portion of the world, permitted opportunity for achieving methods of use which gave some degree of performance. But World War II, which was fought all over the globe under the widest variations conceivable of climatic, terrain, and water supply conditions, necessitated the supplying of items which could function under as many different conditions as possible. The Army's cleaning products, procured at a rate exceeding 600,000,000 pounds yearly during the peak of the War, were among the military "musts."

This paper is divided into two parts: Part I is a brief discussion of the specific major soap and detergent problems of World War II and the role the Quartermaster Corps played in the research and development of products to meet these demands. It is presented in the chronological order that the work was undertaken to solve them; the order of discussion is not necessarily an indication of the relative importance of the problems. Part II presents some of the most urgent of the soap and detergent problems which need to be solved from the standpoint of the Army today.

It is desired to emphasize that the Quartermaster Corps, during the War just terminated, did not undertake to do fundamental research on cleaning products from the standpoint of synthesizing new chemical compounds. The primary reason was lack of sufficient technical personnel. Also, new products may require different kinds of manufacturing equipment and oftentimes different raw materials. The only way to get sufficient products that would do an acceptable, not necessarily the best, job was to start with components already available, which promised to remain available, and make modifications in the finished mixtures adaptable to manufacturing facilities in existence. When possible, new methods of using these items were developed for enhancing performance. This is obviously not the ideal approach to a problem.

During World War II the Army bought many different kinds of products to do its cleaning operations. Unfortunately, it was not possible to procure each item under a specification because either no specification existed or the existing specification was inadequate. The most serious over-all deficiency of specifications has been the lack of proper test methods for evaluating products in terms of actual use requirements. The Quartermaster Corps has expended much effort in research and development of suitable "yardsticks" so that industry could have tangible evaluation figures plus specific technical criticism of the merits and shortcomings of the products offered to meet the Army's needs. By this means the American soap and detergent industry was better able to produce items that met the desired military characteristics.

No one individual or organization can claim the entire credit for the development and production of these many detergent items. The products which were used on the far flung battle fronts were the results of the excellent cooperation given the armed forces by the manufacturers, various technical societies, national research organizations, and other government agencies. And, although it cannot be said that the best products were always obtained, certainly there is justifiable pride in the products that were developed.

PART I

Quartermaster Corps Research and Development of Cleaning Materials in World War II

a. *Mobile Laundry Detergents*

FOR many years before World War II the Army recognized the need for power laundering facilities in the fields of operation. Even prior to Pearl Harbor the development of a mobile laundry was underway. Hand in hand with this development came the necessity of obtaining new cleaning products as it was not believed that the available commercial soap products were adequate for power laundering with water supplies which the Army encountered in the field. In 1941 a Quartermaster Corps specification was written for mobile laundry detergents which essentially provided for the alkyl aryl sodium sulfonate type material containing a minimum of 40% active ingredient. Such products, like practically all synthetic detergents, are of material advantage for washing in extremely hard water, a condition in which soap products fail to perform. However, under soft water conditions none of the synthetic detergents at that time were considered equivalent to soap and alkaline builder in soft water. This was certainly no military secret. However, the many advantages of synthetic detergents over soap were quite apparent, and it was adopted for mobile laundry use as the exclusive cleaning product. It is emphasized that this type of product, however, was not used by the Army in fixed laundry installations.

From a supply standpoint, as well as a desire to procure more efficient type of detergents if such were available, it became necessary in the early part of 1943 to consider other synthetic detergents for mobile laundry use. As an expedient the usual laboratory evaluations were omitted and the readily available commercial products of sufficient manufacturing capacity were field tested at Camp Lee, Va., under actual use conditions. These tests justified the approval of six synthetic detergent products for mobile laundry use, among them being the original alkyl aryl sodium sulfonate type. Federal policy does not favor specifications involving trade name products, and this point, plus the lack of adequate performance tests, made it advantageous to authorize procurement of these six detergents by procurement directive which included (a) trade name designations, (b) a

technical description of each specific item, and (c) provided for laboratory analysis of deliveries. It was believed that the detergent knowledge did not permit the writing of any other type of specification which would assure the procurement of the desired products and at the same time guarantee the exclusion of those found by actual field experience to be inadequate.

The Army's experience with the mobile laundries was not always on the bright side. A shortage of monel metal and stainless steel did not help matters. The necessity of using extremely short washing formulae, the using of only one cleaning material and a "sour" in the formula rather than the customary five or six which the commercial laundry uses, the uncertainty of hot water, and the necessity of using detersing materials not designed for the purpose, all contributed to the grief of Quartermaster laundrymen. In all fairness to these laundrymen though, it must be stated that the primary objective in these mobile laundries was to service the clothing of a large group of men in the shortest possible time so that the garments were usable; there was never an attempt to take the time, fuel, and materials necessary to achieve the quality of work expected in the better type commercial establishments. Certainly the cleaning was far superior to the manual washing methods relied upon in all previous wars. Where conditions permitted, the laundry crew added refinements to the washing technique which afforded considerable improvement in the quality.

The first priority for mobile laundries was given to hospitals in the theaters. The reports were practically unanimous of the excellent job done by these units. And the fact that no hospital ever relinquished one of the units for other field use is ample proof as to the service rendered. It is a matter of medical record that no epidemics or conditions of contagious diseases existed in any theaters of sufficient significance to cause the Surgeon General's Office to request a change in washing formulae or products. However, it can now be told that field tests had actually been conducted jointly by the Office of The Quartermaster General and the Surgeon General's Office to determine the merits of germicidal products which could be utilized in the laundering process to sterilize clothing. Should the occasion have arisen, products satisfactory for this purpose could have been available in any part of the world within a very few days. Fortunately, however, it was never necessary to do this.

By July, 1945, laundry detergent development work had progressed sufficiently, chiefly through better methods of evaluation, that three detergents were designated exclusively for this use. Only one of these was on the list approved in 1943. The laundry detergent studies have been continued, and it is anticipated to revise the list of approved products from time to time. Several factors are responsible: 1. development of better detergents, 2. specific requirements of the many special treatments given military clothing (flame-proofness, water repellency, moth proofness, mildew resistance, insect repellency, etc.), and 3. the development of detergent supplements to enhance specific performance characteristics. At the time of this writing it can be stated that one such detergent auxiliary was among the scientific "finds" by American technologists investigating German industries and research organizations. The Quartermaster Corps is now conducting a thorough investigation of its possibilities. Details of the original material are being released to the American public as soon as possible.

b. *Soap, Toilet, Soft, Hard, or Sea Water (All Purpose)*

One of the first shortages encountered in this war was the supply of palm kernel and coconut oils. In the summer of 1942 it became apparent that so-called hard water soaps utilizing any of these oils would no longer be available. By that time it was realized we were going to fight this war in all four corners of the world, and it would be necessary to supply soap products which would function in soft, hard, and sea water at any temperatures ranging from almost freezing to boiling. During the fall of 1942 the soap and detergent industry was requested to assist in developing an all-purpose product which would do as many different detergent jobs under theater conditions as possible. It was to be a bar given to each individual soldier to meet his entire personal needs of toilet, shaving, mess gear cleaning, hand laundering, and other miscellaneous cleaning. A large number of commercial products were examined, but none were found satisfactory for the purpose.

The Quartermaster Corps found that one of the first steps necessary in this development program was to establish a performance yardstick for evaluating the products and by which to guide the development work. The most useful tests developed were: 1. a hand washing test involving the removal of an oil type of dirt; 2. a method of mechanical laundering of standard soiled wool swatches; 3. a procedure for determining foam formation and stability; and 4. other physical characteristics such as storage ability. The soiling of the standard wool swatch was not a development of this office but was patterned largely after the technique developed by the National Association of Dyers and Cleaners for evaluating dry cleaning efficiency. Detailed information concerning the application of this standard soil is given by Staubley, Lloyd, and Fulton in "Bulletin No. S-2" published by the National Association of Dyers and Cleaners on September 15, 1943.

Sufficient progress had been made in the early part of 1943 to make a field test of some of the most promising all-purpose soap items at Camp Lee, Va., under the auspices of the Quartermaster Board. As a result of this field test and laboratory findings a specification was written in January, 1943. A sufficient amount of this item was procured to meet the requirements of the 10-in-1 ration package for the fourth quarter of that year. The development did not stop with this specification, however, and in January, 1944, at the time of officially standardizing the item for general use in theaters of operation, the specification was revised. This specification (QMC Tentative Specification OQMG 100A *Soap, Toilet, Soft, Hard, or Sea Water*) is still in effect. It provides for two types of products: framed and milled type bars. The composition requirements in this specification are based on tests of many formulations, both as to kind of ingredients and amount of the ingredients.

It was one thing to make an experimental bar, but the Quartermaster Corps and the soap and detergent manufacturers found it quite another problem to duplicate the approved samples in full-scale produc-

tion with the equipment available in the soap plants. Five of the country's foremost soap companies worked many months before they were able to get the item into satisfactory production. The problem was further aggravated by an acute shortage of synthetic detergents. Each specific detergent had to be individually considered from standpoint of performance, availability, toxicity, and many kindred points. Each one behaved differently in each soap maker's particular equipment. Each plant was a specific problem of intensive development work conducted jointly by the soap company, the detergent manufacturers and the Quartermaster Corps. And since it required as much technical assistance for a small plant as a large one, the program had to be limited to the large soap companies and to utilize only synthetic detergents of sizable production.

The War Production Board gave the detergent requirements of this program one of the top priorities as each soap company had to develop a specific formulation peculiarly adapted to its own equipment and which met all of the performance characteristics. The specific formulation finally approved for each company was "frozen." The approved formulations did not always come within the composition limits of the specification, which, after all, served only as a guide for those interested in developing other detergents or cooperated in supplying the finished product. The main objective determined by these months of laboratory and field testing were: 1. to limit the soap content to two parts of soap for one part of active ingredient synthetic detergent; 2. use a short chain detergent (as part of the total detergent) for increasing foam; and 3. use 10% to 30% coconut oil in the soap stock. Through all of this cooperative effort it was possible to achieve a production rate second only to the yellow bar laundry soap.

Finally the item was available in the field—not to the extent desired, though, as food, armament, and clothing must come first. But the reports that came back from the theaters all over the world indicated it to be outstandingly better than any commercial product ever used and, what is mort important, it did a good job for all things it was designed to do.

c. *Chipped and powdered soaps*

In the summer of 1943 the Quartermaster Corps was faced with the problem of stabilizing chipped and powdered soaps against oxidation during storage. The rancidity developed by this oxidation process, of course, was one objectionable feature, but the principal urgency was the imminent danger of fire from spontaneous combustion. A few such instances did occur. Several meetings were held with the principal soap manufacturers in an effort to solve this problem. As a result of extensive consideration by the soap manufacturers the Quartermaster Corps, National Bureau of Standards, and such professional societies as the American Oil Chemists' Society, and the American Society for Testing Materials it was possible to issue in November, 1943, three Quartermaster Corps specifications covering all powdered and chipped laundry soaps: JCQD No. 26, *Soap, Chip (High Titer)*; JCQD No. 27, *Soap, Laundry, Powdered (High Titer)*; and JCQD No. 28, *Soap, Medium Titer, for Low Temperature Washing.* These specifications, which are still in effect, provided for minimizing the moisture content, a minimum of 4% sodium silicate, containers required not be headed until temperature of the soap within the container was definitely decreasing and no container to be headed until the contents was below 100° F., a maximum limitation on the iodine number of the fatty acids, an exceedingly small maximum limitation on copper, maximum of 2.0% rosin, and a requirement that the finished product contain a minimum of 0.1% of an approved oxidation inhibitor. (These approved inhibitors are diphenyl amine, ortho diphenyl biguanadine, para tertiary butyl phenol, and para tertiary amyl phenol.) The finished products are required to pass a stability test—a new test developed for measuring stability to oxidation during storage under adverse conditions. In many instances these specifications worked hardships on manufacturers, but the Army had too much at stake to jeopardize warehouses and cargo ships from fires set by spontaneous combustion in these products. A rigid order was issued, and no exception whatever was made, that all existing products on hand be stored in well ventilated facilities and carefully inspected at short time intervals. From that date on, none of the old products were shipped overseas; existing stocks were disposed as rapidly as possible. The results were most gratifying: not one single instance has been reported of rancidity or spontaneous combustion fires since these products were obtained, and in addition a greater uniformity of detersing quality has been maintained.

d. *Soap, Ordinary Issue*

Soap, ordinary issue, or some times known as "yellow bar laundry soap," or "GI soap," is by far the largest single soap item used by the armed forces. The peak requirements during World War II was about 425,000,000 lbs. yearly. Its major role has not been entirely a matter of free choice, nor has it been an entirely satisfactory item. As everyone knows, it is a heavy duty soap which is usually deleterious to human skin, painted surfaces, and wood surfaces. In spite of all of these criticisms it is hard to conceive of a war being fought without the ever-present yellow bar soap, and it will probably continue to be a major item in the soap industry for a long time to come.

The Quartermaster Corps experience in the early months of the war was not too good in regard to the quality of this item. Too often the moisture content exceeded the limitation set in the existing Federal specification, and other features of the finished product were not what a good soap manufacturer would consider desirable in the product. Poor quality of fats and oils and a lack of proper control in manufacturing by some of the more poorly equipped plants certainly added to the Quartermaster's troubles. The ink was not dry on the new specifications for chipped and powdered soaps just discussed before active consideration was given to the revision of existing Federal specification for this item (P-S-591) with the primary objectives of 1. reducing the moisture content as much as practicable, 2. provide greater control of the finished composition, and 3. to provide a fairer basis of inspection and payment. It was a long struggle to get industry wholeheartedly to support the proposed changes as advantageous and one which could be accomplished without reducing the rate of production. However, some of the larger soap companies agreed that the proposed specification should provide a better product. So the soap industry put

its shoulder to the problem of supplying the Army its biggest soap item on the new Quartermaster Corps specification, JCQD 1008 *Soap Ordinary Issue,* issued in May 1944. One by one the manufacturers were able to comply with this rigid specification. Today the Army and the soap manufacturers consider that this joint effort has paid dividends in supplying a better product. It is reasonable to expect that a substantial part of the civilian market can expect to procure the improved item.

e. *Compound, Germicidal Rinse*

(Although this material has no detergent properties, its use is so intimately tied in with the detergent problems it seems opportune to include a brief discussion of it.)

One of the biggest problems that faces any Army is that of proper food and the sanitation measures which must be enforced regarding its preparation. In World War I dysentery and other ailments were attributed partly to improper cleaning of dishes and cooking utensils. To avoid repetition of this situation the Medical Corps and the Quartermaster Corps cooperated in the development of a germicidal material which would effectively prevent accumulation of organisms in the final rinse water. It was designed for use in cold solutions—where it was needed the most. It is used after the washing operation. The item, named "Compound, Germicidal Rinse," was used rather extensively in practically all the theaters of war. Certainly this item helped the soaps and detergents achieve the ultimate objective of clean mess gear. It has not only been used to sterilize mess gear but also to some extent for the sterilization of fresh vegetables to be served raw so that troops could use the locally available products with safety.

Up to the present time two formulations have been used; each utilizes the principle of a chlorine-liberating compound with the proper oxidation potential to assure good sterilization, which is sufficiently stable for storage purposes. The real merits of this item have been the subject of considerable scientific discussion. Research and development on this item is continuing as one of the post-war investigations. One of the objectives will be to give germicidal properties to various soap and detergent products so that cleaning and sterilization can be accomplished simultaneously under all the varying conditions encountered in the field.

f. *Mechanical Dishwashing Products*

For several years preceding Pearl Harbor a Federal specification (P-D-236) had been written for detergents suitable for mechanical dishwashing. However, in the problem of conserving critical chemicals it has been necessary to utilize cheaper dishwashing products in areas where the water is comparatively soft. This was indeed the case in the beginning months of the war when our Army was being expanded and trained in this country. It would have been wasteful to insist upon use of polyphosphates and other critical chemicals for these soft water areas when other products would meet the same performance requirements. It was therefore necessary to issue a Quartermaster Corps specification which provided for 1. a soft water type (maximum 120 p.p.m. hardness) and a hard water type (above 120 p.p.m. hardness); 2. somewhat more exacting chemical and physical requirements for the finished item; 3. four additional test requirements which are related to actual use conditions; and 4. inclusion of specific use instructions in each package. Like the Federal specification it has no composition limitations. This specification was the first to include the measurement of film formation resulting from possible reaction of the product and the hardening chemicals present in the water. However, the test method as it is now written is not considered too satisfactory. Several research organizations are now undertaking additional development of test methods for dishwashing. It is anticipated that this program, plus that conducted by the Quartermaster Corps, will ultimately afford a profitable revision of the present specification.

g. *Miscellaneous Specialty Dry Cleaning and Laundering Problems*

The Quartermaster Corps was required to develop a number of highly specialized types of clothing and equipage particularly suited to the extremes of climatic and terrain conditions encountered in global warfare. A number of special items, therefore, came into existence which required development of special processes of cleaning and reconditioning these worn items so their useful life could be extended. A paper of this scope will not permit a discussion of these items, but it is believed desirable at least to mention a few of them in passing. Winter garments made of alpaca pile or lined with this material, mukluks (a leather and fabric boot worn in extremely dry cold climates—particularly dry snow), Arctic felt shoes, head bands, helmets, water repellent outer garments (including the Army field jackets, hoods, parkas, etc.), specially constructed wool garments, ski socks, and a host of other items could not be maintained for proper usefulness by ordinary commercial cleaning methods in existence. The fastest method of obtaining satisfactory servicing methods was to develop new procedures for existing laundering and dry cleaning facilities plus the use of suitable retreating products to restore the special properties of the items (water repellency, flame proofness, etc.). These practices usually afforded only partial answers, but they were the best obtainable under the circumstances.

There was and still is one real shortcoming in servicing processes: the lack of specifications and standard procedures for dry cleaning. American industry and the American public have been slow to recognize the necessity for such standard products and procedures. The Quartermaster Corps did not have the time and personnel to develop them although it did make repeated appeals to various groups and organizations for assistance in this direction. This situation has been so deplorable it has been necessary in a large number of instances, particularly with water repellent garments, to forego the possible advantages of dry cleaning and issue orders that these garments be serviced only by the approved wet cleaning procedures developed by this office.

The Quartermaster Corps used considerable dry cleaning facilities for the general cleaning requirements of troops stationed in the various posts, camps, and stations in this country, but there was no mobile dry cleaning equipment comparable with the mobile laundry.

h. *Products and Procedures for Sea Water Laundering*

Previous mention has been made of the value of the mobile laundry units. The standardization of synthetic detergents as the cleaning agent was indeed a fortunate choice as all kinds of waters were encountered in the various theaters ranging from very soft to sea water. It was recognized in the beginning that the synthetic detergents available at the beginning of the war would do a job very superior to soap products in hard water and would do a satisfactory job in soft water, but frankly, it was hoped that there would be no necessity for laundering in sea water. However, as far back as the North African campaign it was necessary upon occasion to use sea water for power laundering and, surprisingly enough, some degree of cleaning was obtained.

All personnel facilities became increasingly overtaxed on all ships by the additional crewmen required for anti-aircraft, radar operation, and special task forces. For some time the Navy had been developing products and processes for power laundering with sea water to help alleviate the situation by requiring less equipment and fuel for obtaining distilled water for such purposes. However, the Navy had little opportunity to solve the problem by the summer of 1944 when the Surgeon General's Office recognized the need for products and procedures suitable for power laundering with sea water to increase the patient-carrying capacity of its hospital ships. In September of that year the Surgeon General's Office adopted a synthetic detergent and washing formula which largely used sea water for laundering on these ships. This appeared to be a satisfactory emergency answer to the problem.

However, in the early part of 1945 a more extensive investigation was initiated by Research and Development Branch, Office of the Quartermaster General, of products and procedures for this purpose. This program has included the testing of practically every available synthetic detergent of any consequence on the American market today. These approximately 150 products were evaluated in small-scale operations and laboratory tests. A large number were disqualified due to extensive incompatibility with sea water. The most promising of the products were then subjected to extensive laundering tests at Camp Lee, Va. The tests were made in regular mobile laundry equipment with synthetic sea water and included the most promising synthetic detergents and such auxiliary products as alkaline builders, water conditioners, bleaching materials, and laundry sours. These materials were tested at different concentrations, temperatures, operation times, and water levels. Some study was made of the possibilities of an extremely low-level soft water washing cycle which utilizes rinsing operations in the extractor; however, time has not permitted the completion of these studies.

At the conclusion of the field tests at Camp Lee the products and procedures which appeared most meritorious were then given final confirmatory testing on board a hospital ship under actual use conditions. This test was conducted during the summer of 1945.

In all of the tests (small scale testing, Camp Lee tests, and the shipboard tests) there were included three different kinds of standard soiled swatches. All of these tests had the advantage of measurements on these standard soiled swatches plus careful control and inspection by experienced laundrymen.

It is believed that this work has served several purposes. The first point is the actual approval of four synthetic detergents as being satisfactory for this purpose (and a fifth one as a satisfactory alternate), and the development of washing formulae by which white hospital linens, colored cotton and wool items can be laundered satisfactorily in sea water. Of course it is pointed out that the term "laundered satisfactorily" does not mean the same performance level as obtained in good quality commercial laundries using soft water. But the quality is considered satisfactory for military hospital ships in wartime.

The second fundamental point has been the establishment of the relationship between and actual value of a) laboratory evaluations, b) actual use tests with synthetic sea water, and c) the tests made on board ship with natural sea water. This work has shown that the full-scale laundering tests with synthetic sea water (as done at Camp Lee) will give approximately the same results as will be obtained on shipboard. These findings appear sufficiently valid that future development for sea water laundering products and procedures will probably be done with synthetic sea water.

In the third place this research has afforded perhaps for the first time a fair comparison of three recognized standard soil swatches on a sufficient scale that their true merits are better understood. This is perhaps the most fundamental advantage from a long range standpoint of development.

PART II

The Army's Soap and Detergent Needs

OBVIOUSLY this discussion cannot include a detailed enumeration of all of the many improvements and developments which would be desired in the Army's soap and detergent products and processes for using them. In addition to the many problems in the war just terminated, the future will doubtless show the necessity for entirely different products and procedures to cope with problems not now anticipated. Many people have asked why the Quartermaster Corps did not carry some of the development work further than was actually done as it was obvious, in a great many cases, that surely more satisfactory answers could be achieved based upon the new findings. The reason was simple. There were so many problems pertaining to types of products, raw materials, manufacturing facilities, procurement and distribution, that as soon as a minimum satisfactory item or procedure was developed it had to be virtually shelved in favor of problems having no answer at all at the moment. For this reason it is hoped that the post-war period will afford the completion of much of the development work which at least obtained a good start during this war.

In addition to continuing the development of specific items initiated during the recent war, the Quartermaster Corps would nominate the following work as being pertinent to any comprehensive detergency research program. It is pointed out that the proposed program is not all-inclusive nor does it intend to exclude other related problems.

1. Develop tests which measure physical and chemical properties of detergents correlated with actual detergency performance. These would include both

aqueous and *solvent* types of products. At present, it would appear that these would come under four broad categories:

a) Methods of measuring the ability to remove various types of soilage from 1. extremely pervious materials such as textiles, leather, and human skin; 2. somewhat pervious (non-continuous) surfaces such as ceramics, plastics, and coated items; and 3. extremely impervious (continuous) surfaces such as metals and alloys.

b) Methods of determining the ability of a detergent to prevent re-deposition of soil previously removed from the surface.

c) Methods of measuring the extent and effect upon cleaning efficiency of any possible reactions between the detergent and solution medium.

d) Methods of determining the effect of the detergent upon the object to be cleaned, i.e., specific effect upon the surface and any changes in composition or structure which may occur.

2. Develop detergent products for use in aqueous and solvent systems which will permit the maintenance of necessary military characteristics in clothing and equipage such as proper resistance to penetration of water, insects, ignition, shrinkage, atomic energy radiations, etc. The problem of protecting the individual are more involved than ever. To answer these problems may require entirely different approaches than used in the past.

3. Develop detergency products whose performance is not affected by chemicals usually found in inland waters or sea water. It would appear more logical, from a military standpoint at least, to work in this direction rather than consider products which inactivate the interfering chemicals in these waters. This carries the development in the direction of obtaining universal products, i.e., usable in soft, hard and sea waters.

4. Develop detergents for various aqueous systems which will more efficiently remove the oil and oil-soluble soilage native to mechanized warfare. It would be still more advantageous if this type of detergent could be used in both aqueous and solvent systems. If suitable for solvent systems, it should remove soilage ordinarily removed in wet-cleaning processes.

5. The development of materials to enhance the soil-suspension (preventing re-deposition) ability of detergents. This failure is probably the biggest reason synthetic detergents today will not equal soap products (in soft water) for washing cotton goods. If it develops that this is not the true explanation, it will be necessary to develop new detergent products more suitable for cotton items.

6. The development of soap and detergent auxiliaries for increasing and decreasing foam formation and foam stability. These auxiliaries must not affect the other properties of the soap and detergents. Until this is done many detersing products cannot be used in optimum concentrations due to the limitation of foam formation. The converse is also true. Hand in hand should go the development of equipment designed for specific types of detersing materials so that optimum operating conditions will be available. For example, the biggest handicap to the widespread usage of synthetic detergents may doubtless be attributed to having to use them in equipment originally designed for soap products.

7. Develop a more universal all-purpose hand soap by eliminating the packaging difficulties, improving the shaving characteristics, making it a suitable dentifrice and making it germicidal.

8. Standardization of dry cleaning products, which would necessitate the development of more adequate products and procedures. This has been a sadly neglected field. Manufacturers are reluctant to divulge formulations sufficiently for specification purposes, and on the other hand, no performance tests are sufficiently developed to warrant adoption as standards.

9. Develop better means of cleaning and inhibiting corrosion of metal surfaces.

10. It is important that product engineering strive to produce items which minimize packaging and storage problems. All too often products become unusable due to caking, gelling, separating, oxidation, or reaction with the container. The bulk factor cannot be ignored. Perhaps one of the most serious deficiencies of packaging is the failure to print on the package simple, adequate instructions for proper use of the product. Without good packaging the product will never get an opportunity for use, and without instructions for use more than likely will be used wrongly.