Investigation of Soap Powders

by G. A. Bragg

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INVESTIGATION OF SOAP POWDERS.

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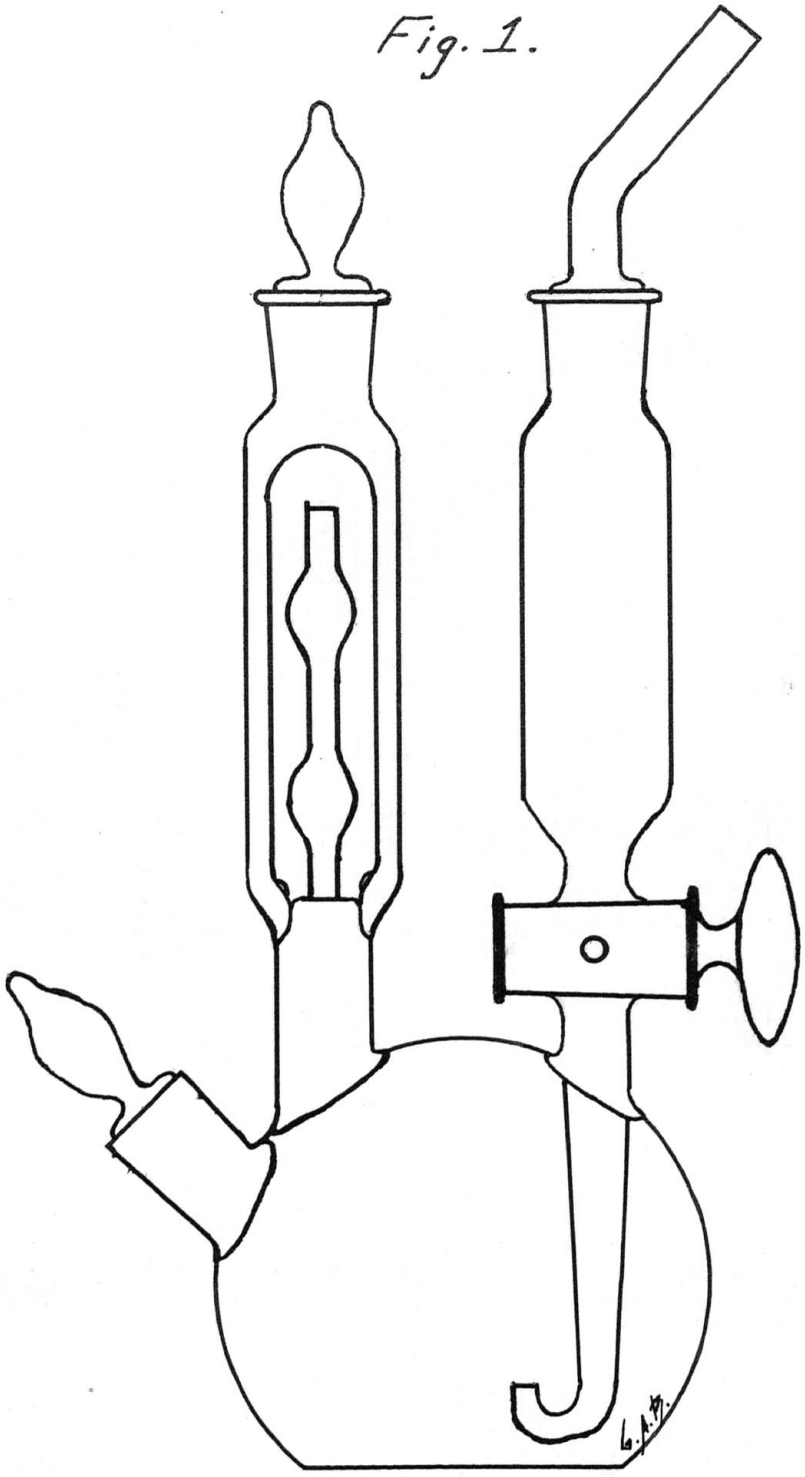
PREFACE.

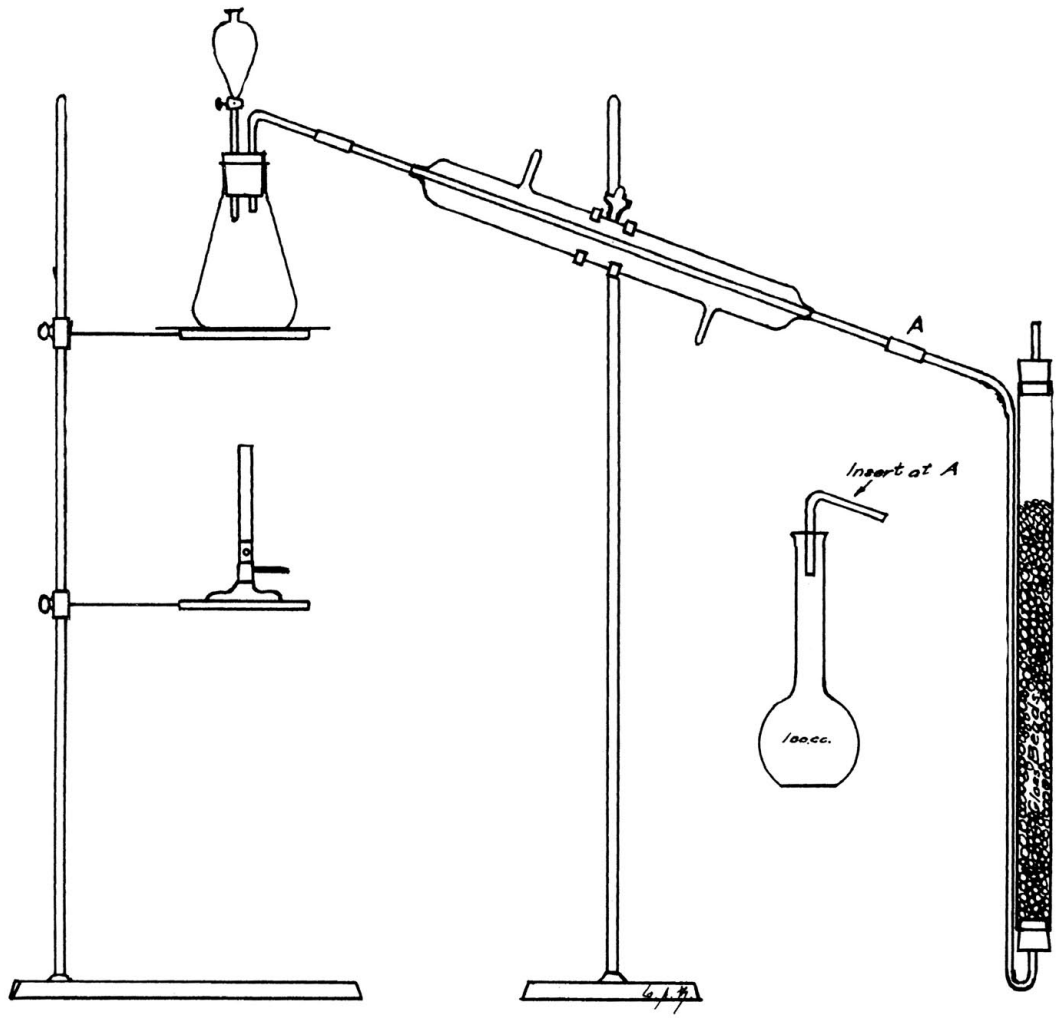
The work, the results of which are given in the following pages, was carried out at the suggestion, and under the supervision of Mr. C. C. Young, and I take this opportunity of expressing my thanks for his kindly interest and helpful suggestions during its progress.

W. A. Bragg.

Fig. 1.



Schroedter Alkilimeter.



Bowser's CO_2 Apparatus.

INVESTIGATION OF SOAP POWDERS.

Preliminary Remarks.

The work reported in this paper was done by the writer during 1912 in the State Water Survey Laboratory at the University of Kansas, under the supervision of Mr. C. C. Young, Director. The object of the work was to secure comparative data on the composition of as large a number as possible, of the more common soap powders, washing and scrubbing compounds, and polishers. These have all been designated by the general title of soap powders, for the reason that of the twenty one mixtures analyzed, all but one contained soap, and all but two were in powdered form.

All of the samples used for analysis were collected by state food inspectors, from grocery and supply houses in different parts of the state where they were being offered for sale. Each package was sealed by the inspector at the time of purchase and was not opened until the analysis was begun in the laboratory, at which time a sample, usually about one-fourth of a package, was placed in a dry glass stoppered bottle to prevent any change in the moisture content after analysis was begun. The atmosphere of the laboratory was

drier than that of the average grocery store, and any moisture absorbed by the powders before they were bottled up for analysis would hardly be as much as would have been absorbed by the same package, had it stood for an equal length of time in a grocery store. Special mention is made of the moisture for the reason that in many powders, it constitutes one-third to one-fifth of what the purchaser gets for his money. The powders are divided into two groups:

Group I.

All powders containing abrasives or polishing material.

(a) Powders containing abrasives only.

(b) Powders containing abrasives and soap.

(c) Powders containing abrasives, soap and a softener.

Group II.

All powders not containing abrasive material.

(a) Powders containing nothing but softeners.

(b) Powders containing softeners and soap.

By the term softeners is meant such substances as soda ash, borax and sodium phosphate, all of which are frequently used to decrease the hardness of water.

The methods used for determining the constituents are described below. The moisture content was determined by weighing five grams of the powder into a large tared aluminum dish, drying in an oven at 120° C. for five hours, and weighing the loss, calculating it as water.

In determining abrasive material such as sand, or volcanic ash, a sample of 0.5000 or 1.0 gm. was weighed into a beaker and washed several times by decantation with boiling water to remove the soap, then with hot 1:6 HCl, after which the residue was washed onto a Gooch and dried at 120° C. If a qualitative examination shows that there is no soap present, the first washings with water may be omitted and the sample simply extracted with boiling HCl, (1:6), the residue dried, and weighed. If the powder contains soap, it must first be extracted by the treatment with water as otherwise the abrasive would be contaminated by the fatty acids, precipitated by the HCl.

The soap in each powder was determined by extracting a 2 gm. sample of the powder in a Wiley extractor with 95% alcohol, as Na_2CO_3 and Na_2HPO_4 are both practically insoluble in 95% alcohol, the sample of powder

may be weighed directly into the Gooch, and placed in the extractor. After the soap has been completely extracted the solution is rinsed out, filtered into a platinum dish, evaporated to dryness on a water bath, dried at 100^0, and the soap weighed. Unless redistilled alcohol is used it is best to use a definite volume, say 50 ccs.,for each extraction so that a correction can be made for the dissolved matter in the alcohol. This correction is found by evaporating 50 ccs. of the alcohol, drying and weighing, just as in the determination of the soap.

No powders were found which contained both sodium phosphate and soap, so that to determine phosphate, it was only necessary to extract with water, acidifying if the powder contained sodium carbonate, and then precipitate the PO_4 in the usual way with magnesia mixture, filter, wash, ignite, and weigh as $Mg_2P_2O_7$.

The determination of Na_2CO_3 may be made in several ways. If the powder contains no other substance, a weighed sample is dissolved in H_2O and titrated with N/10 acid, using methyl orange as an indicator. In the cases where the powder contained soap it was found practicable to extract the Na_2CO_3 with hot water from the residue after the soap extraction with alcohol. This

water extraction was then titrated with acid as before. If the powder contains both Na_2CO_3 and Na_2HPO_4, it is necessary to correct the amount of acid used for the Na_2HPO_4 present as the Na_2HPO_4 reacts alkaline to the extent of one mole of NaOH per combining weight.

$$Na_2HPO_4 + H_2O = NaOH + NaH_2PO_4$$

This correction is easily made after the determination of the Na_2HPO_4.

Before the actual work of analysis of the powders was begun, some experiments were carried out with a view to finding if possible, the quickest way of determining the CO_2 content of a mixture, and from this the Na_2CO_3.

Although the gravimetrie method of liberating CO_2 by acid, absorbing in potash bulbs, and weighing the increase is known to be accurate, it is tedious in operation, requires rather elaborate and fragile apparatus, and is also subject to numerous errors.

The Schroedter Alkilimeter, a sketch of which is shown, was tried out thoroughly and it was found that even with the most careful manipulation, the minimum error between two parallel determinations might easily be as high as 5%. In testing out the apparatus it was carefully cleaned out, the drying tower filled

with concentrated H_2SO_4, a weighed amount of Kahlbaum's C. P. Na_2CO_3, with enough H_2O to dissolve it, introduced into the bottom bulb and the tube for holding the acid which liberates the gas filled. The whole apparatus was then wiped dry, placed in a dessicator, and allowed to come to room temperature. It was next weighed, care being taken to avoid touching with hands, so as neither to warm nor moisten it. The acid was then allowed to fall slowly upon the Na_2CO_3 solution so that the gas bubbled through the coneentrated H_2SO_4 at the rate of about two bubbles per second. After ebullition was complete, dry air was drawn through the apparatus to insure complete removal of the CO_2 and it was again weighed. The effect of using both HCl and H_2SO_4 for liberating the CO_2 was tried. Results are shown in the table below.

Concentrated HCl.

Wt. Na_2CO_3 taken	Loss found	Loss calculated	Error
1.000 gm.	0.6115 gm.	0.4153 gm.	+ 45%
1.000 "	0.2953 "	0.4153 "	- 25%
1.000 "	0.5470 "	0.4153 "	+ 25%
	1:3 H_2SO_4		
.5000 "	0.2205 "	0.2076 "	6%
.5000 "	0.2232 "	0.2076 "	8%
.5000 "	0.2123 "	0.2076 "	3%

From these results it would seem that the apparatus works better when 1:3 H_2SO_4 is used for liberating the CO_2 than when HCl is used, but even with considerable care the results are at best only a crude approximation.

Several articles have recently appeared on the rapid volumetric determination of CO_2.[6] Of all of these, the apparatus proposed by Bowser fig. 2, appeared best adapted for the purpose, in that it was easily constructed, rapid in operation, and not liable to breakage. The method is briefly as follows: A solution of KOH 1:1 was made up and kept in stock for use. Exactly 10 cc. of this were pipetted into the absorbing tower for each determination, and a measured quantity of the material in which the CO_2 was to be determined, placed in the boiling flask. The whole apparatus was connected up, acid from the dropping funnel allowed to run slowly into the boiling flask, heating it at the same time. When ebullition was just beginning the acid was run in slowly, and the flask heated gently so that the rate of passage of the bubbles up the absorbing tower did not exceed 3 per

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[6] A New Apparatus for Determination of CO_2, E. W. Gaither J. Ind. and Eng. Chem. Vol. 4, p. 649. A New Apparatus for the Volumetric Determination of CO_2, H. W. Brubaker, J. Ind. & Eng. Chem. Vol. 4, P. 559. Carbon Dioxide, Its Volumetric Determination, L. T. Bowser, J. Ind. & Eng. Chem. Vol. 4, No. 3. Volumetric Determination of CO_2 in Soils. L. T. Bowser. J. Ind. & Eng. Chem. Vol. 4, No. 4.

second. The heat was increased gradually to boiling, and five or ten ccs. of liquid distilled over into the tower to insure the complete removal, and absorption of the CO_2. The tower was then detached from the condenser and the little bent tube inserted to facilitate blowing the liquid from the tower into a volumetric flask. The tower was rinsed out four time with water, which was sufficient to remove all of the alkali. The contents of the flask was made up to 100 ccs. and 25 ccs. aliquots taken for titration.

The principal upon which the titration is based is as follows: In the presence of an excess of NaOH all the CO_2 will be in the form of Na_2CO_3. Both NaOH and Na_2CO_3 are alkaline to phenolphthalein and methyl orange, but $NaHCO_3$ is acid to phenolphthalein and alkaline to methyl orange. Hence, if to the above solution acid is added until the pink color of the phenolphthalein disappears all of the NaOH will have been neutralized and all of the Na_2CO_3 changed to $NaHCO_3$.

$$2\ Na_2CO_3 + H_2SO_4 = 2\ NaHCO_3 + Na_2SO_4.$$

If now a drop of methyl orange is added to the solution, it will still be alkaline to the methyl orange due to the $NaHCO_3$. If this solution is now titrated with standard acid until it is acid to methyl orange, the acid

consumed will be equivalent to exactly one-half of the CO_2 originally present in the solution. As nearly all NaOH contains some Na_2CO_3, it is necessary to use exactly the same amount of NaOH each time and also to run a blank on it and subtract the CO_2 already present from that found in each determination. In practice 2N H_2SO_4. was used until the pink of phenolphthalein was almost discharged, then N/10 H_2SO_4 until the color disappeared, the burette read two drops of methyl orange added and the titration finished with the N/10 H_2SO_4. A complete determination may be made in this manner in thirty minutes and if several are run one may be titrated while the next one is distilling. 10 ccs. of 95% ethyl alcohol added to the NaOH, Na_2CO_3 mixture before titration, increases considerably the sharpness of the end point with phenolphthalein. The chief objection to the method lies in the fact that methyl orange in the presence of such a large excess of Na_2SO_4 as is usually present, does not give a sharp end point, but a gradual fading from yellow to pink so that some little practice is necessary before the operator can hit the end point accurately. Practice does away with this difficulty to a large extent and the results are as satisfactory as those usually obtained by any other method. After some practice I was able to

obtain results of about the following degree of accuracy on pure Na_2CO_3.

		CO_3 found	calc.
.5000 gram	sample	41.32%	41.53%
.2000 "	"	42.15%	41.53%

In the soap powders in nearly all cases it was found possible to extract the Na_2CO_3 in water solution free from interfering impurities, so that it could be directly titrated. The above method as described can not be used when the mixture contains soap, as the fatty acids distill over to a certain extent, and since they do not have a very definite end point either with methyl orange, or phenolphthalein, they interfere and render the titrations inaccurate.

The analyses of the soap powders classified in the beginning follow in the order in which they come in the table.

ANALYSIS OF POWDERS.

Group I. (a)

Containing abrasives or polishers only.

Nature's Polisher

Manufactured by Purity Cleanser Company, Atchison, Kans.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	0.97%
Sand	87.82%
Fe_2O_3	1.51%
CO_2	0.56%
Loss on ignition less H_2O and CO_2..	5.44%
Total	96.30%

Group I. (b)

Containing abrasives and soap.

Bon Ami.

Manufactured by Bon Ami Company, New York, N. Y.

Wt. 10 ounces Price 10 cents.

Analysis.

Moisture	0.28%
Soap	6.54%
Albite	93.18%
Total	100.00%

N. B. Albite is an orthoclase of the following composition:

SiO_2	68.1%
Al_2O_3	20.0%
Na_2O	12.1%

Group I (c)

Containing abrasives, soap and softeners.

Lighthouse Cleanser.

Manufactured by Armour & Company, Chicago, Illinois.

Wt. 1 pound Price 5 cents.

Analysis.

Moisture	2.87%
Soap	7.30%
Na_2CO_3	5.83%
$CaCO_3$	2.61%
Volcanic Ash	80.83%
Total	99.44%

Swift's Pride Cleanser.

Manufactured by Swift and Company, Chicago, Illinois.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	3.54%
Soap	14.75%
Volcanic Ash	80.52%
Total	98.81%

Gibson's Soap Polish.

Manufactured by Gibson Soap Company, Omaha, Nebraska.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	1.98%
Soap	7.65%
Na_2CO_3	5.82%
Volcanic Ash	84.00%
Total	99.45%

Volco Cleanser.

Manufactured by Volco Manufacturing Company, Wichita, Kans.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	1.85%
Soap	3.69%
Volcanic Ash	93.51%
Total	99.35%

Polly Prim Cleaner.

Manufactured by N. K. Fairbanks Company, Inc., Chicago.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	4.51%
Soap	10.10%
Na_2CO_3	9.68%
Volcanic Ash	75.94%
Total	100.23%

Wizard Cleanser.

Manufactured by Floor Clean Company, Inc., Chicago.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	2.67%
Soap	3.31%
Na_2CO_3	10.01%
Volcanic Ash	80.88%
Total	96.87%

Old Dutch Cleanser.

Manufactured by Cudahy Packing Company, Omaha, Nebraska.

Wt. 1 pound Price 10 cents.

Analysis.

Moisture	2.34%
Soap	7.29%
Na_2CO_3	5.09%
Volcanic Ash	83.38%
Total	98.10%

Sapolio.

Manufactured by Enoch Morgans' Sons, New York. N.Y.

Wt. 10 ounces Price 10 cents.

Analysis.

Moisture	1.90%
Soap	13.40%
Na_4CO_3	3.15%
Sand	81.55%
Total	100.00%

Group II (a)

Powders containing softners only.

Larkin Water Softener Compound.

Manufactured by Larkin Company, Buffalo, New York.

Wt. 1 pound Price 15 cents.

Analysis.

Moisture	48.63%
Na_3PO_4	50.58%
Total	99.21%

Wyandotte Cleanser Powder.

Manufactured by J. B. Ford Company, Wyandotte, Mich.

Wt. 2 pounds Price 10 cents.

Analysis.

Moisture	27.42%
Na_2CO_3	71.52%
Total	98.94%

Sopade.

Manufactured by James Pyle & Company, New York, N. Y.

Wt. ~~pack~~ Price 5 cents.

Analysis.

Moisture	26.23%
Na_2HPO_4	18.17%
Na_2CO_3	55.32%
Total	99.72%

Rub No More.

Manufactured by Summit City Soap Works, Ft. Wayne, Ind.

Wt. 1 pound Price 5 cents.

Analysis.

Moisture	23.26%
Na_2CO_3	75.80%
Total	99.06%

Hippo Washing Powder.

Manufactured by Roach Brothers, Ft. Wayne, Indiana.

Wt. 1 pound Price 5 cents.

Analysis.

Moisture	20.73%
Na_2CO_3	78.12%
Total	98.85%

Borax Washing Compound.

Manufactured by Peet Brothers, Kansas City.

Wt. 3/4 pound Price 5 cents.

Analysis.

Moisture	28.25%
Borax	4.66%
Na_2CO_3	66.67%
Total	100.08%

Nine Oclock Washing Tea.

Manufactured by W. M. Williams Company, Indianapolis, Indiana.

Wt. 1 pound. Price 5 cents.

Analysis.

Moisture	22.33%
Na_2CO_3	77.57%
Total	98.90%

Group II (b)

Powders containing softeners and soap.

Pearline.

Manufactured by James Pyle & Sons, New York.

Wt. 1/2 pound Price 5 cents.

Analysis.

Moisture	13.69%
Soap	30.86%
Na_2CO_3	55.41%
Total	99.96%

Wizard Washing Powder.

Manufactured by Floor Clean Company, Chicago.

Wt. 1 pound Price 5 cents.

Analysis.

Moisture	16.54%
Soap	13.24%
Na_2CO_3	68.38%
Total	98.16%

Gold Dust Washing Powder.

Manufactured by N. K. Fairbanks Company.

Wt. 3/4 pound Price 5 cents.

Analysis.

Moisture	14.79%
Soap	35.02%
Na_2CO_3	49.10%
Total	98.91%

Star Naphtha.

Manufactured by Proctor & Gamble, Kansas City.

Wt. 1 pound , Price 5 cents.

Analysis.

Moisture	13.36%
Soap	38.96%
Na_2CO_3	45.44%
Total	97.76%

C O N C L U S I O N.

To facilitate comparison, the following table has been compiled, showing at a glance the relative compositions of the powders. The column in the table headed, " price " gives the price of the smallest package of that particular brand for sale, the weight of the package being given in the column immediately preceding. The column headed " estimated cost," was found as follows; the total price of the actual ingredients of each powder was calculated based on the following figures, which, it is believed, are exceedingly liberal.

Na_2CO_3	0.8 cent per pound
Soap	4.0 " " "
Sand & Volcanic Ash	0.25 " " "
$Na_3B_4O_7$	3.5 " " "
No figures obtainable for Na_3PO_4 and $NaHPO_4$	

To the cost thus found was added two cents (2¢) to cover preparation, overhead charges and container, and these figures given under " estimated cost."

TABLE OF COMPARISON.

Name	Moisture	Volcanic ash	Soap	Na_2CO_3	Na_2HPO_4	Na_3PO_4	Borax	Sand	Weight	Price	Estimated Cost
Nature's Polisher	0.97							87.82	1 lb.	10 cts.	2.25
Bon Ami	0.28	Albite 93.18	6.54						10 oz.	10 "	2.51
Lighthouse Cleanser	2.87	80.83	7.30	5.83					1 lb.	5 "	2.52
Swift's Pride Cleanser	3.54	80.52	14.75						1 lb.	10 "	2.80
Gibson's Soap Polish	1.98	84.00	7.65	5.82					1 lb.	10 "	2.58
Volco Cleanser	1.85	93.51	3.69						1 lb.	10 "	2.39
Polly Prim Cleaner	4.51	75.94	10.10	9.68					1 lb.	10 "	2.67
Wizard Cleanser	2.67	80.88	3.31	10.01					1 lb.	10 "	2.40
Old Dutch Cleanser	2.34	83.38	7.29	5.09					1 lb.	10 "	2.53
Sapolio	1.90		13.40	3.15				81.55	10 oz.	10 "	2.48
Larkin Water Softener	48.63					50.58			1 lb.	15 "	
Wyandotte Cleanser	27.42			71.52					2 lb.	10 "	3.12
Sopode	26.23			55.32	18.17				1 lb.	5 "	
Rub No.More	23.26			75.80					1 lb.	5 "	2.61
Hippo Powder	20.73			78.12					1 lb.	5 "	2.62
Borax Washing	28.85			66.67			4.66		3/4 lb.	5 "	2.51
Nine Oclock Washing Tea	21.33			77.57					1 lb.	5 "	2.62
Pearline	13.69		30.86	55.41					1/2 lb.	5 "	2.83
Wizard Washing Powder	16.54		13.24	68.38					1 lb.	5 "	3.08
Gold Dust	14.79		35.02	49.00					3/4 lb.	5 "	3.34
Star Naptha	13.36		38.96	45.44					1 lb.	5 "	3.92

These figures have no other significance than that they represent the author's estimate of cost to the manufacture and offer a relative basis of cost comparison.