BAKING POWDER

BAKING POWDER

AND

OTHER LEAVENING AGENTS

By F. N. FOOT

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CHAPTER I

SOME COMPARISONS

THE manufacture of baking powder seems so simple a matter that a book on this subject would hardly appear to be demanded. It is a fact, however, that many houses that have been eminently successful in other lines, never have made any pronounced success with baking powder, and we are also told that some of the foremost manufacturers in this line have made mistakes that have cost them hundreds and even thousands of dollars to rectify.

In view of these facts we believe that a careful consideration of the subject by those now in the business and a more careful consideration by those who are contemplating it, is of sufficient importance to justify the time that a perusal of these pages will require.

We have consulted many well informed chemists and manufacturers regarding much of the contents of this book and have profited by their experience and observation.

Let us first consider the process of leavening and how it is accomplished by the various leavening agents.

All bread, biscuit, cakes, etc., owe their lightness or spongy quality to some kind of a leavening agent, of which yeast and baking powder are the most important. Sour milk, combined with saleratus or soda, is also largely used to accomplish the same purpose. Without a leavening agent, all bread would be like that referred to in Scripture as "unleavened," or simply a hard, tough, solid mass, or cake, which one would find difficult to eat and in no way inviting.

The leavening is produced by a gas diffused throughout the dough and generated either before or in the process of baking.

Yeast being essentially the germ of fermentation, when it is introduced into the dough and allowed to stand in a warm atmosphere for a certain length of time, fermentation results, a part of the dough is decomposed and a gas commonly called carbonic acid gas is evolved, and continues to form during the first part of the baking process. In a baking powder there is simply the action of one chemical upon another, by which this same gas and perhaps other gases are evolved and new chemical combinations are created. In the use of sour milk or buttermilk, the chemical action is much the same as in baking powder, the lactic acid which has been formed by the souring of the milk taking the place of the cream of tartar or other acid ingredient of the baking powder.

Some authorities, writing upon this subject, seem to take it for granted that yeast and baking powder are used with about the same facility in any kind of cookery; in this they are mistaken. Generally speaking, yeast is used for bread, rolls and buns, and often for buckwheat cakes, while for making cakes and pastry, baking powder is almost a necessity. The word "biscuit" is used in different localities to mean so many different things, that it is difficult to say just what a biscuit is, but as it is most generally known, it is made with baking powder or sour milk and soda. Baking powder is not used in what is generally known as bread. The different kinds of bake-stuffs in which yeast and baking powder are used hardly make a comparison necessary, yet there are one or two things worth noting. After bread, or any other bake-stuff, has become two or three days old, if thoroughly baked, it becomes dry and in some degree hard, and every vestige of fermentation is gone, the result being practically the same, whatever the leavening agent. Most of us, however, prefer to eat it fresh, and if we make a comparison of fresh breads, as to healthfulness, we shall find it to the advantage of the baking powder. This is due mainly to the fact that fermentation remains in the yeast-raised bread after it is baked, to make havoc in a delicate stomach; the yeast-raised bread contains much more moisture, so that the dough seems to mass together in the stomach in a sort of soggy condition, much more than results when bread is raised with baking powder, and many people find that they suffer from eating fresh yeast-raised bread, while they may eat hot baking powder biscuit without inconvenience, and will bear us out in this conclusion from their own experience. The uncertainty as to results is greatly reduced in using a reliable baking powder, because the ingredients are in exact proportions, while in yeast bread it may be heavy or imperfectly leavened or too light and sour. Besides this, the fact that yeast raised bread is partly decomposed by the action of the ferments, is not in its favor.

There is, however, one point that has been raised against baking powder of all kinds that we do not think important, but may be worth a passing notice, and it being our purpose to consider everything pertaining to the subject impartially, we here present it. The residuum from any kind of baking powder is a mineral substance remaining in the bread and having a distinct medicinal effect. It is but a homeopathic dose, and if it comes into a system that needs just that medicine, good may result; otherwise, there may be a deleterious effect, so slight as not to be noticeable at the time, but in the end of some importance. We never knew but one man, however, and he a man of prominence, who was consistent about the use of minerals in food, and he excluded even salt from his table, as well as all dishes prepared with it. We don't know whether his experience was satisfactory, but we do know that he is dead and we still live.

In regard to the use of sour milk or buttermilk, the principal argument in favor of this form of leavening power is cheapness, but this, of course, applies only under certain conditions; if milk has to be bought, as in the city, it would be a most expensive kind of leavening agent. Buttermilk is preferable to other sour milk, as it contains butter fat, which adds to the richness of the food, and in the opinion of many, either sour milk or buttermilk produces a more palatable biscuit. In the action of the lactic acid on the soda (bicarbonate) or saleratus (bicarbonate of potash), there is always uncertainty as to the result, because the amount of acid is a varying quantity that keeps the cook always guessing as to how much soda to use, and the result is largely a matter of luck; sometimes the biscuit or cake will be decidedly sour and at other times there will be an excess of alkali that will make yellow biscuit that is anything but appetizing; besides all this, there is not enough acid in the milk to produce a really light biscuit, even though the other conditions are favorable, but this difficulty may be overcome, however, by adding a small amount of baking powder, in addition to the other ingredients.

CHAPTER II

BAKING POWDER MATERIALS

IN selecting the materials for baking powder, two or three things should be considered, one of which is the healthfulness of the ingredients and more especially of the resulting chemical combinations which remain in the biscuit.

The first is of minor importance, because all the ingredients used are almost entirely neutralized, but the character of the residuum may be a more serious matter. The amount of gas-producing power should also be considered, because it is desirable to make a powder equal to the best in leavening strength, and this also has an indirect effect on the cost. Another desirable quality is the giving off of the gas somewhat regularly from the time the dough is made until the process of baking is complete, which produces bake-stuffs of more even and firmer texture, and yet the lightest that can be made.

Still another feature is the selection of ingredients that will not give any bad taste or smell to the bake-stuff and also that no bad odor be given off in cooking.

All baking powders consist essentially of acid and alkaline ingredients, which act upon each other when heat and moisture are present, and in most cases of a neutral substance, such as starch or flour, to keep the other ingredients from acting before the powder is wet up or baked.

Bicarbonate of soda or baking soda is the only alkali in general use. It is easily neutralized, gives off a large amount of gas and is cheap, and the ordinary soda of commerce is so nearly pure as to practically insure the manufacturer a satisfactory article. Besides this article, carbonate of magnesia, usually spoken of as magnesia, is used in small proportions. It produces about the same amount of gas per pound as bicarbonate of soda, but requires twice the amount of acid to neutralize it. It serves an excellent purpose, however, as it is extremely light, its bulk being about seven times as much as soda, and for this reason it increases the bulk of the baking powder and the buyer is more easily convinced that he has good value for his money. For the same reason, also, baking powder made with magnesia is a better keeper, because the other ingredients do not lie as closely together. There is also another argument in its favor when used in connection with soda; it is desirable to have enough alkaline substance to thoroughly neutralize all the acid, and to be on the safe side we want an excess of alkali, but if we have any appreciable excess of soda, the biscuit will be yellow; if, however, the soda is well within the limit, it will act before the magnesia and will be entirely neutralized; then the magnesia, which is more inert, will take up the remaining acid and an excess of magnesia being, of course, only a small percentage, is not in any way objectionable.

Sesquicarbonate of ammonia has also been successfully used in baking powder and is an excellent leavening agent. It may be entirely volatilized or changed into gas, leaving no residuum whatever, being, in fact, a complete baking powder in itself, as it requires no acid to neutralize it. It has proven, also, to be a valuable addition in baking powders that were evenly balanced without it so far as the acid and alkali are concerned. The principal users of this article abandoned it a long time since, however, because there is a deep-seated popular prejudice against ammonia, founded, no doubt, on a knowledge of the first sources from which it was obtained. Ammonia gas is given off in large quantities in cooking and the odor is very pronounced, so that its presence is readily recognized. No substantial reason exists for the prejudice referred to, because all commercial ammonia is now obtained from coal as a by-product in the manufacture of illuminating gas.

Egg albumen, which is in use by some manufacturers, we do not consider of any real value in the proportions in which it is used. We believe that it was first used in baking powder on account of the effect it would produce in showing up the powder mixed up in a glass of water. The starch and albumen thicken up the water so that a good body of foam is made to stand in the glass, while any baking powder that contains only a small amount of starch and no albumen will not foam up in this way. Albumen is of some value as a leavener, but its cost prohibits its use in proportion large enough to be of any real efficiency.

The neutral substances used in baking powder consist principally of flour, corn starch, rice flour and terra alba. The objection to wheat flour and similar substances is that they often contain the larvæ of weevils and other insects that develop worms, etc., in the baking powder, and there is no way of guarding against them.

Corn starch, therefore, is the practical thing; being made by a chemical process, it is free from any danger of this sort, but it should be examined with care, to be sure that it is as dry as it can be made, and that it is free from any taint of any kind, due either to partial decomposition or to chemicals. We would suggest any or all of the following tests:

Pour on boiling hot water and smell the fumes and taste it. Add to another sample one-fourth the quantity of tartaric acid or calcium acid phosphate and then test with boiling hot water, in the same way; the acids referred to are thought to bring out any objectionable odor. Have a sample made into a corn starch pudding, in which the other ingredients do not obscure the starch, and eat it hot. Use it in the preparation of milk toast. The last we have found to be very effective, as it will bring out a very slight defect in the starch.

If starch is sufficiently dry it will gain in weight, as it takes up moisture from the atmosphere. A little practice will also enable you to judge of the dryness by squeezing it in the hand and observing how it packs.

We also advise testing starch by mixing with water to which a very small amount of litmus has been added. Make a thin solution, and if it is exactly neutral you will have a purple color; if alkaline, it will be blue, and if acid, red. Neither, however, would entirely condemn it. A perfectly neutral starch is decidedly preferable, while an alkaline reaction suggests an objectionable quantity of lime. A test for dryness may be made by weighing a quantity, say ten pounds, and then drying this thoroughly, when it should show a shrinkage of 8 per cent., and would then weigh about 9 lbs. 3 oz. If the shrinkage is over 8 per cent. the starch was not dry enough when it left the factory.

Terra alba, two Latin words meaning white earth, is used only in very cheap goods and is not allowed to be sold in many of the States of the Union. We never have heard an argument in its favor, except its cheapness, and it will kill the sale of any article of food that contains it as soon as the fact is known.

CHAPTER III

THE ACID INGREDIENTS

THE acid ingredients used in baking powder are more numerous than the alkalies, and may be arranged in three classes, viz.: Tartrates, phosphates and alums. The tartrates include hydric potassium tartrate or cream of tartar and dihydric tartrate or tartaric acid. Cream of tartar was the first acid ingredient used in baking powder and the baking powders containing it have been extremely popular from that time to the present; doubtless due in the main to two facts, the most important of which is that some of the baking powders containing it have been extensively advertised as cream of tartar powders, and also that as a rule these goods have been most carefully and evenly manufactured. Its neutralizing strength is only 45; that is, 100 parts of cream of tartar neutralize but 45 parts of bicarbonate of soda, and considering this fact it is the most costly of all baking powder ingredients.

Cream of tartar is derived from grape juice in the process of fermentation, in which it becomes deposited in the form of crude argols on the inside of wine casks;

these argols contain lime and other impurities, from which the cream of tartar is separated by a process of refining which has reached such a degree of success that the ordinary commercial article is now about 99 per cent. pure. In the use of cream of tartar baking powder, effervescing occurs while the bread is being wet up; it is therefore necessary that the oven be very hot, so that the biscuit can be baked immediately, or a failure is certain; the same thing would be true if tartaric acid were used, but not to the same extent with any other acid ingredient in common use.

Tartaric acid has two and a half times the neutralizing strength of cream of tartar; it is an extremely active acid, and can be used with safety only in small proportions, except it be in the granular form and with a large proportion of starch. It has been used in this way in England, but not to any extent in the United States. One high authority on such subjects says: "I do not know why this * * * should be used so seldom by baking powder manufacturers," but he evidently did not know that it will not keep. It is a valuable ingredient, however, when used in a proportion of 2 or 3 per cent. only, because it begins the leavening process the instant it is wet up and the leavening is therefore more continuous and uniform, and a better result is obtained.

All phosphates in common use are similar, but do not conform to an exact formula; they are somewhat irregular in composition, but as furnished to the baking powder manufacturers they are of a uniform standard of strength. The large part consists of ortho-calcium phosphate. They also contain free phosphoric acid in small quantities and in the cheaper grades there are considerable quantities of undissolved bone, lime, alumina and other impurities.

These phosphates are made from bones and the better grades are first produced in a liquid state. To this a certain proportion of starch is added, and it is then evaporated to dryness, the amount of added starch being just sufficient to leave it, when dry, with a neutralizing strength of 45 or 50 or about that of cream of tartar. After the drying process, it may be ground either into the powdered or granular form. The granular we believe to possess better keeping qualities, and it is therefore adapted for use in a pure phosphate baking powder, although some manufacturers claim to offer a powdered phosphate with good keeping qualities. As to the safety of depending on these claims, we will only say that in each instance we would take into consideration the standing of the manufacturer offering the goods and would also make a practical test by making up samples, and keeping them for as long a time as practicable in a comparatively warm place. This latter rule will apply to all kinds of baking powder materials; test everything you buy in the most practical way. Phosphates are also obtained from certain rock formations, but these do not seem to possess sufficient keeping quality to make them available for baking powder.

Acid phosphate of soda, also known as pyro-sodium phosphate, has been used at different times and seems to have some claim to favorable consideration. Except for the cost, which is much higher than the phosphates of calcium, we should think favorably of its use. Its healthfulness has been challenged, but we know of no real ground for it.

We do not think that a straight phosphate baking powder, that is, a baking powder which contains no other acid except phosphate, has ever been made with first-class keeping qualities, and we therefore believe that the best way to use it is in connection with alum, whereby its virtues are preserved until they are drawn out by the proper application of moisture and heat.

Alum is a double salt of aluminum and some other base of which there is a large variety; only three of the alums, however, have been in practical use in baking powder; they are known as potash alum, ammonia alum and soda alum. These various alums also exist in three commercial forms, namely, lump alum, powdered alum and anhydrous, or what is commonly called "burnt alum." Only the last of these forms, anhydrous alum, is now used in baking powder, it being usually known to the trade as C. T. S., these initials being understood to stand for "Cream of Tartar Substitute."

All alums are usually manufactured from clay, which in its pure state is a silicate of aluminum. The original form in which it was used is known as potash alum. This served every purpose as a leavening agent, but when used in baking powder left a bitter taste in the product which was a decided objection. Ammonia alum was much better in this respect, and because of the fact that a considerable part of the ammonia is also volatilized it possesses the highest leavening power and would be greatly preferred were it not for the prejudice against ammonia, to which we have already referred. On this account its use has been about discontinued.

Sodium alum or soda alum has recently come into use as a material for baking powder, having almost entirely superseded all other alums. We will therefore consider it at some length. It resembles both of the other alums to which we have referred in general appearance and many other characteristics. In its manufacture an atom of sodium takes the place of an atom of potassium, as it exists in the potash alum, it gives off no odor in baking like ammonia alum and does not impart an unpleasant taste to the bread like potash alum.

In future reference to alum, therefore, let it be understood that we refer to soda alum in the anhydrous form. This kind of alum is practically tasteless in the bread. As compared with all acid ingredients used in the manufacture of baking powder it produces the largest amount of gas for the smallest weight of baking powder and leaves the smallest amount of residuum, calculated on an anhydrous basis, with the exception of ammonia alum and tartaric acid. Soda alum has a neutralizing strength of 97½, or more than twice as much as cream of tartar. It is the cheapest of all acid ingredients, and when its neutralizing strength is considered the cost is extremely low. However, its low cost is not the most important reason for considering it favorably; there is one feature in which it far excels all other baking powder acids, and that is in its perfect keeping quality; besides this, if used in connection with other acids, as it is most commonly used with phosphates, it preserves all the other ingredients. Perhaps we could best describe it by calling it an extremely thirsty ingredient; it readily takes up all the moisture with which it comes in contact, and thus keeps the baking powder very dry, and even when alum is wet up in the dough it effervesces but very little until it is heated, and the dough may stand for hours before baking, providing alum is the only acid ingredient.

Alum, if used in bread without the other ingredients of the baking powder, may be harmful in a small degree. but we design to show that with these ingredients the alum is entirely destroyed and new and harmless combinations are formed.

CHAPTER IV

CHEMICAL ACTION OF BAKING POWDER

IT is not necessary for our readers to take an exhaustive course in chemistry to know something about the chemical action or reaction that occurs in the process of leavening. We will therefore undertake a brief explanation of the most rudimentary principles on which this chemical action is based.

Most of the substances with which we are familiar are made up of more than one element, and this is the case with all baking powder materials. These elements combine under certain circumstances to form compounds entirely different from either of the elements composing them, and they combine in unvarying and exact proportions so that their action may be determined in most cases with perfect mathematical accuracy. A most simple example is the burning of hard coal. Hard coal and charcoal are nearly pure carbon, and when heated to a high temperature combine with the oxygen of the atmosphere and produce a gas called carbon-dioxide or carbonic acid, at the same time evolving very much more heat and light, causing the phenomena with which we are all familiar.

As already stated, each elementary substance combines with other elements in an exact proportion; in the case of those elements that occur in a gaseous form these proportions are by volume, and in those not known in this form, in such proportions as they would probably exist in volume if it were possible to produce them in a gaseous form: thus water is composed of one part by volume of oxygen and two parts of hydrogen. Each of these volumes has a definite weight by which it is computed, known as the combining weight. These elements are represented by symbols, usually the initial letter, which also represents one volume; two or more volumes are represented by small figures immediately following the symbols—thus H represents two volumes of hydrogen, and this being the lightest known gas, is taken as the standard of weight, its combining weight being the unit, or 1, while oxygen is sixteen times as heavy, and its combining weight is therefore 16.

H_2O therefore represents two volumes of hydrogen and one of oxygen, and by weight two (2) units of hydrogen and sixteen units of oxygen. A figure preceding a chemical expression indicates how many quantities are to be taken: thus $4H_2O$ would represent four times as much water as H_2O.

The following are the elements referred to in this article:

	Symbol	*Atomic, or Combining Weight.*
Hydrogen................	H	1
Oxygen.................	O	16
Nitrogen................	N	14
Carbon................	C	12

	Symbol	Atomic, or Combining Weight.
Sodium..................	Na	23
Potassium...............	K	39.1
Phosphorus..............	P	31
Aluminum................	Al	27.4
Sulphur.................	S	32
Calcium.................	C	40
Magnesium	Mg	24

Besides these we shall refer to Ammonium, which, though composed of nitrogen and hydrogen, represented by NH_4, still seems to act the part of an elementary substance.

Chemical action in baking powder occurs when the baking powder comes in contact with moisture or moisture and heat, and the active ingredients of the baking powder, the acids and alkalies, act upon each other so that, as shown in the burning of coal, the original ingredients are destroyed and new combinations are formed and the leavening gas eliminated. We give on pages 28 and 29 a table of formulæ showing the reaction that takes place with the various kinds of material in common use.

The atomic weight referred to is the sum of the atomic weight of all the elements in each substance, and shows their exact proportion by weight. It will be observed that every atom of matter that enters into this combination is accounted for and the total combining weight is exactly the same after chemical action has taken place that it was before.

Some of our readers who are more or less familiar with these formulæ may find it a convenience to have them grouped together in this way for ready reference. In the first formula given we see that 188.1 parts by weight of cream of tartar and 84 parts soda produce 44 parts of gas, 18 parts of water and 210.1 parts Rochelle salts in the bread, and of the entire amount of material used, 272.1 parts, there would be eliminated 44 parts by weight of gas, or 16.2 per cent. This, however, is found to be in excess of the actual, because there is some deterioration before the baking takes place, and the chemical action is not quite perfect. If the mixing has not been perfectly done each cubic inch of dough will not contain exactly its proper proportion of all the ingredients, and therefore will not eliminate all the gas which it contains. Besides this, it is necessary to allow for the amount of starch or other neutral matter in the baking powder, and if this were 20 per cent. it would reduce the efficiency of the baking powder in that proportion, making it theoretically nearly 13 per cent. All of these equations do not express the entire chemical action that takes place and, perhaps, not in every instance the exact chemical action, owing to a variety of causes; but in each case we have shown what is the practical result. In some instances there are various impurities in the ingredients that reduce their strength and perhaps introduce some other kind of chemical action in a very small degree. In the case of ammonia alum we have not been able to entirely substantiate our formula by experiment, but have been led to the conclusion that all the ammonia gas (NH_4) may not be driven off, a small proportion remaining in the form of ammonium sulphate $(NH_4)_2\ SO_4$, so that a safe formula would not perhaps require quite so large a percentage of soda as we have given.

Another matter that must be taken into consideration is that there is water of crystallization, that is, water which is taken up with the substance in its crystalline form; if any of this exists in the material it will make it necessary to use a larger amount to accomplish the same result. The residue formed after chemical action has taken place will be increased by taking up water in this form.

It is quite probable that other action takes place that we have not indicated, which is only preliminary to the final result, but this after careful study we have decided is of little importance, because it does not effect the final result. As an illustration it may be supposed that in some instances a part of the gas is driven off from the soda before it combines with the acid ingredient; but if this should occur and the remaining sodium carbonate be acted upon by the acid, the total amount of gas driven off and the residuum would be exactly the same, both in kind and in quantity.

Where a baking powder is composed of a variety of ingredients the final result appears to be exactly the same as if each kind of acid acted separately; although the chemical action that really occurs may be a rather complicated one. For instance, in what is commonly known as a phosphate-alum baking powder, it may be that a phosphate of aluminum is first formed, but if so this is afterwards decomposed by the soda and the residuum that remains is practically the same as though each acid ingredient had acted separately.

TABLE OF CHEMICAL ACTION RESULTING FROM THE USE OF VARIOUS KINDS OF BAKING POWDER

Potassium Bitartrate (Cream of Tartar)	and	Bicarbonate of Soda	give	Carbon Dioxide		Water		Potassium Sodium Tartrate (Rochelle Salts)
$KHC_4H_4O_6$	+	$NaHCO_3$	=	CO_2	+	H_2O	+	$KNaC_4H_4O_6$
188.1	+	84	=	44	+	18	+	210.1
Tartaric Acid	and	Bicarbonate of Soda	give	Carbon Dioxide		Water	and	Sodium Tartrate
$H_2C_4H_4O_6$	+	$2NaHCO_3$	=	$2CO_2$	+	$2H_2O$	+	$Na_2C_4H_4O_6$
150	+	168	=	88	+	36	+	194
Tartaric Acid	and	Carbonate of Magnesia	give	Carbon Dioxide		Water	and	Magnesium Tartrate
$5H_2C_4H_4O_6$	+	$(MgCO_3)_4Mg(OH)_2$	=	$4CO_2$	+	$6H_2O$	+	$5MgC_4H_4O_6$
750	+	394	=	176	+	108	+	860
Sodium, Aluminum Sulphate (Soda Alum)	and	Bicarbonate of Soda	give	Carbon Dioxide		Sodium Sulphate (Glauber's Salts)	and	Aluminum Hydrate
$Na_2Al_2(SO_4)_4$	+	$6NaHCO_3$	=	$6CO_2$	+	$4Na_2SO_4$	+	$Al_2(OH)_6$
484.8	+	504	=	264	+	568	+	156.8
Basic Aluminum Sulphate	and	Bicarbonate of Soda	give	Carbon Dioxide		Sodium Sulphate (Glauber's Salts)	and	Aluminum Hydrate
$Al_2(SO_4)_3$	+	$6NaHCO_3$	=	$6CO_2$	+	$3Na_2SO_4$	+	$Al_2(OH)_6$
342.8	+	504	=	264	+	426	+	156.8

Ammonia Alum and Bicarbonate of Soda give Ammonia Gas, Carbon Dioxide, Water, Sodium Sulphate and Aluminum Hydrate

$$Al_2(NH_4)_2(SO_4)_4 + 8NaHCO_3 = 2NH_3 + 8CO_2 + 2H_2O + 4Na_2SO_4 + Al_2(OH)_6$$
$$474.8 + 672 = 34 + 352 + 36 + 568 + 156.8$$

Mono-Calcium Orthophosphate and Bicarbonate of Soda give Carbon Dioxide, Water, Di Sodic Phosphate and Calcium Hydrogen, Phosphate

$$CaH_4(PO_4)_2 + 2NaHCO_3 = 2CO_2 + 2H_2O + Na_2HPO_4 + CaHPO_4$$
$$234 + 168 = 88 + 36 + 136 + 142$$

Hydric Pyro Sodium Phosphate and Bicarbonate of Soda give Di Sodic Phosphate, Water and Carbon Dioxide

$$H_2Na_2P_2O_7 + 2NaHCO_3 = 2Na_2HPO_4 + H_2O + 2CO_2$$
$$222 + 168 = 284 + 18 + 88$$

Sesquicarbonate of Ammonia gives Ammonia Gas, Water and Carbon Dioxide

$$NH_4HCO_3NH_4NH_2CO_2 = 3NH_3 + H_2O + 2CO_2$$
$$157 = 51 + 18 + 88$$

CHAPTER V

THE RESIDUUM

THE skillful chemist, after he has observed the result of a chemical action, usually proceeds to examine the residuum; by this we mean what remains after chemical action has taken place.

Let us proceed to do the same thing, though not exactly in the same way.

We will endeavor to gather what we can from the conclusions of chemists, physicians and others who have made this subject a study as to what really remains in the bread, both as to quantity and quality, and also as to the effect on the human system.

The gist of this we have tabulated on page 32.

Sesquicarbonate of ammonia if pure produces only gas and water. As a large part of this is ammonia gas, when reduced to the basis of carbon dioxide, we show the equivalent of over 100 per cent. of gas, because where ammonia gas exists it is estimated at three times its weight to increase it to the same basis as to volume as carbon dioxide.

We have estimated the ammonia alum on a basis of neutralizing 120 parts of soda, which represents our experience with this substance, although theoretically it seems to show that it would neutralize 141 parts. The anhydrous residuum, given in the second column, is what it would weigh if absolutely free from water.

The third column of figures shows the percentage of residuum in the usual crystalline form, as we would find it at the druggist's. It will be observed that in nearly every instance this is over 100 per cent.; that is, the amount of salts left in the bread after taking up water enough to crystallize it weighs more than the baking powder, exclusive of starch. In actual work allowance must be made for the starch or other neutral matter; we therefore include in the third column a table that shows how much starch may be added to produce a powder of 14 per cent. (theoretical) gas, which is a fair standard.

In the fifth or last column we give the percentage of residuum that would remain from a baking powder producing 14 per cent. (theoretically) of gas.

We have already shown the result of chemical action with the various kinds of baking powder material, and this table covers the same materials, showing the theoretical percentage of gas and also of residuum.

THESE TABLES REPRESENT PROPORTIONS BY WEIGHT

	Per cent. Gas.	Per cent. Residuum Anhydrous.	Per cent. Residuum with Water of Crystallization.	Per cent. Starch to be used for a 14% B'k'g Powder.	Crystallized Residuum after adding Starch.
Cream tartar and soda	16.2	77.2	103.7	13.6	89.7
Tartaric acid and soda	27.6	61.	72.5	49.	37.
Magnesia and tart. acid	15.4	75.2	.....	9.	......
Sodium alum and soda	26.7	73.3	130.3	47.4	68.5
Basic aluminum sulphate and soda	31.2	68.8	132.6	55.	59.7
Ammonia alum and soda (practical basis)	33.	63.2	126.	57.6	53.4
Calcium phosphate and soda	22.	69.	122.7	36.4	78.1
Sesquicarbonate of ammonia (alone)	153.5	.....	.....	90.9	......
Phyro-sodium, phosphate and soda	22.6	72.8	181.	38.	112.22

We observe from this table, therefore, that after we have added starch to get the same basis of leavening power of the three kinds of material in general use cream of tartar produces by far the most residuum, while phosphate comes next and sodium alum much lower, or about three-fourths as much as cream of tartar.

Basic and ammonia alum and tartaric acid show a much smaller residuum than any of the others and sesquicarbonate of ammonia shows none, but these substances are not in common use, and therefore are not considered in the same light as the first three referred to, though this fact certainly offers a strong argument in their favor. There is another item, however, to be considered in the alum powders, and that is that a part of the residuum is aluminum hydrate, an insoluble inert substance which probably does not exert any medicinal effect whatever on the system. If we consider the amount of active salts in the residuum shown in the last column it will reduce these figures to the following: Sodium alum, 57.3 per cent.; basic aluminum sulphate, 50 per cent.; ammonia alum, 49.5 per cent.

In regard to the medicinal effect of the residuum from these various salts we gather the following from the United States and National Dispensatories:

Rochelle Salts.—"Mild, cooling purgative, among the mildest and least unpalatable of natural salts. Dose as a purgative ½ ounce to an ounce. In small and repeated doses does not purge but is absorbed and renders the urine alkaline."

Sodium Tartrate.—"An agreeable purgative almost without taste, power equal to magnesium sulphate. Dose 1¼ ounce."

Calcium (or Calcic) Phosphate.—"In certain states of the system characterized by defective nutrition, its use is increasing; recommended for such diseases as rickets, phthisis, etc., and it has also proven useful in hastening the union of fractured bones. Dose 10 to 30 grains."

Sodium Phosphate (or Di Sodic Phosphate).—"Mild purgative, well adapted to children and persons of delicate stomach. For this purpose the dose is 1 to 2 ounces. Also considerably used and generally in connection with other phosphates for any real or supposed deficiency of phosphates in the system; best administered with food. Dose 20 to 40 grains."

Glauber's Salts.—"An efficient hydragogue and cathartic in doses of ½ to 1 ounce. In small doses an aperient and diuretic. It is an ingredient in the artificial Cheltham salts." We would also add that this is also the largest chemical ingredient in the waters of some of the most popular mineral springs.

Magnesium Tartrate.—"Similar to citrate of magnesia; a mild, agreeable purgative."

From which it will be seen that the medicinal effect of all these salts is similar, except the phosphates. The amount prescribed, however, as a dose is so large that we see at once that neither of them produces any very decided effect on the system in the quantities usually consumed in baking powder. However, let us make a calculation as to how much that would be. For an ordinary size family the amount of baking powder for a baking would be 2 teaspoonfuls, or about 3 drams, say, 180 grains. If a cream of tartar baking powder had been used this would leave a residuum of active salts of 162.4 grains. The result of this baking would give about thirty-two ordinary size biscuits, or say five grains to each biscuit. If phosphate baking powder were used, each biscuit would contain but about four grains, and if sodium alum baking powder were used there would not be over three grains to each biscuit. Therefore, in order to get a full dose where cream of tartar baking powder is used it would take forty-eight to ninety-six biscuits. If phosphate baking powder were used you would require 120 to 240 biscuits, and if alum baking powder were used, about 80 to 160 biscuits would be all you would require.

We observe that in the case of Rochelle salts small and repeated doses are absorbed into the system, and this is doubtless true of the other salts, the effect probably being that of an aperient and diuretic in every case. It will be seen that the prescribed dose for this purpose is about what one would get by eating a half dozen biscuits. So that we may fairly assume that the quantity of salts one would consume in using any kind of baking powder would be more beneficial than otherwise in almost any condition of the system. We also find that a glass of mineral springs water, such as Carlsbad or Cheltenham, contains about as much sulphate of soda as four or five biscuits made with alum baking powder.

Much has been said and written pro and con regarding the so-called injurious effect of alum. It is a fact, however, that nearly all the attacks on alum originate with the manufacturers of cream of tartar baking powder; they are to be taken, therefore, with a great degree of allowance. Some of the best authorities in this country have been strong in its support and, considering that hundreds of tons are consumed annually and no serious case of illness has ever been traced to alum baking powder, we believe it to be a perfectly safe and healthful ingredient. The professor of chemistry in one of the leading Eastern colleges, who has also taken a course in medicine, said of it that he believed that "anyone who did not die until he died as the result of using alum baking powder would live to be as old as Methuselah." Many people either do not understand or lose sight of the fact that alum is entirely changed by chemical action in the cooking process, and therefore simply consider what the effect of alum would be if this change did not take place. If it were argued that some unneutralized alum still remains in the bake-stuff, we could reply that the amount must be very small, and that its effect medicinally, being astringent, would be to only partially offset that of the active salts formed by the baking powder. The amount of residuum from this substance being smaller than that from any other baking powder material is very much in its favor.

Aside from these influences on the digestive organs, we have seen that phosphates have another very beneficial effect, which may extend to those of both delicate and robust health, and we conclude that phosphates in general are not only harmless but we believe exert a highly beneficial influence on the human system.

A grain of wheat consists essentially of three distinct parts, the greatest of which is the starchy portion and which goes into the system largely as "filling"; it is easily digested and performs an important part in sustaining our physical organization. Another part is the gluten, which is the harder part of the wheat, and lies close to the bran or outer covering.

Formerly much of this was wasted, but modern ingenuity in the process of milling has succeeded in recovering nearly all of it. It contributes to the muscles of the body.

The bran contains the third important part in the shape of phosphates; these, of course, are all eliminated, except in Graham or whole-wheat flour; these phosphates contribute their wealth to the brain and sinews as well as other parts of the system, and also aid the digestion.

When a baking powder contains a fair proportion of phosphate the loss which the grain has suffered by parting with the bran is made good by the baking powder, so that a good phosphate baking powder, or one containing a reasonable amount of this important ingredient, may be considered as a brain, nerve and sinew builder.

It has been argued that we get enough phosphates in the ordinary way. This would be true if we lived largely on potato skins and Graham bread. Most of us, however, can utilize an excess of this kind of nutriment and are perhaps somewhat like a young man who wanted to be a journalist and wrote to a New York daily applying for a staff position. He mentioned in his letter that he had heard that a man who had a large amount of brain work to do ought to eat fish, and asked for advice as to how much he should eat. The answer came through the columns of the paper: "Judging by the kind of a letter you have written, we would say to eat about a whale."

It is true that we get phosphates in many other foods, but in these days of strenuous life a little extra nutrition of this character is very much in place; besides this, the combination of phosphates that exist in the residuum of baking powder is about the right quantity and would seem to be just the right combination to produce the desired results in the system.

If we should attempt to decide as to the relative healthfulness of the various classes of baking powder, we would place the phosphate first in the list; the alum powders next, and, considering cream of tartar powder as the only tartrate powder in common use, we would place this last, principally because of the larger amount of active salts in the residuum. We think that it is probable, however, as already stated, that all these salts in the proportions used in baking powder will prove more beneficial than otherwise.

There are, however, important advantages that can be secured by a combination of these ingredients that we will discuss in another chapter.

CHAPTER VI

APPROXIMATE FORMULÆ OF SOME POPULAR BRANDS

WE give on following pages approximate formulæ of a number of brands of baking powder, well known in some sections of the country. These have been obtained from various sources, which as the analyses of State and Government chemists as well as by personal examination. We do not claim these formulæ to be exact, because any sample would probably vary slightly from the maker's formula, and owing in part to the fact that chemical action takes place as soon as the chemist begins his analysis, his results are determined mainly from the examination of the residuum, and from this he forms his conclusion as to the materials used.

We must also consider that some of these brands of baking powder have changed from time to time, and this, in one or two instances, is shown by two or three different formulæ for the same baking powder.

In the case of the Royal baking powder, this at one time contained ammonia, probably in the form of sesquicarbonate of ammonia, but owing to the unpopularity of this ingredient it was taken out and only cream of tartar, soda and starch were used. We presume, however, that this was not so satisfactory because of its lesser leavening power and that tartaric acid was, therefore, added. These formulæ may be considered accurate with regard to the ingredients named, although the proportions will doubtless vary slightly from the amounts we have given.

They may be useful as furnishing suggestions to the intelligent manufacturer.

It will be seen that in most instances more than one acid ingredient is used. In the case of cream of tartar baking powder where no other acid is used, we believe that it is entirely on account of the prejudice in favor of this ingredient, although there is another objection to using cream of tartar with either phosphates or alum, and that is due to chemical action that occurs between these ingredients.

No conclusion can be drawn from these formulæ as to the kind of alum that is being used at this time because nearly all manufacturers have made changes in that article.

In estimating the phosphates used in these baking powders we have considered the amount of starch that is incorporated into the commercial phosphate, with the purpose of bringing the formula to a commercial basis, that is to say, we have made these formulæ as nearly like those actually used by the manufacturer as we could. To illustrate, let us take the Rumford baking powder, which shows by analysis about 22 parts of starch, but we estimate that 8 parts had been incorporated into the phosphate used and therefore our formula shows the amount of starch as 14 parts.

The approximate formulæ are as follows:

ROYAL.

Cream of Tartar	54
Bicarbonate Soda	27
Sesquicarbonate Ammonia	1
Starch	18
	100

ROYAL.

Cream of Tartar	55¼
Bicarbonate Soda	27½
Starch	17¼
	100

ROYAL.

Cream of Tartar	50
Tartaric Acid	3
Bicarbonate Soda	27
Starch	20
	100

DR. PRICE'S.

Starch	21
Bicarbonate Soda	25½
Cream of Tartar	53½
	100

DR. PRICE'S CREAM.

Cornstarch	21
Cream of Tartar	48
Tartaric Acid	3
Soda	28
	100

CLEVELAND'S.

Starch	9
Bicarbonate Soda	29½
Cream of Tartar	61½
	100

SEA FOAM.

Starch	10
Bicarbonate Soda	30
Cream of Tartar	60
	100

DE LAND'S.

Bicarbonate Soda	30
Cream of Tartar	70
	100

No neutral matter except it be tartrate of potassium and sodium, which may have been due to deterioration of the baking powder, as it showed a smaller amount of available gas than baking powders containing a filler usually show.

SHILLING'S BEST.

Practically the same as DeLand's; contains no filler.

ROYAL (MADE IN ENGLAND—NOT ROYAL B. P. CO.)

Starch	48
Tartaric Acid Granular	25
Bicarbonate Soda Granular	27
	100

RUMFORD'S.

Starch	14
Phosphate	58
Bicarbonate Soda	28
	100

PATAPSCO.

Starch	37
Anhydrous Alum	30
Bicarbonate Soda	33
	100

CROWN.

Starch	51
Alum	24
Bicarbonate Soda	25
	100

ONE SPOON.

Starch	18
Alum	40
Bicarbonate of Soda	42
	100

BON BON.

Starch	56
Alum	21
Soda	23
	100

KENTON BAKING POWDER.

Starch	40
Alum	20
Phosphate	14
Bicarbonate Soda	26
	100

ATLANTIC AND PACIFIC.

Starch	37
Alum	21
Phosphate	17
Bicarbonate Soda	25
	100

PATAPSCO.

Starch	42
Alum	19
Phosphate	20
Bicarbonate of Soda	19
	100

DAVIS—(R. B.).

Starch	31
Alum	18
Phosphate	22
Bicarbonate of Soda	29
	100

I. C.

Starch	43
Alum	24
Phosphate	6
Bicarbonate of Soda	27
	100

CALUMET.

Starch	34
Alum	20
Phosphate	17
Albumen	1
Bicarbonate of Soda	28
	100

ADDITIONAL FORMULÆ.

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CHAPTER VII

SUGGESTIVE FORMULÆ AND COST COMPUTATION

THE following observations with regard to the accompanying formulæ will be helpful to manufacturers of baking powder who desire to use them:

The first and second formulæ given are for the simplest kind of alum baking powder. If the materials are all first-class it will be a satisfactory article, and, considering the very low cost, a good baking powder. The difference between the available and theoretical gas in No. 1 may be more than in other formulæ, owing to the fact that the ammonia gas which is reckoned in is not eliminated until the baking process is well under way and the crust has, perhaps, begun to form. We have already discussed the relative merits of Sodium and Ammonium Alum.

The formula No. 3, being a phosphate powder, can be made most successfully from granular phosphate. There are manufacturers who make other phosphates which they recommend for pure phosphate powders, and if used, we would advise manufacturing according to their plans and formulæ. We do not believe, however, that a perfect keeping baking powder can be made with phosphate as the only acid ingredient. All things considered, we decidedly advise the use of more than one acid ingredient for a first-class baking powder, and believe that several acid ingredients are preferable. This is demonstrated in formula No. 7, and the operation of this baking powder is something as follows: Just as soon as water is added to the dough, the process of effervescence begins—due to the quick action of the tartaric acid. Then, as it is being wet up, the elimination of gas continues by the action of the phosphate, and finally during the baking process, the alum acts and continues to act until the baking is completed. The effect on the bake-stuffs is that it produces a very porous substance, in which there would be no large holes, but it will be symmetrically aerated and the crust will also be more even and present a better appearance. So far as the healthfulness of the baking powder is concerned, we believe that it is improved by using a variety of acid ingredients, and the keeping quality is also decidedly better on account of the proportion of alum or C. T. S.

In manufacturing a pure phosphate or pure cream of tartar baking powder the greatest care should be used or these powders will rapidly deteriorate. In the first place, the starch should be super-dried. All starch exposed to the atmosphere contains about 8 per cent. of moisture, which can be eliminated by heat, and this moisture must be driven out and the starch used at once, before it has time to take up more, which it will do very quickly, if left exposed in the atmosphere. Then the baking powder should be put in the cans and sealed up as quickly as possible after it is made.

Soda should also be used in pure phosphate and pure cream of tartar baking powders, in the granular form. The other ingredients, except the starch, can also be used to advantage in this form, because it has been discovered that the ingredients in the granular form keep much better than if powdered.

At the present cost of materials in markets where they can be procured to the best advantage, the first baking powder named should be made for a little above 2 cents per pound, for the first cost of materials.

In addition to this, we would add a certain amount per pound for the work of manufacturing, a percentage for waste, and a percentage covering the cost of supervision and all the general expenses of the business. These items will vary with different manufacturers, under different conditions, but the following memorandum would probably serve the purpose for many of our readers.

Let us take for example formula No. 1:

Ammonia alum, 24 parts, 3¼c	$0.78
Bicarbonate of soda, 29 parts, 1½c	.44
Starch, 47 parts, 2 c	.94
Material only	$2.16
Manufacturing	.25
Waste, 2 per cent	.04
Net cost	$2.45
Fifteen per cent. to cover supervision and general expense	.37
Complete cost	$2.82

It is of great importance that the matter of cost be carefully studied. If a manufacturer estimates his cost too high, it may stand in the way of his getting desirable business, while on the other hand, if he estimates too low, he may be doing business at a loss, and never discover it until he gets his annual balance sheet; it is very difficult to lay down rules that will meet all conditions. It is sometimes important to consider two different costs, one of which may be called the "net cost" and only covers the material and actual work; the other may be called the "complete cost" and covers all incidentals applying to the same. The reason for this would be that it will sometimes pay to take on additional business which comes in large amounts on a basis of the net cost, while if all the business of the house were computed on that basis it would evidently lead to error and perhaps bankruptcy.

The manufacturer must also consider that the real volume of baking powder business is necessarily small and that he is entitled to a much larger profit than on most other goods that he makes or sells; in fact he must have a large percentage of profit if this part of his busi-is really remunerative.

In case a baking powder of greater leavening strength is desired, Formulæ Nos. 1, 2, 6 and 7 can be changed by reducing the amount of starch as low as 20 per cent., although this would not seem to be desirable in most cases, and any formula can be reduced in cost by increasing the proportion of starch.

Good self-raising flour can be made by adding any baking powder made according to our formulæ to the flour in the proportions of five or six pounds of baking powder to one hundred pounds of flour and one and one-half pounds of fine salt. We strongly recommend, however, that no acid ingredient except phosphate be used because it keeps perfectly in self-raising flour, and finely ground phosphates especially adapted to that purpose can be readily had. Our self-raising flour formulæ are made up on this basis.

Our suggestive formulæ are as follows:

No. 1.—ALUM BAKING POWDER.

Ammonia Alum	24
Bicarbonate Soda	29
Starch	47
	100

Theoretical gas 17½ per cent., estimating the ammonia gas on the volumetric basis of carbon dioxide.

No. 2.—ALUM BAKING POWDER.

Sodium Alum	28
Bicarbonate Soda	29
Starch	43
	100

Theoretical Gas 15.4 per cent.

NO. 3.—PHOSPHATE BAKING POWDER.

Granular Phosphate	56
Granular Bicarbonate Soda	25½
Starch Super-dried	18½
	100

Theoretical Gas, 13¼ per cent.

NO. 4.—CREAM OF TARTAR BAKING POWDER.

Cream of Tartar	61
Bicarbonate of Soda	28
Starch	11
	100

Theoretical gas, 14½ per cent.

The cream of tartar and soda should be in the granular form and the starch super-dried, otherwise use more starch. This also applies to formula No. 5.

NO. 5.—CREAM OF TARTAR AND TARTARIC ACID BAKING POWDER.

Cream of Tartar	50
Tartaric Acid	3
Bicarbonate of Soda	26½
Starch	20½
	100

Theoretical Gas, 13¾ per cent.

NO. 6.—PHOSPHATE AND ALUM BAKING POWDER.

Sodium Alum	22
Phosphate	11
Bicarbonate of Soda	27
Starch	40
	100

Theoretical Gas, 14¼ per cent.

NO. 7.—PHOSPHATE, ALUM AND TARTRATE BAKING POWDER.

Sodium Alum	17
Phosphate	20

Tartaric Acid	2
Bicarbonate of Soda	28
Carbonate of Magnesia	2
Starch	31
	100

Theoretical Gas, 14¼ per cent.

NO. 8.—SELF-RAISING BUCKWHEAT FLOUR.

Phosphate	7
Bicarbonate of Soda	3¼
Fine Salt	3
Buckwheat Flour	130
Low-grade Wheat Flour	56¾
	200

NO. 9.—SELF-RAISING PANCAKE FLOUR.

Phosphate, Soda and Salt, same as above	13¼
Kiln-dried White Corn Flour	100
Medium-grade Wheat Flour	86¼
	200

NO. 10.—SELF-RAISING BISCUIT FLOUR.

Phosphate, Soda and Salt, same as above	13¼
First Quality Winter Wheat Flour	186¾
	200

Neither of the above formulæ for self-raising flour comes within the law requiring United States revenue stamps, because the buckwheat and pancake flours do not contain as much as 50 per cent. of wheat flour and the biscuit flour is not mixed with any other kind of flour.

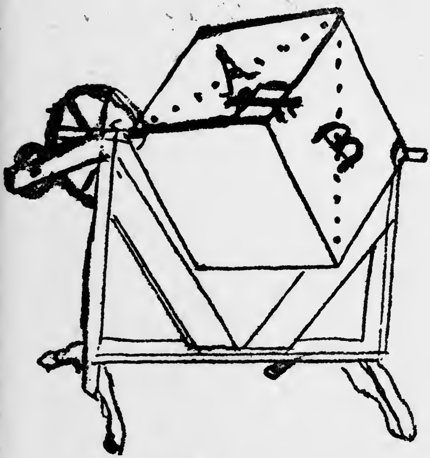
ADDITIONAL FORMULÆ

CHAPTER VIII

MANUFACTURING EQUIPMENT

THE equipment of the baking powder factory may be varied according to the quantity to be manufactured, but the essential features are a good mixer and appliance for sifting. The convenient arrangement of these, together with bins for finished baking powder as well as for the material to be manufactured, is of importance. It is also an excellent idea to pass the material through a pair of rolls or some other device to crush out the lumps.

In regard to the mixer, our experience extends to three different kinds or classes. The first is that represented in cut No. 1 and may be a home-made affair and still be capable of producing the best results; the most difficult features are the bearings and the opening. The first of these can probably be best solved by your machinist but as there are churns and other devices constructed on this principle, it would perhaps be practicable to get the bearings from a factory where something of this character is made. The opening must be directly in the corner in order to empty out completely; the lid should be removable, so that it will not be in the way when dumping out the contents; it should also be made to fit perfectly tight. We would suggest, therefore, that it be made similar to cut No. 2: of two thicknesses of lumber, one piece fitting in the opening and the other lapping over it on all sides; the inside surface or edge of the outer and larger piece can be covered with felt, or if

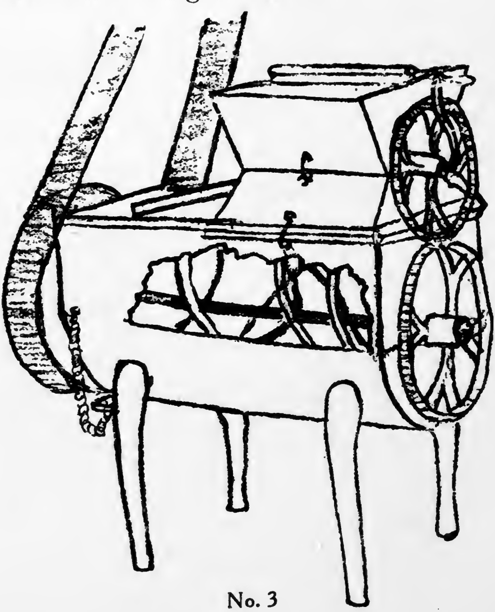


No. 1

No. 2

none is at hand, two or three thicknesses of heavy wool cloth will serve the purpose. The lid may be fastened on securely by a bar across it, held in place by irons in the form of staples on either side. One or more wedges may be driven between the bar and lid until it is perfectly tight. In the interior of this mixer there should be a set of sticks running directly across from the dots A on the cut to the opposite side, and another row intersecting these, running directly across from the dots B. These sticks should be about an inch square and will keep the material from massing together in any way, and insure a perfect blending. It may be emptied into a barrel or bin by turning it down until the lid is at the lowest point, which must, of course, be directly over the barrel or bin and close to it; the lid can then be slowly removed and the contents easily emptied without spilling.

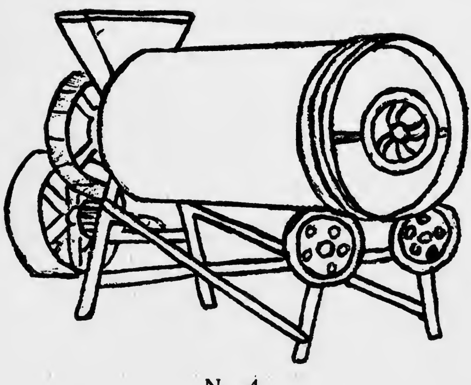
A box thirty inches each way will mix two hundred pounds at a time. The advantages of this machine are low cost and perfect work; the objections to it are that it takes rather more room than the other kinds, both on the floor and in the perpendicular. It is not so convenient to handle and there is danger of waste.



No. 3

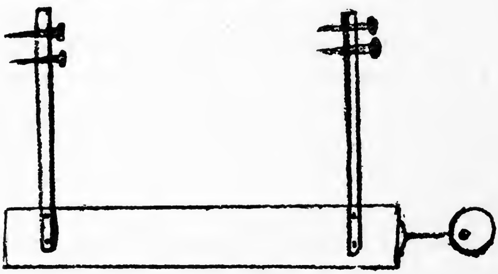
Another mixing machine which we have used for some time is represented in cut No. 3. This is an extremely convenient machine and may be combined with a sifter as shown in the cut. The material is stirred up by a sort of steel worm, shown through a break in the side, running the entire length and in close contact with the sides and bottom of the machine; the operation is such as to carry the contents back and forth from end to end, mixing it continually. Its special advantages are small space and quick work, and it can be easily operated. Its objectionable features are that there are corners inside where material in small quantities may lodge and not be properly mixed; then it is liable to get out of order and may be doing imperfect work for some time before it is discovered and repaired.

The other style of mixer is the one shown in cut No. 4. In this machine the entire cylinder revolves so that the mixing is practically perfect. There is a sort of flange running from end to end diagonally across inside the



No. 4

cylinder and back again in the opposite direction, thus carrying the material back and forth continually through the entire length. It should be filled through the hopper shown at the further end, and is emptied by opening the head of the cylinder which is held tightly in place by the hand wheels shown in the cut. It has the advantage of doing perfect work, and doing it very quickly, and seldom, if ever, gets out of order. It is not quite as convenient to operate as the one last described.



No. 5

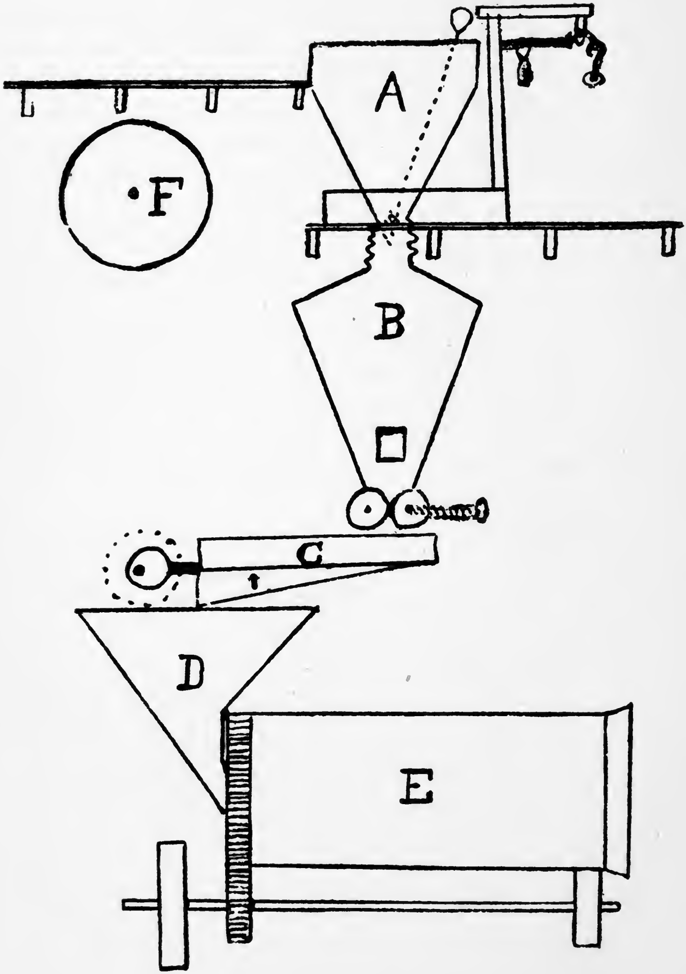
Regarding the sifter, a pattern in very common use is constructed with a revolving brush running against a wire screen at the bottom, by which the material is broken up and forced through the screen. This is no doubt the most convenient form that could be devised; we do not approve of it, however, because the tendency is to force through small granules that ought to be broken up, and unless examined frequently and with great care, the sieve becomes broken or perforated with nails or sticks, so that there is continual danger of getting into the powder granules of sufficient size to be a serious detriment.

We advise using a shaking sieve, shown in cut No. 5.

operated by an eccentric wheel at one end, running with considerable speed; another plan would be to operate it from a ratchet or cam wheel at the end, so placed that a projecting piece of iron extending out from the sieve will press against it by the natural spring of the hangers. The only objection to this plan is the noise. This sieve should be suspended by thin, flexible hardwood or steel hangers, although it may be run on casters or rollers; if the sides and ends are three or four inches high a quantity of material can be put in it and left to gradually sift out; what remains unsifted can be broken up by the operator and put back on the sieve. If a fine sieve is used the result will be perfect. Although it will take more time to do the work than with the sifter first described, it is not very liable to get out of order and the sieve will not require renewal very often.

One serious difficulty about handling baking powder is due to the fact that in process of manufacture it runs almost like water, and will leak out of a hole not much larger than a pin in a continuous stream. Then, if left standing a few hours, it packs down so that it is difficult to start it running at all. This we have guarded against in a plan shown in cut No. 6, which is designed to illustrate a convenient arrangement for a baking powder factory of moderate size. By this arrangement two men could easily turn out three to five thousand pounds per day. It will require two floors on which to do the work, and the lower room must be high between joists, or if three floors can be used it will be more convenient.

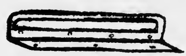
The materials are supposed to be in barrels or bins on the top floor shown on the left side of the sketch. Each



No. 6

kind of goods should be weighed in a separate galvanized iron can kept especially for that purpose, and this can should be balanced by a weight made for the purpose; this weight may be made of tin similar in form to the ordinary weight, with a small hole in the top which may be closed by a cover fastened on like the revolving top to a dredge spice can. Through this you can put in or take out shot until you have the correct amount. To determine this accurately first weigh the empty can and then put in the material until you have the correct amount of the desired ingredient, then set your scales at 0, put on the tin weight and fill this with shot until it counter-balances the can and contents. The can for each kind of material should be painted a separate color, and the weight to be used with the can should be the same color.

No. 7



No. 8

After weighing the ingredients in separate cans the weight should be verified by weighing the entire quantity together. This may be done by putting all the cans on a large platform scale—which we will call an "assembling scale"—or by pouring into the hopper A, which can be built on an ordinary platform scale—and taking the net weight. This hopper has a valve at the bottom through which its contents can be dropped into hopper B, below. This valve is closed by an iron rod as shown in the cut. To close this valve perfectly tight have a hole near the top of the rod as shown in Fig. 7, and on the edge of the hopper attach a flat piece of iron represented by Fig. 8. This iron is bent at right angles, and has a long slot through which the rod projects; when it is drawn up a pin is thrust through the hole referred to, in the rod, and if it is not then perfectly tight the rod may be slid along in this slot until it is tight; and if necessary to keep it from sliding back put a hole through the side of the hopper next to the rod and put a wooden pin through it. The top of this hopper should be covered with a reasonably heavy and coarse screen of about two-inch mesh, so that no lumps shall be allowed to go into it that are big enough to clog up the outlet. The scale shown in the cut is on a platform about two feet below the floor, so as to enable the attendant to empty the ingredients into it without lifting them. The hopper A is connected with B by a canvas bag which must be nailed on carefully at both ends, so as to allow no dust to escape, but at the same time it must have sufficient slack so that it will not interfere with the operation of the scale. The hopper B is entirely enclosed, and near the bottom there should be a small window, say 5x6, on either side, so that you can, at any time, see whether it is full or empty. The sides should be as steep as they can conveniently be made and there should be nothing inside on which the baking powder can lodge, so that with a slight jarring it will empty out completely.

At the bottom of this hopper there should be a pair of wooden rolls, one of which is operated by a belt, the other running by the action of the first. The rolls can be adjusted by two screws, one at either end of one of the rolls. The purpose of the rolls, it will be readily seen, is to feed the material regularly to the sifter and also to crush any lumps. The hopper B should be nearly as wide at the bottom as the rolls are long, and inside of this hopper there should be what we can perhaps best describe as an inside hopper to narrow down the outlet to two or three inches square, because this will allow as much material to pass as the rolls can take care of. The sieve C should correspond to cut No. 5. It may be entirely over the lower hopper D and sift directly into it or, as represented in the cut, it may have an inclined bottom of tin which, on account of the shaking motion, will carry the material down a very slight incline; this tin will need cleaning occasionally and should be so made that it can be opened or taken out for that purpose, or if the sieve directly over it is made on a tightly fitting removable frame it will serve the same purpose. The hopper D should be closed by a slide at the bottom, to be worked by a lever from below, or from one side. The baking powder mixer is represented at E, but either kind which we have already described may be employed. If the one represented in cut No. 1 is used it would be best to attach a bag to the bottom of the hopper D for the purpose of conveying the material into the machine. This bag, of course, has the bottom cut through, and when not in use the bottom end may be hung up on the side of the hopper. Either one, two or all of these hoppers may be dispensed with, but they have been found to expedite work very much—and where there are two or more hands at work one does not delay the other, nor is it necessary to wait for any part of the machinery to do its work. It is quite important, however, to see every time these hoppers are emptied that the entire contents has passed out, because a pound or two of any kind of material that may be left over and thus go into another mixing would upset the formulæ of both.

A convenient place for a countershaft would be at F, from which a quarter twist belt would run the mixer, and belts to the rolls and shaker would be pretty well out of the way.

A convenient but rather crude way to dispose of the baking powder after it is made, is to run it into barrels, which should always be kept tightly covered. If you can utilize another story below, you could have several bins fitted with spouts into which the baking powder would run directly from the machine, or it may be carried by elevators or conveyors to any other part of the building. If another floor is available above those we have represented in our plan, an arrangement of bins for the material would be of great advantage. This would enable a workman to break open the barrels of material on the top floor, dump them through an opening in the floor into a bin below, each opening being protected by a coarse, heavy wire screen to break up the lumps. Then the material can be drawn from these bins into the receptacles in which it is to be weighed. If the work is to be done on one floor we would suggest that a platform be built above the mixing machine on which the materials can be weighed out and verified, or they can be carried up to this platform after this has been done. The hopper B can be made smaller and the materials fed into it with a scoop. Bins for storing baking powder can be arranged to draw the baking powder from the bottom by means of a slide operated by a lever, but it is also necessary to attach to the outlet a bottomless bag to keep the baking powder under control. Bins for storing material should have a slide at the bottom and on one side, and this slide may have an attachment that will coax down the material where it is inclined to clog.

CHAPTER IX

THE PROCESS OF MANUFACTURE

ABSOLUTE uniformity is of the utmost importance in baking powder, as well as in most articles of merchandise, and to secure this is worth your best effort.

The wrecks that have been caused in this line of business by a few poorly made mixings of baking powder are very numerous, and all this can be avoided by proper precautions. There are a number of little details regarding the process of manufacture that go far toward making it a success. The most extensively sold baking powder in the world has, no doubt, obtained that preeminence largely because of the great care given to the making of it, by which a superior result is obtained, and, of course, perfect uniformity.

Some of these details may be neglected and fair success may be attained, but if there is a general disregard of them, or, in other words, if baking powder is carelessly and imperfectly made it will not bring first-class results.

In an alum or alum phosphate powder less care is necessary than in a straight phosphate or cream of tartar powder, because it is not so easily injured by moisture.

Remember, however, that dampness is the enemy of baking powder, and we would suggest that no manufacturing be done on rainy or damp days; also to keep materials in a dry place and carefully covered. In leaving parts of barrels of materials it is well to level them off and press down over the surface a heavy sheet of paper, besides having a cover on the top of the barrel. These precautions will go far toward protecting your materials from the action of the atmosphere. The ingredients should be put together in a certain order, and, as a rule, we would recommend that the starch and soda be put in the mixer first when it is running; then if magnesia is used let that be added, and after this the acid ingredients. If tartaric acid is used we would prefer that which is freshly made and that has not become caked; then add to it, as soon as received, say three times as much starch and mix thoroughly in your baking powder mixer. By this means you can keep your tartaric acid in good condition until used, using four times as much as the quantity of tartaric acid called for in your formula and deducting the proper amount of starch from the amount called for by the formula. Another useful purpose may be served by a manufacturer who wishes to keep his entire formula from employees who, perhaps, are entrusted with most of the work. This can be done by mixing up this acid and starch yourself and letting it be known by some certain letter or name, say "Super Extra"; then the formula that your employee knows calls for so many pounds of "Super Extra," and as he does not know what that is he can never give away your formula. It would also be well to adopt a similar plan with C. T. S. (alum) if necessary to keep it on hand any length of time. You cannot, however, add any more starch than is called for by your formula. For instance, if you were using formula No. 7, you could mix any quantity of alum you happen to have with starch in the proportion of 15 parts alum to 33 of starch. Then, when you want to make your baking powder, use 48 pounds of this mixture, which will give you the correct quantity of starch and soda. If, however, you make more than one kind of baking powder using the same kind of alum, you can mix your alum and starch in equal quantities. You can then easily rearrange your formula to adjust it to this combination.

The difficulty to be overcome in the manufacture of cream of tartar baking powder is mainly the elimination of moisture. If the baking powder is made sufficiently dry it will keep, and if the ingredients are pure and in proper proportions, it will be a first-class baking powder and will meet all demands. In order to manufacture the baking powder of sufficient dryness it is necessary to have some kind of a drying outfit. What we would recommend as useful on a small scale would be steam pipes running back and forth under a sort of table. This table may have a perforated top or a slat top. The latter would probably be preferable, and should be so arranged that the hot air may have free access about the pipes and up through the table, the pipes being also partially enclosed beneath the table.

The baking powder material should then be put in open pans one or two inches deep. These pans can be cheaply made from sheets of tin for the bottom, nailed on to a wooden frame constituting the four sides, which should be about two inches high.

The time necessary for the material to be perfectly dried will vary according to the degree of heat, but under ordinary conditions, we should say four to five hours would probably be sufficient. These pans can be placed one above another with a space between, and they should be boxed in with openings at the top sufficient to permit of the proper circulation of air. As a means of ascertaining whether the material is sufficiently dry, would suggest that the starch should lose about 8 per cent. in weight; that is to say, 100 pounds of starch after being properly dried would weigh only 92 pounds. The other ingredients lose a comparatively small quantity, but would probably take nearly as long in drying. A suction fan exhausting the air from the top of this dryer will hasten the process.

The baking powder should be made promptly after the material has been dried. If it is allowed to stand for a few hours it will again gather moisture and will be unfit for use so far as obtaining the best result is concerned. A good result may, perhaps, be obtained by making the baking powder first and drying it thoroughly afterwards; another method which is probably the best in some respects is to mix your baking powder and let it stand in barrels for a month, or perhaps more, when it will be found to have caked considerably. It should then be put into a drying-room or on a table such as we have described, and thoroughly dried, after which it must be crushed to a fine powder. Baking powder made in this way loses very little gas by the caking process, and will not become lumpy. If tartaric acid is used, it should not be added until the process is completed.

For phosphate baking powder we would recommend the first method suggested for cream of tartar powder, because about the same precautions are necessary to secure the best keeping quality.

After making cream of tartar or phosphate baking powder by either process given above, it should be put into cans and closed at once, and all baking powder should be allowed as little exposure to the air as possible. The selection of granular soda for cream of tartar and phosphate baking powder is imperative, and we also advise the use of finely granulated cream of tartar, and in the phosphate powder granular phosphate, which we have heretofore shown to be important, while in the powders which contain alum the powdered phosphate will serve as well. We would not recommend the drying of soda because, unless this is done with great care, you will drive off part of the gas; but you should see that your soda is in proper condition when it comes from the manufacturer.

If you would be sure your baking powder is correct, adopt some kind of a check against errors that will be an absolute protection. We devised a system several years ago that we consider perfect and do not think we have ever sent out an imperfect can of baking powder since that time; and whoever does the actual work of mixing, if he makes an error it will be discovered in the office, and can be rectified.

To follow this system you will weigh the gross amount of all your ingredients before you begin the day's work, and also whatever amounts you may have when the day's work is over. Whenever you open a new barrel of any kind of material you should also carefully weigh this, and weigh whatever may remain of the old barrel. Your tally sheet can then be made to show if any error has been made, because the amount tallied out of the barrel will not agree with the amount actually used. Whoever weighs up the material notes down these items just as they occur, using gross weights, also noting the weight of each mixing of baking powder and designating it by a number.

We give below memoranda supposed to be made to represent the work done on two different days, using our formula No. 6 on January 2 and No. 2 on January 5 and doubling the quantity for each mixing.

JANUARY 2.
Starch, 178.
Soda, 386.
C. T. S., 216.
Phosphate, 198.
No. 1. 224—23½.
No. 2. 222—23.
Bal. of starch, bbl., 22 gr.
New bbl. of starch, 276 net
No. 3. 223½—23½.
No. 4. 222—22½.
Bal. of C. T. S., 42 gr.
New bbl. C. T. S., 355 net.
No. 5. 222½—23.
Starch, 63.
Soda, 107.
C. T. S., 353.
Phosphate, 88.

JANUARY 5.
Starch, 63.
Soda, 106½ (showing loss in weight).
C. T. S., 354 (showing gain in weight.
New bbl. starch, 270 net.
No. 6. 225—23½.
Bal. of Soda, 48½ gr.
New bbl. of soda, 402 net.
No. 7. 223—23.
No. 8. 222—23.
Balance of starch, 75.
New bbl. starch, 280.
No. 9. 222½—22.
Starch, 269.
Soda, 276.
C. T. S., 130.
Phosphate, 88.

The above memoranda should be transferred to the tally sheet shown on the next page, at the close of each day, entering all gross weight except for new packages opened, which are entered net, the tare being estimated; the reason for this is that it avoids the necessity of estimating and figuring out tares at both ends of the day's work. The tally sheet should be made up in the office after the day's work is over, or at intervals during the day, as the memoranda is turned in by the mixer. It will only be necessary to use the space for "Brand or Formula No." when you use your tally sheet for more than one grade.

The balances on hand at the completion of the day's work we have carried forward for the next day's run. They should be compared with actual weights taken, as the figures for the beginning of that day, and these will often vary a pound or so owing to shrinkage by waste or to increase in weight by gathering moisture. We have shown some slight differences of this sort between our two tally sheets on previous page. If our work is correct, the total of the first and second columns will equal the total of the third column, and the total of the fourth and fifth columns will also equal the total of the third column, the total of the fifth and eighth columns also equals the total of the sixth and seventh columns, as shown on the following page.

TALLY SHEET FOR PREVENTION OF ERRORS IN MIXING BAKING POWDER.

Kind of Material.	Brand or Formula Number.	Number of Mixings.	Beginning.	New Packages Broken.	Total.	Remainder.	Amount used by Mixer's Tally.	Amount used by Formula.	Short.	Over.
Starch......	6 2	5 4	178 63 *269	276 270 280	454 613	63 269	391 344	390 344	1	....
Soda........	6 2	5 4	386 107 *276	 402	386 509	107 276	279 233	280 232	 1	1 ....
C. T. S......	6 2	5 4	216 353 *130	355	571 353	353 130	218 223	220 224	....	2 1
Phosphate...	6	5	198 *88	....	198	88	110	110	....	....
		9	1501	1583	3084	1286	1798	1800	2	4

			1501 1583	1286 1798	1798 4	1800 2
Proof. .	....	....	3084	3084	1802	1802

*Not included in totals.

A full-sized sheet can be used, and will serve to show the work of several days; it can then be proved as already indicated.

When you discover an error has been made, you will generally be able to figure out just what it was, and by adding an equivalent amount of other ingredients, you will be able to correct it.

You will often discover such an error in weighing up your completed mixings of baking powder, which should weigh within a pound of the amount called for by your formula. If you do not discover the error until you have completed your day's run, you may be able to locate the mixings in which it occurred by figuring each ingredient separately up to each new package broken into or by the use of test tubes, as shown below, making a test of each mixing separately.

We would recommend that you provide some test tubes, which are very inexpensive, and also supply yourself with some litmus paper. You can then take a sample of your baking powder after it has been finished, put a small amount, say the fourth of a teaspoonful, into a test tube, fill it half full of water, and heat it gently over a lamp or gas burner until it boils, and test it with a litmus paper, when it should show a sort of purple color. If it is red, the presumption would be that there is too much acid; and if it is blue, too much alkali; but, having a standard sample to test by, and using it at the same time, you will thus be able to judge with some degree of accuracy as to whether your baking powder is exactly right in this particular. Some find it more convenient to add a little litmus solution to the liquid in the test tube and note the color, and others use turmeric in the same way. Phenolphthalein is more delicate as a test than either of the above; none of these tests, however, can be absolutely relied upon, but where an error has been made you can compare several different samples in this way, and after a little experience the one sample that is not correctly made will be detected.

We would also suggest that frequent tests be made by baking biscuits, which is often the most convenient method, and it is certainly one of the best, and besides noting the leavening power, observe also the color of the biscuit. If it is yellow, make a reduction of, say, one-half pound soda for each 100 pounds of baking powder. My suggested formulæ are gotten up with the purpose of using the maximum quantity of soda in order to secure the highest efficiency of baking powder, and if any of the materials are not of standard strength, it is possible that there would be an excess of soda sufficient to affect the color.

CHAPTER X

ADVERTISING SUGGESTIONS

ALMOST everything that brings the name of a firm or a brand of goods to the attention of any number of people has a certain value as an advertising medium. An important question arises as to which medium will bring it to the attention of the largest number of people and of the class of people you most desire to reach, for the least cost, and in the most impressive way. The kind of an impression that is to be created will depend principally on the advertising matter itself.

The advertising of food products has a certain field and certain important points to be developed, answering such questions as naturally suggest themselves to the buyer, regarding the matter of healthfulness, convenience for use, ease of preparation, strength, purity and other distinctive features. The advertising of baking powder also has its peculiar features. The amount that any one family consumes in a year is comparatively small, and the advertising, therefore, must reach a large number of people; for the same reason it cannot be too expensive.

In preparing matter for advertising it is important that it be striking in order to command attention, and we would be disposed to say that it must tell the truth were it not that one of the most successful baking powder advertisers does not seem to have been very scrupulous along this line. We cannot really say, however, that even this advertiser is guilty of actually false statements. Any kind of a picture or cut is an attractive feature and brings the eye of the reader over columns of type to your ad. It is not always easy to find a subject for such a cut, except that it be a cut of your can; this may be shown as held in the hand, or against a background of lines and shades that any sketch artist can devise; a can that is shown in a slanting position will probably be observed by more people than if perpendicular. Reference to any desirable qualities ought not to be omitted from the reading matter. The question of price as a rule ought to be left to be answered by the grocer. One reason for this is that it often leads to inquiry resulting in sales that would not otherwise be made; another reason is that consumers may form judgment against the article in advance that would have been different had they talked with the merchant about it before they knew the price.

A list of names of dealers who sell the article in any certain town or city is often a good thing; it shows the public that the article is popular with a good class of dealers, it encourages the dealer to keep it before his customers, and tells the consumer where he can find it.

Letters of commendation from reputable consumers, physicians, chemists, etc., are of great value, but the space which can be profitably employed for baking powder in the average newspaper will not admit of using them very liberally. What we have said thus far has reference principally to newspaper advertising, but the value of such advertising and the kind of medium depends very largely on what has already been accomplished in the trade, and on what work is being done. If your goods are already in the hands of about every dealer in any certain city or community, or if you are doing work that will place them in their hands very soon, a paper or magazine that covers this field will certainly pay; if, however, not one merchant in ten has your goods or is likely to have them, such a medium would probably not be remunerative.

No one can afford to employ a magazine having a world-wide circulation unless the article advertised is almost as widely distributed; in other words, advertising to be effective must reach people who find your baking powder on the shelves of their own grocer.

When all methods of advertising that have ever been devised are carefully compared, if the results obtained could be known and tabulated, we think newspaper advertising would be in advance of all others; still there are many other things that work out great results as a temporary expedient.

Bill-board advertising may have some merit, but we hardly think it commensurate with results unless it be permanently placed in a favorable location. Printed matter of the right sort should always be placed in mail going to dealers and consumers; what we term the right sort may be matter similar to that used in newspapers, but may be more extended. A little humor introduced in this way, provided it is not undignified nor hackneyed, may be of substantial value. By way of interesting dealers we have found it works well to have a quantity of advertising matter arranged in a series to be sent out at intervals of four or five days for a period of perhaps a month; then when this is followed up by a salesman he finds that the dealer is already convinced that you are offering a good article that people will buy. All baking powder manufacturers have found, however, that the real problem is not to get goods into the hands of merchants, but to create a demand from the consumer. To a limited extent we have secured such a demand by taking from a merchant a list of some of his desirable customers, which need not be a very large list; to each of these send a circular letter in imitation of typewriting, asking them to call and present a card to their grocer which you also enclose, and receive free a regular can (4, 6 or 8 oz.) of the baking powder, enclosing also such recommendations and other advertising matter as you have. The few who try it in this way will generally speak of it to others; it will begin to move off the merchants' shelves, and the result will be very satisfactory.

We have arranged entertainments for ladies' clubs, library associations, etc., that have brought good results. We made the principal feature of the entertainment a cake baking contest, in which we offered several premiums for cakes baked with the use of our brand. We arranged badges for committees and advertised the entertainment through the papers in a way that brought our brand conspicuously before the public. The effect of a large array of beautiful cakes which had never been equaled in the eyes of most of those present all made with one particular brand of baking powder is an object lesson that has a very striking effect.

The publishing of recipes for cakes, doughnuts or biscuits that have been made with your baking powder and have won prizes or been made otherwise conspicuous, as well as the printing of a full book of recipes, would be a valuable feature if the sale of the baking powder was large enough to justify it.

The wholesale grocer or the manufacturer of a large line of grocers' specialties must look upon the advertising proposition from a different viewpoint than the man who has only one article. The wholesale grocer, for instance, if he advertises his baking powder extensively, cannot fail to help his general business in a very important degree. Money spent in this direction brings prominently before the public and the trade the fact that you have a manufacturing department as well as the importance of your business in general. It is hardly practicable, however, for a baking powder made by a wholesale grocery house to ever command a large business outside of the people who regularly patronize the house, so this limitation must be considered in the plans for advertising. We also feel impelled to say that any advertising in order to be profitable must be backed up by vigorous, persistent and regular work among the trade. A wholesale grocery house can hardly expect this work from its regular salesmen, but if it is to command a large trade on any special article it is almost necessary that a special salesman be kept for this article or for a certain department, of which baking powder may be an important part.

CHAPTER XI

PRACTICAL HINTS

IN concluding our articles on baking powder we desire to emphasize a few points that are, in our estimation, of great importance and ought to be continually borne in mind. We assume, in the first place, that you are making or desire to make a good, reliable baking powder and that you are turning it out at a good profit, and that uniformity is absolutely essential to secure and hold any desirable business. If you are not turning out a uniform article, hundreds of dollars may be spent to secure trade that may be lost almost in a day.

BUY GOOD MATERIALS from reliable manufacturers. You can't afford to experiment along this line; a slight variation in quality may cost you valuable customers, and this variation of quality may come from a change in your source of supply or from an ingredient of varying quality. Perfect uniformity, even if you make a low-grade article, is of great value.

An error in mixing your powder may be a fatal error. We know of instances where such errors have destroyed a fine trade that it had cost a great deal to secure.

A handsome package is probably worth all it will cost, and too much care cannot be given to it. "A good name" for a baking powder will almost justify the scriptural quotation of being preferable to "great riches," and in selecting a name we would suggest that several points be borne in mind, such as its significance; does it sound well? will it be easily remembered? The name ought not to be too long, and sometimes one with local significance has some merit.

When you know you have a good thing, stick to it; don't make changes unless you are certain they are for the best. Let the other fellow do the experimenting, or at least don't experiment on your customers. Make frequent tests of your output by methods already noted and thus insure yourself, as far as practicable, regarding the uniformity of your goods.

Be careful to keep your materials dry and well covered. They will gather moisture by exposure to the air, particularly on a damp day.

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