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Effect of Common Mill Fumigants on the Baking Qualities of Wheat Flour.

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SUMMARY.

1. *These tests were made on three grades* of *hard winter-wheat flour, consisting of a patent, a straight, and a low grade; and four grades of soft winter-wheat flour, consisting of a patent, a straight, a clear, and a low grade.*

2. *The fumigants were hydrocyanic acid gas and carbon bisulphide, used at the maximum strength employed in flour mills and elevators, and the treatments were given in an air-tight, constant-temperature chamber for a period of twelve hours, at a temperature of 90° F.*

3. *Baking tests were made immediately after each fumigation, and were repeated under the same conditions two or three days later. Similar duplicate baking tests from the same samples were made at the end of thirty days and at the end of sixty days.*

4. *To afford direct comparison, tests were made at the same time and under identical conditions on the same flours not fumigated.*

5. *Photographs were taken of all the loaves baked, and in the plates the check loaf made from the unfumigated flour stands alongside of the loaf made from the fumigated flour.*

6. *An examination of the tables and the plates will show that the effects of fumigation are so small as to be negligible. It is only in the careful measurements employed in the test that any difference between the fumigated and unfumigated flour is apparent at all. The only notable difference appears in the maximum volume of the dough in the test made immediately after fumigation, but not after thirty days. The finished loaf shows no deleterious effect from fumigation in any of the tests.*

THE EFFECT OF MILL FUMIGATION UPON FLOUR.*

Within recent years flour mills in the United States have experienced great trouble with injurious insects, and these troubles are increasing year by year. To eliminate this evil by controlling this class of insects, it has been necessary to fumigate a part of the plant, or the entire plant, at least once, and sometimes twice, per year. In connection with fumigation, many inquiries have naturally arisen as to whether the fumigation would have any deleterious effect upon the flour. In reply to questions of this sort it has been necessary to state that it is generally accepted by those who have had experience with fumigation of mills with hydrocyanic acid gas and carbon bisulphide that these fumigations do not have any deleterious effect upon the baking qualities of the flour. Inasmuch as there were no positive data upon this subject, it seemed advisable to conduct a series of extensive baking tests using the common grades of soft-wheat and hard-wheat flour after they had been fumigated with hydrocyanic acid gas and carbon bisulphide.

In these experiments four grades of soft winter-wheat flour, consisting of a patent, a straight, a clear, and a low grade, and three grades of hard winter-wheat flour, consisting of a patent, a straight, and a low grade, were used. Two sets of ten to twelve-pound samples of each of the grades of soft and hard winter-wheat flours were treated with hydrocyanic acid gas and carbon bisulphide, respectively, at the maximum strength used in flour mills, elevators and bins; namely, one pound of potassium cyanide to 1000 cubic feet, and one pound of carbon bisulphide to 500 cubic feet of space. These treatments were given in an air-tight constant-temperature chamber for a period of twelve hours at a temperature of 90° F.

From each of these samples baking tests were made immediately after each fumigation, and were repeated under the same conditions two or three days later, in order to check up any error that might have entered into the first baking. Simi-

* This bulletin is the outcome of a series of experiments undertaken by the Departments of Entomology and Chemistry for the purpose of settling the vexed question as to whether the common fumigants have any deleterious effect on the bread made from flour treated with them. In course of the investigation of the insects injurious to mill products and methods to be used in their control, the settlement of this question had become necessary.

The baking tests reported in this bulletin were performed by Miss Leila Dunton, B. S. The success of the experiment is largely due to her careful and painstaking work.

lar duplicate baking tests from the same samples were made at the end of thirty and at the end of sixty days. In every baking, under the same conditions and at the same time, one loaf was made from each grade of fumigated flour, and, as a check, one loaf was made from each grade of unfumigated flour. As a check to show that there is usually a slight variation in loaves baked from the same flour, under the same conditions and at the same time, four loaves of a high patent grade of soft winter-wheat flour and four loaves of a high patent grade of hard winter-wheat flour were baked.

Photographs were made of all bakings, and in the photographs the check loaf made from the unfumigated flour stands alongside the loaf made from the fumigated flour.

EQUIPMENT FOR MAKING BAKING TESTS.

As this equipment will be more fully described in a forthcoming publication of this Experiment Station, special attention will be called only to such features as will make clear the discussions which follow. The equipment consists of a sponge case, a Simplex electric oven, specially constructed baking pans, special cylinders for proving the dough, a Koelner dough kneader connected with an electric motor, a device for measuring the loaf volume, and such accessories as are generally found in connection with a chemical laboratory.

SPONGE CASE.

This is made of wood and is heated by electric bulbs, and the construction of the case is such that an even, uniformly distributed temperature is easily maintained.

SPECIAL BAKING PANS.

The notable feature of these pans is that the rise of the dough before baking, as well as the spring in the oven, can be accurately measured. This is accomplished by means of a plunger supported by the cover and a disc made in the form of a watch glass supported at the lower end of the plunger. As the dough rises it lifts this disc and the plunger, and the rise can be accurately measured.

SPECIAL PROVING CYLINDERS.

These cylinders are 35 cm. high and made on such a scale that 1 cm., or nearly 2/5 inch is equal to 100 cc. volume. On one side of this cylinder, extending from near the bottom to the top, is a glass strip about an inch wide, graduated to ½ cm. By means of this the behavior of the dough inside the cylinder can be observed and the volume read to 50 cc.

METHOD OF MAKING THE TESTS.

In making a series of tests like the following, the method of procedure is somewhat different from that of making the ordinary baking tests. Since it was desired to study the effect of fumigation only, as many factors as possible which might influence the results of the test were eliminated. In every case the untreated flour was tested identically the same as the fumigated flour. In this way a direct comparison is always obtained and the influence of the yeast, temperature, manipulation, and individuality of the operator is the same on both the untreated flour and that which was fumigated. Furthermore, in every case the test was repeated two or three days later. The tables giving the results of these tests are made up from the average results of these two individual tests.

In working out the details of these tests, the aim has constantly been to obtain as many measured factors as possible. In the ordinary tests where different flours are used, thirty-one measurements or observations are recorded for each loaf. As these tests were made from the same flours throughout, twelve of these measurements or observations were the same for all of the loaves. Further, in devising this method, it has been the aim to secure a loaf which conforms to the standards for good bread.

YEAST.

Yeast is one of the most important factors in making a baking test, and one which is very difficult to control. However, as the nonfumigated flour was always baked alongside of the fumigated, the effect caused by variation in yeast is eliminated, except as far as the behavior of the yeast would be affected by the results of fumigation. The most noticeable effect from variation in yeast is in the time it takes for the dough to rise a standard amount. Other factors less noticeable are seen in

the maximum expansion of the dough, loaf volume, and spring in the oven. The effect on the latter in most cases is very slight, but in all cases each one of these results would be the same on the two flours. The yeast used in these tests was of the Fleischmann brand, and bought from a local baker. To secure uniformity in the yeast used for the day, it was cut up into small pieces, the size of rice grains, and thoroughly mixed. From this mixture ten-gram portions were weighed out and placed in small beakers.

ABSORPTION TESTS.

This is to determine the amount of water necessary to make a dough of standard stiffness from a given flour. In making this test several thirty-gram portions of the flour are weighed out and placed in strong porcelain cups. From a burette the probable amount of water needed to make a dough of proper consistency is added. The water is worked into the flour by means of a spatula, care being taken that nothing is lost. As soon as the dough permits of handling with the hands, it is worked into a homogeneous, even texture. The standard stiffness is decided upon by the operator, and in this he must be guided largely by experience. Inasmuch as these tests were to be strictly comparable throughout, and as many factors eliminated as possible except that of fumigation, an average amount of water was decided upon. This amount was 16 ½ cc. for 30 grams of flour, or an absorption of 55 per cent. This gave to each loaf the same amount of water.

FLOUR.

In these baking tests the following grades of flour were used: Hard winter-wheat flours: low grade, 3 per cent; straight, 97 per cent; patent, 78 per cent. Soft winter-wheat flours: low grade, 5 per cent; clear, 35 per cent; straight, 95 per cent; patent, 60 per cent.

BAKING FORMULA.

Flour, 340 grams.	Yeast, 15 grams.
Water, 187 cc.	Salt, 10 grams.
Sugar, 15 grams.	Lard, 5 grams.
	Total materials, 562 grams.

PRELIMINARY FERMENTATION.

The sugar and salt were weighed out and the requisite amount of water was measured into as many beakers as there were tests to be made that day. Thirty minutes before the

doughing commenced this solution was heated to 95° F. and the yeast added. The yeast was thoroughly mixed with the solution and placed in the sponge case, where it was allowed to ferment for thirty minutes. One of these preliminary fermentations was started every ten minutes. In this way a continuous process was kept up. This preliminary fermentation not only shortens the time of making the tests but gives a good indication in regard to the strength and behavior of the yeast.

MAKING THE DOUGH.

The flour was usually weighed out the evening before and placed in the sponge case with the lights turned on, In this way it had sufficient time to assume the proper temperature before the mixing commenced, the lights coming on at seven o'clock in the morning. The temperature of the sponge case was kept at 35° C., or nearly 95° F. Besides the flour, all of the ingredients, as well asthe apparatus, were heated and kept at this temperature from the time the dough was started until it was ready for the oven. The lard was weighed out and placed in each portion of the flour. About two-thirds of the warmed flour, together with the lard, is placed in the kneader and the fermented yeast liquor added. The machine is started and allowed to work at high speed for just five minutes, when it is stopped and the rest of the flour is added. It is then allowed to work for five minutes at low speed. As the dough stiffens, all of the flour is worked into it by means of a flexible steel spatula. Most of this can usually be done while the machine is in motion, stopping only long enough to work the last portion into the dough. It is not necessary that every particle of flour be worked into the dough, since the amount left in the kneader is accounted for in the subsequent weighings. The amount of material left in the kneader is usually not more than twenty grams, and often less than ten grams. The greater portion of this loss is water. The total time of working the dough is ten minutes.

PROVING THE DOUGH.

While the machine is yet in motion, the dough is removed with a deft motion of the hand, worked into a ball, and placed in a special cylinder and pressed down firmly. A record is made of the time. The cylinder is placed in the sponge case, and the dough allowed to rise until it has trebled its volume.

It has been found by experience that this is when the top of the dough is 16 ½ cm. high, corresponding to very nearly 1650 cc. volume. When this point is reached the dough is removed from the cylinder and worked lightly for about one minute. The dough is returned to the cylinder, pressed down gently, and the time recorded. This gives the time of the first rise. The dough is now allowed to rise until it shows signs of falling or that it will not rise any more. This point is one of the most difficult to determine and requires presistent care. The total height is now read in the same manner as before, and the time noted. This gives the time for the second rising of the dough. This reading gives the maximum expansion of volume of the dough, and the figures thus obtained correspond very closely to the figures used for loaf volume by a number of operators, notably those in the bread-testing laboratories of the Northwest. The dough is now removed from the cylinder, worked lightly for one minute, and placed in the special baking pan. This last working is just sufficient to remove the larger gas bubbles from the dough, and no more. The manipulation of the dough at this point is the most important of all in its effect upon texture. The dough and the pan are now weighed. This gives the figures for computing the loss in making and rising. The time is noted and the dough is set in the sponge case to rise. This rising is allowed to continue until the dough has reached a definite volume, which is indicated by the height to which the plunger has risen. This height has been found by experience to be 2 cm. This point has to be watched very carefully, as more or less rising at this time affects very materially the volume and texture of the bread. The measurements are made with a pair of dividers and a millimeter scale. The time is noted, which gives the figures for computing the time for the third rise.

BAKING.

The pan is placed in the oven, previously heated to 220° C., or 438° F., and allowed to bake for just forty minutes. In comparative baking tests it is very necessary that the oven temperature be the same at the time each loaf is put into the oven and remain constant while the bread is being baked. At the end of the forty minutes the loaf is removed from the oven and the height to which the plunger has risen is measured. The hot loaf is placed on a wire screen and allowed to cool for

just thirty minutes, when it is weighed. This gives the data for computing the loss in baking and cooling.

TAKING THE VOLUME AND JUDGING THE BREAD.

The volume of the loaf is taken by means of displacement of flax seed, A specially constructed apparatus is made for this purpose. The volume can be read quite accurately, within 10 cc. In all cases this bread was judged by two or more persons. It was judged for color and texture on a percentage basis.

RESULTS OF FUMIGATION.

The results of these baking tests on the flours fumigated, together with the flours of the same kind not fumigated, are given in tables I-XII. The factors of importance, such as might be affected by fumigation, are time for proving, maximum volume of dough, measure of oven spring, volume and texture of loaf. For the sake of completeness the figures for losses in mixing and rising, for losses in baking and cooling, and for weight and color of loaf, are added. Fumigation might show its effect on the time for proving either by increasing or by decreasing this time. As was said before, this time for proving is very materially influenced by the character of the yeast, but since in these tests the fumigated flour was always baked alongside of the nonfumigated, this factor was eliminated. Experiments conducted in this laboratory have shown that small quantities of chemicals may very materially influence the time for proving. In giving the time separately for the first, second, and third rise, together with the total time, the figures would show whether this influence is momentary or persists throughout the whole period for proving. An influence shown in the time of first rise and not in the second and third rise would be momentary; while if it was shown in all the periods, it would be persistent, and would not be due merely to the presence of an undesirable substance which can be speedily gotten rid of, but probably to a more profound change in the gluten or to some other effect. The time of the second rise should be considered together with the maximum volume of the dough. In this case, where the dough is allowed to rise to its maximum volume, a period short in comparison, indicates weakness of gluten and a corresponding effect on the maximum volume. The maximum

volume of the dough, as stated before, can be read to 50 cc.; a smaller difference than this must be neglected in individual cases. However, when several figures are averaged from a flour similarly treated, smaller differences than 50 cc. would show a general tendency.

The spring of the loaf in the oven is due to several factors. The increased heat would cause for a few minutes a rapid yeast activity, with an accompanying increase of gas formation. As the heat increases the yeast activity soon ceases. The rising temperature causes expansion of the carbon dioxide, which in turn does it's share in expanding the loaf. The high heat causes a rapid development of steam, and this will also cause loaf expansion. The amount of expansion due to these causes will be ,determinedpartly by the quality of the gluten. The expansion of the loaf will cease when the gluten stiffens to such an extent that it has lost its elasticity. In these tests the influence of fumigation on the gluten would be shown by a loss of elasticity in comparison with the flours not fumigated. The oven spring is also influenced by the temperature of the oven. A low temperature gives a larger oven spring than a higher temperature, but in these cases the two flours were baked at identically the same temperature, and hence this factor is eliminated. A large oven spring is not necessarily an indication of a strong gluten. Sometimes weak flours will give a larger oven spring than stronger flours. However, if two flours are compared where there is a difference of only one factor, a larger oven spring would indicate a stronger gluten. A strong gluten tends to produce a more dome-shaped loaf, while a weaker gluten produces a flatter loaf. This would be indicated by the differences in oven spring; therefore, in these tests, wherever there is a larger oven spring it is an indication of a stronger gluten, or where the oven spring is smaller there is an indication of a weakening of the gluten.

The losses in mixing and rising, as well as those in baking and cooling, have no particular significance in these investigations, but are given merely because of their effect on the weight of the loaf.

The volume of the loaf is not by itself an indication of quality. As was stated in regard to the oven spring, large loaves may often be produced from weak flours. In the market, flours are preferred one above the other because of particular quali-

ties. One of these qualities is the ability to produce a loaf with a large volume. This quality is usually considered together with other qualifications; therefore, any weakening of this ability to produce a large loaf would to such an extent injure the value of the flour, and hence one of the objects of this investigation was to determine if fumigation injures the capacity of a flour to produce a large loaf-volume.

The texture of the crumb was judged upon the fineness of the cell walls and the size of the holes. Fineness approaching that of angel food cake is considered the ideal texture. The texture of a loaf must also be considered in connection with the volume. Other things being equal, a small loaf will produce a finer texture, and a large loaf a coarser texture.

The color of a loaf is very difficult to judge, because of the lack of standards and because of the difficulty of eliminating the influence texture has on color. Coarse texture, other things being equal, will not produce the same color impression as that produced by a fine texture. However, in an investigation like this, all that was attempted was simply to compare the two loaves from the same flours, one being fumigated and the other not.

ARRANGEMENT OF FIGURES IN THESE TABLES.

All figures in these tables represent the average of two separate tests. The figures for the results from the nonfumigated flour are always given first, followed immediately by the figures from the fumigated flour. In this way direct 'comparison is in all cases very easy. For the hard-wheat flours, the figures in the first two lines are from the low-grade flours, the second two lines from the straight flour, and the last two lines from the patent flour. For the soft-wheat flours, the first two lines are from the low-grade flour, the second are from the clear, and the third are from the straight, while the last two are from the patent flour.

ARRANGEMENT OF TABLES.

Tables I-IV are from the tests made immediately after the fumigation, V-VIII those made after thirty days, and IX-XII those after sixty days. The tables follow each other in this order: first, the flours from the hard wheat, fumigated with hydrocyanic acid gas and carbon bisulphide; second, those from the soft wheat in the same order with reference to the gas used.

VARIATIONS DUE TO THE BAKING TEST ITSELF.

In order to show how close an agreement is possible when all factors of variation are eliminated, except those due to the baking test itself, two baking trials were made on patent flour and two on soft-wheat flour, the two flours being the same as the two patents used in this investigation. The averages of these two pairs of trials are given in table XIII. In the test on the hard-wheat flour we notice the following extreme variations : first rise, 1½ minutes; second rise, 8½ minutes; thirds rise 1½ minutes; total time, 3½ minutes; maximum volume of dough, 25 cc. ; oven spring, 2 mm.; volume of loaf, 40 cc.; and texture, ½ per cent, In the test on the soft-wheat flours the extreme variation's are : first rise, 4½ minutes; second rise, 11½ minutes; third rise, 1½ minutes; total time, 16 minutes; maximum volume, 50 cc.; oven spring, 2 mm.; volume of loaf, 17½ cc.; and texture, ½ per cent. These variations are due to the uncontrollable factors incident to the baking tests, and in the preceding tables, unless the variations are larger than these variations shown in table XIII, they are not necessarily due to any effect from fumigation, but are merely such variations as are beyond the operator's control. It seems that as compared with the hard-wheat flour, there is a larger variation in the soft-wheat flour in regard to the period of fermentation but a smaller variation in the final result.

TABLES XIV TO XXIII.

To bring the significant factors from all the tests into such form that a direct comprehensive comparison can be made, tables XIV to XXIII were made from the figures in the previous tables. Each table gives the results obtained for one factor in all the trials and under all conditions. In table XIV, for example, we have the minutes for proving, first rise, for both of the flours, for both of the gases used, in all the tests, both those made immediately and those made at the end of thirty and of sixty days. These results for the treated and the untreated flours are placed in parallel columns. The results for the different grades of flours are totaled and averaged separately for the hard- and for the soft-wheat flours. Also a grand total and a grand average are made. This serves to bring out in the fullest way possible the effect of fumigation in regard to the significant factors so grouped.

An examination of these tables will show that the most noticeable results which can be traced to fumigation, and not to the conditions of the experiment, are the effects on the maximum rise of the dough grouped in table XVIII. There are also slight effects on the spring in the oven and loaf volume grouped in tables XIX and XXI.

EFFECT OF FUMIGATION ON HARD-WHEAT FLOURS.

Maximum Volume of the Dough.

With the low-grade flour there is no decrease in the maximum volume of the dough from fumigating with hydrocyanic acid gas; if there is any change it is an increase. With carbon bisulphide, there is a decrease of 150 cc. for the test made immediately after fumigation, and no pronounced effect after that other than that due to the conditions of the experiment.

For the straight-grade flour the maximum decrease is 75 cc. when the flour was fumigated with the hydrocyanic acid gas. With the carbon bisulphide the maximum decrease is 175 cc. for the test made immediately, with no pronounced result after that.

For the patent flour there is the same maximum decrease in the test made immediately after the treatment with the hydrocyanic acid gas, as with the straight flour, but no result in the later tests. With the carbon bisulphide the maximum decrease is 225 cc. in the first test, with no result in the two later ones.

Thus it is seen that with the flours from the hard wheat there is a small noticeable effect from fumigation with hydrocyanic acid gas when the baking is made immediately after fumigation, and the same is true to a larger degree when carbon bisulphide is used. The results here obtained would correspond very closely to the results obtained by the bread-testing laboratories of the Northwest. However, in both cases the effect of fumigation is slight, and at most after thirty days the results are not evident. It seems, therefore, that the impairment of the power of the dough to rise to a maximum volume is not permanent. If there were a real change in the properties of the gluten, the results would be just as pronounced at the end of thirty and at the end of sixty days. The cause is probably due to the residuum of gas left in the flour. Experi-

ments made in this laboratory have shown that very small quantities of chemicals may affect the rising qualities of the dough to a very pronounced degree. The effects shown in table XVIII may not be due to any effect of the gas on the gluten, but to the effect on the vital activities of the yeast. Any one familiar with making baking tests will appreciate that the cause which will produce the effects shown may be very slight indeed, and it is only when very careful measurements are made that the results are apparent at all.

Measure of Oven Spring.

The hydrocyanic acid gas treatment shows a small decrease in the straight and patent flour in the test made immediately, but no pronounced effect with the low grade. The carbon bisulphide gives no result which cannot be consistently traced to the conditions of the experiments.

Volume of Loaf.

The fumigation with hydrocyanic acid gas shows a tendency towards decrease in loaf volume for the patent and straight flours, but not with the low grade. However, the decrease in loaf volume is very small when we consider the amount of variation possible due to the experiment as shown in table XIII. The carbon bisulphide shows no effect on loaf volume in any of the flours.

We see, then, that the effect of hydrocyanic acid gas is more persistent, while that of carbon bisulphide is not seen beyond the dough-rising stage. It seems, therefore, very probable that the result with carbon bisulphide is due to the effect that a residuum of the gas has on the yeast, and not to any permanent change in the gluten. With the hydrocyanic acid gas, the result is probably due to a small influence on the gluten as well as on the yeast.

EFFECT OF FUMIGATION ON SOFT-WHEAT FLOUR.

Maximum Volume of the Dough.

As with the hard-wheat flour, there is no decrease for the low grade, but with the clear and patent there is a decrease of 100 cc. in the first trial after the fumigation with hydrocyanic acid gas. Why there is no such result with the straight flour is not apparent. With carbon bisulphide there is a decrease in some cases, but the amount is small and shows no regularity, and can therefore easily be traced to the conditions of

the experiment. That the effect of carbon bisulphide should be stronger on hard-wheat flour than on soft-wheat flour is peculiar. There seems to be no apparent reason for this result.

Measure of Oven Spring.

Beyond the low-grade flour, treated with the hydrocyanic acid gas, there is no decrease in the oven spring which can be traced to the results of fumigation with either the hydrocyanic acid gas or the carbon bisulphide.

Volume of the Loaf.

There is no change with either of the fumigating agents used in any of the flours which can be traced to the results of fumigation. Thus, on the whole, the effects on the soft-wheat flours are much less than on the hard-wheat flours, and in all cases where a change is noticeable the amount is very slight. In all the tests no detrimental results on color and texture could be traced to fumigation.

TABLES XXIV AND XXV.

These tables give in summary form the averages of all these tests. It is only with the careful measurements used that the effects of fumigation can be detected at all, and they are so small that they would not be noticed in the ordinary method of baking.

EXPLANATION OF PLATES.

Each plate, except I, shows the cuts of the loaves made in the two duplicate tests whose results are averaged for the figures in the tables. The cuts plainly show the close agreement between the duplicate tests. The odd-numbered loaves are from the nonfumigated flour and the even-numbered loaves placed directly on the right are from the fumigated flour. The figures for any loaf number in the table are the averages of the two loaves of the same number in the plate. These cuts show more plainly than the figures that the effect of fumigation was not noticeable in the finished loaf.

TABLE No. I.—Hard-wheat flour fumigated with hydrocyanic acid. Tested October 15-17, 1910, immediately after fumigation. (See plate I.)

TREATMENT.	Grade of flour.	Loaf number.	Time for proving. First rise, minutes.	Time for proving. Second rise, minutes.	Time for proving. Third rise, minutes.	Time for proving. Total time, minutes.	Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising, grams.	Loss in baking and cooling, grams.	Weight of loaf, grams.	Volume of loaf, cc.	Texture of crumb, per cent.	Color of loaf, per cent.
Not fumigated	Low grade	1	96	75.5	38	209.5	1975	3.8	22.5	34.5	505	1585	90	85
Fumigated	Low grade	2	79.5	77	34.5	191	2000	4.35	16	38	508	1655	86	85
Not fumigated	Straight	3	67.5	83.5	32 5	183.5	2300	5.65	8.5	45	508.5	1780	96	96
Fumigated	Straight	4	73	80.5	36.5	190	2225	5.25	16.5	39.5	506	1740	96	96
Not fumigated	Patent	5	70.5	81	36	187.5	2300	6	12.5	38.5	511	1840	96.5	98
Fumigated	Patent	6	75.5	69	37	181.5	2225	5.3	17	36.5	507.5	1765	97.5	98

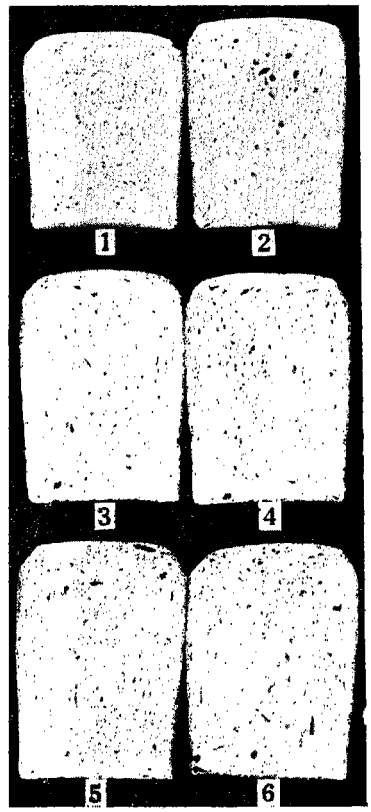

PLATE I.

TABLE No. II.—Hard-wheat flour fumigated with carbon bisulphide. Tested October 27-29, 1910, immediately after fumigation. (See plate II.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving.				Maximum volume of dough, cc	Measure of oven Spring, cm.	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
			First rise, minutes	Second rise, minutes	Third rise, minutes	Total time, minutes								
Not fumigated	Low grade	1	65	74.5	32	171.5	2200	4.15	14.5	45.5	502	1560	90	85
Fumigated	Low grade	2	62.5	72.5	29.5	163.5	2050	3.85	15	46.5	500.5	1560	90	85
Not fumigated	Straight	3	66.5	88.5	31.5	186.5	2475	6.05	15	41.5	504.5	1760	96.5	96
Fumigated	Straight	4	68.5	82	32.5	183	2300	6.05	16	46	500	1757.5	96.5	95.5
Not fumigated	Patent	5	67	90.5	33	190.5	2575	5.95	25.5	35	501.5	1810	96.5	97
Fumigated	Patent	6	69.5	91	33.5	194	2350	6.1	13.5	41.5	507	1800	97.5	97.5

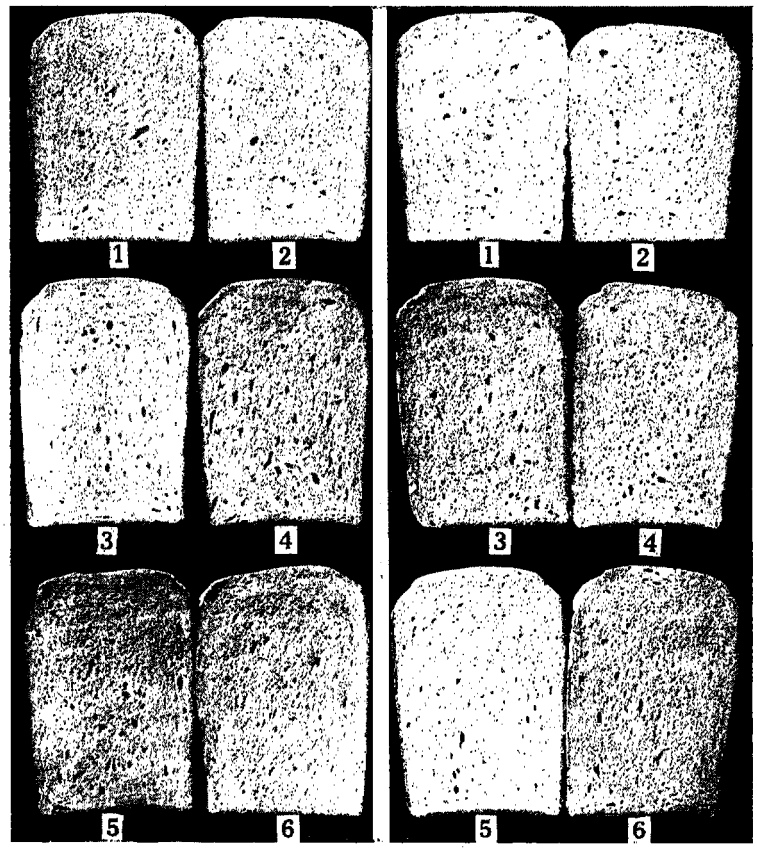

PLATE II.

TABLE No. III.—Soft-wheat flour fumigated with hydrocyanic acid. Tested November 10-12, 1910, immediately after fumigation. (See plate III.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving. First rise, minutes	Second rise, minutes	Third rise, minutes	Total time, minutes	Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
Not fumigated	Low grade	1	76.5	48.5	25.5	150.5	1525	1.55	11.5	46.5	504	1240	85	77.5
Fumigated	Low grade	2	73	50.5	26.5	150	1500	1.3	8.5	49	504.5	1265	85	77.5
Not fumigated	Clear	3	55	83	32.5	170.5	2625	6.3	11	51	500	1865	94.5	94.5
Fumigated	Clear	4	58	83	31	172	2525	6.5	10.5	55.5	496	1855	94.5	94
Not fumigated	Straight	5	71	92.5	37	200.5	2575	5.8	14	48.5	499.5	1785	95.5	96
Fumigated	Straight	6	64	90.5	36	190.5	2600	6.15	13	45.5	503.5	1810	95.5	96
Not fumigated	Patent	7	65.5	105	39	209.5	2750	6.1	25	35	502	1807.5	97.5	97.5
Fumigated	Patent	8	77.5	110.5	40	228	2650	6.05	12	48	502	1787.5	98.5	98

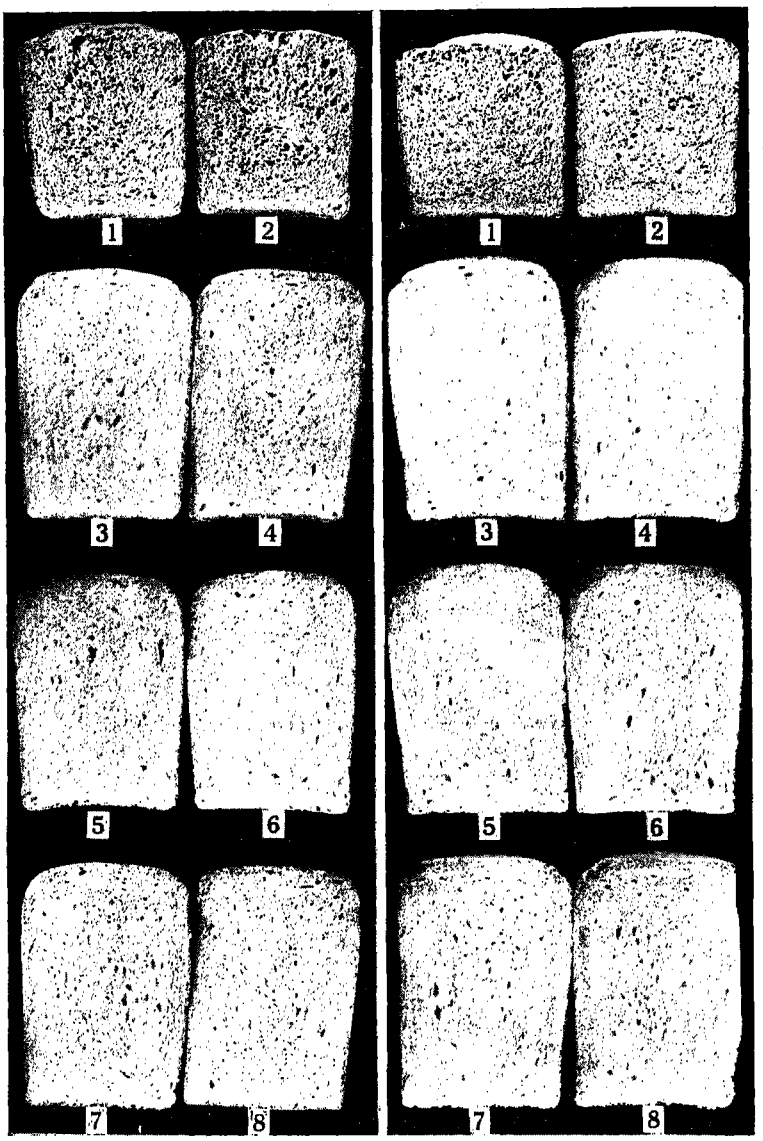

PLATE III.

TABLE No. IV.—Soft-wheat flour fumigated with carbon bisulphide. Tested November 17-21, 1910, immediately after fumigation. (See plate IV.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving. First rise, minutes	Second rise, minutes	Third rise, minutes	Total time, minutes	Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent.	Color of loaf, per cent.
Not fumigated	Low grade	1	70	63	26.5	159.5	1475	.15	22.5	36.5	503	1125	85	80
Fumigated	Low grade	2	71	61	27.5	159.5	1400	—.45	21.5	38	502.5	1135	85	80
Not fumigated	Clear	3	62	92	34	188	2575	6	17	45.5	499.5	1785	95	96
Fumigated	Clear	4	61	90.5	32.5	184	2550	6.2	16	45	501	1795	95	96
Not fumigated	Straight	5	58	93.5	36.5	188	2575	5.4	16	45.5	500.5	1730	96	96
Fumigated	Straight	6	62.5	93	40.5	196	2575	5.4	21.5	46	494.5	1785	96	97
Not fumigated	Patent	7	62.5	93	36.5	192	2700	5.95	30.5	36.5	495	1840	98	99
Fumigated	Patent	8	61	102	28.5	191.5	2750	5.95	18	51	493	1830	98	99

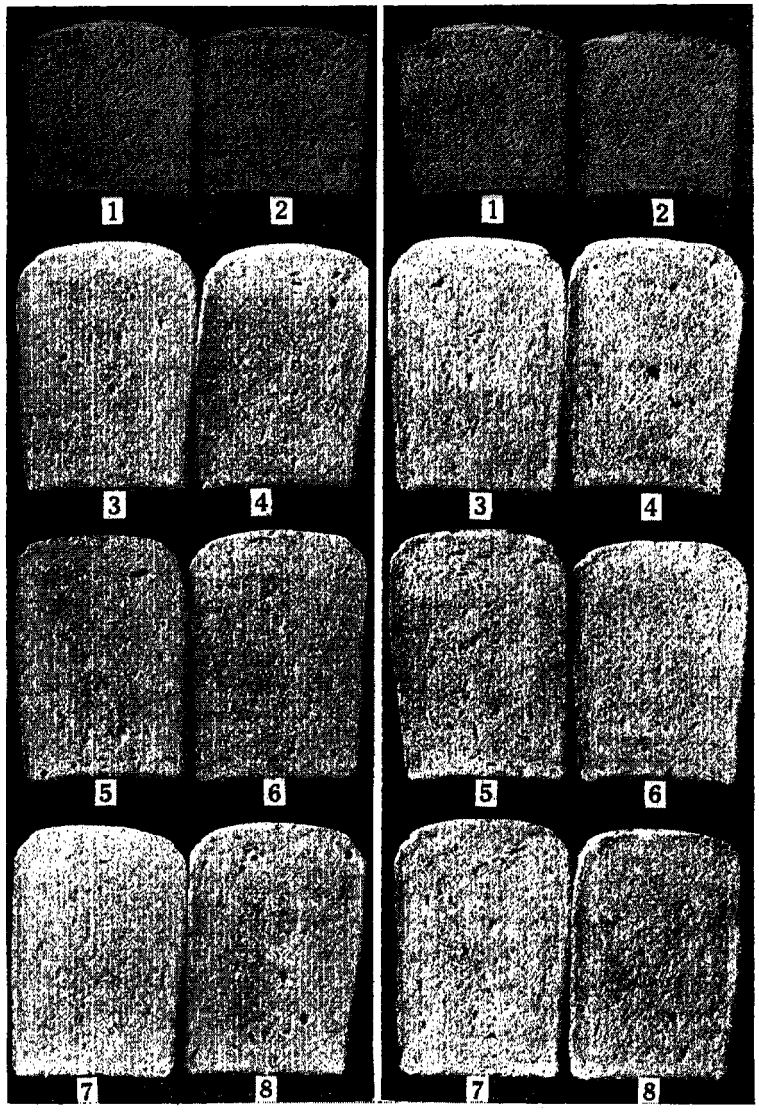

PLATE IV.

TABLE No. V.— Hard-wheat flour fumigated with hydrocyanic acid. Tested November 23-25, 1910, thirty days after fumigation. (See plate V.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving.				Maximum volume of dough, cc	Measure of oven spring, cm	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc	Texture of crumb, per cent	Color of loaf, per cent
			First rise, minutes	Second rise, minutes	Third rise, minutes	Total time, minutes								
Not fumigated	Low grade	1	74.5	83	31.5	189	2100	4.6	14	46	502	1620	91	82.5
Fumigated	Low grade	2	72.5	82.5	32	187	2150	4.45	13.5	45	503.5	1625	91	82.5
Not fumigated	Straight	3	65.5	98.5	35.5	199.5	2500	6	15	46.5	500.5	1770	96	96
Fumigated	Straight	4	65.5	99.5	38	203	2525	5.8	12.5	51	498.5	1710	95.5	95.5
Not fumigated	Patent	5	66.5	103.5	37.5	207.5	2575	5.8	14.5	45	502.5	1785	95.5	97
Fumigated	Patent	6	70.5	98	38.5	207	2575	5.75	15.5	47.5	499	1775	97	97.5

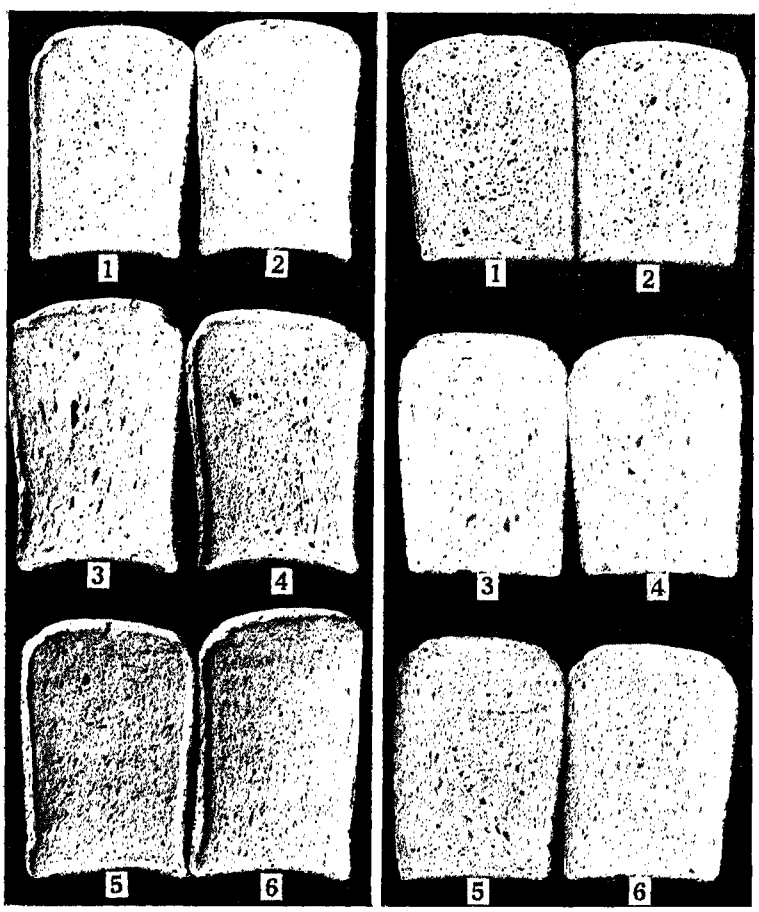

PLATE V.

The crumpled appearance of the loaves on the left was due to drying before the photograph was taken.

TABLE No. VI.—Hard-wheat flour fumigated with carbon bisulphide. Tested November 26-29, 1910, thirty days after fumigation. (See plate VI.)

TREATMENT.	Grade of flour.	Loaf number.....	Time for proving. First rise, minutes...	Second rise, minutes...	Third rise, minutes...	Total time, minutes...	Maximum volume of dough, cc....	Measure of oven spring, cm.....	Loss in mixing and rising, grams..........	Loss in baking and cooling, grams..........	Weight of loaf, grams..........	Volume of loaf, cc....	Texture of crumb, per cent........	Color of loaf, per cent.......
Not fumigated....................	Low grade...........	1	69	75.5	32	176.5	2125	4.25	10.5	46	505.5	1640	90	87
Fumigated........................	Low grade...........	2	74	71.5	31	176.5	2100	4.3	16.5	38	507.5	1625	90	87
Not fumigated....................	Straight.............	3	74.5	82	35.5	192	2350	6.05	12.5	43.5	506	1780	96.5	97.5
Fumigated........................	Straight.............	4	75.5	80.5	38.5	194.5	2400	6	14.5	46.5	500.5	1810	97.5	97.5
Not fumigated....................	Patent................	5	70	95	37.5	202.5	2525	5 85	10.5	48	503.5	1760	97	98
Fumigated........................	Patent................	6	73	97	38.5	208 5	2500	6	14	45	503	1805	98	98.5

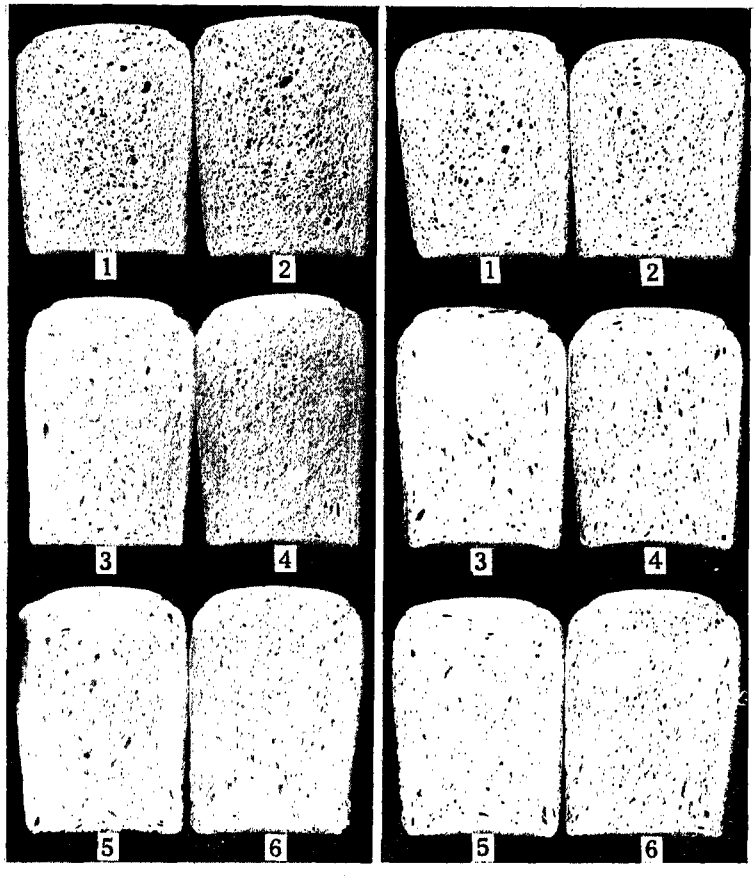

PLATE VI.

TABLE No. VII.—Soft-wheat flour fumigated with hydrocyanic acid. Tested December 3–10, 1910, thirty days after fumigation. (See plate VII.)

Treatment.	Grade of flour.	Loaf number	Time for proving.				Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
			First rise, minutes.	Second rise, minutes.	Third rise, minutes.	Total time, minutes.								
Not fumigated	Low grade	1	71	43	24.5	138.5	1500	1.4	10.5	45	506.5	1245	85	77.5
Fumigated	Low grade	2	69	43	29	141	1500	1.3	9.5	44	508.5	1255	85	77.5
Not fumigated	Clear	3	60	75	31	166	2425	6.65	11	50	501	1830	96	94.5
Fumigated	Clear	4	56.5	74.5	30	161	2475	6.85	10.5	50	501.5	1855	96	94.5
Not fumigated	Straight	5	62.5	80	35	177.5	2550	6.1	12	46.5	503.5	1810	95.5	95.5
Fumigated	Straight	6	63	86	38	187	2525	5.65	13	45.5	503.5	1765	95.5	96
Not fumigated	Patent	7	62.5	81.5	37	181	2625	6.25	13.5	42	501.5	1835	97	97.5
Fumigated	Patent	8	67	84.5	37.5	189	2625	6.05	12.5	48.5	501	1780	97.5	97.5

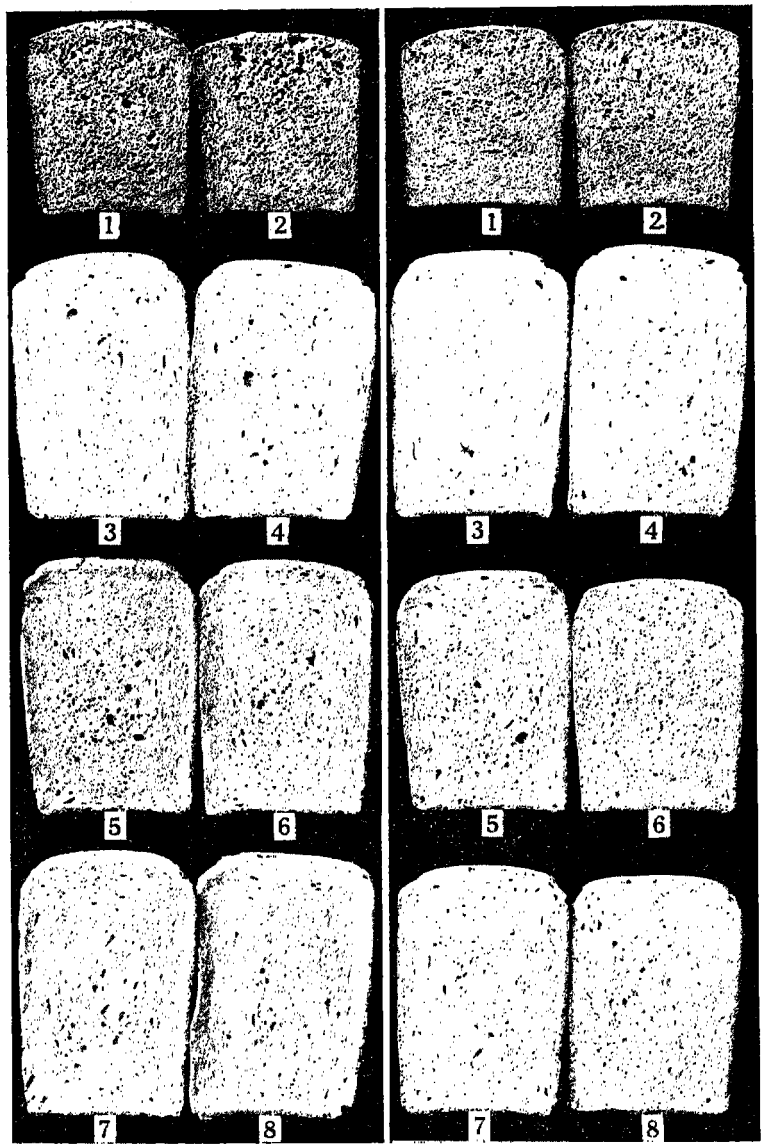

PLATE VII.

TABLE No. VIII.—Soft-wheat flour fumigated with carbon bisulphide. Tested December 17-19, 1910, thirty days after fumigation. (See plate VIII.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving. First rise, minutes	Time for proving. Second rise, minutes	Time for proving. Third rise, minutes	Time for proving. Total time, minutes	Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
Not fumigated	Low grade	1	65	45	22.5	132.5	1500	1.3	10	49	503	1242.5	85	75.5
Fumigated	Low grade	2	63	44.5	22.5	130	1525	1.6	7.5	51	503.5	1290	84.5	75.5
Not fumigated	Clear	3	74.5	76.5	33.5	184.5	2475	6.1	9.5	49.5	503	1825	95.5	93.5
Fumigated	Clear	4	79	77	35	191	2450	5.65	10.5	46.5	495	1760	95.5	93.5
Not fumigated	Straight	5	77.5	77.5	37.5	192.5	2350	5 65	11.5	50	500.5	1775	96.5	96
Fumigated	Straight	6	83.5	79.5	42	205	2350	5.45	12	49.5	500	1745	97.5	96
Not fumigated	Patent	7	96	74.5	42.5	213	2525	6.6	13.5	47	501 5	1835	97.5	99
Fumigated	Patent	8	109	68.5	42	219.5	2500	6.4	13.5	44	504.5	1800	99	99

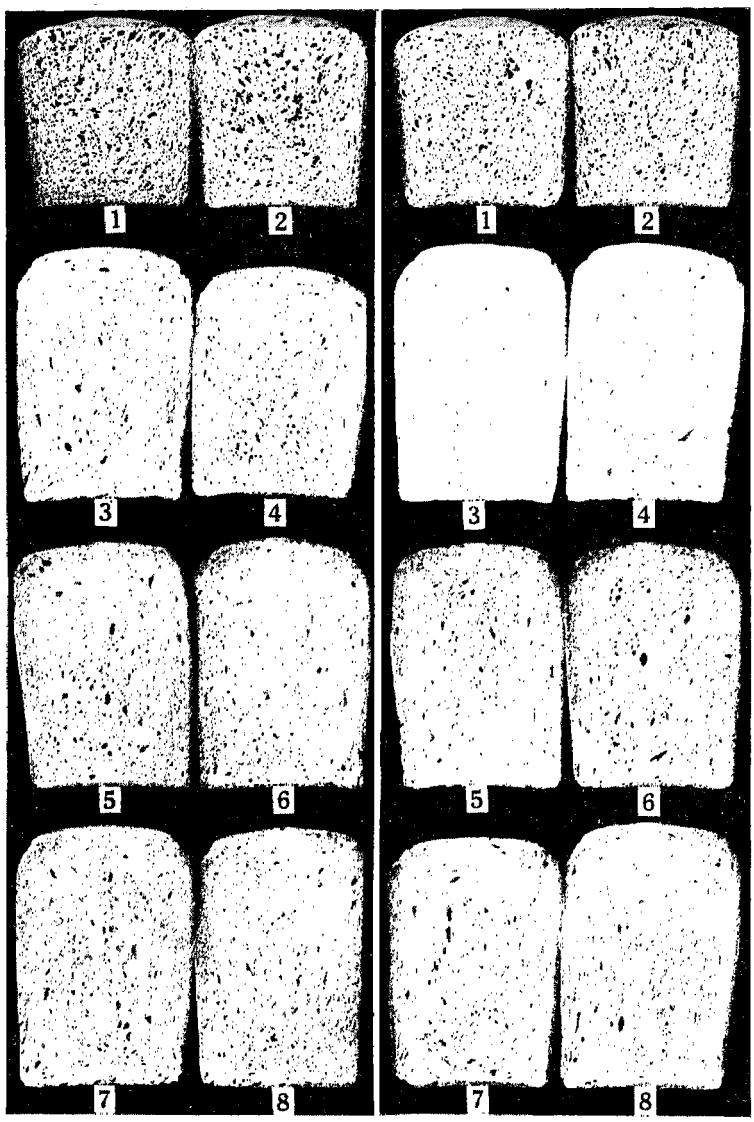

PLATE VIII.

TABLE No. IX.—Hard-wheat flour fumigated with hydrocyanic acid. Tested December 15–17, 1910, sixty days after fumigation. (See plate IX.)

Treatment.	Grade of flour.	Loaf number	Time for proving.				Maximum volume of dough, cc.	Measure of oven spring, cm	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
			First rise, minutes.	Second rise, minutes.	Third rise, minutes.	Total time, minutes.								
Not fumigated	Low grade	1	62	80	29	171	2150	4.6	7.5	47.5	507	1640	89	86.5
Fumigated	Low grade	2	59.5	77	39	165.5	2175	4.55	7	46	509	1630	91	86.5
Not fumigated	Straight	3	54	82.5	34.5	171	2550	5.35	7	49.5	505.5	1745	95	94
Fumigated	Straight	4	57.5	84	35	176.5	2475	5.9	7	49.5	505.5	1750	96	94.5
Not fumigated	Patent	5	59.5	92	39.5	191	2525	6.35	9.5	47	505.5	1815	96.5	96
Fumigated	Patent	6	60.5	89.5	35.5	185.5	2525	5.35	19.5	40.5	502	1715	96	96.5

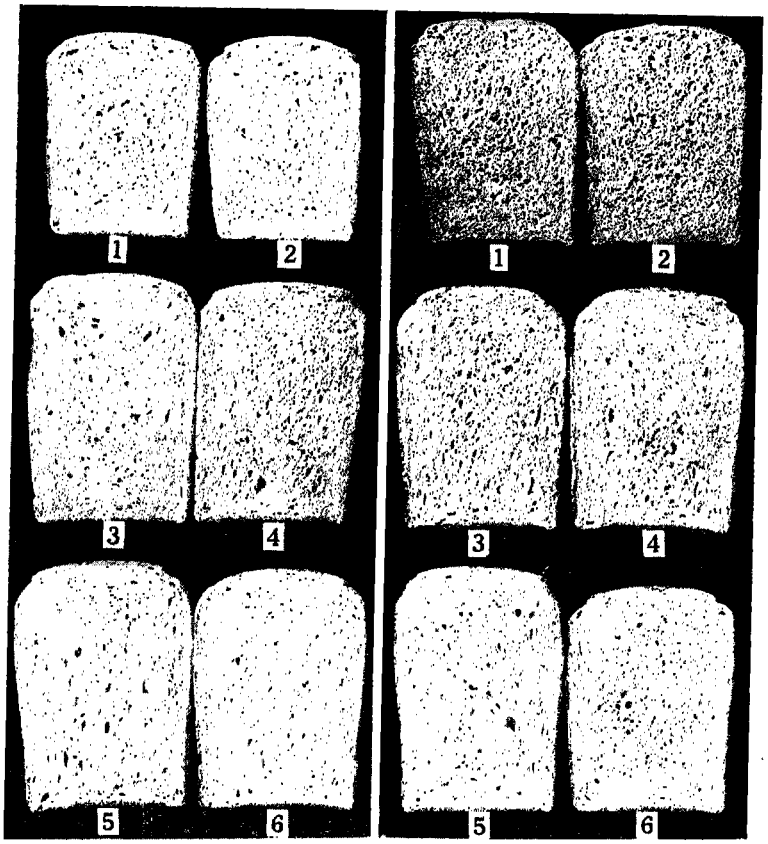

PLATE IX.

TABLE No. X.—**Hard-wheat flour fumigated with carbon bisulphide.** Tested December 27-28, 1910, sixty days after fumigation. (See plate X.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving, First rise, minutes	Time for proving, Second rise, minutes	Time for proving, Third rise, minutes	Time for proving, Total time, minutes	Maximum volume of dough, cc.	Measure of oven spring, cm.	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc.	Texture of crumb, per cent	Color of loaf, per cent
Not fumigated	Low grade	1	68.5	89	49.5	207	2050	4.45	10.5	47.5	504	1590	90	87
Fumigated	Low grade	2	70.5	82	49.5	202	2050	4.5	10.5	48	503.5	1590	90	87
Not fumigated	Straight	3	68.5	106.5	40.5	215.5	2450	6.05	13	47	502	1752.5	97.5	98.5
Fumigated	Straight	4	68	107	38.5	213.5	2475	6.3	13	46	503	1775	98	98.5
Not fumigated	Patent	5	67	106	37	210	2525	6.2	13.5	45.5	503	1750	98.5	100
Fumigated	Patent	6	100	96.5	38	234.5	2525	6.2	12	44.5	505.5	1780	99	100

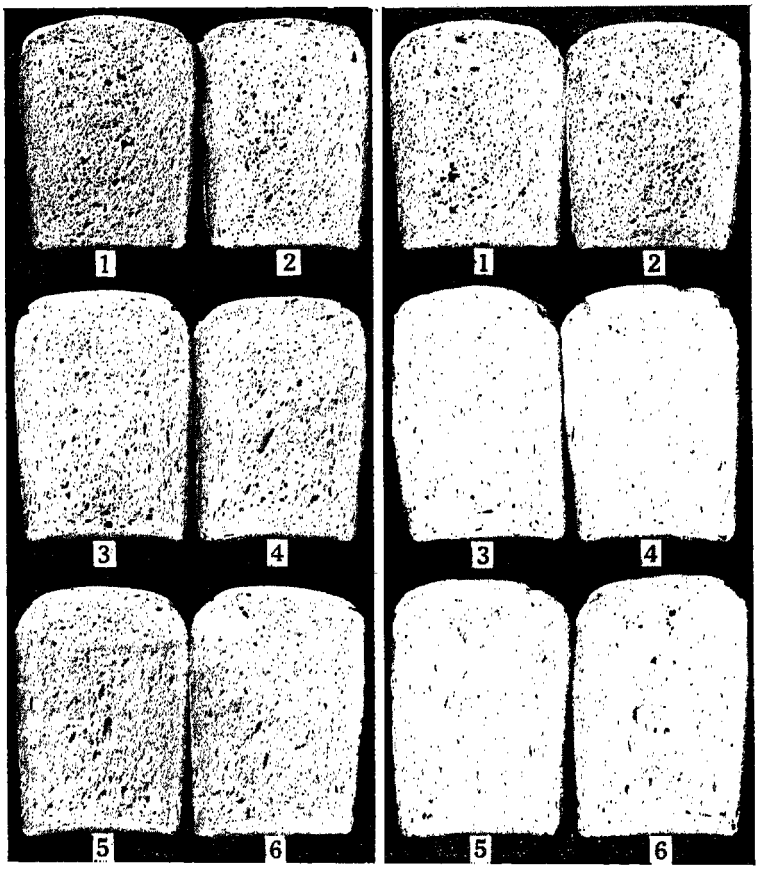

PLATE X.

TABLE No. XI.—Soft-wheat flour fumigated with hydrocyanic acid. Tested January 5-7, 1911, sixty days after fumigation. (See plate XI.)

TREATMENT.	Grade of flour.	Loaf number	Time for proving.				Maximum volume of dough, cc	Measure of oven spring, cm	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc	Texture of crumb, per cent	Color of loaf, per cent
			First rise, minutes	Second rise, minutes	Third rise, minutes	Total time, minutes								
Not fumigated	Low grade	1	74	47.5	27	148.5	1450	1	10	45.5	507	1200	85	75
Fumigated	Low grade	2	69	52	27	148	1450	.65	10	48	504	1170	85	75
Not fumigated	Clear	3	64.5	80	36	180.5	2350	5.7	13	52	497	1760	96	93
Fumigated	Clear	4	65	77	40	182	2350	5.8	12.5	52	497.5	1780	96	93
Not fumigated	Straight	5	68.5	87	39	194.5	2425	5.7	14.5	47	500.5	1735	97	96
Fumigated	Straight	6	70	85	41.5	196.5	2425	5.6	11.5	44	506.5	1722.5	97	96
Not fumigated	Patent	7	70	95	44.5	209.5	2550	6.1	16	41.5	504.5	1825	97.5	98
Fumigated	Patent	8	69.5	94	44	207.5	2550	6.4	14	44	504	1840	97	98

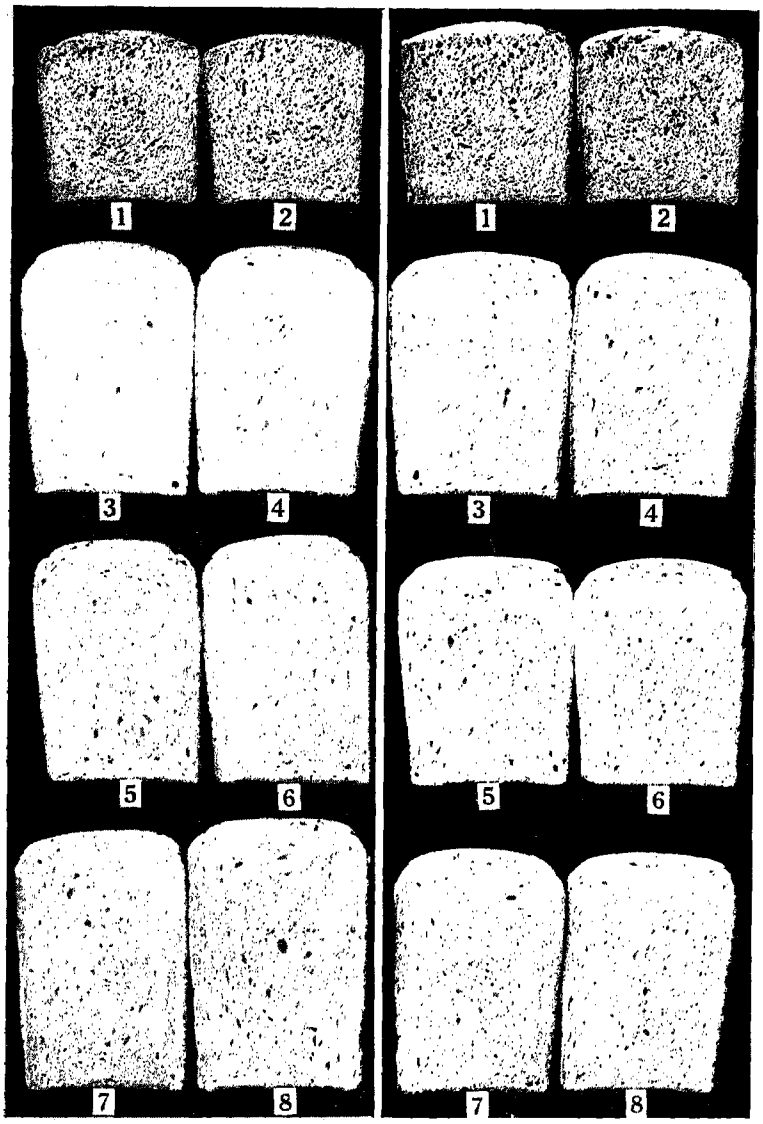

PLATE XI.

TABLE No. XII.—Soft-wheat flour fumigated with carbon bisulphide. Tested January 19-21, 1911, sixty days after fumigation. (See plate XII.)

TREATMENT.	Grade of flour.	Loaf number......	Time for proving. First rise, minutes...	Time for proving. Second rise, minutes...	Time for proving. Third rise, minutes...	Time for proving. Total time, minutes...	Maximum volume of dough, cc.....	Measure of oven spring, cm......	Loss in mixing and rising, grams..........	Loss in baking and cooling, grams..........	Weight of loaf, grams..........	Volume of loaf, cc..............	Texture of crumb, per cent........	Color of loaf, per cent........
Not fumigated.....................	Low grade...........	1	70	46.5	24	140.5	1525	1.35	8.5	46.5	507	1250	85	75
Fumigated..........................	Low grade...........	2	69	47	22.5	138.5	1525	1.25	8	46.5	507.5	1235	84.5	75
Not fumigated.....................	Clear.................	3	71.5	83	36	190.5	2375	6.25	11	50.5	500.5	1835	96	94
Fumigated..........................	Clear.................	4	69	86	34	189	2400	6.2	12	49.5	500.5	1835	96	94
Not fumigated.....................	Straight	5	69.5	97.5	40.5	207.5	2500	5.55	14.5	49.5	498	1760	97	97
Fumigated..........................	Straight	6	68	92	43	203	2500	5.5	15	48.5	498.5	1775	97	97
Not fumigated.....................	Patent................	7	66.5	93	41.5	201	2700	6	17	47	498	1820	98	99
Fumigated..........................	Patent................	8	66	96.5	36.5	199	2675	6.1	19	43.5	499.5	1820	99	99

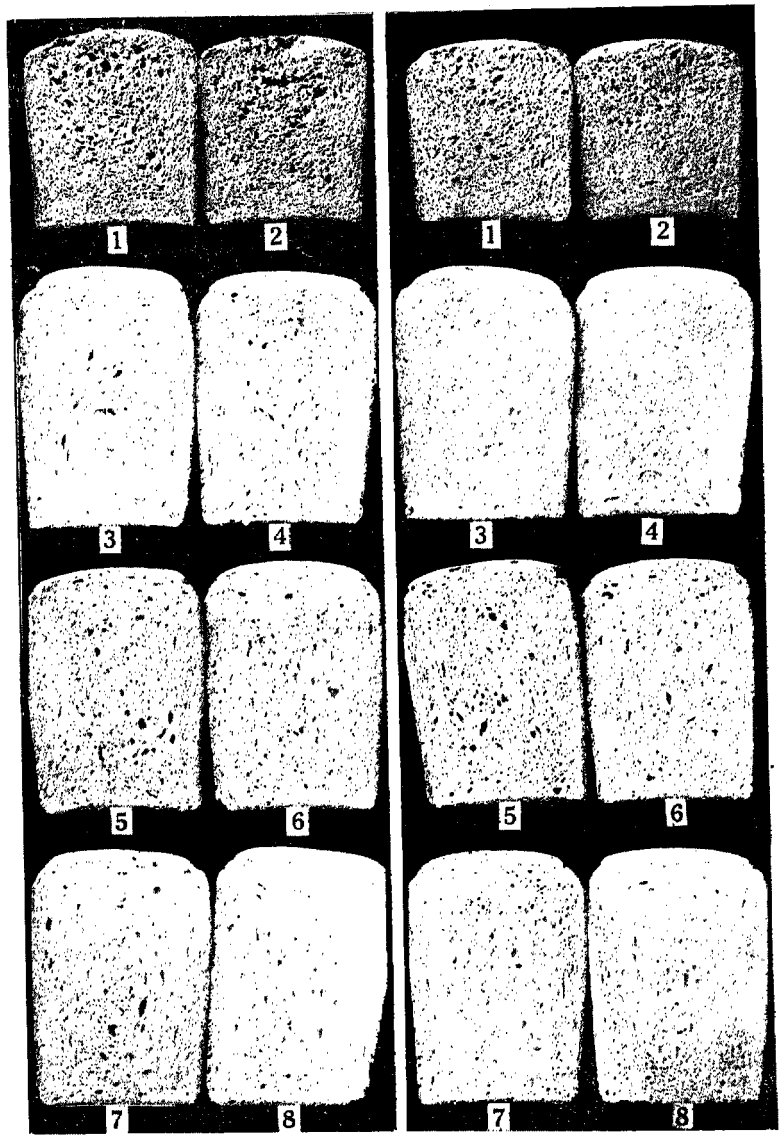

PLATE XII.

TABLE No. XIII.—Hard-wheat flour. Tested January 16-27, 1911. (See plate XIII.)

TREATMENT.	Grade of flour.	Loaf number.....	Time for proving. First rise, minutes...	Second rise, minutes...	Third rise, minutes...	Total time, minutes...	Maximum volume of dough, cc....	Measure of oven spring, cm.....	Loss in mixing and rising, grams	Loss in baking and cooling, grams	Weight of loaf, grams	Volume of loaf, cc............	Texture of crumb, per cent.......	Color of loaf, per cent.......
Not fumigated....................	Patent...............	1	63.5	84	33	180.5	2450	5.9	16.5	48.5	497	1780	98	98
Not fumigated....................	Patent...............	2	63.5	91.5	34	189	2425	5.75	16.5	47	498.5	1765	98.5	98
Not fumigated....................	Patent...............	3	65.5	83	34	182.5	2450	5.75	17	47	498	1775	98	98
Not fumigated....................	Patent...............	4	65	84.5	34.5	184	2425	5.95	16	48	498	1805	98.5	98
Soft-wheat flour. Tested January 16-27, 1911.														
Not fumigated....................	Patent...............	5	67	87.5	39.5	194	2500	5.95	17	47	498	1810	98	98.5
Not fumigated....................	Patent...............	6	70	99	41	210	2550	6.1	17	45.5	499.5	1797.5	98	98.5
Not fumigated....................	Patent...............	7	71	95	40.5	206.5	2550	6.15	19	43.5	499.5	1805	98.5	98.5
Not fumigated....................	Patent...............	8	71.5	97	40	208.5	2525	6.15	16	46	500	1815	98	98.5

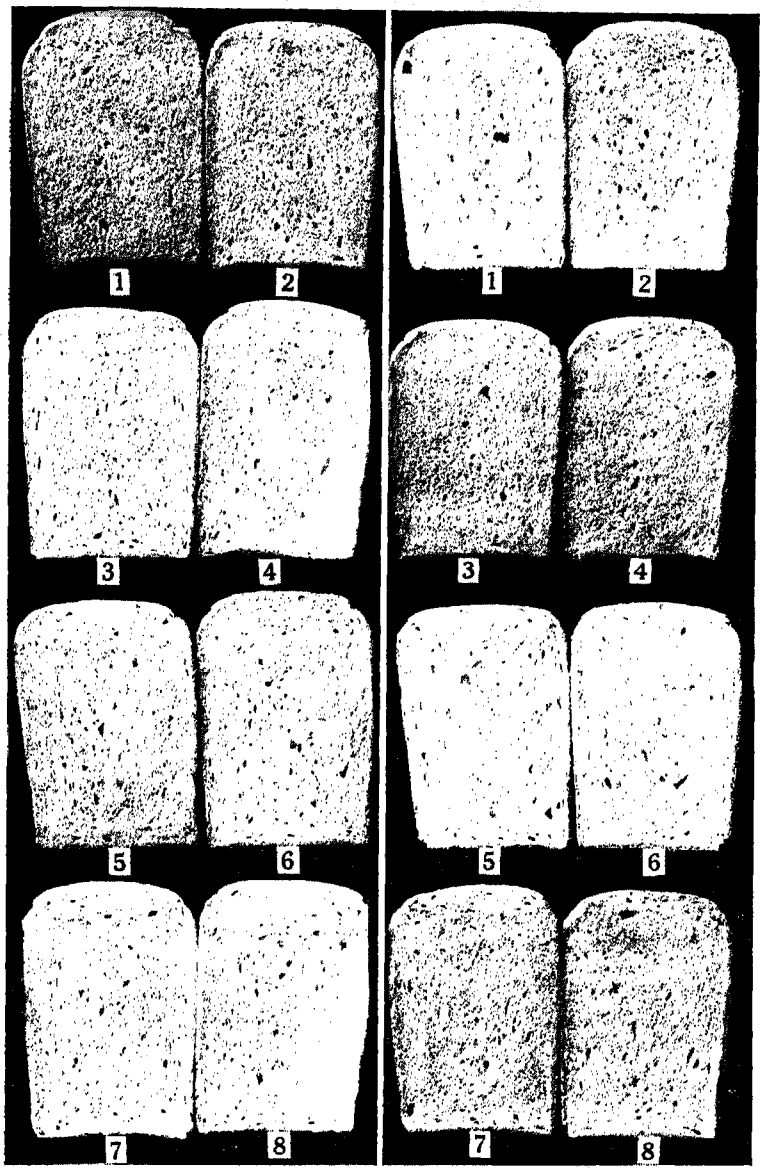

PLATE XIII.

The loaves shown in plate XIII were all made from nonfumigated flour. Loaves on the left were baked January 16, the loaves on the right were baked January 27. The eight upper loaves were from the same lot of hard winter-wheat patent flour; the eight lower loaves were from soft wheat patent flour. This plate, together with the figures in table XIII, which are the averages from the two tests, show the variations due to the baking test itself.

TABLE XIV.—Minutes for proving. First rise.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	96	79.5	74.5	72.5	62	59.5	65	62.5	69	74	68.5	70.5
	Straight	67.5	73	65.5	65.5	54	57.5	66.5	68.5	74.5	75.5	68.5	68
	Patent	70.5	75.5	66.5	70.5	59.5	60.5	67	69.5	70	73	67	100
	Total	234	228	206.5	208.5	175.5	177.5	198.5	200.5	213.5	222.5	204	238.5
	Average	78	76	69	70	59	59	66	67	71	74	68	80
Soft-wheat flour.	Low grade	76.5	73	71	69	74	69	70	71	65	63	70	69
	Clear	55	58	60	56.5	64.5	65	62	61	74.5	79.	71.5	69
	Straight	71	64	62.5	63	68.5	70	58	62.5	77.5	83.5	69.5	68
	Patent	65.5	77.5	62.5	67	70	69.5	62.5	61	96	109	66.5	66
	Total	268	272.5	256	255.5	277	273.5	252.5	255.5	313	334.5	277.5	272
	Average	67	68	64	69	68	68	63	64	78	84	69	68
	Grand total	502	501	463	464	453	451	451	456	527	557	482	511
	Grand average	72	72	66	66	65	64	64	65	75	79	69	73

TABLE XV.—Minutes for proving. Second rise.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	75.5	77	83	82.5	80	77	74.5	72.5	75.5	71.5	89	82
	Straight	83.5	80.5	98.5	99.5	82.5	84	88.5	82	82	80.5	106.5	107
	Patent	81	69	103.5	98	92	89.5	90.5	91	95	97	106	96.5
	Total	240	226.5	285	280	254.5	250.5	253.5	245.5	252.5	249	301.5	285.5
	Average	80	76	95	93	85	84	84	82	84	83	101	95
Soft-wheat flour.	Low grade	48.5	50.5	43	43	47.5	52	63	61	45	44.5	46.5	47
	Clear	83	83	75	74.5	80	77	92	90.5	76.5	77	83	86
	Straight	92.5	90.5	80	86	87	85	93.5	93	77.5	79.5	97.5	92
	Patent	105	110.5	81.5	84.5	95	94	93	102	74.5	68.5	93	96.5
	Total	329	334.5	279.5	288	309.5	308	341.5	346.5	273.5	269.5	320	321.5
	Average	82	84	70	72	77	77	85	87	68	67	80	80
	Grand total	569	561	565	568	564	559	595	592	526	519	622	607
	Grand average	81	80	81	81	81	80	85	85	75	74	89	87

TABLE No. XVI.—Minutes for proving. Third rise.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	38	34.5	31.5	32	29	39	32	29.5	32	31	49.5	49.5
	Straight	32.5	36.5	35.5	38	34.5	35	31.5	32.5	35.5	38.5	40.5	38.5
	Patent	36	37	37.5	38.5	39.5	35.5	33	33.5	37.5	38.5	37	38
	Total	106.5	108	105	108.5	103	109.5	96.5	95.5	105	108	127	126
	Average	36	36	35	36	34	37	32	32	35	36	42	42
Soft-wheat flour.	Low grade	25.5	26.5	24.5	29	27	27	26.5	27.5	22.5	22.5	24	22.5
	Clear	32.5	31	31	30	36	40	34	32.5	33.5	35	36	34
	Straight	37	36	35	38	39	41.5	36.5	40.5	37.5	42	40.5	43
	Patent	39	40	37	37.5	44.5	44	36.5	28.5	42.5	42	41.5	36.5
	Total	134	133.5	128	134.5	146.5	152.5	133.5	129	136	141.5	142	136
	Average	34	33	32	34	37	37	34	32	34	35	36	34
	Grand total	241	242	233	243	250	262	230	225	241	250	269	262
	Grand average	34	34	37	35	36	37	33	32	34	36	38	37

TABLE No. XVII.—Total minutes for proving.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	209.5	191	189	187	171	165.5	171.5	163.5	176.5	176.5	207	202
	Straight	183.5	190	199.5	203	171	176.5	186.5	183	192	194.5	215.5	213.5
	Patent	187.5	181.5	207.5	207	191	185.5	190.5	194	202.5	208.5	210	234.5
	Total	580.5	562.5	596	597	533	527.5	548.5	540.5	571	579.5	632.5	650
	Average	194	188	199	199	178	176	182	180	190	193	211	217
Soft-wheat flour.	Low grade	150.5	150	138.5	141	148.5	148	159.5	159.5	132.5	130	140.5	138.5
	Clear	170.5	172	166	161	180.5	182	188	184	184.5	191	190.5	189
	Straight	200.5	190.5	177.5	187	194.5	196.5	188	196	192.5	205	207.5	203
	Patent	209.5	228	181	189	209.5	207.5	192	191.5	213	219.5	201	199
	Total	731	740.5	663	678	733	734	727.5	731	722.5	745.5	739.5	739.5
	Average	183	185	166	170	183	184	182	183	181	186	185	182
	Grand total	1312	1303	1259	1275	1266	1261.5	1276	1272	1294	1325	1372	1370.5
	Grand average	187	186	180	182	181	180	182	182	185	189	196	196

TABLE No. XVIII.—Maximum volume of dough as affected by fumigation.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	1975	2000	2100	2150	2150	2175	2200	2050	2125	2100	2050	2050
	Straight	2300	2225	2500	2525	2550	2475	2475	2300	2350	2400	2450	2475
	Patent	2300	2225	2575	2575	2525	2525	2575	2350	2525	2500	2525	2525
	Total	6575	6450	7175	7250	7225	7175	7250	6700	7000	7000	7025	7050
	Average	2192	2150	2392	2417	2408	2392	2417	2233	2333	2333	2342	2350
Soft-wheat flour.	Low grade	1525	1500	1500	1500	1450	1450	1475	1400	1500	1525	1525	1525
	Clear	2625	2525	2425	2475	2350	2350	2575	2550	2475	2450	2375	2400
	Straight	2575	2600	2550	2525	2425	2425	2575	2575	2350	2350	2500	2500
	Patent	2750	2650	2625	2625	2550	2550	2700	2750	2525	2500	2700	2675
	Total	9475	9275	9100	9125	8775	8775	9325	9275	8850	8825	9100	9100
	Average	2369	2319	2275	2281	2194	2194	2331	2319	2213	2206	2275	2275
	Grand total	16050	15725	16275	16375	16000	15950	16575	15975	15850	15825	16125	16150
	Grand average	2294	2246	2325	2339	2286	2279	2368	2282	2264	2261	2304	2307

TABLE No. XIX.—Measure of oven spring.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	3.8	4.35	4.6	4.45	4.6	4.55	4.15	3.85	4.25	4.3	4.45	4.5
	Straight	5.65	5.25	6	5.8	5.85	5.9	6.05	6.05	6.05	6	6.05	6.3
	Patent	6	5.3	5.8	5.75	6.35	5.35	5.95	6.1	5.85	6	6.2	6.2
	Total	15.45	14.9	16.4	16	16.8	15.8	16.15	16	16.15	16.3	16.7	17
	Average	5.1	5	5.5	5.3	5.6	5.26	5.35	5.3	5.38	5.43	5.56	5.6
Soft-wheat flour.	Low grade	1.55	1.3	1.4	1.3	1	0.65	.15	—.45	1.3	1.6	1.35	1.25
	Clear	6.3	6.5	6.65	6.85	5.7	5.8	6	6.2	6.1	5.65	6.25	6.2
	Straight	5.8	6.15	6.1	5.65	5.7	5.6	5.4	5.4	5.65	5.45	5.55	5.5
	Patent	6.1	6.05	6.25	6.05	6.1	6.4	5.95	5.95	6.6	6.4	6	6.1
	Total	19.75	20	20.4	19.85	18.5	18.45	17.5	17.1	19.65	19.1	19.15	19.05
	Average	4.9	5	5.1	4.96	4.62	4.61	4.37	4.27	4.91	4.77	4.79	4.76
	Grand total	35.2	34.9	36.8	35.85	35.3	34.25	33.65	33.1	35.8	35.4	35.85	36.05
	Grand average	5	5	5.3	5.12	5.04	4.9	4.8	4.7	5.11	5.05	5.12	5.15

TABLE No. XX.—Weight of loaf.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	505	508	502	504	507	509	502	501	506	508	504	504
	Straight	509	506	501	499	506	506	505	500	506	501	502	503
	Patent	511	508	503	499	506	502	502	507	504	503	503	506
	Total	1525	1522	1506	1502	1519	1517	1509	1508	1516	1512	1509	1513
	Average	508	507	502	501	506	506	503	503	505	504	503	504
Soft-wheat flour.	Low grade	504	505	507	509	507	504	503	503	503	504	507	508
	Clear	500	496	501	502	497	498	500	501	503	495	501	501
	Straight	500	504	504	504	501	507	501	495	501	500	498	499
	Patent	502	502	502	501	505	504	495	493	502	505	498	500
	Total	2006	2007	2014	2016	2010	2013	1999	1992	2009	2004	2004	2008
	Average	502	502	504	504	503	503	500	498	502	501	501	502
	Grand total	3531	3529	3520	3522	3529	3530	3508	3500	3525	3516	3513	3521
	Grand average	504	504	503	503	504	504	501	500	504	502	502	503

TABLE No. XXI.—Volume of loaf.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulpide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	1585	1655	1620	1625	1640	1630	1560	1560	1640	1625	1590	1590
	Straight	1780	1740	1770	1710	1745	1750	1760	1758	1780	1810	1753	1775
	Patent	1840	1765	1785	1775	1815	1715	1810	1800	1760	1805	1750	1780
	Total	5205	5160	5175	5110	5200	5095	5130	5118	5180	5240	5093	5145
	Average	1735	1720	1725	1703	1733	1698	1710	1706	1727	1747	1698	1715
Soft-wheat flour.	Low grade	1240	1265	1245	1255	1200	1170	1125	1135	1243	1290	1250	1235
	Clear	1865	1855	1830	1855	1760	1780	1785	1795	1825	1760	1835	1835
	Straight	1785	1810	1810	1765	1735	1723	1730	1785	1775	1745	1760	1775
	Patent	1808	1788	1835	1780	1825	1840	1840	1830	1835	1800	1820	1820
	Total	6698	6718	6720	6655	6520	6513	6480	6545	6678	6595	6665	6665
	Average	1675	1679	1680	1664	1630	1628	1620	1636	1670	1649	1666	1666
	Grand total	11903	11878	11895	11765	11720	11608	11610	11663	11858	11835	11758	11810
	Grand average	1700	1697	1699	1681	1674	1658	1659	1666	1694	1691	1680	1687

TABLE No. XXII.—Texture of crumb.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	90	86	91	91	89	91	90	90	90	90	90	90
	Straight	96	96	96	95.5	95	96	96.5	96.5	96.5	97.5	97.5	98
	Patent	96.5	97.5	95.5	97	96.5	96	96.5	97.5	97	98	98.5	99
	Total	282.5	279.5	282.5	283.5	280.5	283	283	284	283.5	285.5	286	287
	Average	94	93	94	95	94	94	94	95	95	95	95	96
Soft-wheat flour.	Low grade	85	85	85	85	85	85	85	85	85	84.5	85	84.5
	Clear	94.5	94.5	96	96	96	96	95	95	95.5	95.5	96	96
	Straight	95.5	95.5	95.5	95.5	97	97	96	96	96.5	97.5	97	97
	Patent	97.5	98.5	97	97.5	97.5	97	98	98	97.5	99	98	99
	Total	372.5	373.5	373.5	374	375.5	375	374	374	374.5	376.5	376	376.5
	Average	94	93	94	94	94	94	94	94	94	94	94	94
	Grand total	655	653	656	658	656	658	657	658	658	662	662	664
	Grand average	94	93	94	94	94	94	94	94	94	95	95	95

TABLE No. XXIII.—Color of loaf.

		Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
		0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
		Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Hard-wheat flour.	Low grade	85	85	82.5	82.5	86.5	86.5	85	85	87	87	87	87
	Straight	96	96	96	95.5	94	94.5	96	95.5	97.5	97.5	98.5	98.5
	Patent	98	98	97	97 5	96	96.5	97	97.5	98	98.5	100	100
	Total	279	279	275.5	275.5	276.5	277.5	278	278	282.5	283	285.5	285.5
	Average	93	93	92	92	92	93	93	93	94	94	95	95
Soft-wheat flour.	Low grade	77.5	77.5	77.5	77.5	75	75	80	80	75.5	75.5	75	75
	Clear	94.5	94	94.5	94.5	93	93	96	96	93.5	93.5	94	94
	Straight	96	96	95.5	96	96	96	96	97	96	96	97	97
	Patent	97.5	98	97.5	97.5	98	98	99	99	99	99	99	99
	Total	365.5	365.5	365	365.5	362	362	371	372	364	364	365	365
	Average	91	91	91	91	91	91	93	93	91	91	91	91
	Grand total	645	645	641	641	639	640	649	650	647	647	651	651
	Grand average	92	92	92	92	91	92	93	93	92	92	93	93

TABLE No. XXIV.—Summary of Averages. Hard wheat.

	Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
	0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated	Check.	Treated.
Time for proving:												
First rise, minutes	78	76	69	70	59	59	66	67	71	74	68	80
Second rise, minutes	80	76	95	93	85	84	84	82	84	83	101	95
Third rise, minutes	36	36	35	36	34	37	32	32	35	36	42	42
Total time	194	188	199	199	178	176	182	180	190	193	211	217
Maximum volume of dough, cc	2,192	2,150	2,392	2,417	2,408	2,392	2,417	2,233	2,333	2,333	2,342	2,350
Measure of oven spring, cm	5.10	5.00	5.50	5.30	5.60	5.26	5.35	5.30	5.38	5.43	5.56	5.60
Volume of loaf, cc	1,735	1,720	1,725	1,703	1,733	1,698	1,710	1,706	1,727	1,747	1,698	1,715
Weight of loaf, gms	508	507	502	501	506	506	503	503	505	504	503	504
Texture of crumb, per cent	94	93	94	95	94	94	94	95	95	95	95	96
Color of loaf, per cent	93	93	92	92	92	93	93	93	94	94	95	95

TABLE No. XXV.—Summary of averages. Soft wheat.

	Fumigation with hydrocyanic acid.						Fumigation with carbon bisulphide.					
	0 days.		30 days.		60 days.		0 days.		30 days.		60 days.	
	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.	Check.	Treated.
Time for proving:												
First rise, minutes	72	72	66	66	65	64	64	65	75	79	69	73
Second rise, minutes	81	80	81	81	81	80	85	85	75	74	89	87
Third rise, minutes	34	34	37	35	36	37	33	32	34	36	38	37
Total time	187	186	180	182	181	180	182	182	185	189	196	196
Maximum volume of dough, cc	2,294	2,246	2,325	2,339	2,286	2,279	2,368	2,282	2,264	2,261	2,304	2,307
Measure of oven spring, cm	5.00	5.00	5.30	5.12	5.04	4.90	4.80	4.70	5.11	5.05	5.12	5.15
Volume of loaf, cc	1,700	1,697	1,699	1,681	1,674	1,658	1,659	1,666	1,694	1,691	1,680	1,687
Weight of loaf, grams	504	504	503	503	504	504	501	500	504	502	502	503
Texture of crumb, per cent	94	93	94	94	94	94	94	94	94	95	95	95
Color of loaf, per cent	92	92	92	92	91	92	93	93	92	92	93	93