



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

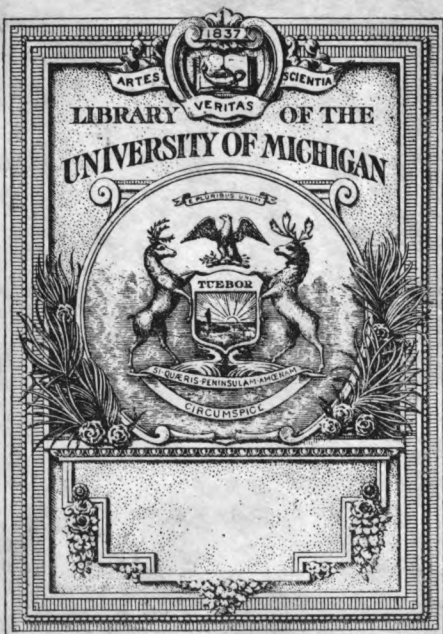
Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

Manual for army bakers

United States.

Army.

Quartermaster ...



UC

723

.A25

1917

Quintessence of War

MANUAL FOR ARMY BAKERS

1916



WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

WAR DEPARTMENT.
Document No. 563.
OFFICE OF THE QUARTERMASTER GENERAL.

CONTENTS.

	Page.
CHAPTER I.—WHEAT.....	5
CHAPTER II.—FLOUR.....	9
CHAPTER III.—YEAST.....	24
CHAPTER IV.—BREAD.....	43
CHAPTER V.—SPECIAL RECIPES.....	61
CHAPTER VI.—POST BAKERY EQUIPMENT.....	64
CHAPTER VII.—FIELD BAKERIES.....	72
CHAPTER VIII.—FIELD BAKING EXPEDIENTS	102

ILLUSTRATIONS.

Yeast plant.....	25
Flour cell.....	30
Molding table.....	68
Dough trough.....	69
Field bread just out of oven.....	83
Field oven No. 1 partially set up.....	86
Field oven No. 1 completely set up.....	88
Arrangement of mixing tent for warm and moderate weather.....	90
Arrangement of mixing tent for cold weather.....	91
Field oven No. 1 packed on escort wagon.....	94
Field bread packed on escort wagon.....	97
Field bread packed on truck.....	99
Bread-carrying rack.....	100
Plan of trench cover.....	102
Baking in steep bank.....	105
Two-barrel clay oven.....	106
Baking in the open trench.....	107
Appendix A. Camp of bakery company.....	109
B. Brick foundation for trench.....	110
Plan of brick fire trench.....	110

MANUAL FOR ARMY BAKERS.

CHAPTER I.

WHEAT.

1. **Wheat** is the most important of the cereals grown in this country. It thrives in temperate regions, but does not flourish in the Tropics.

2. All wheats may be divided into two general classes:

(a) **Winter wheat**, which is sown in the fall and is hardy enough to survive the winter.

(b) **Spring wheat**, which is sown in the spring, in climates where there is danger of killing winter frosts.

Winter wheat is generally classified as soft wheat and spring wheat as hard wheat, but there are hard and soft varieties of both.

CLASSIFICATION OF WHEAT.

3. In the United States the wheats used for making flour may be grouped under the following heads:

(a) **Soft red winter wheat**, grown in eastern United States, in a mild, even, moist climate—light-red grain, containing a medium percentage of gluten.

(b) **Hard red winter wheat**, grown in the region south of central Iowa and between Ohio and the Rocky Mountains, in a climate having extremes of temperature and moisture, with hot, dry summers. A red grain with a high percentage of gluten.

(c) **Hard spring wheat**, grown in Minnesota and the Dakotas, Wisconsin, Iowa, Nebraska, and Canada, in a climate too severe

for winter wheat. A small reddish grain, containing a high percentage of gluten.

(d) **White winter wheat**, grown on the Pacific coast and in some of the Rocky Mountain States, in a mild, even climate. A large, white, plump grain, containing a low percentage of gluten.

(e) **Durum wheat**, commonly known as macaroni wheat from its use in the manufacture of that article, is grown principally in the semiarid region extending north and south of western Kansas and eastern Colorado. It will withstand drought and heat and flourish in dry alkaline soil. In some mild climates it is sown in the fall, but is generally classed as a spring wheat. It has large, hard, reddish-yellow kernels containing a very high percentage of gluten. Its flour is yellow and makes a dark bread and when unblended is not considered desirable by bakers for bread-making purposes.

4. Generally speaking, flour from hard wheat contains a relatively large proportion of gluten, say from 10 to 16 per cent, and flour from soft wheat much less, generally from 7 to 9 per cent. From a baker's standpoint starch is of secondary importance. Flour is composed almost entirely of these two elements, and each serves a most important function in the process of bread making.

GRADING OF WHEAT.

5. The rules for grading wheat vary somewhat in different sections of the country, according to the kinds of wheat there grown.

These rules are uniform, however, in one particular—the number of grades.

No. 1 wheat must be perfectly sound, plump, dry, have an even color, be free from all foreign matter, and have a sweet flavor.

No. 2 wheat must be sound, unaffected by must, rain, sun, or dew.

No. 3 wheat may be somewhat bleached and otherwise unsound—slightly inferior to No. 2.

No. 4 wheat, unsound from any cause, sufficient to render it unfit for No. 3.

All lower grades are rejected.

As a general rule No. 1 should weigh not less than 60 pounds to the bushel, No. 2 not less than 58 pounds, and No. 3 not less than 56 pounds.

Only a small percentage of wheat grown will grade No. 1, and it is usually, if not always, retained and used for seed.

COMPOSITION OF WHEAT.

6. An average hard wheat contains about—

10 per cent water,

12 per cent gluten, producing flesh and muscle. The gluten cells are distributed throughout the heart of the grain among the starch cells. The amount and quality of gluten determine the water-retaining capacity of a flour and regulate the quantity of bread produced.

68 per cent starch, producing heat, energy, and fat. The starch cells comprise the greater portion of the kernel. Starch is the water absorber. During the process of fermentation about 2 per cent is transformed into alcohol and carbonic-acid gas. The carbonic-acid gas forms in cells, giving lightness to the bread, but the alcohol vaporizes in the oven, where most of it escapes.

2 per cent fat, found mostly in the germ. As fat tends to produce rancidity in flour, the germ is now generally removed in modern milling.

8 per cent bran, the five outer coats of the wheat kernel are strong in woody fiber, mineral ingredients, and coloring matter. It is very indigestible in the human stomach and is excluded in the process of manufacture except where graham or whole wheat flour is desired.

The proportions in which the several ingredients appear vary considerably in different wheats. For example, Oregon white winter wheat contains about 9 per cent gluten, Minnesota hard spring wheat about 14 per cent, Oklahoma hard winter wheat about 15 per cent. All wheat raised in low, damp districts contains more moisture, generally less gluten, and gluten of inferior quality than that raised in higher and drier climates.

Soft wheat contains less gluten and more starch and water than hard wheat.

SWEATING OF WHEAT AND FLOUR.

7. About September or October the wheat from the new crop and the flour made from it undergo a natural change of condition. They evolve (or give off) a portion of the water contained in them, and this change is accompanied by a rise in temperature. After passing through the sweat the wheat becomes dry, hard, and flinty, and it should not be milled until this time. Flour takes on a darker appearance during this period, and if it does not sour it becomes white again as the sweat passes off. While passing through the sweat it should not be used. If made from wheat that has not yet passed through the sweat it should be used up as soon as practicable in order that it may not become musty and a total loss. Wheat is generally allowed to sweat in the stack, and always before milling, unless it is intended to use the flour at once. If used, however, before it has passed through the sweat it is lifeless and produces a dark and heavy loaf. It must, therefore, be mixed with at least 50 per cent of an aged, hard wheat flour to obtain a fair loaf.

Wheat improves in quality until after it passes through the sweat, after which it does not undergo any perceptible change for years.

CHAPTER II.

FLOUR.

8. *Flour* is the pulverized, refined, and bolted product of wheat and other grains. In this book the term will be used to designate wheat flour, unless otherwise designated.

MILLING.

9. There are two processes of milling, known as—

(a) *Low milling*, in which the grain is ground between two large, round, flat stones with radial grooves cut in their grinding faces. The upper revolves at such a distance from the lower, which is stationary, as to crush the grains and finally reduce them to powder. In this process the flour is heated to a temperature of at least 120 degrees Fahr., and it is believed that this injures the gluten, making it less tenacious and consequently less fit for making light bread. In addition, there is the objection that portions of the indigestible husks are ground into meal and mixed with the flour. This method is practically obsolete, for the reason that it produces a flour inferior in every respect to that produced by modern methods.

(b) *High milling*, in which the wheat, when received at the mill from the country, is first weighed and then conveyed by elevators to storage bins. From the storage bins the wheat goes to the first cleaning process, known as a milling separator, which is merely a series of metal sieves. The perforations of the first two sieves are just large enough for a kernel of wheat to pass through, and therefore oats, straw, and other impurities larger than wheat kernels are separated from the wheat on these sieves. The lowest sieves of the series have perforations considerably smaller than a kernel of wheat, through

which the mustard seeds and other impurities smaller than a kernel of wheat pass.

From the milling separator the wheat is passed to what is called the wheat scourer, an upright, perforated cylinder, in the center of which, revolving about the shaft, are large beaters. The wheat falls down in the center, is struck by the beaters and thrown against the outer case and after revolving a number of times against the casing passes through the opening in the bottom of the cylinder. While it is falling through the cylinder there is a strong current of air passing upward, which carries off the dust from the scouring.

After thus being partially cleaned, the wheat is moistened, generally by introducing a stream of water into the wheat, in order to toughen the bran and other fibrous matter in the wheat berry, making possible its more complete extraction.

This wetting process is also necessary for the maintenance of a uniform percentage of moisture in the flour, some wheats containing more and some less moisture in their natural state.

After the wheat has been moistened it is allowed to stand in bins for a varied length of time, dependent upon the character of the wheat used and the quality of the flour desired.

The wheat is then drawn from these tempering bins, generally steel tanks, and passed through another scourer, as described above, to complete the process of cleaning.

It then passes to the first set of corrugated rolls, commonly called the first break. These rolls have corrugations cut lengthwise in their surface of greater or less depth and from 10 to 14 to every inch of circumference. They are set at such a distance apart as to little more than crack the wheat open.

This is ordinarily termed the first break or first reduction.

After passing through the first break, the now partially ground and broken wheat goes into a sifter machine. This machine contains a number of sieves clothed with wire and silk cloth of different degrees of fineness of mesh and has a quick gyrating motion, making it possible thereby to separate the ground material into various qualities or classes.

The coarser material or bran particles pass on to the next pair of corrugated rolls, which are similar to the first, but on



which the corrugations are somewhat finer, and the rolls are set somewhat closer together.

This process of grinding by corrugated rolls and separating by sifter machines is repeated ordinarily about five times, the bran finally passing from the last sifter to a duster machine, which brushes off the few remaining flour particles from the bran.

In the separations made by the sifter machine there are various qualities of middlings, resultant from the grinding of the wheat on the corrugated rolls, as above described.

These different qualities of middlings are classified and passed on to the purifiers. These purifiers have long, narrow sieves clothed with silk cloth, with a strong current of air passing upward through the cloth.

The middlings travel from one end of the sieve very gradually to the other, the current of air being strong enough to lift the dust and fine particles out of the middlings, blowing them out of the machine, but still not strong enough to disturb the middlings which pass through the cloth.

After these middlings are thoroughly purified, they are reduced in a manner similar to the gradual reduction of the wheat, except that instead of having the rolls corrugated they are smooth, the grinding action being obtained by the differential in the speed of the rolls, generally about one and one-half revolutions of the fast roll to one revolution of the slow.

The different grades of middlings when ground are passed into sifter machines with varied numbers of silk cloths, and the different separations are made similar to those handling the product from the corrugated rolls.

This gradual reduction of middlings is necessary in order to thoroughly eliminate the germ and fine particles of bran and fibrous material, the grinding action of the smooth rolls being to the effect of the good particles disintegrating and becoming finer and the impurities flattening out and becoming larger, after which separation by sifting process is very easy.

A greater or less proportion of flour is made with every grinding of either wheat or middlings, the object being, however, to make reductions very gradually until all impurities are eliminated, after which further reductions are regulated by the

character of granulation desired in the flour, whether coarse or fine.

Flour made from the gradual reduction of middlings is of the highest quality, by reason of its containing the highest percentage of gluten.

The various grades of flour, as separated during the process of milling, pass to their several bins and into the flour packers where they are packed into barrels and sacks for shipment.

PRODUCTS OF HIGH MILLING.

10. *First patent flour*, derived from the reduction of the middlings; thoroughly purified and will produce a white loaf.

Second patent flour, similar to the first but not as thoroughly purified; not quite as white.

Straight or standard patent flour, ordinary flour as found on the market; it consists of a mixture of first and second patent.

First clear grade flour, second grade of flour; it contains a small but noticeable quantity of bran.

Second clear grade flour, third grade of flour; it contains more fine bran than first clear.

Red Dog, first grade of feed; it contains a considerable quantity of fine bran.

Shorts, fine bran containing a small quantity of second-grade flour.

Bran, the outer covering of the wheat kernel; it has no food value for man.

GLUTEN.

11. That constituent of wheat-flour dough which enables the dough to expand, and thus retain the fermentative gases, is called gluten. Gluten, as such, does not exist in dry flour. Two elements of flour, distinct from each other in the dry state, unite upon the addition of water to form gluten. These two elements are *gliadin* and *glutenin*. The *glutenin* gives solidity and body to the gluten; the *gliadin* gives it toughness and elasticity. If either of these elements is absent or should be extracted from flour, no gluten will be formed. For this reason light bread can not be made from rye flour, as it contains no glutenin.

12. To ascertain the percentage of *gluten* in flour, weigh out carefully any small quantity, say one pound; add to this enough water to make a stiff dough. Let it stand for 30 minutes. Place a rather deep dish under a faucet and turn on a steady trickle of cold water. Hold the dough in this stream of water over the dish and knead gently between the fingers. The milky water coming from the dough shows the starch that is being kneaded out. When the water from the dough runs clear lay the ball of gluten, left in the hand, aside. Pour off the clear liquid in the dish and gather up in the hands the solid particles of dough in the bottom. Knead these in the same way. Repeat the operation until nothing but the gluten is left. Now unite the particles of gluten in one ball and knead again under a slow stream of water until the water from the gluten runs perfectly clear. The substance left in the hand is "wet gluten." It should have a light yellow tinge, be tough and pliable, and so elastic that it can be pulled into threads or into a thin sheet before breaking. A dark-gray or reddish gluten or one spongy in texture is not of good quality. Place the ball of gluten in water for one hour, then remove it, squeeze out the water, and weigh the gluten accurately. Place it on a plate and leave in a temperature of about 90° for 48 hours. The result is called "dry gluten." It is about the consistency of dry glue, hard, yellow, and brittle. Weigh again—the difference in weight between the wet and dry gluten is the water that was contained in the wet gluten. The percentage of gluten present in the flour is found by dividing the weight of the dried gluten, in ounces, by the number of ounces of flour used in the test and multiplying by 100—thus, 2 divided by 16, multiplied by 100, equals 12½ per cent, the approximate percentage of gluten present. A good flour should show from 32 to 50 per cent moist gluten and from 11 to 18 per cent dry gluten. Some flours, notably *Durum wheat flours*, will show as much as 16 to 18 per cent dry gluten. But it by no means follows that a flour containing the highest percentage of gluten will make the best bread. It is true, however, that flours with low gluten content do not make good bread. The color of wet gluten usually indicates its quality. A dark-gray, putty-like gluten will not make good bread.

13. The actual amount of gluten found is of importance in that it represents the percentage of muscle-building material present in the flour. *The strength of a flour*, however, is determined more by the *quality* of the gluten than by the *amount*. The great elasticity and tenacious character of wheat gluten renders the making of light bread possible. It forms layers of envelopes within the dough, preventing the escape of carbonic acid gas that results from fermentation. This gas, as it rises, forms in pockets, or cells, within the dough, causing the latter to expand, and gives corresponding lightness to the bread. As there is no gluten in either rye or cornmeal each should be mixed with a strong wheat flour in order to produce a fairly light loaf.

14. The *gluten* of wheat raised in low, damp localities contains much moisture and therefore appears to be in greater quantity than it really is. It is not tough enough to retain the fermentative gases, and consequently the bread is heavy and of poor quality. Gluten of poor quality is also found in the flour of immature wheat, of sprouted wheat, of wheat that has been frosted and of wheat raised on exhausted soil.

GRAHAM AND WHOLE WHEAT FLOUR.

15. **Graham flour** is the whole of the wheat, including the bran, ground together.

A great deal of the graham flour put on the market is generally a mixture of bran, shorts, and some of the various low-grade flours. In this so-called graham flour the choicest portion of the wheat is missing, having been extracted and used in the manufacture of high-grade flour. In consequence this flour is inferior to true graham as the latter contains all the wheat—the best portions as well as the poorest.

In mixing the so-called graham flour the following formula is used by a well-known milling company :

Second-grade flour, 270 pounds.

Shorts, 100 pounds.

Bran, 30 pounds.

As shorts and bran are practically indigestible in the human stomach, it is noted from the above formula that the flour thus

prepared contains but $67\frac{1}{2}$ per cent as much actual nutriment as a corresponding weight of white flour.

16. **Graham flour** is a valuable article of diet for those suffering from constipation. The outer bran husk is almost pure silica (glass), and in passing through the system it scratches the delicate membranes, setting up an irritation, causing increased secretions and consequently acting as a laxative.

17. **Whole wheat flour** (or entire wheat flour) is made by grinding the entire wheat kernel on a corrugated roll, removing only the coarse, fibrous part of the bran.

GLUTEN FLOUR.

18. **Gluten flour** is wheat flour from which a portion of the starch has been removed. The term is often applied to a flour strong in gluten.

RYE FLOUR.

19. **Rye flour** is darker than wheat flour, but is in many other respects similar to it. Owing to the fact that rye contains no glutenin, and consequently no gluten, it is impossible to make from it a light loaf such as will result from wheat flour. In nutritive value, however, the two flours are practically equal. A good, palatable loaf of so-called rye bread may be made by mixing wheat flour with rye flour in the proportions of two parts wheat and one part rye.

Wheat is fast replacing rye throughout the world, although the latter is still extensively used in Europe. Rye is cheaper and easier to produce than wheat. It will grow in dry soil and very cold climates, where wheat would not thrive. The principal objections to the use of rye flour in bread making are its color and the fact that occasionally a fungus, ergot, is developed within it. This fungus is poisonous and may cause serious injury to health. Ergot is sometimes found in wheat, but more frequently in rye.

SELF-RAISING FLOURS, YEAST FOOD FLOURS, ETC.

20. So-called "self-raising" flours consist of flour—made either of wheat, some other cereal, or a mixture of cereals—and baking powder in proper proportion to produce carbonic gas sufficient to aerate the mixture desired. They have no particular merit. The best that can be claimed for them is that they save the baker the time used in mixing his flour and baking powder.

Several flour preparations have been put on the market labeled variously as "yeast" or "yeast-food" flours. They usually consist largely, or altogether, of corn flour or potato flour. Sometimes a small amount of sugar is added or the flour is subjected to a process whereby a portion of the starch is dextrinized. It is claimed that the addition of a small amount of such flour will materially increase the yield of bread. It is not believed that such claims can be substantiated.

COLOR, AGING, AND GRANULATION.

21. The best flour for the use of the army baker is that having a slight creamy tinge. A flat or dead white color is to be avoided. Such flour contains much starch and little gluten. A gray or dark colored flour indicates a poor quality of gluten or poor milling.

If flour is milled from sound, strong, cleaned wheat, it will be much improved both in color and bread-making properties by storing in a well-ventilated storehouse for a period of from two to four months. In other words, aging improves flour within certain limits. If the wheat from which the flour was milled was unsound, or if the storage conditions are unfavorable, flour will deteriorate during such storage. Good flour, well milled, will become considerably whiter if stored for a period of several months.

The best flour, when rubbed between the fingers, will feel as though it contained a considerable portion of very fine sand. The granular particles thus felt are reduced middlings. Any flour in which this granular matter can not be detected is not a good flour for bread-making purposes. It is most probably

milled from soft wheat and contains a low percentage of gluten. On the other hand, too coarse granulation must be avoided.

STORING AND TRANSPORTATION.

22. **Flour** ordinarily contains from 9 per cent to 14 per cent of water, and, under the influence of heat, natural or artificial, not strong enough to expel the moisture but strong enough to start fermentation, it will heat and sour. Flour is peculiarly sensitive to the exhalations from other substances and should not be stored in the same room with sour liquids, decaying vegetables, or articles that emit unsavory or noxious vapors, as oil or gasoline. For the reasons stated it is evident the "*flour should be kept in a cool, dry, well-ventilated storeroom.*" If properly taken care of it will keep in a good condition for a year or more. A temperature of about 70° F. is considered best. High temperature favors acid fermentation and mold.

23. **In order to protect flour** against *rats* and *mice*, newspapers should be stuffed in convenient cracks between the sacks. They will use the papers in preparing their nests and leave the sacks alone.

24. **For shipment by rail**, flour should be loaded in clean, dry cars. The sacks should be laid lengthwise of the car, ears toward the center.

KEEPING QUALITIES.

25. **If possible**, flour should not be kept for more than a year. When animal and vegetable parasites begin to appear it is generally an indication of decomposition of the gluten and consequent deterioration of the flour.

26. **Weevils and cockroaches** often work their way into good flour under certain conditions and should be removed by sifting. Much of the flour received in the Philippines after a long voyage in the hold of a ship is found to be fairly alive with these little insects, and if the flour were destroyed or thrown away the troops would at times be without bread. Inasmuch as such insects have frequently been found in tinned flour, presumed to

have been hermetically sealed soon after milling, it must be either that the germs from which they develop exist in the wheat and survive the process of milling or that some cans are not air-tight and that the vermin enter at the leaks and deposit their eggs, which is more likely. Bread made from such flour has a distinctly cockroach flavor.

27. **Wet flour.**—Flour that has become wet and quickly dried is not spoiled. Sacks of flour left in the rain or dropped into the water should be dried at once in order to prevent molding. If taken care of promptly, the loss will be trifling.

UN SOUNDNESS.

28. **A good flour can not be made from a poor wheat.** An expert miller may produce a fair flour, even though an inferior quality of wheat be used, but such flour will soon develop some undesirable quality. The odor of flour is a good indication of its soundness. Any deviation from the normal fresh, wheaty smell should be regarded with suspicion. Any odor that indicates sourness or acidity, or any taint of mustiness should be sufficient to reject it. If flour has a musty odor, that odor will be more pronounced in the baked bread. *A flour tainted with even the slightest degree of must will rapidly deteriorate; also a flour made from sprouted wheat; or one in which there is any considerable mixture of such wheat will deteriorate quickly on account of the fermentative action of moisture on the ruptured starch cells. A flour that contains more than 14 per cent of moisture is liable to become unsound.*

BLENDING. .

29. It is an almost invariable rule that a soft wheat, by reason of its relatively greater proportion of starch and lesser proportion of gluten, will yield a whiter flour, and consequently whiter bread, than a hard wheat. A high patent flour will yield a whiter loaf than a low patent or straight flour. Good bread can be made from the flour of either winter or spring wheat. If the flour on hand in the bakery is milled from soft winter

wheat, it would be advisable to blend or mix it with another flour made from hard spring wheat in order to increase the yield of bread and add to it a proper proportion of proteid matter. Some bakers advocate the addition of soft wheat flour to hard wheat flour in order to improve the flavor and color of the resulting bread. It is not believed that, for our purposes, such blending is either necessary or advisable.

An inferior flour which will not of itself make good bread can be utilized by mixing it with a strong flour. If the sponge and dough process is employed, the strong flour should be used in the sponge and the inferior flour in the dough. If the straight dough process is used, the two flours should be thoroughly mixed by sifting while dry. The proper proportion of each flour thus used can only be determined experimentally by baking.

Soft winter wheat flour alone is often used in making crackers and pastries, as the resulting product is white and brittle. A flour strong in gluten is desired for making bread.

SIFTING.

30. All flour, regardless of presumed condition, should be carefully sifted before using. Small nails, pieces of twine, slivers of wood, etc., in addition to hard lumps, are frequently removed from flour supposed to have been put up in the most careful manner.

BLEACHING.

31. High-grade flours have often been successfully bleached in order to secure a higher price or a more ready sale on the market, *as very white bread, as well as very light bread is frequently in demand.*

Low-grade flours can not be bleached so as to resemble the high grades because the small bran particles left in low-grade flours blacken during bleaching and become more prominent.

Flour may be bleached by careful exposure to sunlight, but ordinarily bleaching is accomplished by passing nitrous or sulphurous fumes over it. The United States Department of Agri-

culture has ruled that where chemicals are used there is adulteration, and that in such cases the practice is illegal.

Bleaching is also accomplished by electricity.

ADULTERATION.

32. **Adulteration of wheat flour** is of rare occurrence. The addition to wheat flour of foreign matter or of other flour, such as rye or corn, will interfere with its bread-making qualities and result in a heavier loaf.

FLOUR TESTS.

33. **The best test of flour** is said to be in the baking, but there are many indications as to its true quality before proceeding to this stage:

Color.—*Good flour* should be of a creamy, yellowish-white shade. If dead white, or nearly so, the indications are that much of the gluten has been removed in milling and what is left is almost pure starch. A gray or bluish color indicates inferior wheat and poor quality of gluten.

To test for color place a small quantity of the flour on a glass slab or smooth board, side by side if possible, with a flour of known worth. If the flour to be tested is a spring wheat flour, the standard should also be spring wheat; if a winter wheat flour, the standard should be milled from winter wheat. Smooth down the flours with a flour spatula, being careful to give each the same amount of pressure. Compare color dry, then slip the slab under water, hold it there for a few seconds, bring it out and compare again for color. The color wet will be very nearly the color of the resulting bread.

Smell and taste.—The smell and taste should be that of freshly ground wheat. It should be sweet and nutty, without a trace of sourness and free from must or any disagreeable odor. Any unusual taste or odor in flour is objectionable.

Feel.—*Good flour* falls loosely apart when squeezed in the hand and retains the impression of the fingers and even of the skin much longer than poor flour. If flour feels damp or sticky it is not of the best. Dampness is indicated by the possibility

of rolling a pellet of the flour between the thumb and finger. It may be detected by plunging the dry, open hand into the flour.

Granulation.—Flour, when rubbed between the fingers, should not feel soft and powdery; it should have a somewhat gritty feeling, and its individual particles should be vaguely distinguishable. When put between the teeth it should crunch a little.

Gluten.—If a handful of flour is thrown against the side of a trough or other smooth vertical surface and a considerable portion of it sticks there, the indications are that the flour is rich in gluten. Good gluten, when heated to a temperature of 150° F., swells and assumes the appearance of bread.

The method of determining the quantity of gluten in flour has already been described in a previous paragraph.

Doughing test.—Mix into a dough a small portion of flour and one-half of its own weight in water, kneading the dough thoroughly. Roll the dough into a round ball, place it on the bottom of an inverted saucer, and let it stand for 30 minutes. If at the end of that time the dough has held its shape and has formed a crust, the flour possesses strength; if, on the other hand, it has flattened out and spread, it is an evidence of deficient gluten. Take the ball of dough and flatten it out so that it resembles a biscuit. If by gradual pulling the dough can be so manipulated as to be made into a thin transparent sheet, it contains a good quality of gluten. Make it into a roll and gently pull it lengthwise. If on release of the pull the dough returns to its original shape, the flour is strong in gluten.

Good flour when kneaded into dough is elastic and easy to handle. It will stay in a round, puffy shape and will have taken up a great deal of water. Dough made of poor flour will be sticky, flatten out, and run over the board and will never seem to get sufficiently stiff no matter how much flour is added to it.

If the foregoing tests have proven successful, the baker may rest assured that the flour sample is good. To dispel all doubts the baking test should be resorted to. In this test the bread baked from the sample should be compared with bread baked at the same time from a well-known standard flour. In conducting this comparative test care should be exercised to insure the same conditions throughout for both flours.

CONDITIONS REQUISITE FOR STRENGTH.

34. "A loaf of bread consists of a baked, aerated mass of elastic dough. The first requisite of a strong flour is that there must be a sufficiency of sugar or other material available for fermentation and consequent production of gas in the dough. As dough fermentation involves a series of changes, in which the distension by gas is but one, the source of gas must be sufficient for its continuous production, not only at the earlier stages but throughout the whole process and essentially during that period in which the loaf is acquiring its final shape and volume; that is to say, some little time before and after it is placed in the oven.

"Then next there must be some substance present in the flour which shall be capable of retaining a sufficiency of the gas generated in the dough, and elastic enough to be evenly distended by such gas. According to the kind of loaves to be made the requirements for strength vary somewhat. If the bread is to be baked in a tin, it is supported on all its four sides, the top only being open; the same holds good, though to a slightly lesser degree, in close-packed, oven-bottom bread, where the loaves support each other. For bread of this kind the dough must be very soft and even '*runny*,' provided it is elastic and of good gas-retaining capacity. But when the bread is baked into crusty loaves, whether of the cottage or Coburg type, the dough must not only be elastic and gas-retaining, but it must also possess sufficient rigidity to maintain its shape when standing alone and independently. Otherwise it will make a large but flat loaf and not a bold, well-risen one. The requisites necessary for strength under one of these sets of conditions are not precisely the same as in the other.

"It is generally recognized that the constituent of wheaten flour, in virtue of which its dough possesses these qualities of gas-retaining power and elasticity, is that known as gluten, that curious body largely composed of gliadin and glutenin. There must be sufficient gluten present to adequately retain gas and confer elasticity. Too much may be injurious, inasmuch as it may offer too great a resistance to the action of the distending gas. The consequence of this is the production of small and

what are sometimes called "gluten-bound" loaves. Further, the gluten must be of the right quality; it must be sufficiently impermeable to gas; it must be highly elastic, yielding readily to distension without breaking, and yet it must be sufficiently rigid, particularly in the case of crusty loaves, to maintain a well upstanding, bold shape. Quantity and character of gluten may to a certain extent compensate each other. If the gluten is exceptionally good, a little less of it may suffice, while slight deficiency in quality may be made up by a little extra in amount. Added to all this, important changes are going on in the gluten during the whole of the time of its fermentation. Normally it is softening as fermentation proceeds, and becomes more yielding and gas-retaining during the operation. There comes a time, however, when the gas-retaining power is at its best, and further change simply injures and diminishes its tenacity. The art of the baker in part consists in so balancing all these various factors as to get the best possible result out of the flour with which he is working." (Jago.)

NUTRITIVE VALUE OF FLOUR.

35. The nutritive value of wheat flour is found to be about equal to that of rye and corn flour; a little less than that of peas, beans, and pork; a little greater than that of beef; and from 4 to 10 times greater than that of fresh vegetables. It will thus be seen that flour contains much nourishment, which when presented in the form of bread is both palatable and digestible.

CHAPTER III.

YEAST.

ELEMENTARY PRINCIPLES OF FERMENTATION IN BREAD MAKING.

36. In order to understand the process and purpose of bread making it must be remembered that flour consists largely of starch and gluten, and that these ingredients can be taken up and used in the system only after they have been converted into more soluble forms.

Something must also be known about the process of fermentation, which renders it possible to make bread that can be easily digested by the juices supplied within the body for that purpose.

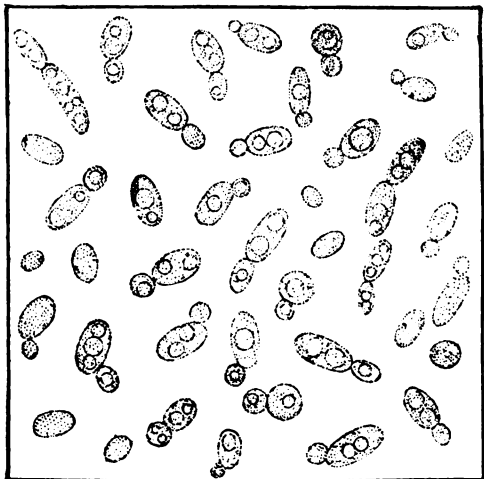
37. **Fermentation.**—Light bread can be made by forcing compressed air through the wet dough and baking at once, or by making use of the gas generated by certain so-called “baking powders,” but from time immemorial the ordinary process has been to set up fermentation within the dough by some means or other, utilizing the gas generated to produce the cellular structure.

“A microscopical examination was recently made of some bread over 4,400 years old found in Egypt with other remains of a long-vanished people. It was made of ground barley and the yeast cells were plainly visible.” (H. W. Atwater, U. S. Department of Agriculture.)

DEPARTMENT OF AGRICULTURE.

Now fermentation is simply the change which takes place in vegetable matters when the starch and sugar they contain are decomposed and changed into new compounds. The change is

hastened by the presence of a certain amount of *moisture* and a *uniform temperature* of from 80° to 90° F., and may take place in two ways:



Atwater, Bull. 112, U. S. Dept. of Agriculture.

YEAST PLANT.

(Highly magnified.)

Each yeast cell is said to reproduce itself in from four to five hours under favorable conditions. The growth and development of cells as seen under the microscope is illustrated above.

(a) It may be spontaneous under favorable conditions of *air*, *moisture*, and *warmth*. Such is the case when virgin (head) yeast is made, no ferment being added to the solution to start fermentation. Grape juice, cider, etc., ferment in the same manner.

Spores of fermentation are at all times floating about in the air and *fermentation will start up spontaneously wherever proper conditions exist.*

(b) Fermentation can be quickly started and greatly hastened by the introduction of a ferment. Thus we are accustomed to hasten the process by the following methods:

(1) By adding virgin yeast or other yeast to the mixture from which stocked yeast is developed.

(2) By adding stocked yeast or compressed yeast to the mixture from which potato ferment is developed.

(3) By adding stocked yeast, compressed yeast, dried yeast, or potato ferment to the other ingredients used in the preparation of a sponge or straight dough.

Fermentation would eventually take place in each of the cases just cited without the introduction of a ferment, but we would not get the lively action desired, in some cases not even the same kind of fermentation; sour fermentation is apt to predominate and ruin the dough, sponge, or other mixture.

In the beverage called *malt extract* active ferments do not appear. They are killed by sterilizing before being placed on the market.

Ground malt contains these active elements, as well as the sugar and digested gluten produced by them; hence it is a most useful ingredient to be used in making yeast. If, however, it is subjected to temperatures above 160° F., the ferments will be killed; consequently this ingredient should be added to the flour batter after it has cooled to below that temperature. Enzymes, in contrast to organized ferments, do not grow or otherwise change their form while fermentation is taking place, and the reason why fermentation occurs in their presence is not understood. It is said that in certain malt extracts there is sufficient diastase to transform six times its weight of sugar into starch. It reduces the amount of sugar to be used in bread making and adds desirable flavors. For each 100 pounds of flour used in bread making about 1½ pounds of standard malt extract should be used.

In the human body *enzymes* are found in the saliva (the element here found is called *ptyaline*), and by its action starch is transformed into sugar. Other enzymes are found in the

pepsin and *trypsin* of the digestive juices of the stomach, where they perform their important function.

(c) A ferment is a form of bacteria or germ that causes fermentation. The term was first applied to the yeast plant, which in its growth caused the decomposition of sugar into alcohol and carbonic gas. It is also applied to other bacteria which produce fermentation, as, for example, in milk causing it to sour or in cider causing it to turn to vinegar. These ferments belong to a class called *organized ferments*; during their growth the fermentation of substances in which they are found takes place.

There is a second class of ferments called *unorganized ferments*. These are chemical substances called "*enzymes*," in whose presence certain fermentations take place without any change whatever in the ferment producing them. In nature we find enzymes in all grains. Thus when a grain of wheat, barley, or oats is moistened and subjected to a certain amount of heat an enzym, called diastase, appears and causes the starch present to turn into sugar, and another enzym, called peptase, causes the gluten to be transformed into a more digestible form. These two elements are necessary for the growth of the germ (baby plant), and nature has ordained that growth shall not take place so long as they exist in a raw state, but by its laws these substances are transformed into digestible forms by the enzymes in the presence of heat and moisture. Now, it is evident that if we produce the necessary conditions in grain we can start the growth of the germ, the starch and gluten being changed into certain forms that are food for the plant.

In making barley malt the germination of the seed is stopped as soon as the transformation has taken place. The plant is killed by drying the grain at a moderate temperature, but the diastase and peptase retain their fermenting power. Malt extract contains these elements in a concentrated form and it presents the appearance of molasses.

THE DIFFERENT GENERAL METHODS OF MAKING BREAD.

38. *Lactic fermentation*.—If a dough were made without a ferment and set in a warm place, what is called *lactic fermenta-*

tion would take place. Acid would be formed the same as in the souring of milk, and the bread baked from the dough would be sour and heavy.

39. If a piece of old dough is left to sour and is then mixed with new dough, both *lactic fermentation* and *alcoholic* (or yeast) *fermentation* would take place. As a result of the lactic fermentation an acid is formed which causes sourness in the bread. As a result of the alcoholic fermentation carbonic gas is formed, and the bread, although sour, would be light and spongy. The sour dough here referred to corresponds to the *leaven* ("left-over" dough) of Bible times.

40. **Salt-rising bread.**—Make a stiff batter of hot milk and corn meal and let it stand in a temperature of blood heat for several hours, when it will have become fermented throughout. Now, make a stiff sponge with warm water, to which considerable salt has been added; mix thoroughly with the corn-meal batter, and allow to rise as usual before baking. In this case a spontaneous alcoholic fermentation is set up and the bread produced would be light and good, but it is not liked by many people, and it does not keep well. This is called salt or milk-rising bread.

41. **Yeast bread.**—Making bread by using yeast as a ferment is the best method known, and it is probably the only one that will be used in Army bakeries. In making yeast bread, alcoholic fermentation alone (or accompanied by slight acid fermentation) takes place, and the carbonic gas, rising toward the surface, is retarded within the dough by the tenacious gluten, and a light spongy loaf is formed.

If, however, fermentation is allowed to proceed too far, or in a temperature much above 80° F., a change to acetic fermentation takes place, an acid is formed, and sour bread is the result.

42. **Necessity for light, spongy bread.**—Take a small piece of fresh bread, bread that is less than 24 hours old, and roll it in the hands until it forms a solid mass. This is practically the condition of fresh or heavy bread when it is swallowed. On account of its indigestibility it rests like a heavy weight in the stomach; the juices can not penetrate and digest it. In order that bread can be digested something must be done in order that the juices may come in contact with all the particles that compose it.

Place the mass in water and only the particles you see on the surface become wet. If it were spongy, the water would penetrate it at once and come in contact with particles throughout the mass. Just so it is with light, spongy bread that is less than 12 hours old. The digestive juices easily penetrate to all parts of the masses swallowed, and the conversion of starch into sugar goes on throughout the masses at the same time. A piece of candy placed in the mouth will dissolve very slowly; crush it into powder and it will soon be gone. This is exactly similar to the action of the digestive juices upon a gummy piece of bread as compared with one that is light and spongy and crumbles into small particles during the process of mastication.

43. *Gluten* and *starch* must be converted into more soluble forms before they can be taken up and used in the system.

This is done in a greater or less degree in fruits while they are ripening on the trees and in some foods during the process of cooking; but in the case of bread almost all of this work must be done by the digestive juices after the bread is taken into the mouth.

Hence, we see that the art of making bread consists largely in producing a light, spongy loaf. In addition, the bread must be palatable, being properly seasoned and flavored. Bread is the most important of foods and the cheapest article of diet. The more flour and bread used in the company kitchen the cheaper will be the running expenses of the mess.

44. *Hard bread* is made from water and inferior flour, with a little salt added to make it more palatable. Hot cakes and dumplings furnish altogether too much of the gummy masses spoken of above. Good bread is in a class by itself, and Army bakers fill a most responsible position in supplying this most important component of the ration.

THE GROWTH, CULTIVATION, AND USE OF YEAST.

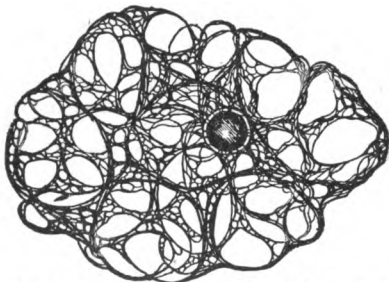
45. Wild yeast and other microscopic plants in the air.—Floating about in the atmosphere at all times are found certain spores (minute particles capable of reproducing their kind), which multiply rapidly wherever they find lodgment under conditions that favor their growth. These conditions are *suitable food*,

warmth, moisture, and atmosphere. Air is not essential, but hastens the process.

The spores here referred to are the active agents in fermentation, and are at all times found mixed with flour, grain, and particles of food from which the air has not been excluded.

Yeast is but one of the various forms of plant life (or spores) found in the air, and in this state it is called "*wild yeast.*"

46. What results from the growth of certain of these spores.—
(a) Certain of the spores above referred to find conditions suit-



After Cobb. Atwater, Bul. 112, U. S.
Dept. of Agriculture.

FLOUR CELL.

(Highly magnified.)

Notice the bands that must be dissolved or broken before the grains of starch are exposed to the free action of the yeast plant.

able for their growth in *cider*, and if they develop here an acid (acetic acid) will be formed, changing the *cider* into vinegar. In this case "*acetic fermentation*" will be said to have taken place.

(b) Certain spores develop in *sweet milk*, producing *lactic acid*. The milk sours and "*lactic fermentation*" is said to have taken place.

(c) If spores of "*wild yeast*" find lodgment in food suitable for their growth and the proper conditions of *moisture, warmth,* and *air* exist, they will grow, quickly reproducing themselves, and during this process feed upon the starch and sugar present, transforming it into alcohol and carbonic gas. "*Alcoholic (or yeast) fermentation*" will then be said to have taken place.

Many other microscopic plants floating in the air find their way accidentally into surroundings that favor their growth, and in each case a certain kind of fermentation peculiar to that plant results.

47. **Cultivation of the yeast plant.**—If we mix up certain ingredients and produce conditions suitable to the growth of the yeast plant, we find that it will soon develop. We do this in making "*virgin (head) yeast.*" *Acid fermentation* in excess may also set up, so that the action of the yeast in bread making will be more or less ununiform (variable) and unreliable, and sour bread will result.

In the preparation of *compressed yeast* (such as Corbey's, Fleischmann's Spielmann's Riverside, and Red Star) a pure culture of the yeast plant has been made—that is, the spores producing acids have been eradicated, so that more uniform results are secured by its use than when dried yeast or home-made liquid yeasts are used.

Yeast can not grow except in the presence of a certain amount of moisture. While in a dry state it will lie dormant for an indefinite period. Many different commercial companies take advantage of this fact and prepare a *dried yeast* that will keep for several months if not exposed to a moist atmosphere. It is generally supplied in the form of square or round cakes of granular appearance.

48. **Yeast in bread.**—Yeast feeds largely upon sugar, but sugar alone does not contain all the elements necessary to its growth. Certain *albuminates* and *phosphates* are also necessary, and these are found in the food prepared for the reception of the yeast plant. Incident to its growth, considerable sugar is decomposed into alcohol and carbonic gas, and "*alcoholic fermentation*" is said to have taken place. The carbonic gas forms in pockets and cells throughout the dough, causing it to rise and

expand and producing the desired cellular structure. It finally escapes from the bread, upon which it produces no chemical changes whatever.

49. Much more sugar (or starch) is decomposed than is necessary for the growth of the yeast plant, and it is on account of using up so much of the nutriment in the flour that efforts have been frequently made to discover some other process of producing the cellular structure in bread. As a result we have the "*aerated process*" of making bread, and others in which baking powder and other chemicals are used. Both of the latter methods have their advantages and are used to considerable extent. The great convenience and saving of time effected by using *baking powder* in making biscuits, etc., is familiar to all, but in its use certain compounds are formed and left in the bread and are said to be more or less injurious if used continuously.

POINTS TO REMEMBER ON YEAST FERMENTATION.

50. Yeast lives on sugar, *nitrogenous compounds* and certain *inorganic salts*.

Yeast requires *moisture* to grow.

Yeast thrives best at temperatures from 77° to 95° F.

Yeast ceases to grow at about 50° F. For preservation yeast should be kept below 55° F.

Yeast is not killed by freezing.

Liquid yeasts are killed at about 140° F., but **dried yeast** will stand much higher temperatures without injury. While yeast grows well at all temperatures from 77° to 95° F., in order to keep down the growth of undesirable acid ferments temperature should not be allowed to go above 80° F.

The flour, potatoes, or other starch used for yeast food should be scalded at boiling temperature.

When *ground malt* is used in making yeast the malt should be subjected to the action of water at about 160° F. If temperatures higher than 160° F. are used, the diastase of the malt will be killed. *Sugar* is necessary for the growth of the yeast. When *flour* is *gelatinized* (scalded) the diastase in the flour

changes the gelatinized starch to maltose and dextrin (forms of sugar).

51. *In making potato ferment* the water in which the potatoes are boiled should always be used as it contains a large amount of the nitrogen necessary for the growth of the yeast plant.

The stock should be added to the mixture when it has cooled to 80° F. or below.

A *solution* containing more than *one-third* of its weight in sugar will not be fermented by yeast.

52. *Yeast fermentation* is arrested (checked) when the amount of alcohol in the solution reaches about 18 per cent. If the percentage of alcohol present is reduced, yeast fermentation will start up again.

Yeast fermentation is *arrested* and the yeast plant killed by strong *acids* or large quantities of salt.

Air is not essential to yeast fermentation, but greatly favors it.

The total amount of *starch*, etc., lost as a result of yeast fermentation amounts to about 2 per cent of the flour used.

The *alcohol* resulting from yeast fermentation assists in producing the cellular structure in bread when it is vaporized during baking. Most of it escapes into the oven, but a small quantity (about 0.3 per cent) remains in the bread. In stale bread this is reduced to about 0.15 per cent.

Hops are not a *necessity* in the preparation of yeast; they are not a food for the yeast plant, but serve to check acid fermentations, and thus facilitate alcoholic fermentation.

INFLUENCE OF TEMPERATURE ON YEAST GROWTH.

53. "**Temperatures most favorable** to the growth of yeast are from 77° to 95° F. Between these two points yeast flourishes and grows well. At temperatures lower than 77° F. growth proceeds, but not so rapidly. At a temperature of about 49.6° F. the action of the yeast is arrested; the vitality, however, of the cell is only suspended, not destroyed, for with a higher temperature it again acquires the power of inducing fermentation. *Actual freezing* does not destroy yeast, provided the cells do not get mechanically ruptured or injured. Above 95° F. the effect

of heat is to weaken the action of yeast, until at a temperature of about 140° F. the yeast is destroyed. This applies to moist yeast. When dry the cells are able to stand higher temperatures than when suffused with water; thus dried yeast has been heated to 212° F. without destroying its vitality." (Jago.)

THE INGREDIENTS USED IN THE PREPARATION OF YEAST AND THE PROPERTIES OF EACH.

54. **Dried yeast** (or dessicated yeast), also sometimes erroneously called dried compressed yeast, such as *Magic Yeast*, *Hart's Yeast*, *Ralston's Yeast*, *Yeast Foam*, etc. It is generally made up in square or round shapes, of granular appearance, and sold in pasteboard packages. If hermetically sealed it will keep in good condition for several months, and hence can be taken and used anywhere. It gives best results in the sponge and dough process. Its action will be greatly stimulated by the addition of about 2 pounds of cane sugar per 100 pounds of flour used, or, better, by 5 pounds of boiled and mashed potatoes placed directly in the sponge.

Not being a *pure culture like the compressed yeast*, it does not give the same uniform and reliable results.

Dried yeast, if fresh, gives fairly good results in bread making. Before purchasing a large quantity of dried yeast, samples should be taken and a baking test made. A second test should be made on delivery, to see that stock is up to sample. On orders for large lots for Army use dealers are apt to supply old, worthless stock. Lots of 5,000 pounds furnished for Army use have been found on delivery to be absolutely worthless. Dried yeast for the use of troops in the field should be put up in sealed tins, with the date of manufacture stamped on the tins. Under good conditions for storage dried yeast will remain active for about three months.

55. **Compressed yeast**, in which a *pure culture* of the yeast plant is made and mixed with a certain proportion of starch to give it body. It is pressed into blocks about the size, shape, and color of butter bricks, except that it may have less color. It is very perishable and spoils quickly when removed from cold storage and exposed to a warm temperature, and for this reason can

be used at posts distant from the railroad and in the field only when careful arrangements are made for its cold storage. *If wrapped in heavy paper when removed from cold storage, or if placed in a moderately cool place, a basement, a hole in damp ground, or a porous jar covered with wet cloths, compressed yeast will keep for a number of days.* If well chilled it can be shipped almost any distance in a *fireless cooker*.

Compressed yeast should be used whenever obtainable by Army bakers. Other yeasts, particularly potato ferment, give good results, but none are as reliable as compressed yeast.

56. Liquid yeasts.—*Potato ferment* (potato yeast), *stocked*; *flour yeast, stocked*; and *flour and malt yeast, stocked*, are the most common yeasts prepared by Army bakers. They are really old-fashioned yeasts, and are generally considered as out of date or behind the times, and they have been almost entirely displaced by the compressed yeasts, which are great savers of time and trouble and a boon to those who do not or can not make liquid yeast. All Army bakers should know how to make and use liquid yeasts, for there will be times that compressed yeast is not obtainable. It should be the practice for Army bakers to make and use a potato ferment, flour, and flour and malt yeast at frequent intervals, even when absolutely fresh compressed yeast can be obtained daily.

All liquid yeasts should be stocked.

Rice and bean yeasts have their advantages, and formulas for their preparation are given.

It would be difficult to state positively exactly what process of making liquid yeast is the best. Yeasts that produce equally good results are made in accordance with methods which first appear to be quite different, but which in reality amount to practically the same thing. In order to make yeast all we need is a suitable food, moisture, and the proper degree of warmth. Free access to the air assists in its growth, and if hops or salt are added certain undesirable acid fermentations are checked, thus preventing sourness in the bread and at the same time adding certain agreeable flavors.

The starch used in the preparation of yeast food, whether from the potato, or flour, is found to be in minute cells covered

with a thin membrane. This membrane is in practice dissolved or ruptured by contact with scalding hot water before the introduction of the yeast, which in liquid forms is killed by high temperature. It really makes no difference whether the potatoes are boiled and mashed or whether they are grated raw and then mixed in boiling hot water.

Similarly the flour batter may be added to the hop tea, which should not boil thereafter, or the batter may be made by adding sufficient hop tea to dry flour and the remainder of the hop tea immediately thereafter, or when both it and the batter have cooled to a temperature below that at which the yeast plant is killed (preferably 80° F.). The stock should be added at this time. The only advantage of the second method is that the preparation is reduced to a working temperature in a short period. If ground malt is used in making the yeast it should not be added to the latter until it has cooled to a temperature below 160° F. A higher temperature than this would kill its active element, *diastase*, which transforms starch into food for the yeast plant.

If these simple facts are borne in mind much of the mystery connected with the making of yeast is removed. It is the ignorant baker who condemns all methods of making yeast except that followed by himself.

PROPERTIES OF THE INGREDIENTS USED IN MAKING LIQUID YEAST.

57. **Hops** do not furnish food for the yeast plant, but they add a pleasant flavor. Their greatest usefulness, however, lies in the fact that they contain that element (*called lupulin*) which is active in checking the acetic and lactic fermentations that generally accompany the alcoholic fermentation which always takes place as an incident to the growth of the yeast plant. To extract this active agent (*lupulin*) from hops, place them in water and allow to boil for about 10 minutes (15 minutes in the case of very fresh hops). Longer boiling will extract a bitter flavor. One-half to 1 ounce of fresh hops to each gallon of water should be used, or generally twice this amount of

compressed hops according to their strength, as found by experience. The resultant liquid is commonly called "*hop tea*."

For the purpose stated hops surpass any other ingredient used in the food for the yeast plant.

The best hops are of a bright color, between yellow and green. Yellowish-brown hops are old and require less boiling. Brown hops are generally unfit for use.

58. Salt.—Salt may also be added to check undesirable acid fermentations that may set up accidentally in the yeast. In the absence of hops salt is always used, and generally in addition to them. The amount is from one to two level tablespoonsful to each gallon of water. Used in small quantities, salt renders fermentation more uniform, thus giving a more even grain to the loaf. In larger quantities salt would retard yeast fermentation. Salt is a necessity in bread making not only on account of the property just cited but in order to make the bread more palatable.

59. Potatoes.—Chemists tell us that the potato furnishes one of the best forms of starch for the growth of the yeast plant. Yeast made from it ripens quickly, but does not keep so long as flour yeast. The bread resulting is light and sweet and does not dry out or sour so quickly as that from other yeasts. Old potatoes contain more sugar than new ones and should be used in the preparation of this yeast.

As a matter of economy of time and material, the potatoes may be washed and boiled with their jackets on and finely mashed in a portion of the water in which they were boiled, the remainder being added later. To produce equally good yeast that will make whiter bread the potatoes should be pared before boiling.

60. Flour.—Flour is used in the preparation of yeast to furnish starch, albuminous matter (gluten), and phosphates for the growth of the yeast plant. It should be strong in *gluten*, a deficiency in starch should be made up by the addition of sugar. Cane or malt sugar is best. The granules of starch are bound together into cells by means of fibrous bands. To rupture these cells and expose the starch to the action of the yeast the application of hot water is necessary. This process is generally called "scalding" the flour.

61. **Malt.**—Although *barley, oats, wheat, corn, and rice* are all capable of being “malted,” as the expression goes, the term *malt* is generally applied to *barley malt*, and it is this kind that is used in connection with making yeast. It is the crushed barley that has first been allowed to germinate (grow) in warm, moist rooms of even temperature for two or three weeks, the grain then being dried at a moderately low temperature and crushed. Malt contains certain elements (diastase and peptase) which induce a change of starch and gluten into other forms more favorable to the growth of the yeast plant and the formation of alcohol and carbonic gas incident to its growth. As noted above, oats can be malted and used the same as barley. In practice we also get good results by scalding the flour and malt together, but it is probable that the flour and malt mixture drops below 160° F. before the elements referred to have been greatly injured.

62. **Malt extract.**—*Malt extract* contains these important elements (*diastase* and *peptase*) in a more concentrated form, and by diastase companies several different grades of it have been so prepared as to be best suited to the different qualities of flour that may be used in bread making. The quantity used depends upon the particular brand and strength. It is used as a substitute for sugar and to give an agreeable flavor to the bread. Its general use in the Army is not recommended.

63. **Sugar.**—During the growth of the yeast plant sugar is decomposed into alcohol and carbonic gas. When the bubbles of gas rise to the surface we say that the yeast has begun to “work.” Sugar may be used as an ingredient of the mixture prepared for the growth of the yeast plant; if so, cane sugar, malt sugar (or *maltose*), or *glucose* is best. However, it generally appears in the yeast food first in the form of starch. During the process of fermentation it is transformed into sugar and then decomposed into *alcohol* and *carbonic gas*.

64. **Water.**—Water used in the preparation of yeasts should be suitable for drinking. Long boiling of water removes the *air*, which promotes fermentation.

Hard water retards the working of yeast slightly.

NOTE.—*Porcelain and granite ware.*—Porcelain or granite ware should, if practicable, be used in boiling hops and potatoes, as tinware or iron will cause the hop tea or potato water to take on a darker color and the bread produced will not be so white as it otherwise would be. Clean hardwood, glass, or porcelain-lined receptacles should be used for yeast, as otherwise certain chemical action might take place that would either darken the solution or spoil it altogether.

65. Résumé.—For the growth of the yeast plant we must have certain *albuminous matters and phosphates*, and in addition starch, which is transformed into sugar and converted into alcohol and carbonic gas, incident to the growth of the yeast plant. Boiling-hot water must be added to the mixture in order to rupture the starch cells and expose the starch used in fermentation. After the solution has cooled to about 80° F. we have a proper food for the development of the yeast plant, and fermentation may take place spontaneously if the solution is left undisturbed in a moderate temperature. In this case "virgin" (head) yeast would be formed, but if a yeast is introduced to start the fermentation the solution is said to be "*stocked*," and the yeast resulting is a "stocked yeast" or "potato ferment," according to the ingredients used. The livelier the yeast introduced the stronger will be the yeast which results. In addition to the food for the yeast, hops or salt should be introduced to check the acid fermentations that might otherwise set up and spoil the yeast. Many different formulas for preparing the yeast bring about the same result.

RECIPES.

66. Potato ferment.—Recipe for 1 gallon:

Ingredients: 1 pound potatoes, $\frac{1}{2}$ pound flour, $\frac{1}{2}$ ounce hops (or $\frac{1}{2}$ ounce salt). Water enough to make 1 gallon. (Always use the potato water.)

Clean the potatoes thoroughly. Cut up and boil in water enough to cover. When well done strain and mash the potatoes thoroughly. Add the flour to the mashed potatoes. Add the potato water and sufficient boiling water to make a stiff paste. Mix the paste thoroughly. Allow to cool to 80° F. Add the

stock, $\frac{1}{2}$ ounce compressed yeast, $1\frac{1}{2}$ ounces dried yeast, or 1 pint of liquid yeast. Set to ripen at 80° F. Will be ripe and ready for use in from 9 to 12 hours.

Use an earthenware or clean wooden receptacle where possible.

Potato ferment, or potato yeast as it is sometimes called, produces as good bread as can be made. In making it, great cleanliness is necessary, as acid fermentations may set up from obscure causes and produce sour bread. It is best to have two sets of utensils, in order that one set may be thoroughly cleaned while the other is in use. Potato ferment is the form in which liquid yeast is generally used in making bread and generally it should be made fresh each day for use the next.

67. Flour and malt yeast, "virgin."—Recipe for 1 gallon.

Ingredients: 1 pound malt, $\frac{1}{2}$ pound flour, 4 quarts water, $\frac{1}{2}$ ounce hops (or $\frac{1}{2}$ ounce salt).

Boil hops in the water for 10 minutes. Put flour in earthen or wooden receptacle. Pour 1 quart of the boiling hop tea on the flour. Stir well to break up lumps. When the remainder of the hop tea has cooled to 160° F. add to flour paste. Put in the malt. Stir well. Allow mixture to cool to 80° F. Keep at 80° F. from 48 to 60 hours or until all hissing has stopped. Yeast is now ready for use.

68. Flour and malt yeast, "stocked."—Made same as above, except that when mixture is cooled to 80° F. it is stocked with $\frac{1}{2}$ ounce compressed yeast, $1\frac{1}{2}$ ounces of dried yeast, or 1 pint of stocked yeast. Should be ready for use in from 18 to 24 hours after stocking.

If kept at temperature from 50° to 55° F., the yeast will keep from 5 to 10 days.

69. Flour yeast, "virgin."—Recipe for 1 gallon:

Ingredients: 4 pounds flour, 3 quarts water, 1 ounce sugar, $\frac{1}{2}$ ounce salt.

Put water to boil. Put flour in earthen or wooden receptacle. Dissolve sugar and salt in water. When water is heated to 125° F. add 1 quart to flour, enough to make a stiff dough, and work up by hand. Allow remainder of water to come to a boil and then add to flour dough gradually, stirring well to

make a thin batter. Set to cool. When cooled to 80° F., keep at that temperature for from 48 to 60 hours, when it will be ready for use.

70. Flour yeast, "stocked."—Made same as above, except when cooled to 80° F. stock with $\frac{1}{2}$ ounce compressed yeast, $1\frac{1}{2}$ ounces dried yeast, or 1 pint of stocked yeast. Should be ready in from 18 to 24 hours.

This yeast has a strong *lactic* fermentation as well as *alcoholic*. The yeast when ripe tastes not unlike buttermilk. The dough should have a characteristic *buttermilk smell*. The baked loaf will have a characteristic acid taste, not unpleasant, and should not be confused with sour bread. In using this yeast the amount of flour used in the dough should be reduced by the amount used in preparing the flour yeast.

71. Tuba de nipa, as it is commonly called by the *Filipinos*, furnishes an excellent substitute for stocked yeast. It is the sap collected from the *nipa palm*. The sap, having been placed in a deep can with a small exposure, is set in the sun for about 12 hours and allowed to ferment. A thick scum forms on the surface and the *tuba* is removed to a cool place where it will keep for several days. The scum should be allowed to remain on the tuba as a protection against contamination.

Fermented tuba de nipa is used as stocked yeast and in the same proportions.

72. Dried yeast.—Dried yeast is very easy to manufacture, and can be made with facility by any baker. If made from the potato ferment, the results obtained at the training school have been better than those obtained when using the commercial product, probably for the reason that such yeast is fresh or of known age.

(a) Dried yeast from potato ferment.—Make a potato ferment according to formula given, using compressed yeast as a starter in preference to stock yeast or dried yeast. After working pour off the supernatant liquid, disturbing the sediment as little as possible. Take $1\frac{1}{2}$ gallons of sediment, 13 pounds of corn meal, and 1 ounce of cooking soda, and mix into a stiff dough. Shape into cakes about half an inch thick and $2\frac{1}{2}$ inches square, drying at a temperature of about 60° F. or less.

This mixture makes about 15½ pounds of dried yeast, and it has been found to be superior to any purchased on the market.

(b) *Dried yeast from stock yeast.*—Make a stock yeast according to formula given. After working pour off the supernatant liquid, disturbing the sediment as little as possible. Take 1 quart of sediment, 2½ pounds of corn meal, and ½ pound of flour, and mix into a stiff dough. Shape into cakes and dry as above.

This mixture makes about 3 pounds of dried yeast of excellent quality, but hardly equal to that prepared as in the preceding paragraph.

CHAPTER IV.

BREAD.

73. There are two general classes of bread:

Fermented bread.—This includes all bread made *with yeast*, such as issue bread, graham bread, rye bread, and all rolls made with yeast.

Unfermented bread.—This includes all breads made *without yeast*, such as aerated bread, hard bread, crackers, baking powder biscuits, etc.

GENERAL METHODS.

74. There are two general methods of making bread:

By the sponge and dough process, in which a *sponge* is first set, by using about one-half of the flour, about four-sevenths of the water, and all of the yeast, and incorporating all the other ingredients in a second operation some time later, when the dough is made. The *left-over process* is a modification of the sponge and dough process.

By the straight dough process, in which all of the ingredients are incorporated in one long process of mixing and kneading rather than in two short ones, as in the sponge and dough process.

75. **In making bread**, by either the straight dough or sponge and dough process the average temperature of the water, flour, and bake shop should be 80° F. (78° F. in summer and 82° F. in winter). The temperature of the shop should be kept as near 80° F. as is practicable, both in summer and winter. If possible flour should be stored in a room adjoining the bake shop and kept at the same temperature as the shop for at least several

days before using. In the post bakery small quantities, sufficient for a week's supply, can usually be stored in a corner of the bake shop if a heated storeroom is not provided.

With the field bakery a supply for two days can be kept in the mixing tent, and if necessary the flour store tent can be heated. If flour is very cold and must be used at once, it may be stacked around the stove or spread out in the dough troughs near a stove and the flour turned over every few minutes.

76. To obtain the proper water temperature.—Take the sum of the flour and bake shop (or tent) temperatures. Subtract this sum from 234° F. in summer or 246° F. in winter. The result will be the proper temperature of the water to be used in the summer or winter, respectively.

<i>The following are examples:</i>	$^{\circ}$ F.
Temperature of flour-----	70
Temperature of bake shop (or tent)-----	82
	<hr/>
Total-----	152

The proper temperature of the water in summer is 234° F. minus 152° F., or 82° F.

The proper temperature of the water in winter is 246° F. minus 152° F., or 94° F.

	$^{\circ}$ F.
Temperature of flour-----	65
Temperature of bake shop (or tent)-----	76
	<hr/>
Total-----	141

The proper temperature of the water in summer is 234° F. minus 141° F., or 93° F.

The proper temperature of the water in winter is 246° F. minus 141° F., or 105° F.

It is customary to use the water as the variable quantity for the reason that we can most easily change its temperature. The temperature of the water used should not, however, exceed 130° F. for the reason that higher temperatures will affect the yeast.

77. When the temperature of the bake shop or tent is subject to change during the time the dough is proving, allowance must be made for the change.

When using tents for the mixing and proof rooms the temperature will often change 15° F. from the time the dough is mixed until it is ripe. A temperature of 85° F., when a dough is mixed at 6 a. m. on a summer morning, will frequently rise to 100° F. by 10 a. m.

78. *If using sponges*, the sponge may be held back by adding small amounts of ice water.

If using straight doughs, the doughs may be held back by increasing the amount of salt or decreasing the amount of yeast normally used.

79. *A considerable amount of heat* is given off as a result of fermentation. In cool or cold weather the dough should be well covered to retain this heat. The cover also serves to prevent air circulation and consequent crusting of the dough.

In warm weather the doughs should be covered with mosquito netting.

80. *Mixing must be done thoroughly* in order to distribute the yeast equally throughout the dough or sponge, to prevent lumps, and to allow the air to come in contact with all parts of the mixture. *Careful and thorough kneading of the dough and moulding of the loaves ruptures the large bubbles that have formed, distributes the yeast to every part of the dough equally and insures a close and even texture of the loaf.* Careless and indifferent workmanship or insufficient kneading are apparent to the careful observer. The crumb will be "*coarse grained*" and of very ununiform structure, large holes will show, and often lumps of unmixed flour are present.

81. *If a dough* has been properly handled and baked, the tops of the loaves will present a nicely rounded and browned appearance, and the crumb a uniform cellular structure. The color of the crust is governed by the amount of sugar or malt extract used, the heat of the oven, and the age of the dough. A pale loaf results from an *absence of sugar, a slow oven, or an old dough.*

82. Sometimes the tops of the loaves present a flat, smooth, or wrinkled appearance. If smooth, the flat appearance is due to too little age in the sponge or dough or too soft a dough. If the top is flat and has a wrinkled appearance, the dough was too old or had too much proof in the pan. A streak of dough running lengthwise through the center of the loaf is generally the result of shifting the pans in the oven before the cellular structure of the loaf has been fixed. This fault is not apt to appear when baking in the brick or tile oven of a post bakery, but is very apt to occur in the field ovens, where more or less shifting of the pans is generally necessary.

83. The question as to which method—sponge and dough or straight dough—should be used is debatable.

When a new brand of flour or a green (freshly milled) flour is received it is advisable to use sponges in garrison or in the field. No attempt should be made to use the straight-dough process at once. Shorten the time of fermentation. A new flour must be handled with great care and the temperature of the sponge or dough should not be allowed to exceed 80° F. during the time of proving. When possible, sufficient old flour which the bakers are familiar with should be kept on hand to blend with the new. In the fall when new flour is placed on the market it is best to have stored as much old flour as possible with which to blend the new product. Flour when freshly milled, or green, is more difficult to handle with good results than after it has been stored for several months.

84. The chief advantage of the straight-dough method is simplicity and quickness.

In civilian bakeries, where time is the most important consideration, it is used almost exclusively and great care is exercised in maintaining an even temperature of about 80° F. for all proving of doughs. It has been claimed that a bread of finer cellular structure which will keep longer with a better flavor results when the straight-dough method and rapid fermentation is used. After trying out both methods and comparing the bread produced in a short fermentation, about five hours for a straight dough from the time of mixing to the pan and about nine hours for the sponge and dough from time of mixing the sponge to the time of panning the loaves. It is the opinion

that equally good results are obtained and that the differences noted are largely a matter of fancy. The question as to which method is to be used is one of convenience. Bread can be produced in less time by the "straight-dough" method, and it should be used when time is the chief consideration. In the post bakery or in the field bakery the straight dough and the sponge and dough process may be used together in order that several runs of bread may be made without interference in the ovens. This enables the men to do the work in seasonable hours.

85. Among other advantages of the sponge and dough method is the fact that several types of bread may be made from the same sponge, such as sweet doughs, rye, graham, or whole-wheat bread. If, for example, graham bread is desired, all that is necessary after the water is added and the sponge broken up is to dip the required amount of sponge into a separate receptacle and proceed to complete the dough. The diluted sponge is approximately one-half water; 2 quarts of this sponge represent 1 quart of water. Two quarts of the diluted sponge will make about 5 pounds of bread. For example, if 50 pounds of graham bread are desired, dip 20 quarts of the diluted sponge.

86. Long fermentations are to be avoided in either method. In using the straight-dough method about seven hours' fermentation should be allowed between the time the dough is first mixed and the time of placing it in the oven; this time may be reduced to five hours in emergency by increasing the amount of yeast used.

In using the sponge and dough method not over nine hours should be allowed from the time the sponge is first mixed until the pans are placed in the oven. This time may be reduced to 5½ hours if required by increasing the amount of yeast used.

Fermentation should last long enough to soften the gluten in the flour and no longer. A strong flour requires more time than a weak flour. A low grade of flour or a new flour produces the best results when given short fermentation.

87. The baker must know what *accelerates* and what *retards* fermentation.

The more *yeast* used the faster fermentation proceeds.

The *strength* and *vigor* of the yeast must also be considered.

The use of *sugar* and *malt extract* hastens fermentation.

Salt in quantities of more than 2 per cent of flour used retards fermentation.

Temperature is a very important element in the time of fermentation. The higher the temperature (within limits) the more rapidly fermentation proceeds.

A *soft sponge* or dough ferments more rapidly than a *stiff* one.

For practical purposes hardness or softness of water has but little effect. Hard water retards fermentation slightly.

Soft, weak, starchy flours ferment more rapidly than hard, strong flours.

88. The recipes given in this manual are for compressed yeast. The following gives substitutive quantities of other yeasts for doughs of the same age: 5 ounces of compressed yeast equals 1 gallon potato ferment; 5 ounces of compressed yeast equals 1 gallon malt and flour yeast; 5 ounces of compressed yeast equals 1 gallon flour yeast; 5 ounces of compressed yeast equals 15 ounces dried yeast.

Dried yeast used in this proportion gives a decided corn-mel flavor to the bread. Dried yeast should not be used in short doughs if other yeasts are available.

TO MAKE A DOUGH BY THE SPONGE AND DOUGH METHOD.

89. Take one-half the flour to be used, all the yeast, and four-sevenths of the water. Make a mixture that will just drop from the hands when taken up. This mixture is called the *sponge* and is set to rise at a temperature of 80° F. When it has about doubled in volume *bubbles will be seen breaking on the surface* and the sponge will begin to fall. It is now said to be *ripe* and ready to be made into dough. (The proper time to take a sponge is just after it has fallen 1 inch for the first time.) If undisturbed, it will rise and fall two or three times, but if this takes place the *dough is liable to sour*. A strong flour will stand more age in the sponge than a weak one.

As soon as the *sponge is ripe* pour in the remainder of the water, after dissolving in it the sugar and salt to be used. One-half the cottonseed oil or lard to be used should be added at this time. Make the sponge into a thin batter. After the

sponge is well broken up and no stringy portions remain add the remainder of the flour. Mix the whole, which now becomes the dough, until it becomes a stiff, elastic mass.

Clean one end of the trough carefully with the scraper and grease it well with cottonseed oil or lard. Cut off about 30 pounds of dough from the mass, thoroughly knead it until the desired stiffness is obtained, and place it in the end of the trough just cleaned. Continue this process until the whole dough has been "cut over." In cutting over the dough use the remainder of the cottonseed oil or lard. The dough should be cut over at least twice. Dam up the dough with the partition board. The dough should about half fill the part of the trough occupied by it. (If necessary the dam board can be held in place by a sack of flour placed on the side opposite the dough.) Set to prove at a temperature of 80° F. When the dough has risen to the top of the trough and has fallen 1 inch it should be punched the first time. Allow to rise the second time until nearly to the top of the trough. Punch the second time and give it about 10 minutes proof. The dough is now ready to be rounded up on the bench or molded into loaves.

The loaves should be rounded up and allowed to prove about 15 to 20 minutes on the bench.

For garrison bread make 2-pound loaves, scale at 2 pounds 3½ ounces, 6 loaves to the pan. The molded loaves should be firm and about half fill the pan. Set to prove at about 80° F. When the loaves are about doubled in size they are ready for the oven.

RECIPE—GARRISON BREAD.

90. Sponge and dough method.—*Ingredients:* 100 pounds flour, 1½ pounds sugar, 1½ pounds salt, 1½ pints cottonseed oil (or 1½ pounds lard), about 6 gallons and 3 quarts water, 10 ounces compressed yeast.

NOTE.—The time of fermentation may be increased to eight hours in the sponge by using one-half the above amount of yeast. Regulate the time of fermentation as desired by using different amounts of yeast.

Set sponge, using 50 pounds flour, 4 gallons water, and 10 ounces of compressed yeast. Allow to stand about 5 hours in the sponge. When the sponge has dropped the first time add 2 gallons and 3 quarts of water, $1\frac{1}{4}$ pounds of sugar, $1\frac{1}{4}$ pounds of salt (sugar and salt to be dissolved in the water before adding), $\frac{1}{2}$ pint of oil, and mix thoroughly. Use the remainder of the oil in cutting over the dough. Dam up and allow to prove about two and one-half hours. Punch first time, allow to rise about one-half hour, punch second time, round up and let prove about 15 minutes on the bench. Mold into loaves scaled at 2 pounds $3\frac{1}{2}$ ounces. Put 6 loaves to the pan. Allow to prove about 45 minutes or until doubled in size. Bake 1 hour and 10 minutes. Should produce about 136 pounds of bread.

TO MAKE A DOUGH BY THE STRAIGHT DOUGH METHOD.

91. Take all the flour, water, yeast, sugar and salt, and one-half the cottonseed oil or lard to be used (dissolve salt and yeast in separate receptacles), and mix until it is a stiff elastic mass. Clean one end of the trough and grease it well, as explained for the sponge and dough process, cut over the dough in the same manner, and work in the remainder of the cottonseed oil or lard during the cutting over. When the dough is thoroughly kneaded dam it up and set to prove. It will be ready to punch the first time in about 5 hours, punch and allow to rise about 40 minutes, punch second time and allow to rise 20 minutes. The dough is now ready to be rounded up on the bench. For garrison bread make 2-pound loaves, scale at 2 pounds $3\frac{1}{2}$ ounces, 6 loaves to the pan. The molded loaves should be firm and about half fill the pan. Set to prove at about 80° F. When the loaves are about doubled in size they are ready for the oven.

92. **Straight dough method.**—*Ingredients:* 100 pounds flour, $1\frac{1}{4}$ pounds sugar, $1\frac{1}{4}$ pounds salt, $1\frac{1}{2}$ pints cottonseed oil (or $1\frac{1}{4}$ pounds lard), about 6 gallons and 3 quarts water, 10 ounces compressed yeast. Mix thoroughly into a medium dough. Use one-half the cottonseed oil (or lard) in mixing and one-half in cutting over. Time to first punch, 5 hours; allow to rise second time 40 minutes, punch and allow to rise 20 minutes, punch down and scale at 2 pounds, $3\frac{1}{2}$ ounces, round up and let prove 15

minutes on the bench. Mold into loaves and allow to prove about 45 minutes in the pan or until double in size. Bake 1 hour and 10 minutes. Should produce about 136 pounds of bread.

GENERAL RULE FOR THE AMOUNTS OF INGREDIENTS USED IN BREAD MAKING.

93. For each 100 pounds of flour about 7 gallons of liquid will be required, using either the straight dough or sponge and dough method. No fixed rule for the amount of liquid to be used can be given for the reason that the amount of liquid that will be absorbed varies with different flours. In the *sponge and dough process* about four-sevenths of the liquid is used in setting the sponge, the remainder is added at the time the *dough* is made. In the *straight dough process* all of the liquid is used at the time the dough is mixed.

For each gallon of liquid used allow about 3 ounces of sugar, 3 ounces of salt, and 3 ounces of cottonseed oil (or lard).

For a straight dough or sponge (4 to 5 hour doughs) use about 10 ounces of compressed yeast, 20 ounces of dried yeast, or 1½ gallons of potato ferment for every 100 pounds of flour.

It must be remembered that *increasing the yeast* will hasten the fermentation while *decreasing* the amount will retard the fermentation. If compressed yeast is not obtainable it is best to use a potato ferment, using dried yeast or stocked yeast to stock the potato ferment. Most dried yeast is very uncertain as to strength, and its general use is not recommended unless made in the bakery. In using dried yeast better results will be obtained in the sponge and dough process than in the straight dough process.

94. The use of refined cottonseed oil is recommended in place of lard whenever it can be obtained. At ordinary temperatures it is fluid, and does not require heating. In mixing a dough by hand, using the straight-dough method, it is best to add the cottonseed oil or lard one-half in mixing and one-half when the dough is cut over. If using a mixing machine add the cottonseed oil or lard after the mixer has been running 5 minutes.

95. With the *alcoholic fermentation* which goes on in the dough while proving certain acid fermentations also develop.

The principal are *lactic* and *acetic*, producing lactic and acetic acids. Lactic fermentation is desirable to a limited degree as it assists in softening the gluten, thereby aiding the expansion of the loaf by the alcoholic fermentation. Lactic and acetic acids in large amounts cause *sour doughs*.

96. *A dough may be compared to the human body.* To have a normal, healthy dough we must give it the proper food and drink and house it at the right temperature. *The proper food is good strong flour, sugar, salt, yeast, and lard, with sufficient water.* It should be housed at about 80° F. If the dough is not fed, watered, and housed properly it will not be a strong and healthy dough. You can not get good work out of an underfed dough any more than you can out of an underfed man. Bread can be made by simply using flour, water, and yeast, but it will be comparatively poor bread. It is necessary to use a good flour, plenty of yeast, sugar, and salt; by this means you will produce a strong, healthy fermentation and obtain a good flavor.

INGREDIENTS USED IN BREAD MAKING.

97. **Flour.**—A *good strong flour* is the first essential for good bread. A blend of one-half spring-wheat patent and one-half hard winter-wheat patent will make a high upstanding loaf with good bloom. Kansas hard winter-wheat patent makes a good bread flour for either the sponge and dough or straight-dough process.

Salt.—Salt is a most important element in bread making. It gives flavor to the bread, retards acetous fermentations, and toughens the gluten. Its retarding effect upon the desirable alcoholic fermentation is more than made up for in its retardation of the undesirable acetous fermentations.

Sugar.—The sugar used aids fermentation and gives color and taste to the loaf.

Cottonseed oil (or lard).—The use of a vegetable oil or animal fat shortens the crust, reduces toughness, and adds flavor. The toughness of field bread crust is largely due to the small amount of oil used.

Water.—The water used for bread making should be fit for drinking. It is not believed that for practical baking purposes hardness or softness of water has any material effect.

Yeast.—A liberal quantity of yeast should be used. The use of compressed yeast is recommended whenever obtainable. Its action is much more uniform than either dried yeast or home-made liquid yeast.

Milk and malt extract add flavor and richness to the loaf, but are not ordinarily used in making bread for issue.

98. Left-over dough process.—Take 40 pounds of dough from a batch about to be molded into loaves and place in a cool place for the next batch of bread. (Do not keep more than 24 hours.)

To make the new dough: Take the 40 pounds of left-over dough and add to it 26 pounds of flour and 14 quarts of water. Make a sponge and allow to ripen in the usual manner. When ripe, make into a dough by adding 12 quarts of water, 2 pounds of sugar, $1\frac{1}{2}$ pounds of salt, $1\frac{1}{4}$ pints of cottonseed oil (or 1 pound of lard), and 68 pounds of flour.

This will produce about 130 pounds of bread and leave 40 pounds of dough for the next batch.

By this process excellent bread can be made, provided the old dough is kept at temperatures around 55° F. and for not more than 24 hours.

SCALING.

99. The customary loaf of garrison bread is the 2-pound loaf. It should be scaled at 2 pounds $3\frac{1}{2}$ ounces. This will give a full 2-pound loaf when 24 hours old.

The 4-pound loaf of field bread should be scaled at 4 pounds 8 ounces. This will give a full 4-pound loaf when 24 hours old.

Sales bread is usually baked in 1-pound loaves and should be scaled at $17\frac{1}{4}$ ounces.

One hundred pounds of flour will, when accurately scaled, produce about 140 pounds of bread when 24 hours old. However, practically, the baker always has down weight on the dough side of the scales, and slight overscaling is the rule, consequently the average dough from 100 pounds of flour will produce about sixty-eight 2-pound loaves.

MOLDING.

100. The loaves should be molded until free from large gas pockets. The edges should be well sealed. The loaf should be stiff enough to retain its form in the pan. If a dough has grown "sloppy," it may be slightly stiffened by dusting, but care must be taken that this flour is well worked in when the loaves are rounded up for proof on the bench.

PROVING.

101. After the loaves have been carefully formed they are placed in bake pans, the number and arrangement depending upon the size and shape of the pans. If too few loaves are placed in a pan, they will have a low, "squatty" appearance, as though they had not risen properly; if too many, they will be high and narrow, and although they will be of uniform porosity near the top and bottom large blowholes are apt to appear in the center, where fermentation has continued, without escape for the gas, after the baking elsewhere is well under way.

It has already been noted that up to a certain temperature proving is accelerated by heat. The temperature of the room being greater from the floor toward the ceiling, the pans first filled should be placed on the bottom shelf of the proof rack and the others on the next higher shelves as they are filled.

PROOF ROOM AND PROOF BOX.

102. In the larger bakeries iron racks mounted on rollers are provided to receive the pans as they are made ready for the proof room. *The proof room*, free from drafts and heated to a temperature of about 80° F. by free steam, is made ready to receive the racks, which are wheeled into it. These facilities are not found in the smaller bakeries, and proof boxes are provided instead. The boxes should be practically air-tight, and, if proof racks are provided, of proper size to receive them. If proof racks are not provided, boxes should be made with shelves of narrow slats to permit free circulation for such steam

as may be generated within. Often a pan of water is placed on the bottom shelf, and when the proof box is filled hot bricks are dropped into it to generate steam, which should be present during the proving of the loaves.

If gas is provided, a better method is to let the jet play upon the bottom of the pan, which is conveniently exposed beneath the box. If steam is not provided, the tops of the loaves should be greased to prevent the formation of a crust.

If the pans have been properly filled, the loaves should generally occupy about one-half their depth; when they have about doubled in size—i. e., when they are about on a level with the top of the pan—they are ready for the oven.

If the ovens are not ready to receive the loaves, the proving should be checked by lowering the temperature of the proving room or proof box or by placing them in open air in cool weather.

BAKING.

103. Great care must be exercised to have the ovens ready at the proper time. The proper temperature for brick or tile ovens is from 400 to 450° F., and if a *pyrometer* is not provided the temperature should be tested with the hand or by putting a spoonful of dough on a tin well back in the oven. It should brown in 5 minutes. While filling the oven and for about 10 minutes thereafter or longer, depending upon the temperature of the oven, the oven damper should be left open to carry off moisture and such dust as may be raised in the oven. Incidentally, the temperature of the oven is lowered very slightly, giving the loaves a better chance to spring up from the bottom before the framework is fixed.

It will be noted that the dough has been proving constantly from the setting of the sponge until the loaves have been placed in the ovens, about doubling in volume in the sponge, dough, and in the loaves. In the oven the change is even more remarkable, as the loaves nearly double in size in from 15 to 20 minutes.

During the proving process the yeast plant has been working continuously, and the carbonic gas, liberated as a result of fermentation, has produced the increased size and porous structure.

When the loaves are placed in the oven the heat penetrates to the center, killing the yeast plant and, in consequence, arresting the fermentation, but the gas already formed expands, rapidly increasing the size of the loaf. The loaves should brown in from 15 to 20 minutes. If the oven is too hot, the crust will become dark and thick before there has been sufficient time for the dough within to become properly baked. The loaves will be heavy, gummy streaks will be found near the center, and large blowholes will have formed within.

104. The crust is formed on account of the intense heat to which the outside of the loaf has been subjected, together with the incident drying out of this portion. Here the gluten is changed into a stiff gum and the starch into a more digestible form. The brown color is due to drying out of the exposed surface and to a certain chemical change in the starch known as "*caramelization*." Within the loaf the conditions are slightly different. The crumb near the crust is subjected to a temperature as high as 300° F. or more, being bathed in superheated steam. The temperature grows less as we approach the center, where it never rises above 212° F., the highest temperature of free steam in contact with moisture and not subjected to pressure. Under the action of this temperature the gluten becomes sufficiently stiff to give permanent shape and form to the loaf and to retain the cellular structure even after the gas which has produced it has escaped. From what has just been said it is easy to understand why the crumb of the bread presents such a uniform appearance throughout instead of being baked to different degrees of hardness from the crust toward the center, as one might very naturally expect.

105. *The time of baking* in a temperature of about 400° F. may be assumed to be about 10 minutes for every inch of depth of the loaf, as measured after springing up in the oven.

As it does not take so long for heat to penetrate to the center of the small loaves, it is evident that they can be baked in a much hotter oven than the larger ones, the loaves being subjected to the intense heat for a shorter period. If placed together in the same oven, the smaller loaf will bake in a shorter time; therefore, as a rule, loaves baked at the same time should be of the same depth.

Care must be exercised, especially with overproved dough, not to jar the pans while placing them in the oven, as this might cause the loaves to fall. They will not have time to rise again before the yeast plant is killed, and the bread resulting will show soggy streaks.

106. *To prevent too rapid formation of the crust* many bakers moisten the tops of the loaves with water before placing them in the oven, or arrangements are made to pass steam over the loaves during the process of baking. This causes the loaves to run together in a more compact mass, and it stimulates the tendency to mold, especially in warm, damp climates. If the loaves are treated in this manner or if they are painted with water immediately after taking them out of the oven, they will present a shiny surface—much the same as is generally present in Vienna bread.

To produce nicely separated loaves and bread of better keeping qualities, in addition to preventing too rapid formation of the crust in the ovens, the loaves may be painted lightly with cottonseed oil or lard immediately after molding and again after taking them from the oven.

107. **Cooling.**—After removal from the oven, the bread should be placed on edge to permit free circulation of air while the gases are escaping and the bread is drying. If iron racks are not provided, place on a slatted table. When conditions require, clean cloths of porous material should be spread over the loaves to keep off dust and to prevent flies from spreading infection. Bread, on account of its porous and spongy nature, might easily become a spreader of disease, a point that should be borne in mind by parties carrying bread from the bakery in open wagons. While in transit the bread should be carried in a closed box or crate, or it should be laid on a clean wagon sheet so arranged as to completely cover it and protect it from the dust and flies.

The bread storeroom should always be screened.

108. **Keeping.**—Where a bread room is provided, the loaded bread racks may be wheeled directly into it. Good ventilation should be provided, and an effort made to regulate the amount of bread on hand so that none need be issued until 24 hours old, and generally none should be stored at the bakery more than 48 hours.

If movable bread racks are not provided, a bread rack should be built of slatted shelving. Bread boxes should not be used. Bread boxes are harbingers of mold and vermin. They are difficult to ventilate and hard to keep clean.

109. Stale bread.—When the bread is taken from the oven, the crust is hard and dry and breaks with a snap. If tapped with the fingers a distinctly hollow sound will result (provided it has raised well and is properly baked) ; the crumb is moist and elastic. Within a few hours a large portion of the moisture within the loaf spreads to the crust, making it soft and tough ; the remainder combines chemically with the crumb, giving it the appearance of *dryness*. When bread has attained this condition it is said to be *stale*, and until this time—12 to 18 hours—it is generally considered as unfit for immediate use.

110. Sour bread.—Sour bread is caused principally by poor, cheap flours, overproof of the dough, and lack of cleanliness in the utensils used in bread making.

111. Holes in bread.—Holes in bread are caused by careless molding, overproving the dough, soft, weak flours, or use of too much dusting flour. For poor flour use plenty of yeast and a very young dough.

ROPE IN BREAD.

112. What is commonly called "*rope*" sometimes appears in bread not more than 12 to 24 hours old. It has been known to appear in less than 2 hours in hot, warm climates.

Rope is the worst disease that bread is subject to, and when once started is very hard to get rid of.

It is caused by the *potato bacillus* which is usually introduced in flour. Once introduced its growth will be fostered by poor sanitation.

One good authority says :

" It appears to be caused by forcing doughs too much ; that is, using more yeast than is necessary in a hot climate and not giving the dough enough age. An extra punching of the dough, mixing it as cool as possible and bringing it out in a strong, cool, slow fermentation will always help. Where there

is any danger of rope all utensils should be scalded each day in boiling vinegar.

"The bread after baking was stored in screened tents to cool and dry before distribution. For the first few hours there was little or no change in the loaf at ordinary temperature, but after 24 hours, upon breaking the loaf, an odor not unlike ripe cantaloupe was noticeable. A few hours later yellow or brown spots with a soft, sticky center began to appear, and within 36 to 48 hours, depending on the temperature, the entire central portion of the loaf became a semifluid, sticky mass, totally unfit for food, and could be pulled out into long strings or ropes.

"The potato bacillus is the same as rope in bread. In this instance it was found in the flour. The organism was probably first introduced into the bakery in such numbers by the flour which had been stored on transports as to cause rapid deterioration of the bread. From this highly infected material the mixing utensils were contaminated in such a degree as to transmit enough to the better grade of flour and to continue the process indefinitely. Fumigation by formaldehyde or sulphur, of bake-shop or tentage, in an infection of this kind is practically useless. *The addition of 10 per cent vinegar in the proportion of 1 pint to each 100 pounds of flour is an absolute preventative.* The food value of bread so treated is not reduced. In the absence of vinegar the addition of acetic acid, 10 per cent solution, 1 pint to 100 pounds of flour, is the next most practical procedure." (Extracts from "Rope in Bread in Field Bakery, U. S. Army," First Lieut. Guy L. Qualls, Medical Corps.)

MOLD IN BREAD.

113. **Mold** is one of those minute spores that float about in the air and develop wherever suitable conditions of food, warmth, and moisture are found. Hence, when the proper conditions exist for its growth, it will be found to develop either on the outside or inside of the bread.

"*Mold in bread* is usually a clear index of too high humidity in the place of storage; too high water in the bread may be another factor.

"Of the kinds of mold met, the most common is black mold.

"Under much the same conditions I have found in the products of certain bakeries a little brown mold forming numerous colonies about the size of pinheads.

"*Under moist conditions* the green molds may appear within two or three days. These do not appear as quickly as the two mentioned above. As the bread becomes older and drier, you find the air spaces in the crust first showing green balls, and later yellow balls. This mold requires several days to develop as a rule. Hence it may almost be cited as evidence that the bread containing it is several days old. This organism will develop in very dry bread if the humidity is high.

"*Molds gain access after baking.* The species present in the flour are doubtless all killed in baking, since they are less resistant than the bacteria.

"*Moldiness* begins on the *outside* of the loaf.

"*Sugar favors moldiness*; salt and spices in palatable amounts have no effect on them. The reduction of the activity of the organism is then dependent upon thorough baking, proper water content, controlled humidity in storage, and scrupulous care in destroying or cleaning all moldy substances which could in any way come in contact with the finished product." (Thorn, mycologist, U. S. Department of Agriculture.)

Mold or mustiness in flour will be more apparent in the finished loaf than in the flour.

CHAPTER V.

SPECIAL RECIPES.

114. Sales bread.—In making sales bread the *sponge and dough method* is recommended for the reason that the sponge and dough method allows several varieties of bread to be made by dipping the desired quantity of sponge and adding rye flour, graham flour, or other ingredients which will produce the character of bread desired.

Ingredients: 100 pounds flour, 2 pounds sugar (or 1 pound sugar and $1\frac{1}{2}$ pounds malt extract), $1\frac{1}{2}$ pounds salt, 2 gallons milk, 5 gallons water, $1\frac{1}{2}$ pints cottonseed oil (or 1 pound lard), 1 pound compressed yeast.

Make a sponge, using 50 pounds flour, 4 gallons water, and 1 pound compressed yeast. When the sponge is ripe, add the remainder of the flour and water, the sugar, salt, milk, and one-half the cottonseed oil or lard. Add the remainder of the cottonseed oil or lard in cutting over the dough. Mix into a soft dough. Scale at $17\frac{1}{2}$ ounces. Bake in single-ration pans at temperature from 400° to 450° F. from 35 to 40 minutes. If a thin, light-colored crust is desired, place the molded loaves in a large bake pan and cover with single-ration pans.

115. Rye bread.—*Set a sponge* the same as for sales bread, or dip the required amount from a sales bread sponge already made. When the sponge is ripe add sufficient rye flour to make a stiff dough. Two quarts of sponge will make 5 pounds of bread. The other ingredients are the same as for sales bread except that caraway seeds are sometimes added and often the amount of salt is increased. When sufficiently proved mold into Vienna-shaped loaves, scaled at $17\frac{1}{2}$ ounces. To prevent sticking set to prove on clean cloths placed on the bench. When ready for the

oven sprinkle the peel with cornmeal to prevent sticking, and as the loaf goes in the oven make three oblique, shallow cuts across the top of the loaf to prevent ragged tears while baking.

Rye bread is baked as bottom bread, i. e., on the floor of the oven without using pans. It should be a stiff dough to prevent running.

116. **Graham bread.**—*Set a sponge* the same as for sales bread, or dip the required amount from a sales bread sponge already made. Make the dough exactly the same as for sales bread except that graham flour is used. Bake in single-ration pans.

SWEET DOUGH MIXTURE.

117. This dough is suitable for making Parker House rolls, cinnamon buns, tea buns, doughnuts, or other varieties of sweet doughs:

One gallon mixture (sufficient for 250 rolls).

Ingredients: 13 pounds flour, 3 pounds sugar, 1 quart cotton-seed oil (or 2 pounds lard), 2 ounces salt, 4 ounces compressed yeast, 1 gallon milk. *Mix as a straight dough.*

Parker House rolls.—When sufficiently proved, take pieces of dough of convenient size and roll out until about five-eighths of an inch thick. Cut out with the top of a can or cutter, about $3\frac{1}{2}$ inches in diameter, having first greased the top surface of the dough. Strike through the center of each piece with the edge of the hand; double over one half upon the other and place in a bake pan, keeping them well separated and edges greased to prevent sticking together. After about doubling in size in the pan bake in a quick oven for about 15 minutes. For quicker work the dough is rolled into cylindrical shape under the hands, as in molding a loaf, until it is about $1\frac{1}{2}$ inches in diameter. Pieces are broken successively from the end of the roll in sizes suited to the roll desired, and these pieces of dough are quickly rolled into balls, one under each hand, by a rapid inward circular motion. The balls are then greased, struck in the middle with the edge of the hand, and doubled over as before.

Cinnamon buns.—When ready, roll out into thin sheets about 8 inches wide and of convenient length, grease well (except

about 1 inch of the inner edge, which should be wet with water to make the bun stick together when rolled). Sprinkle liberally with sugar and cinnamon. Begin with the outer edge and gradually roll firmly toward you until the roll is completed. Cut into lengths of about 1 inch (depending upon the thickness of the bun desired) and place them close together in the bake pan, greasing the edges to prevent sticking; or if there is plenty of room, separate them well in the pan, and instead of securing a tall bun you will get one that is flat, as in this case the bun will widen out in proving instead of pushing upward. After about doubling in size in the pan bake in a quick oven.

Tea buns.—When the dough has proved sufficiently roll out into sheets about one-half of an inch thick, cut into disks about 3 inches in diameter. Place in bake pans, keeping the buns well separated. After about doubling in size in the pans bake in a quick oven.

Doughnuts.—Prepare in the same way as tea buns, except that when they are proved sufficiently they are fried in an iron pot containing several inches of smoking fat. When well browned they are removed, using a long pine stick (as a matter of convenience), and rolled in sugar.

Coffee cake.—Roll out into sheets about one-half inch thick, and place in pans of the desired size. Grease the top with butter, cover liberally with sugar, and sprinkle with cinnamon. After about doubling in size in the bake pan bake in a quick oven.

Crullers.—Whip together for about 5 minutes 1 pound of sugar, 2 ounces of salt, and 1 teaspoonful of lemon extract. Mix in 6 pounds of flour and 5 ounces of baking powder, adding enough water (or milk) to make a soft dough. Drop the dough into the hot fat with a basting spoon; each time before using dip it into the water to prevent the dough from sticking to it; repeat until the surface of the fat is covered, leaving only room for turning; remove with a skimmer and place in the dripping pan. Sprinkle lightly with sugar. Repeat the operation until all the dough has been used up.

Cakes and pastries.—See Appendix C.

CHAPTER VI.

POST BAKERY EQUIPMENT.

118. Ovens—classification.—*Ovens are classified—*

(1) *As to the manner of firing, into—*

(a) *Continuous types*, in which the heat generally passes around the oven, rendering it possible to make successive bakings by the same continuous fire. In the “draw-plate” ovens, however, heat is introduced directly into the oven chamber by means of the so-called “steam pipes.” Among the former are the *Simpkins*, *Clauss*, *Peterson*, *Duhrkop*, etc., and the only “draw-plate” oven now installed at Army posts is the *Werner* and *Pfleiderer*.

(b) *Intermittent types*, in which it is necessary to draw the fire before each baking, if baking is done in the chamber in which the fire is built, as in the common brick oven and the semicylindrical type of the knockdown field oven; or in other types, to let the fire die down at some time while each successive batch is being baked, thus requiring a certain lapse of time between the bakings.

(2) *As to their portability, into—*

(a) *Permanent ovens*, which are generally built of solid brick, with no intention of moving them, and weighing as much as 50 tons. Such ovens are installed in many post bakeries. They include the *Simpkins*, *Clauss*, *Duhrkop*, *Peterson*, *Werner*, and *Pfleiderer* “draw plate,” the common brick oven, etc.

(b) *Portable ovens*, which can be taken down and moved. The term is applied to the *Middleby*, that can be taken down tile by tile and moved in many days, as well as to the light knock-down field ovens that can be taken down and prepared for wagon transportation, or set up in a few minutes.

INSTRUCTIONS FOR FIRING AND REPAIRING.

119. (a) Brick ovens:

(1) *Firing: a. First time.*—An oven that has never been fired should be heated by a *slow continuous fire* for four or five days, with all the dampers open, to allow the moisture from the materials of which it is constructed to escape; then fire heavy enough for two days to obtain a proper baking temperature. (If not required for immediate use, it would be advisable to let the oven stand with all drafts open from two to four weeks before starting the first fire.)

b. *Cold oven.*—Brick ovens, if cold, take from two to four days to heat up before they will do good work, and even then the chances are that they will not have become equally heated throughout, baking top and bottom equally well.

c. *Daily.*—For the daily firing, when the oven is regularly used, start the fire at least two hours before baking, leaving the draft dampers open. After the fire is well started put in about 2 bushels of coal, and after it is about half consumed close the draft dampers and the ash-pit door. Be careful not to make too hot a fire at any time, but regulate the dampers according to the draft. Fire boxes have frequently been practically ruined in a few weeks by intense heat. Keep the fire "clean" at all times and do not allow the ashes to accumulate in the pit. Should the grate bars become imbedded in ashes, they will warp and burn out.

All ovens possess certain peculiarities, and new bakers can not expect to turn out loaves of uniformly good quality until they have become accustomed to the particular oven in use. In many double ovens that part near the common partition becomes hotter than other parts, likewise the parts of the oven farthest from the door. Hence it is that pans of bread first run into the oven may go to the hottest parts, and from necessity may be the last to be withdrawn. If such an oven is used to its fullest capacity, some of the loaves are apt to be highly browned or even burned before others are ready to be withdrawn, as shifting under these circumstances is done with difficulty. Care must be taken to

70816°—17—5

keep pans away from the common partition of such an oven and to fill the cooler parts first.

(2) *Dampers*.—While preparing the oven for firing, the oven damper should be kept closed. In case the oven becomes too hot, the temperature may be reduced by opening the damper and also the oven door, to give circulation through the oven. When running bread into the oven, this damper should be opened to draw off the dust that is raised and the moisture from the loaves. It should be left open for the next 10 minutes or such a matter, cooling the oven and giving the bread a better chance to spring up from the bottom before the framework is fixed.

Brick ovens with hot-water connection also have another damper to be used in connection therewith, and it should be regulated according to circumstances.

After each day's firing all dampers should be kept closed to retain all the heat possible within the oven.

(3) *Firing from the rear*.—Most ovens are fired from the baking room, causing unnecessary littering up and annoyance. Wheelbarrows of coal or piles of wood may be in the way and present an untidy appearance. On cold mornings, when first firing ovens, gas and smoke may escape into the baking room, blackening the walls, and rendering work at such times most disagreeable. In the larger bakeries the ovens should be fired from the rear, from a room entirely detached from the baking room, unless oil or gas is used for fuel. It can generally be arranged to have the firing done from the boiler room, without extra assistants, where other fires are necessary for heating the bakery, supplying hot water, and running machinery.

(4) *Tiles*.—Furnace tiles should last about three years. They should be installed by a mechanic familiar with such work.

Water must not be thrown in the oven to cool it. If this is done, the tiles will crack.

(5) *Grates*.—If care is taken in keeping the fire clean and not allowing ashes to accumulate in the ash pit, the grates will last about three years. Any mechanic can replace damaged grates.

If the casing which contains the sockets for the grates is burned out, a mechanic familiar with such work should be employed to install the new casing.

(6) *Repairs.*—All repairs, especially brickwork, should be made by a mechanic familiar with brickwork in oven construction.

(7) *Mopping out the oven chamber.*—It is necessary, from time to time, to mop out the oven chamber to remove dust, etc. Water must not be thrown in the oven for this purpose, as this will cause the tiles to crack.

To mop out an oven, tie a gunny sack on a long pole, dampen the sack (not soak in water), and mop out the oven chamber with the damp sack.

(8) *Cleaning the flues.*—About once in 10 days a quick wood fire should be made in order to burn out the flues and maintain a good draft. "Clean-out" doors are provided for removing such ashes as accumulate and can not otherwise be removed. Generally it will not be necessary to use them oftener than once in six months or a year.

(b) *Marshall continuous baking oven.*—This oven is constructed by the *Middleby Oven Co., of Chicago, Ill.* The oven with outside measurements 10 by 12 feet is designated as No. 30, and the 12 by 14 feet as No. 40.

(1) *Firing.*—The same general rules for firing as given for brick ovens should be observed, though it does not require so long to prepare for the first baking.

(2) *Tiles.*—The tiles are said to be practically indestructible, except those of the arch directly over the furnace. These are interchangeable, and should one be required for repairs it can be replaced by a mechanic unacquainted with the oven.

(3) *Grates.*—In ordering, give designation of oven.

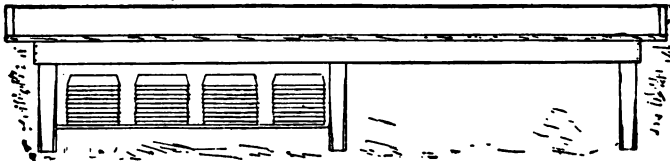
(4) *Cleaning.*—The only flue of the oven that will ever require cleaning out is the top or roof flue, and this is easy of access. It should be cleaned out with a brush every six months to a year, depending upon the kind of fuel used.

120. *Dough troughs.*—Dough troughs were formerly made of wood, and of such kind (generally poplar) that an objectionable flavor would not be taken up by the dough. A wooden trough has the advantage of being a poor conductor, and therefore keeps the dough at a more constant temperature than a steel trough. These troughs have in the larger bakeries been replaced by steel troughs, which are easier to keep clean. The

latter are mounted on rollers for more convenient use in connection with the dough mixer and for running in and out of the proof room.

Sourness in bread is frequently caused by particles of dough becoming lodged in the cracks of wooden troughs, souring, and setting up acid fermentations in dough that is afterwards set in the trough. Wooden troughs must be frequently washed with hot water and thoroughly rinsed and dried, preferably in the sun. Steel troughs are so constructed that they are readily cleaned with a scraper and brush, and there are no cracks in which the dough can lodge and become sour. Steel dough troughs are generally kept in the baking or mixing room with a temperature of 80° F., and consequently can not as a rule be of a much lower temperature than the dough or sponge. It does not therefore necessarily reduce the temperature of the dough, as is sometimes stated, but is simply cold to the touch for the reason that it is a good conductor.

121. Molding table.—Molding tables should be constructed of the same material as wooden troughs. For large bakeries, where many bakers are employed, the table should be broad and set out in the room so that the bakers may work on both sides of it. Where there are but few bakers the table should be smaller and built with a flange, as indicated in illustration. The flange is for the purpose of preventing the dough from spreading and falling to the floor.



MOLDING TABLE.

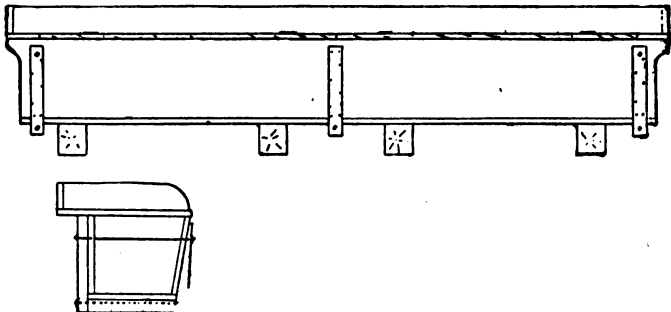
Material.—Preferably, poplar.

Capacity.—About 500 pounds.

Dimensions.—Length, 15 feet; width, 4 feet; height, 2 feet 10 inches. Flange, 8 inches high.

The top and flange are of 2-inch lumber, thoroughly seasoned; the supporting frame, strong and firm.

Pans when not in use are telescoped and placed bottom side up on subshelf. This prevents dust from settling on the inside of pans.



DOUGH TROUGH.

Material.—Preferably poplar.

Capacity.—About 500 pounds.

Inside dimensions.—Length, 14 feet 6 inches; width at top, 26 inches; at bottom, 22 inches; top flange, 8 inches high. Inside raised 10 inches above the floor by means of supports. The trough proper is constructed of 2-inch lumber. The top is provided with two lids of 1-inch lumber, each covering one-half of the trough and provided with strong hinges. Two dam boards are provided to fit the trough; they are of 2-inch poplar.

122. **Proof room and proof box.**—In the larger bakeries proof rooms are generally provided, and the bread as soon as molded is rolled into the room on specially constructed “proof racks.” The room is generally heated with free steam and kept at a temperature of about 80° F. The proof room is also a great convenience for proving the sponge and dough; the sponge is set, or the dough kneaded, in a convenient place at a moderate temperature, and the trough, mounted on rollers, is run into the proof room, where the dough will prove most satisfactorily under the fixed and favorable conditions provided. Especially

is the proof room appreciated in cold and uncertain weather, when it is difficult or impossible to keep the temperature of the baking room at the same even temperature.

At the smaller posts proof rooms are not generally provided and proof boxes are supplied instead. A proof box consists essentially of a box or cupboard that is practically air-tight; several shelves of slats are provided for supporting the pans and permitting free circulation of such heat and steam as may be generated for heating the box.

123. Bread room.—In the larger bakeries bread rooms are generally provided and the bread may, for convenience, be placed on the steel racks as soon as it comes from the oven and be wheeled into the bread room, where it remains undisturbed until issued.

124. Fixtures.—Wooden shelving, cupboards, bread boxes, etc., are great cockroach and vermin gatherers, and as far as possible should be done away with.

It is recommended that sinks be set out from the wall, that pan racks be made of metal and set on wheels, and that when practicable a *bread room* be provided, so that the bread may be issued from the racks upon which it is placed when drawn from the oven.

125. Number of bakers required.—(A. R. 1201, 1913, as amended.)

Average daily production of bread (pounds).

	Bakers.	Assistant bakers.	Bakers' apprentices or laborers.
300 or less.....	1	1
300 to 500.....	1	1
500 to 1,000.....	1	1	1
1,000 to 1,500.....	1	2	1
1,500 to 2,000.....	1	2	2
2,000 to 2,500.....	2	2	2
2,500 to 3,000.....	2	2	3
3,000 to 3,500.....	2	2	4

When the daily production is in excess of 3,500 pounds the number of bakers, assistant bakers, and baker apprentices or laborers is fixed by the Quartermaster General, according to the necessities of the case.

126. *Daily routine, etc.*—The post bakery should be scrupulously neat. On account of the nature of their work, bakers must bathe daily, making a complete change of underclothing. They should be provided with 12 aprons and 4 caps each, furnished and laundered by the Quartermaster Corps, the cost of laundering to be included in the monthly bread cost statement.

The necessity for clean utensils and equipment is apparent. Each morning after the molding is done, advantage should be taken of the period of proving—about one and one-half hours—to clean up the bakery and equipment, as there will generally not be any further littering up for the day. The mixing machine and dough troughs should then be thoroughly cleaned and greased. Every time a bread rack is emptied it should be brushed clean, or washed if necessary.

Wooden dough troughs should be scrubbed out with boiling hot water and then sunned for an hour or two daily. Molding tables and floors should be scrubbed daily.

The chief baker should be held responsible for the police of the grounds in the immediate vicinity of the bakery.

CHAPTER VII.

FIELD BAKERIES.

127. Bakery companies will be established for war service at the rate of one to each division, and for peace service in such number within each territorial department as may be authorized from time to time by the Secretary of War; they are to be formed from enlisted bakers of the Quartermaster Corps, with such civilian employees as may be necessary, and will be assembled only as needed; they are not to be considered as a constituent part of a division, but as elements of the Quartermaster Corps at large and may be assigned in whole or part to concentration or other camps of a permanent or semipermanent character. They are normally to be treated as elements of the line of communication; when such line is established they are attached thereto, according to the needs of the particular situation, and are operated under the direction of the commander of the line of communications.

In time of peace, and for the service of the interior in time of war, bakery companies located within any territorial department are placed under the control of the department commander for all purposes of administration, training, and inspection, and their services may be utilized by him, unless otherwise ordered, in whole or in part, as he may consider advisable, without reference to the War Department.

The organization, personnel, and equipment of a bakery company at war and peace strength are as follows:

ORGANIZATION.

128. A bakery company at war strength is divisible into four sections of three units each. The sections are lettered A, B, C, D,

and the units are numbered from 1 to 12. The company is designed to supply normally a force of the strength of a division; a section, an infantry brigade; and a unit, an infantry regiment at war strength.

A bakery company at peace strength consists of three sections of three units each, with a slight additional personnel as indicated in the table following. The fourth section is unorganized, but the equipment for this section will be kept on hand.

The organization and equipment are such that each unit, section, and company is complete in itself, so that orders directing assembly may specify simply the number of bakery units, sections, or companies required at a given destination and the authority to whom to report.

PERSONNEL.

Bakery companies. WAR STRENGTH.

	Unit.	Section.	Company.
Commissioned officer: Assistant to the quartermaster			1
Enlisted personnel:			
Chief baker—Quartermaster sergeant or sergeant, first class, Quartermaster Corps (acting first sergeant and quartermaster sergeant).....			1
Assistant chief bakers—Sergeants, Quartermaster Corps (in charge of sections).....		1	4
Bakers—Sergeants or corporals, Quartermaster Corps (12 in charge of units; 8 others for assignment to duty with the company, or with detached subdivisions according to the necessities of each case).....	1	3	¹ 20
Assistant bakers—Corporals or privates, first class, Quartermaster Corps.....	3	8	¹ 32
Cooks.....			¹ 2
Cooks or general police—Privates, first class, Quartermaster Corps.....			¹ 2
Total enlisted personnel.....	4	12	61

¹ Authority is vested in the Quartermaster General to substitute civilian employees in numbers not exceeding those here allotted for any enlisted men other than the chief and assistant chief bakers.

PEACE STRENGTH.

Commissioned officer:			
Assistant to the quartermaster			1
Enlisted personnel:			
Chief baker—Quartermaster sergeant, first class, Quartermaster Corps (acting first sergeant and quartermaster sergeant)			1
Assistant chief bakers—Sergeants, Quartermaster Corps (in charge of sections)		1	3
Bakers—Sergeants or corporals, Quartermaster Corps (9 in charge of units; others for assignment to duty with the company, or with detached subdivisions according to the necessities of each case)	1	3	1 22
Assistant bakers—Corporals or privates, first class, Quartermaster Corps	3	8	1 20
Cooks			1 2
Total enlisted personnel	4	12	48

¹ See paragraph 130.

130. Whenever the company as a whole, or a major fraction thereof, is assembled for service in time of peace, authority is vested in the Quartermaster General to substitute civilian employees in numbers not exceeding those here allotted for any enlisted men other than the chief and assistant chief bakers.

Bakery companies will be organized from the available bakery personnel, Quartermaster Corps, and administered as Signal Corps companies are now administered; men absent from the company headquarters will be regarded as detached for duty at the stations where they may be.

The commissioned officer in charge of the bakery company is responsible for the operation of the bakery and the training and discipline of the personnel.

When operating as a bakery company or in two sections, the personnel is rationed separately. When less than two sections are operating separately, they are assigned for rations to the organizations with which they are serving.

DUTIES OF PERSONNEL.

131. *The officer in charge* is responsible for the training and discipline of the personnel. He is responsible and accountable for the field bakery. He can consider his mission accomplished only when the troops are promptly supplied with good bread, both in camp and on the march. When the division is demobilized, he is stationed at the headquarters of the company as assistant to the post quartermaster.

DUTIES OF THE CHIEF BAKER.

132. *The chief baker*, under the officer in charge, has general supervision of the bakery company and field bakery. He acts as first sergeant and as quartermaster sergeant of the company, keeps the company records, keeps record of subsistence stores received and expended in baking, makes issues to organizations, prepares bread-cost statement on the last day of the month. He sees that the units are properly manned, replaces absent and sick bakers from the supernumerary bakers. He assigns bread store tents to the sections, keeps the keys to the store tents, and makes all issues of baking supplies. He is stationed at the headquarters of the bakery company.

DUTIES OF THE CHIEFS OF SECTION.

133. *The chief of section* is directly responsible for the efficiency, cleanliness, and appearance of his section, both personnel and matériel. He is responsible that the firing is properly done, bread baked properly, and that the bread produced is up to the proper standard. He inspects each run of bread after it is baked and before it is put in storage. He takes general charge of his section in making and breaking camp, and is responsible that the equipment and wagons of his section are properly packed. He draws daily from the chief baker the supplies required for his section and issues them to the chiefs of units. He submits a daily report of the amount of bread baked to the chief baker at the close of work. He takes

particular care that the water used in making doughs is of the proper temperature to give an average for flour, tent and water, of 240° F. (234 in summer, 246 in winter). After the completion of the day's baking he sees that the mixing tents, utensils, ovens, and grounds are in good police. In wet weather he sees that wood for the first fire for the next day's run is put in a dry place.

When two or more sections are operating together, a chief of section takes entire charge of all sections of the bakery during the tour of duty of one shift.

DUTIES OF THE CHIEF OF UNIT.

134. *The chief of unit* is responsible to the chief of section for the efficiency, cleanliness, and appearance of his unit. He is responsible for the quality and condition of the bread of his unit. He is responsible to the chief of section for the property of the unit.

135. The material for a field bakery at peace strength is kept on hand ready for immediate shipment or use at the headquarters of the company. The material to bring the field bakery to war strength is kept on hand in reserve.

Each post should be supplied with one unit of the field bakery. The bakers attached to the post should be required, at least once a month, to set up the unit, bake a supply of field bread and a supply of garrison bread on separate days.

136.

EQUIPMENT.

Table of equipment.

	Unit.	Section.	Company.
Axes.....	1	3	12
Boards, dam, for dough troughs.....	2	6	24
Brushes:			
Bench.....	1	3	12
For greasing loaves.....	1	3	12
Scrubbing.....	2	6	24
Buckets, galvanized-iron.....	3	9	36

Table of contents—Continued.

	Unit.	Section.	Com- pany.
Cans, sponge, nested.....	7	21	84
Clocks.....		1	4
Colanders, 12-inch.....	1	3	12
Covers, canvas:			
For bread racks.....	3	9	36
For dough troughs.....	2	6	24
For ovens.....	1	3	12
Covers for sponge cans.....	1	3	12
Desks, field.....			1
Hatchets.....	1	3	12
Hoes, fire.....	1	3	12
Hooks, pan, 5 feet long.....	1	3	12
Lanterns, folding.....	2	6	24
Measures, gallon, graduated.....	1	3	12
Ovens, field.....	1	3	12
Pans, bake, 12 by 24 inches.....	36	108	432
Paulins, large and small (in number as required).			
Pennants.....			1
Pickaxes, with handle.....	1	3	12
Racks, bread, folding.....	3	9	36
Rakes.....	1	3	12
Ranges, No. 2, complete.....		1	4
Scales.....	1	3	12
Scoops, large.....	1	3	12
Scrapers, dough.....	2	6	24
Shovels, long handle.....	1	3	12
Sieves, flour, 13-inch.....	1	3	12
Stoves, Sibley, complete.....	1	3	12
Tables, molding.....	1	3	12
Tents, wall, large, open at both ends.....	2	4	18
Tents, storage.....			2
Tents, pyramidal, large.....	1	2	8
Tents, pyramidal, small.....			3
Thermometers, oven.....	1	3	12
Transportation, motor, wagon, etc. (as required). ¹			
Troughs, dough.....	2	6	24
Wrenches, monkey, 8-inch.....	1	3	12

¹ To be supplied for interior service, supply and transport, as circumstances attending the operations of the bakery company or its detached subdivisions may require.

While not authorized, a tool box should be provided as part of the company equipment. This can be obtained upon requisition.

tion made to the nearest depot and is almost indispensable in the field.

CONTENTS OF TOOL BOX.

- 3 borers, tap (one for each section detached).
- 6 bits, carpenter's, one each $\frac{1}{4}$ -inch, $\frac{1}{2}$ -inch, $\frac{3}{4}$ -inch, $\frac{1}{2}$ -inch, 1-inch, and $1\frac{1}{2}$ -inch expansion.
- 1 brace, carpenter's, 10-inch.
- 1 chisel, wood, $\frac{1}{2}$ -inch.
- 1 chisel, hand, cold, $\frac{1}{2}$ -inch.
- 3 faucets, wood or metal (one for each section detached).
- 2 files, flat, 8-inch.
- 2 files, saw, 8-inch.
- 3 hammers, claw (one for each section detached).
- 1 iron, soldering.
- 1 plane, jack, 5-inch.
- 1 plane, smooth, 9-inch.
- 1 pliers, 8-inch.
- 3 rules, 2-foot, 4-fold (one for each section detached).
- 3 saws, hand, crosscut (one for each section detached).
- 1 saw, hand, rip.
- 1 screw driver, 12-inch.
- 1 screw driver, 6-inch.
- 1 shears, tinner's.
- 1 try square, 10-inch.
- 1 chest, tool.
- 1 tape, steel, 100 feet.
- 3 trowels, mason's (one for each section detached).
- 3 wrenches, monkey, 8-inch (one for each section detached).
- 2 pounds solder.
- 2 pounds resin.
- 1 pint acid, muriatic.

137. The foregoing constitutes the equipment of the unit, section, and bakery company. The term "Field bakery" will be used to designate the bakery equipment for the company. Except when in use, it shall be kept serviceable and intact at the headquarters of the company ready for immediate use or shipment. Articles of equipment will be appropriately marked with the company numeral.

When units or sections are temporarily detached no transfer of accountability is made. The unit or section proceeds with its prescribed equipment and on the completion of such service it returns with its equipment. If, due to losses or depreciation of material, a section or unit requires any equipment, it will be

issued and will then become part of the company equipment. The officer who makes such an issue accounts on his return for the missing or unserviceable material in the usual way.

138. The following supplies, for immediate use upon arrival in camp, should be kept packed and ready for shipment with the field bakery :

To each section, one box containing 20 pounds soap, issue ; 20 pounds candles, issue ; 10 cans lye ; 5 pounds nails, 20-penny ; 5 pounds nails, 10-penny ; 10 pounds nails, 8-penny ; 5 pounds nails, 6-penny ; 20 pounds asbestos rope.

139. *Upon receipt of orders* to proceed to a designated point with the field bakery, *the officer in charge* causes the field bakery to be loaded, and, accompanied by the *chief baker*, proceeds to the point of rendezvous. The field bakery will require one 40-foot box car at peace strength, two cars at war strength.

140. *The field bakery* should carry with it to the rendezvous four days' supplies of baking materials, based on peace strength, for a division ; 30,000 pounds flour, 600 pounds sugar, 500 pounds salt, and 400 pounds lard or 1 barrel of cottonseed oil. (*Arrangements should be made to have yeast supplied at the point desired, by telegraphic notice to a manufacturing yeast company.*) This material should be loaded in a separate car and accompany the field bakery, and be invoiced by the post quartermaster to the depot quartermaster at the point of rendezvous. Before starting for the place of rendezvous the officer in charge of the bakery company arranges to have the enlisted personnel ordered by telegraph to the rendezvous. If possible, the officer in charge and chief baker should proceed by the same train as the equipment. The enlisted personnel, fully equipped, proceed in the shortest practicable time to the rendezvous.

141. *The officer in charge*, as soon as he arrives at the rendezvous, picks out or is assigned a camp site, and makes arrangements for drawing the necessary subsistence supplies. As soon as the enlisted personnel is on the ground he causes the cars to be unloaded and sets up the bakery. Unloading should be started as soon as sufficient of the enlisted personnel arrives to handle the equipment.

142. *The normal camp of a bakery company* and the arrangement and utilization of the tentage and ovens are indicated on the accompanying plan. While such arrangement is desirable, conserving energy and economizing space, it is not to be followed blindly, but the commander should exercise his judgment in making such modifications therein as will best meet conditions as they arise. See Appendix A.

143. *If the equipment is new* it will be necessary to clean the *paraffin coating* from the troughs and bake pans before using them. This is most easily done by building a fire and placing the troughs over the blaze for about 10 minutes. The pans are placed on the fire and allowed to get red hot. Both are then well scrubbed with soap and water and greased.

144. The type of bread baked in a post bakery and distributed to troops is familiar to all. It is usually designated as garrison bread.

Field bread is the term applied to a type of bread having a greater density, a thicker crust, and a consequent higher capacity for retaining moisture than garrison bread. Field bread, as indicated by its name, is intended for consumption in the field by troops at a distance from the bakery. On account of its thick crust and great density it will keep fresh longer than garrison bread, and, as it is hard and firm, it can be transported with less danger of being damaged through rough handling.

Field bread should not be made except for instruction or in emergency to supply troops so distant that garrison bread can not be preserved. This for the reason that its production decreases the capacity of the ovens to two-thirds, and increases the time of baking two-sevenths, thus increasing the hours of labor for the personnel a little less than 100 per cent over the time required to produce a like amount of garrison bread. In order that the bakers be kept proficient in the making of field bread, it should be made and issued once a week in permanent camp.

Garrison bread is intended for consumption in garrison or permanent camp, and in the field when the troops are not too distant to be reached in a day.

145. *A combination of the straight dough and the sponge and dough methods* is used in the field bakery. The following recipe

is recommended when it is desired to produce bread in the minimum length of time. The time of fermentation can be increased to seven hours instead of three and one-half by using one-half the amount of yeast or 12 instead of 24 ounces:

Straight dough—216 pounds of garrison bread.—Ingredients: 160 pounds flour, 2 pounds sugar, 2 pounds salt, 2 pounds cottonseed oil (or lard), $1\frac{1}{2}$ pounds compressed yeast, about 11 gallons water.

Mix thoroughly, using one-half the oil in mixing and one-half in cutting over the dough. The dough should be ready to punch the first time in about three and one-half hours. Allow to prove a second time for one-half hour. Scale at 2 pounds, $3\frac{1}{2}$ ounces. Allow 35 to 45 minutes proof in the pan. Put in the oven and leave chamber doors open from 5 to 10 minutes until the loaf is 1 inch above the top of the pan. Bake 1 hour and 10 minutes, starting at 575° F. and dropping to 550° F.

The straight dough method is recommended for use in the field bakery. Many experienced bakers prefer, however, to use a combination of the straight dough and the sponge and dough methods. Both methods have been used with excellent results. The question as to which is the most convenient should be decided by the officer in charge of the field bakery. Most bakers prefer to set a number of straights and sponges about 8 o'clock in the evening. All of the men on duty with the unit or section work at this time. Two straights may be made and two sponges. These are set with different amounts of yeast, so as to have them ready for the bench at intervals of about 1 hour and 15 minutes when making garrison bread (one hour and a half for field bread).

One man may be assigned to night duty with each section. He looks after the temperature of the tents, punches down the doughs, mixes the sponges when ready, prepares one straight or sponge at midnight, starts the fire in the oven in order to have the baking temperature at the proper time, and calls the chief of his section or unit when the first dough is ready for the bench. Immediately after this dough is panned the sixth dough may be mixed. The seventh, if required, can be mixed after the

second dough is panned. This insures a minimum of work for the men of the section or company. The extra men in the company can be used to fill the places of the men on night duty, thus allowing four men to each unit.

Seven runs of garrison bread insures a production of 1,512 pounds of bread to the unit, 13,608 pounds to the company at peace strength, 18,144 pounds to the company at war strength, and is the maximum amount that can be expected from a field bakery with the present allowance of personnel.

Continuous runs of straight doughs may be made 1 hour and 20 minutes apart. This will give four doughs on hand at one time, two in the troughs and two in the cans. By setting the doughs 1 hour and 20 minutes apart and baking for 1 hour and 10 minutes, 10 minutes are available for withdrawing the old run and placing the new run in the oven.

146. *Field bread (straight dough)*, 14½ pounds.—Ingredients: 105 pounds flour, 3 pounds sugar, 2 pounds salt, 8 ounces cotton-seed oil (or lard), 12 ounces compressed yeast, about 6½ gallons of water.

Mix into a very stiff dough. Dough should be ready to punch the first time in four and one-half hours. Punch second time after one hour. Scale at 4 pounds 8 ounces, round up, and flatten out into a round loaf about 1½ inches thick. Allow only 15 minutes' proof in the pan. Just before putting in the oven make a round hole in the center of the loaf with the ends of the thumb and forefinger joined together. This hole is of sufficient size to permit the gas to escape and will result in a loaf less liable to crush in transportation, less subject to mold, and with a smoother appearance than one that has been slashed across the surface with a knife. (See illustration below).

The advantage of the rounded loaf, flattened out, is in the tighter union of the bottom crust.

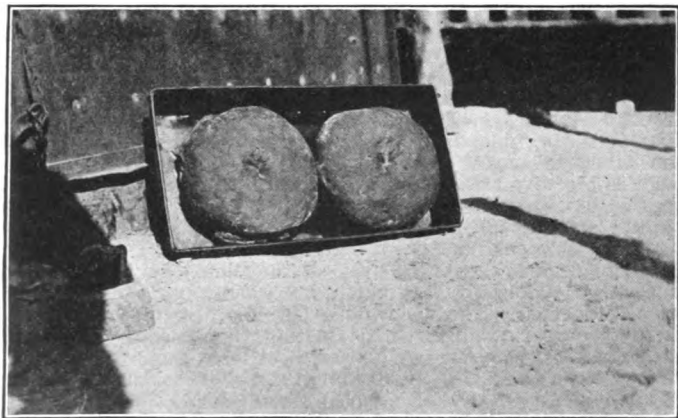
Allow the chamber doors to remain open the last 15 minutes of baking.

Bake for one hour and a half at 475° F., letting fall to 450° F. last half hour.

The close texture of the field bread loaf is due to the extremely stiff dough, well kneaded, and the short proof in the

pan. The tough crust to the small amount of cottonseed oil (or lard used).

When making continuous runs of field bread divide the four men of the unit into two shifts of two men each, each shift working eight hours, and taking up the work at the point left off by the preceding shaft. The shifts should alternate from day to day in order to equalize the work.



FIELD BREAD JUST OUT OF OVEN.

For field bread make a dough every hour and 30 minutes. Seven runs can be produced in 16 hours by this method. This is considered an average day's work for a unit and is about the maximum amount of work the men can stand continuously, although they can produce 10 runs per day for a short time.

Seven runs will give 1,008 pounds per unit each day, 9,072 pounds to the 9 units peace strength, 12,096 to 12 units war strength.

The method of combining the sponges and straights mentioned in paragraph 245 is considered more economical in labor and time, however, and is recommended for field bread as well as garrison bread.

A division in camp at Galveston, Tex., for two years, composed of approximately 12,000 men, drew on the average about 8,000 to 9,000 pounds of bread per day.

One man can mix a field bread dough in 25 minutes.

In panning field bread one man scales and rounds while the other flattens and pans.

Two men can pan a run of field bread in 15 minutes.

A rounded loaf, flattened out, gives the tightest bottom crust.

Two men load and unload the oven, one man passing the pans from the proof rack to the other, who places them in the chamber. In unloading one man uses the pan hook, while the other takes the pan at the door of the chamber and empties the bread on the carrying rack. The pans are stacked crosswise as emptied, and if necessary greased. Pans will require greasing about every sixth run. The man taking the hot pans uses a pan holder on each hand.

One man must attend the oven all the time after the bread is introduced. More or less shifting will always be necessary with field ovens. The firing must be closely regulated to keep the temperature uniform. In shifting the pans in the oven care must be taken not to shift before the crumb is set. If shifted too soon, a doughy streak will show through the center of the loaf.

147. When the bakery is first set up on arrival in camp the ground is accurately staked out, but refinements in adjustment are omitted. The camp is pitched as for temporary occupancy. Later, if the site is to be a permanent one, the tents are accurately aligned, brick fire pits constructed, etc. If running water is available, an effort should be made to have at least one standpipe with faucet ready for use as soon as the ovens are set up. If the entire company and transportation are available, the field bakery can be unloaded from the cars, hauled 1 mile, and set up ready for work in six hours.

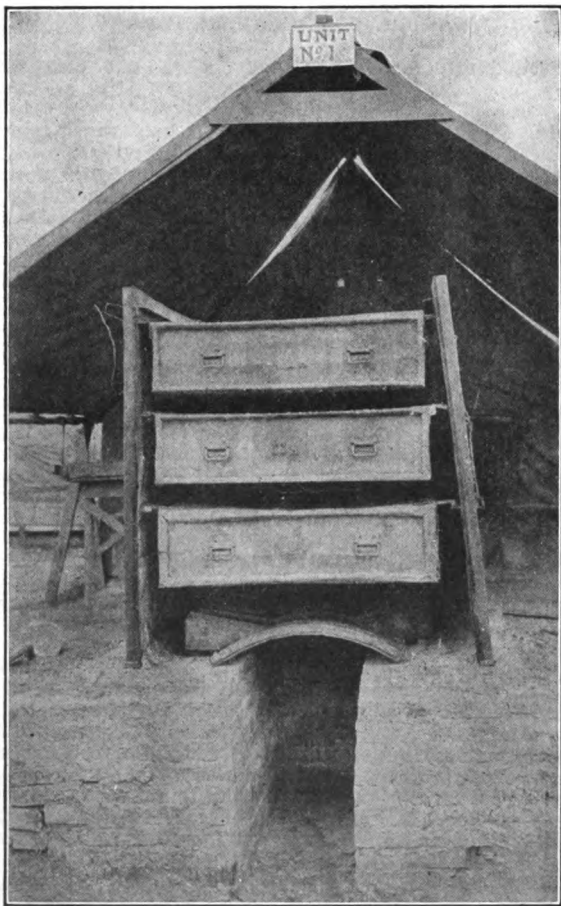
INSTRUCTIONS FOR HANDLING THE FIELD BAKERY EQUIPMENT.

148. **The field oven, No. 1,** is a portable, knockdown type, for continuous baking. It will bake approximately 3,500 pounds of issue bread, or 2,000 pounds of field bread, per day if operated continuously. Each of the 12 metal parts of which the oven is constructed, including the stovepipe and hood, is designated by number. This number, cut from sheet metal, is riveted to each separate part. In submitting requisitions for extra parts the number of the part desired should be referred to. The numbers given in the following instructions refer to the several numbered parts of the oven and run from 1A to 12C, inclusive. In addition, there is a canvas cover, No. 13A, to go over the soil on the top of the oven.

149. **To set up the oven.**—Level a piece of ground 6 by 8 feet. In the center of the leveled ground dig a clean-cut trench, 8 feet long, 20 inches wide on top, 16 inches wide on the bottom, and 24 inches deep. At the firing end of the trench extend the cut sufficiently to make a convenient fire pit. In the center or at one side of the fire pit dig a hole about 1 foot deep, about large enough to hold a G. I. bucket, for a drainage hole. Place the trench cover, No. 5A, so that the front or closed end will extend about 4 inches over the front end of the trench, the center of the trench cover over the center of the trench. The sides of the trench cover should fit the ground closely, in order that the heat and the gas from the fire trench will pass only through the sleeves of the trench cover.

Place the front end of the oven, No. 1A, on the ground in front of the trench cover. Place the sides, Nos. 3A and 4A, engaging the angle irons on the bottom with those of No. 1A, the bottom edges of Nos. 3A and 4A parallel to the trench cover and resting on the leveled ground. Clamp the front edges of Nos. 3A and 4A to the front end, No. 1A.

150. **Next place the oven chambers,** beginning with the bottom, No. 10A, then No. 11B, and then No. 12C. Push the necks of the chambers through the openings in the front end, No. 1A, as far as possible. The front of the chambers are supported by the



**FIELD OVEN NO. 1 PARTIALLY SET UP ON BRICK
FIRE BOX.**

necks on the front, the rear by flanges which rest on flanges on the sides of the oven.

151. **Next place the rear end, No. 2A, by engaging the angle irons at the bottom with the angle irons of Nos. 3A and 4A. The flanges on the inner side of the rear end, No. 2A, fit under the chambers. If the chambers set too low place a small chip under the flanges on the sides of Nos. 3A and 4A, to raise the rear end of the chambers. Clamp the corners. As soon as the chambers are placed a man crawls into the pit, and lying on his back places the flange on the trench cover, No. 5A, over the collar on the bottom of the rear end, No. 2A.**

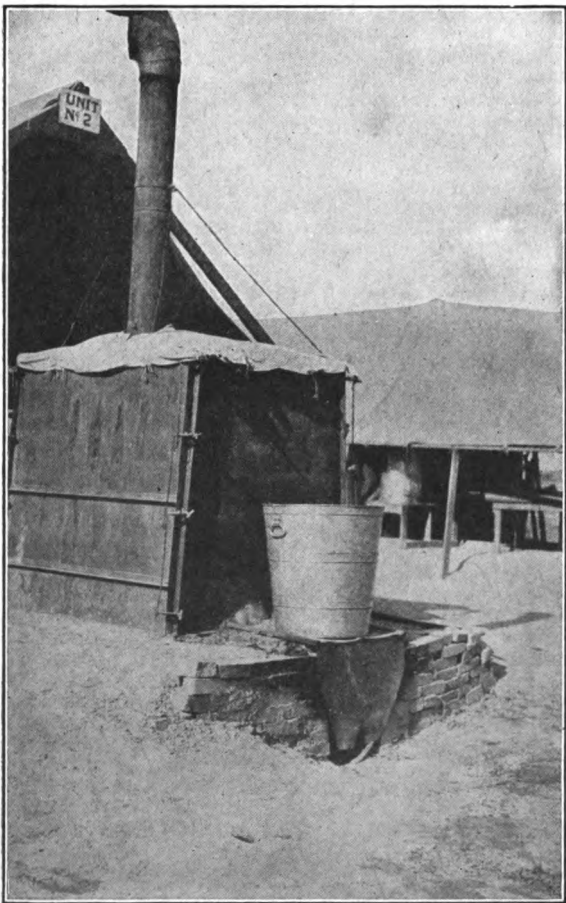
152. **Next place the top of the oven, No. 6A, in position, with the flue hole at the right center. Stop up the edges with clay or mud. Next set up the stovepipe, Nos. 7A, 8A, then the hood, No. 9A. Fasten pipe braces to oven.**

153. **Next cover the top of the oven with dirt taken from the trench. The dirt should form a mound about 8 inches deep in the center and 5 inches deep at the edges. Stop up the cracks around the necks of the oven chambers with asbestos rope, or asbestos cement, if available, otherwise with mud or clay.**

Build a fire in the trench, and after the dirt on the top of the oven has dried out put on the canvas cover.

154. **With seasoned wood baking temperature can be obtained in from one and one-half hours to two hours after the fire is built, depending upon the dryness of the ground. If time is no object, it will be better to use a slow fire at first, in order to bake the trench walls slowly. If the firing trench is dug in sandy ground, the walls of the fire pit, unsupported, will not last more than 48 hours. It will be necessary to revet them with some heat-resisting material. If the field bakery is to be set up for a short period, from 10 to 14 days, the walls can be reveted with galvanized-iron sheeting, held in place by iron pins driven into the ground, or one layer of ordinary building brick can be used.**

If the firing trench is dug in ordinary loams, the trench will last from 4 to 7 days without reveting. If dug in gumbo or adobe, the trench will stand up from 15 to 20 days, depending



**FIELD OVEN NO. 1, COMPLETELY SET UP, WITH
BRICK FIRE BOX SET ABOVE THE NATURAL SUR-
FACE OF THE GROUND**

upon the care exercised in firing. Careless handling of firewood will cut the life of any unrevetted trench in half.

155. If the field bakery is to occupy a camp site permanently, it is best to set the ovens over a fire trench foundation of fire brick. See Appendix B.

If the ground is low or subject to flooding rains, it will be advisable to build the foundation and fire trench entirely above ground. In this case the ground for a space of 16 by 32 feet should be raised to the same height as the oven foundation, so that the floor of the mixing tent and the ground from the mixing tent to the rear of the oven is level with the top of the brick foundation. In sandy ground, or where the rainfall is slight, equally good results will be obtained by digging a pit and building the foundation and fire trench so that the top of the foundation wall is about 1 or 2 inches above the surface of the ground, the mixing tent resting on the natural ground surface.

156. Arrangement of mixing tent equipment for warm weather (temperature above 80° F.).

A wall tent, large, is 14 feet square. Dispose the equipment as shown in the following diagram:

157. Arrangement of the mixing tent equipment in moderate weather.—When the temperature falls to between 80° F., and the freezing point or thereabouts, erect a tent stove in the rear of the mixing tent. When the temperature falls to 20° F. or thereabouts erect a second tent stove in the front end of the tent.

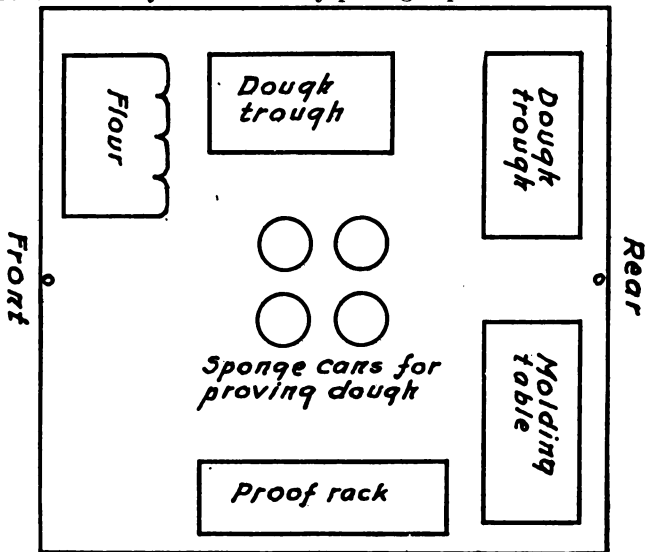
158. Arrangement of the mixing tent equipment in cold weather (10° F., above zero, to 10° below zero).

Erect two wall tents, large, end to end. Roll back and tie the two interior ends of the tent and lace tightly one of the exposed ends. In other words, make one large tent of the two and tightly close one end. Bank the sides with earth. Erect a field oven in the tent, having the entrance, on the right side, facing out, front of the oven facing the rear tent, stovepipe projecting through the second seam of the front tent. In the center, at the rear of the rear tent, erect a tent stove, center of the stove about 36 inches from the rear upright.

The heat radiated by the oven and by the tent stove is sufficient for all purposes. This method has been tried and a tem-

perature of 85° F. maintained in the two tents when a thermometer outside registered 10° F. below zero.

When the temperature of the mixing tent falls below 80° F. and the panned loaves are on the proof rack a sufficient heat to prove them may be obtained by placing a pan of live coals on

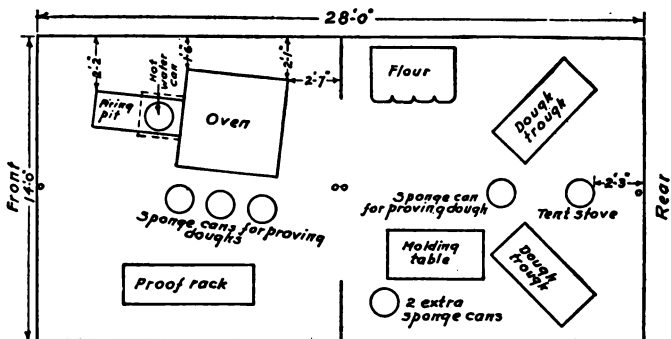


the ground under the rack and another pan filled with water on the lower shelf immediately above the first. Close the canvas rack cover tightly and tuck well around the rack close to the ground to prevent the access of cold air. The moist heat thus generated will prove the dough and keep it from crusting.

159. Tentage.—Consists of pyramidal large and small, wall, large, and storage tents.

In permanent camp all tents should be floored, framed, and screened. It is almost impossible to keep flies out of the bakery under the most favorable conditions. The tents of the men should also be screened. On account of the night work it is always necessary for a part of the men to sleep during the day, and they should be allowed to rest without being disturbed by flies or mosquitoes.

160. **Sponge cans.**—*Seven sponge cans are sufficient for each unit.* Only one cover is provided (for the hot-water can, which sits on the apron at the rear end of the oven). For transporta-



ARRANGEMENT OF MIXING TENT EQUIPMENT, COLD WEATHER.

(10° F. above zero, to 10° below zero.)

tion the small articles are put in the top can of the nested cans. When making 216-pound runs of garrison bread four cans are used for the doughs, one for hot water, one for yeast (if potato ferment is used), and one for cold water. When making field bread three cans are available for hauling and storing water.

161. **Colander.**—The colander is used for straining liquid yeast.

162. Canvas cover for proof rack.—This is used for steaming the doughs.

163. Canvas covers for dough troughs.—These are used to cover the mixed dough to conserve the heat, keep the dough from crusting, and to keep out flies.

164. Proof rack.—The proof rack is for holding the pans during the time of proof in the pans. In summer the proof rack should be covered with a mosquito bar to keep out the flies. If necessary, in cold weather, the canvas cover is put on and pans filled with hot water set on the lower shelf. To keep the water hot, add hot bricks from time to time, or put a second pan filled with live coals under the first.

165. Scales.—*One scale is furnished for each unit.* The balance type, with weights, gives the best service. For garrison bread, scale at 2 pounds 3½ ounces; for field bread, scale at 4 pounds 8 ounces.

166. Molding tables.—The molding table is made of poplar. Some models are furnished without legs, but with cleats on the bottom which fit the trough and permit the table to rest on it without slipping. The table is usually provided with legs which are attached to the bottom in such a manner that they can be folded up against it when the table is not in use.

167. Thermometers.—The oven thermometer is of the expansion spring type. These thermometers do not register alike, and bakers must learn the registration of the thermometer for each oven to give the proper baking temperature. Some ovens will have the right heat when the expansion thermometer registers 450° F., others at 600° F.

Combination.—*The combination thermometer is for use and not for ornament.* If the thermometer is not used to get temperature of the flour and mixing tent before making the dough, the water used must be taken by guesswork. Apparently unexplainable differences in the time of proving of doughs or appearance of different runs of bread can usually be traced to lack of use or carelessness in the use of the thermometer when mixing the dough or regulating the heat of the mixing tent. The case of the combination thermometer is practically indestructible if used with any ordinary degree of care.

168. **Dough troughs.**—Two dough troughs are furnished to each unit. For transportation the legs are folded and the troughs nested.

169. *Preparing field oven No. 1 for transportation.*—Withdraw the fire, remove the canvas oven cover, take down pipe and hood and shovel off dirt from top. Remove the back of the oven, withdraw the trench cover, and throw two or three buckets of water in the fire pit. As soon as sufficiently cooled, withdraw the chambers and unclamp the oven sides and front.

170. **To pack field oven No. 1** in the escort wagon or truck with escort body:

(1) Place 3 *buckets, G. I., scales, and 2 tent flies* under the seat.

(2) Place the *stovepipe joints and hood* inside the A chamber, also the molding table legs, if legs are furnished, and the pipe braces.

(3) Place the *bake pans* in the B and C chambers, 18 pans in each.

(4) Pack the *three chambers, A, B, and C, mouth up, two sides Nos. 3A and 4A, and top, No. 6A, in the front end of the wagon, side by side, against the wagon seat.*

(5) Form a second row by placing *front, No. 1A, and back, No. 2A, on one side of the wagon bed. The angle irons of the front and back should overlap and the pieces set upside down.*

(6) Place *molding table* on opposite side of wagon bed to the front and back, the top of the table out.

(7) *Nest the troughs* and stand them vertically on end, *bottom against chambers* and mouth toward the rear of the wagon. Place *two dam boards* in the bottom of the trough.

(8) *Nest the sponge cans* and place all small utensils, including the rack and trough covers, in the top can. Put on cover, and place cans in the trough on top of dam boards. Put up the tail gate.

(9) *Fold proof rack* and set on end, broad side to the tail gate (if three are furnished place two in wagon on end at right angles to tail gate, invert the other and place between the two).

(10) Put *rake, fire hoe, pan hook, pickaxe, axe, tripod, and shovel* in an empty flour sack, tie up tightly in a bundle, and stand in front of tail gate alongside of proof rack.

- (11) Place *paulins*, small, on top of chambers.
- (12) Place *tents* and *tent pins* in front of proof rack.
- (13) Place the *trench covers* on top of paulins, at right angles, back to back, fire surface under (reserve) trench cover down and extending across the wagon. Lash trench covers together (reserve trench cover put next to chambers to keep brittle iron of used trench cover from falling out).



FIELD OVEN NO. 1 PACKED ON ESCORT WAGON.

- (14) Lash *two uprights* and *one ridge pole* for wall tent, large, and *center pole* for pyramidal tent on wing board on *left side* of wagon. Lash *two poles, upright*, and *one ridge* for wall tent, large, to *right side* of wagon.
- (15) Fasten *tail chains* through *stove* tent at back of tail gate.
- (16) Lash the load *securely, crosswise and lengthwise*.

171. **Instructions for handling field oven No. 2.**—(If used, to be taken from Circular No. 20, Office of the Quartermaster General, dated Sept. 30, 1914.)

172. **Packing field oven No. 2 in wagon.**—(Circular No. 20, Office of the Quartermaster General, Sept. 30, 1914.)

173. When the field bakery is moving frequently, and is transported by wagon or auto truck, time is usually limited, and no attempt for accuracy in laying out the camp should be attempted.

174. The wagons are halted in the vicinity of the site, the officer in charge assisted by the chief baker and the chiefs of sections pace off the distances and set stakes for the front of each tent and the front of the ovens. Each unit is unloaded convenient to its own site (usually between the fire pit and the store tent line). Each chief of section then directs the pitching of camp and the setting up of the equipment for his section. Two men from each unit dig the fire pits. The remaining men pitch the tents. Tents are not ditched at this time. An experienced detail should have the tents up by the time the fire pits are dug. The men of each unit set up the oven and start the fire. They then clean the equipment. When the equipment is ready the doughs are started.

175. If supplies are not immediately at hand, details to haul wood, water, flour, etc., should be made as soon as the wagons are unloaded.

An experienced company should have camp pitched, the ovens up, fire started, and be ready to start in mixing dough in four hours after arrival at the camp site.

176. **For the bakery company,** convenience to *good water* is the first consideration in selecting a temporary camp site. Each unit will use a minimum of 200 gallons of water per day when making continuous runs.

177. **Troughs, cans, pans, etc.,** should always be well cleaned before packing for transportation, so as to avoid the necessity of waiting for hot water to clean them upon arrival in the new camp.

TRANSPORTATION.

178. **Transportation, motor, wagon, etc.** (as required).—To be supplied for interior service, supply, and transport, as circumstances attending the operation of the company may require.

179. **The field bakeries**, one to each division, will usually be set up at the base, and the bread forwarded by rail or motor truck. Whenever practicable, for distances over 30 miles, it should be done by rail. The distance bread can be forwarded by rail is limited only by the distance that railway supply trains can travel in 24 to 48 hours. A fresh supply goes forward daily and is issued to the division supply trains at the refilling point on the railroad. Forty-eight hours is the maximum time that field bread should be stored in a closed car in hot, humid weather. If kept longer without ventilation it is apt to mold. In temperatures of 50° F. and below field bread will keep and be in fit condition to issue two weeks after being loaded on the car, provided it is allowed to stand 24 hours after baking before packing.

180. **A bread car** should be a *box car* or *express car*. The walls and floor should be clean. An ordinary grain car can be prepared for shipping bread by lining the sides 6 feet high with roll wrapping paper, held in place by lath. The floor should also be covered with paper.

Field bread for shipment by rail should be packed in the car by hand, in rows and tiers, working from the ends to the center. Each loaf should be placed on edge and the next placed against it, top to bottom. Each row should be tight. The bread in the center, opposite the doors, can be filled in loosely.

A 40-foot standard box car, with bread stacked four tiers high, will hold 16,000 pounds of field bread. The bread, if 24 hours old and properly packed, can be stacked eight tiers high without injury.

Eight men can load a car to the best advantage, four men to each end. A truck or wagon supplies each door, if possible, to load from both sides of the car. One man on the wagon passes the bread to a second at the car door, the second passes to a third half way from the door to the end of the car, the fourth stacks the bread in tiers.

Four men can unload a wagon containing 500 loaves (2,000 pounds) of field bread and pack it in a car in 15 minutes.

Three men can load a wagon with 500 loaves (2,000 pounds) of field bread and count the loaves in about 20 minutes, one man



FIELD BREAD PACKED ON ESCORT WAGON.

taking the bread from the rack and counting, one at the tent door, and one man packing on the wagon.

181. To pack field bread on an escort wagon or truck. Place an extra wagon cover on the bottom of the wagon bed, the ends extending over the top of the seat and to the height of the tail-

70816°—17—7

board, the sides above the wing boards. Pack the bread cross-wise of the wagon body in tiers (the normal load is five tiers and will be 2,000 pounds of bread). Tie the ropes at the ends of the extra wagon cover together, and fasten down the wagon cover tightly so as to prevent the entrance of a driving rain.

A Quartermaster Department 3-ton truck will carry about 5,000 pounds and a 1½-ton truck about 3,500 pounds of field bread when carefully packed and loaded to the bows.

The large truck will carry about 3,500 pounds and the smaller one about 2,500 pounds of garrison bread when it is piled on edge three tiers high and extra sheets laid flat on the top.

When loading with field bread to the full capacity of the truck, a clean wall-tent fly, large, is laid in the bottom of the truck, so as to cover the floor and extend up the sides of the truck to the top of the loaves, to which it is fastened with the guy ropes at each side of the fly.

The escort wagon sheets are then laid on top of the fly one at each end of the truck bed. One side of the front sheet is then securely fastened to the top of the front bow of the truck, about half of the sheet remains on the floor, and bread is piled on it to hold the canvas in place. About half of the sheet at the rear end is laid on the floor and about one-half is allowed to hang out over the end gate.

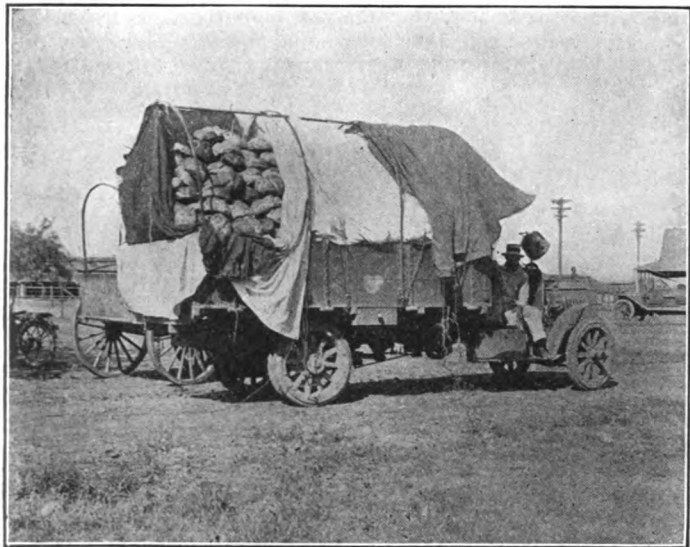
The bread is piled on edge in rows across the truck beginning at the front end, the bottom of one loaf against the top of the one next to it. It is piled in tiers as high as possible, usually about five tiers, after which extra loaves are thrown in to fill the top to the bows.

The guy ropes of the fly are then loosened from the bows and drawn across the top of the load to opposite sides of the truck's bed and securely fastened. The wagon sheet at the rear end is fastened to the top of the rear bow. The truck cover is then drawn back and fastened over the whole.

The illustration below is from a photograph taken just before the rear end of the truck was closed. This load was carried over 50 miles of rough country roads without losing a loaf, and the bread was not damaged.

182. Where the field bakery is using trucks for transportation and following moving troops the bakery is set up and bread

forwarded to the troops by truck until the troops have advanced about 60 miles. The field bakery and personnel are then loaded on trucks and moved up to the next camp site near the troops. Here the bakery is again set up and operations resumed. An experienced company using motor trucks should be able to pack,



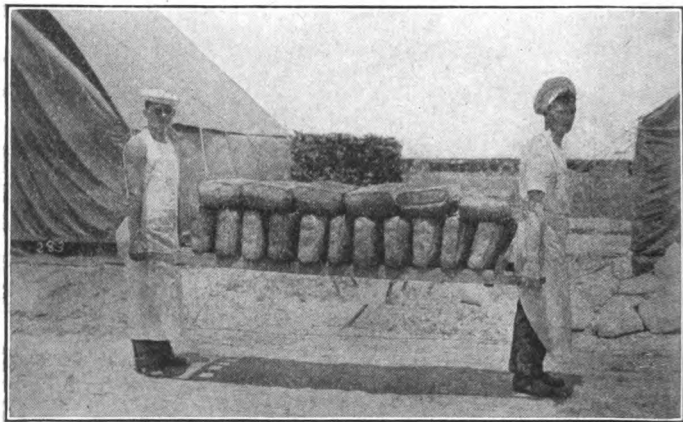
FIELD BREAD PACKED ON TRUCK.

move 60 miles over good roads, set up, and be ready for baking again in about 12 hours.

183. *Wood.*—Each unit, when operating continuously, will consume three-eighths of a cord of good hard wood per day in summer; one-half cord per day in winter. It requires almost

as much wood for the normal day's output of 10 runs as it does to bake continuously.

184. *To make a cloth pan holder.*—Take an empty flour sack and remove the string from the side and bottom seams. Save the string. Lay the sack flat on the ground, fold both ends to the middle, fold again. This gives eight thicknesses 9 by 20 inches. Fold again, putting the two ends together, making a



BREAD-CARRYING RACK.

pad 9 by 10 inches. Cut a slit 6 inches long through the folded pad 2 inches from the end opposite the last fold. Bind the handle thus made with the string taken from the seam.

185. *To make a carrying rack.*—Make an oblong frame 8 by 2 feet, of 1 inch by 4 inch material. Let the side pieces extend about 1 foot at each end to form the handles. Cover the frame with six slats 2 inches by 6 feet. At one end fasten an upright 12 inches high. This rack will hold one run of either field or

garrison bread, and is used to receive the loaves as they are taken from the oven.

186. To construct a trench cover, dig a trench with sloping sides; 30 inches deep, $5\frac{1}{2}$ by 7 feet at surface of ground, and $4\frac{1}{2}$ feet by $6\frac{1}{2}$ feet at bottom of trench.

Make two wooden forms of the following dimensions: The larger 4 feet long, 24 inches high, 20 inches wide at 16 inches from bottom, and 16 inches wide at bottom, and the smaller 2 feet long, 20 inches high, 20 inches wide at 16 inches from bottom, and 16 inches wide at bottom.

Figure A shows cross section of larger form and figure B cross section of smaller. Put a vertical partition across the center of the larger form and close both ends of each form. Nail them together end to end. Figure C shows longitudinal section of forms after being nailed together. The partition is shown at *b f*.

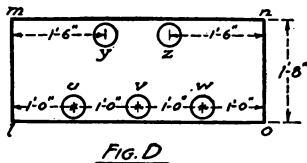
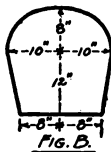
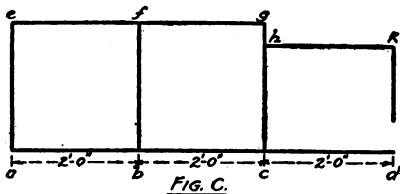
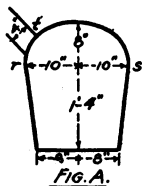
Cut a small hole in the end *d k*. Place the form in the trench with the end *d k* against the rear end of the trench and the end *a e* 6 inches from the front end and with a space of 19 inches between the sides of the form and the side of the trench. Figure D is a horizontal projection of the upper surface of the larger form. Place 5 stovepipe joints on ends so that their centers shall be at *u, v, w, y, and z*, and that they shall be perpendicular to the upper surface of the form as shown at *t*, figure A.

187. Now fill the trench with clay, thoroughly mixed with 10 or 15 pounds of hay or green grass, to the level of the surface of the ground, pack well, and smooth the surface. Before firing allow the clay to dry for two days or more. To fire, dig a sloping trench 18 inches wide, 4 feet long, and 30 inches deep at the rear end of the form. Build a small fire against the hole in the rear end of the form and allow the form to burn out slowly. When it has burned out, remove the pipe joints. As soon as the clay is cool the oven may be placed over the trench. If clay is not available, use a very stiff mixture of 1 part flour and 18 parts sand. Allow this mixture to stand 3 days before firing. Burn out slowly. Sod may also be used, but the life of the trench will be only 7 to 14 days. During the construction keep the sod damp.

Clay trench covers constructed as above have been used for a year, and in good condition at the end of that time.

FIELD BAKING EXPEDIENTS.

188. **Essential principles.**—Occasions are sure to arise when it is desirable to bake bread in the field when no proper baking equipment or no equipment at all is provided. Under these circumstances the essential principles to be followed in the con-



PLAN OF TRENCH COVER.

struction of earth or clay ovens must be thoroughly understood, as well as the methods to be followed in preparing and preserving yeasts and proving the sponge and dough.

189. **Ovens.**—The entire principle of baking is based upon the fact that for each ration of bread baked a certain number of heat units must be provided at a temperature from about 385° F. to 450° F., striking the top and bottom of the loaf with about the same intensity. The quantity of the heat available must be such that a baking temperature will be maintained from 30 minutes to an hour and a half, depending upon the depth of the dough to be baked.

Such ovens as are constructed in the field must generally be of the simplest type possible; that is, of a single chamber in which the fire is built and withdrawn after sufficient heat has been stored up in the surrounding material to do the necessary baking. Such ovens are generally called "straight-fire" or "draw-fire" ovens, and for temporary use are very satisfactory, though they are more laborious to handle than continuous ovens. In the construction of these ovens the following points should be kept in mind:

(1) *The oven must be built of material* suitable for absorbing and retaining the heat required in baking. *Brick, rock, adobe, clay, sods, sand, and loamy soil* will all do if properly handled.

(2) *About 8 inches of earth* of any kind is required to take up and radiate sufficient heat for baking even small batches of bread. A greater depth on top of an oven will cause premature breaking down—a lesser amount would not generally retain sufficient heat.

(3) *A slow fire* must be placed in the oven in order that the heat may be gradually taken up in the surrounding material. *A flash heat* will quickly heat up the inner lining of the oven and produce an intense heat for a short time, but to store up a sufficient amount of heat requires a long, slow firing.

(4) *The greatest difficulty* is in getting a bake on the bottom of the loaves in newly constructed ovens, as the heat from the fire rises from the bottom, which is further protected by the ashes as they accumulate. In damp and loamy soils a hearth of stone or brick should be provided to overcome this difficulty.

(5) *Soil while damp* can not take up and radiate sufficient heat between 385° F. and 480° F. to bake bread. Hence the material immediately surrounding an oven must be thoroughly dried out before any attempt is made to bake. Generally a "slow" fire for several hours will be necessary before the first baking can be made, but after a successful baking not more than three-fourths of an hour to an hour will be required for heating the oven and equalizing the temperature by tightly closing up the oven after the fire is drawn.

190. An oven in a steep bank.—A bank from 4 to 6 feet high is the best for the purpose. The roof covering need not exceed

1½ feet. Two men with a spade and a long-handled shovel can build it, in light soil, in three-quarters of an hour. If such tools are not available, it may be constructed with trowel, bayonet, intrenching tools, or even with knives. To build the oven, dig down the bank to a vertical face and excavate at the base a hole from 4 to 5 feet horizontally, care being taken to keep the entrance as small as possible; hollow out the sides of the excavation and arch the roof until the floor is about 2 feet 6 inches in its widest part and the roof is 16 inches high in the center of the arch. Then tap the back end for the flue. A hole from 4 to 6 inches in diameter will furnish a good draft. A piece of tent stovepipe may be utilized for this purpose. When difficult of construction, the flue may be omitted, and practically as good results will be obtained. The time required for drying will depend upon the character of the soil; if ordinarily dry, a fire kept up for an hour will suffice.

After the oven has been heated the temperature may be regulated by means of the door and flue—opening or closing them as may be necessary.

This is recommended as a very good and convenient oven.

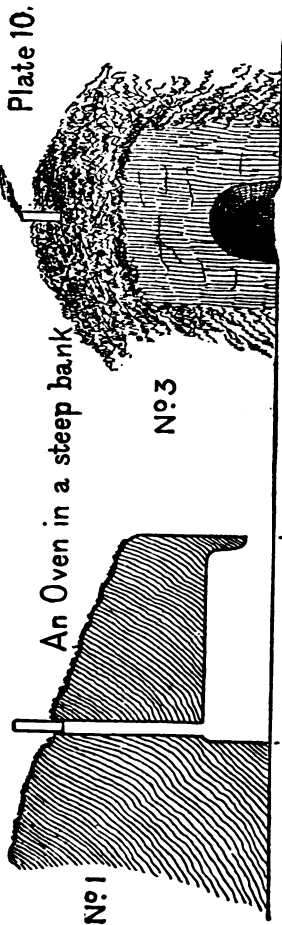
191. How to construct and operate a two-barrel clay oven.—Select a piece of level ground 5 feet by 9 feet. Take two salt or sugar barrels, knock top and bottom from one and a small section from the bottom of the other. Place the two barrels together, end on, the barrel with bottom intact to the rear.

Cover both barrels completely with moist sand; the sand should be about 2 inches deep on top and splay outward at the bottom to about 4 inches. In placing the sand about the form care must be exercised not to use too much force.

Make a good stiff mixture of clay and grass or hay. Cover the sand, beginning at the bottom and working upward, using the hands. The clay should be 12 inches thick at the bottom and taper to 6 inches at the top. Make a shoulder at each side on the front end of the trench to hold the sheet-iron door. This shoulder should extend to the front of the oven proper, so that the sheet-iron door will fit flat against the oven chamber.

After the form is completed, allow to stand for 48 hours, and then burn out the barrels. Use just sufficient wood to start the

AN OVEN IN A STEEP BANK.



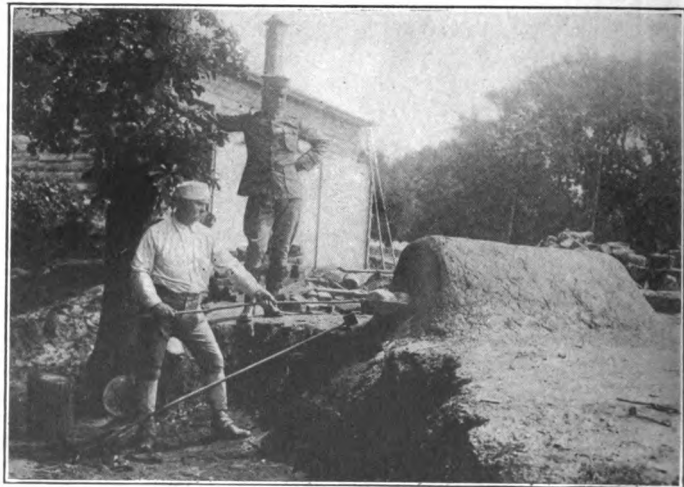
0 1 2 3 4
SCALE OF FEET.

EXTEMPORARY OVEN BUILT IN A BANK.

No. 4.—Longitudinal section. No. 2.—Plan. No. 3.—Front view; not on the scale. No. 4.—Transverse section of interior.

barrels. When the barrels are burned out, scrape out the sand from the top and sides and the oven is complete.

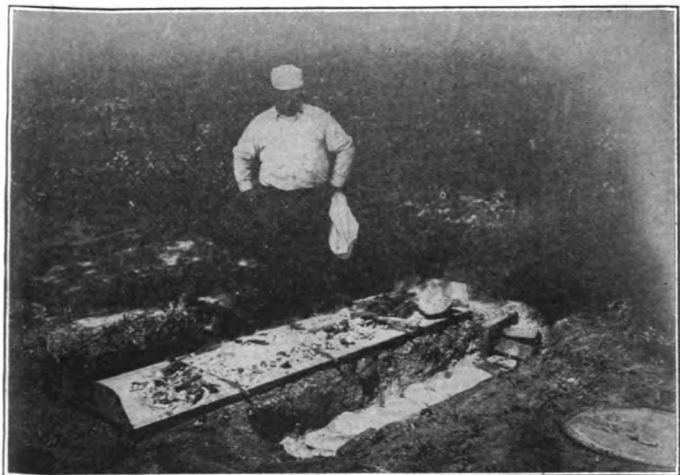
If material is available, before constructing the walls of the oven lay a brick floor 3 feet by 8 feet. Set the barrels on the floor, and then proceed as before indicated, the clay walls resting outside the brick floor.



TWO-BARREL CLAY OVEN.

To obtain the best results with this type of oven it is best to start the fire as soon as the dough is set; keep up a moderately brisk fire for about two hours; as soon as the dough is punched down spread the coals evenly over the floor of the oven and close up tightly. This is to equalize the temperature at all parts of the oven. As soon as the bread is in the pan

draw all the coals from the oven and close for about one-half hour, then take the count; seven counts is the proper heat. If less than seven, the oven is too hot; if more than nine, the oven is too cold and will not bake issue bread.



BAKING IN THE OPEN TRENCH.

NOTE.—The oven is the right temperature when the hand may be held for seven-second counts parallel to the bottom of the trench and 1 inch from it. Or, if a little flour is scattered on the bottom of the trench it should brown in about 2 minutes.

This oven will hold 5 pans, each 12 inches by 24 inches, and, if properly handled, will bake as good bread as any oven made.

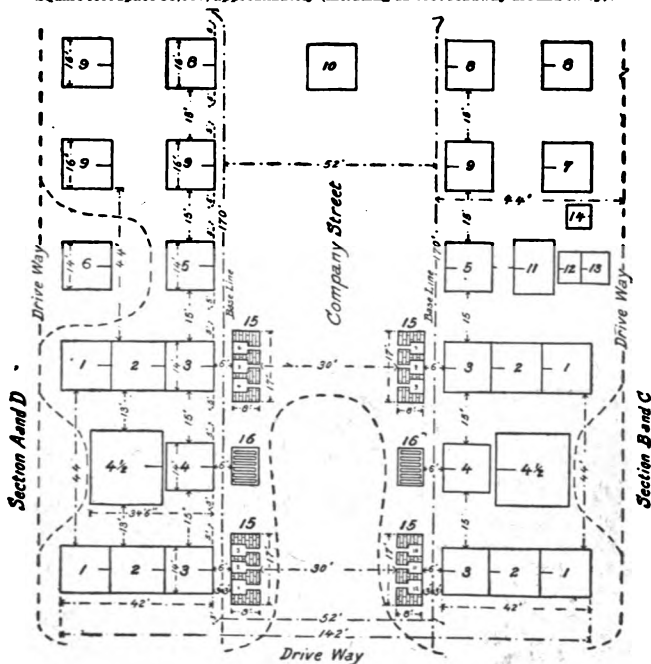
To make a second run put in another fire for about three-fourths of an hour, draw the coals, and close up the oven for about 15 minutes, and the oven is ready for a second run.

It is a great convenience in handling the bread if a 2-foot trench is dug in front of the oven.

192. Baking in the open trench.—A trench is dug about 6 feet long and 15 inches wide and about 1 foot deep. A fire is built in the trench about two hours before the time to bake. A few minutes before the loaves are ready the coals are withdrawn and the trench swept clean. The loaves (Vienna shaped and very dry on the exterior) are carefully laid in the trench about 3 inches apart, covered with an iron sheet of any kind, and the coals which were drawn from the trench distributed over the top. By carefully watching the bread and regulating the top heat most excellent bread can be produced. In an oven of the dimensions given 25 1-pound loaves can be baked. If possible, the bottom should be floored with brick or stone.

APPENDIX A. CAMP OF A BAKERY COMPANY—GROUND PLAN.

Square feet space 30,000, approximately (including 12-foot roadway around camp).



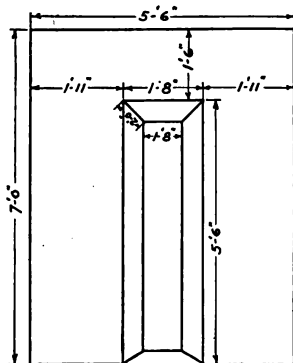
1. Wall tents, large, open both ends (4), mixing tents.
2. Wall tents, large, open both ends (4), molding tents.
3. Wall tents, large, open both ends (4), proofing tents.
4. Wall tents, large, open both ends (2), bread tents.
- 4½. Storage tents (2), bread tents.
5. Wall tents, large, open both ends (2), flour tents.
6. Wall tents, large, open both ends (1), property tent
7. Wall tents, large, open both ends (1), mess tent.
8. Pyramidal tents, large (3), sleeping tents (20 corp. bakers).
9. Pyramidal tents, large (4), sleeping tents (32 asst. bakers).
10. Pyramidal tents, large (1), sleeping tent (5 chief bakers).
11. Paulin, large (1), kitchen.
12. Pyramidal tent, small (1), storage (mess).
13. Pyramidal tent, small (1), cooks (2).

14. Pyramidal tent, small (1), cooks, police, (2).
15. Ovens.
16. Wood piles.

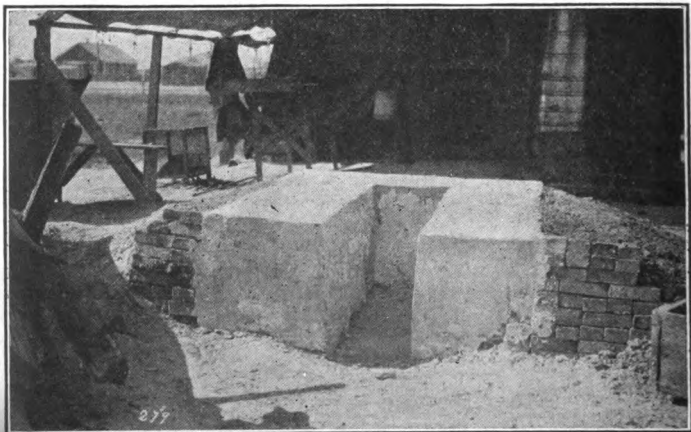
Summary:

- 18 wall tents, large.
- 2 storage tents.
- Paulins, large and small, as required.
- 8 pyramidal tents, large.
- 3 pyramidal tents, small.

APPENDIX B.



*Plan for a brick foundation
and fire trench.*



BRICK FOUNDATION AND THE TRENCH COMPLETE.

	No.
	, 46
	32
	85
	84
	21
	52
	48
Before	, 95
shea	6
the	
Mix v	52
D	82
D	156
Work	157
Make	158
Make	
Stiff c	75
D	
D	
Soft b	132
	133
	134
To be	127
Wash	135
Add t	127
Use st	141
Bake	128
Boil s	129
Bake	135
	VI.
	102
	192
Beat.	



INDEX.

	Paragraph No.
Acetic fermentation	41, 46
Adulteration of flour	32
Advantage of sponge and dough method	85
Advantage of straight-dough method	84
Aging of flour	21
Air, favors growth of yeast	52
Albuminates, necessary to growth of yeast	48
Alcoholic fermentation	37, 39, 40, 41, 48, 95
Alcohol in bread	6
Alcohol in yeast	52
Appearance of loaves	82
Arrangement of mixing tent for warm weather	156
Arrangement of mixing tent for moderate weather	157
Arrangement of mixing tent for cold weather	158
Average temperature for bread making	75
Bakery company :	
Chief baker, duties of	132
Chief of section, duties of	133
Chief of unit, duties of	134
In time of peace or war	127
Material for, kept on hand at company headquarters	135
Normally an element of line of communication	127
Officer in charge	130, 131, 140, 141
Organization	128
Organization table	129
Unit, supplied to each post	135
Bakery, field. (See Field bakery.)	
Bakery, post, equipment	Chapter VI.
Bake pans properly filled	102
Baking in an open trench	192

	Paragraph No.
Bleaching of flour-----	31
Blending of flour-----	29
Bran -----	10
Bread :	
Aerated process of making-----	49
Amount produced per 100 pounds of flour-----	99
Baking -----	103
Baking powder-----	49
Boxes -----	108
Bottom -----	115
Car -----	180
Cooling after removal from oven-----	107
Field, defined-----	144
Field, recipe for-----	146
Garrison, defined-----	144
Garrison, recipe for-----	90, 92, 145
General classes of-----	73
General method of making-----	74
Graham, recipe for-----	116
Hard -----	44
Holes in-----	111
Ingredients used in making-----	97
In transit-----	107
Leavened -----	39
Load for escort wagon-----	181
Maximum water temperature for making-----	76
Mold in-----	113
Molding -----	100
No fixed rule for amount of liquid used in-----	93
Packing in a box car-----	180
Packing in an escort wagon-----	181
Proper water temperature for-----	76
Proving-----	101
Racks -----	102, 108, 164, 185
Rye, recipe for-----	115
Room-----	123
Rope in-----	112

Bread—Continued.	Paragraph No.
Salt rising	40
Sales, recipe for	114
Sour	110
Sponge and dough, processes of making	74, 89, 90, 145
Stale	109
Storeroom	107, 108, 123
Straight dough process of making	74, 91, 92, 145, 146
Two general classes of	73
Yeast	41
Bread making:	
General methods of	74
Ingredients used in	97
Left-over dough process	98
Sponge and dough process of making	74, 89, 90, 145
Straight dough process	74, 91, 92, 145, 146
Brick foundation for fire trench	155
Brick ovens	119
Buns:	
Cinnamon, recipe for	117
Tea, recipe for	117
Cakes	Appendix C
Camp for field bakery	Appendix A
Carbonic-acid gas in growth of yeast	48
Careless workmanship in dough mixing	80
Carrying racks, how to make	185
Chief baker	126, 132
Classification of wheat	3
Cockroaches in flour	26
Coffee cake, recipe for	117
Colander	161
Color of crust governed by	81
Color of flour	21
Color of hops	57
Color test	33
Composition of wheat	6
Compressed yeast	47, 55

	Paragraph No.
Conditions favorable to growth of spores.....	45
Conditions requisite for strength of flours.....	34
Cooling after removal from oven.....	107
Cottonseed oil.....	94
Covers, canvas, for dough troughs.....	163
Covers, canvas, for proof racks.....	162
Crullers, recipe for.....	117
Crust.....	104, 106
Customary to use water as variable quantity.....	76
Cutting over dough.....	89
Daily routine.....	126
Damboards.....	89, 170
Dampers.....	119
Definition of:	
Ferments.....	37 (c)
Field bakery.....	127
Field bread.....	144
Flour.....	8
Gluten.....	11
Issue bread.....	144
Diluted sponge, one-half water.....	85
Dough:	
Compared to human body.....	96
Cutting over.....	89
For a low-grade flour.....	86
Mixing.....	80, 89, 91
Rounded up.....	89
Dough mixer, cleaning and care of.....	126
Doughnuts, recipe for.....	117
Dough troughs.....	120, 168
Dried yeast.....	54, 72
Effect of:	
Decreasing yeast.....	93
Freezing yeast.....	50, 53
Heat on fermentation.....	87
Increasing yeast.....	93
Too hot an oven.....	103

	Paragraph No.
Enzymes	37 (c)
Ferment	37 (b), 37 (c)
Fermentation :	
Acetic	41, 46, 95
Alcoholic	37, 39, 40, 41, 48, 95
Definition of	37
Effect of decreasing yeast on	93
Effect of heat on	87
Effect of increasing yeast on	93
Effect of salt on	87
Go on long enough to soften gluten	86
Heat given off in	79
Lactic	38, 46 (b), 95
Long, to be avoided	86
Spontaneous	37 (a)
Started	37 (b)
What accelerates	87
What retards	87
Fermented bread	73
Ferment, potato, recipe for 1 gallon	66
Field bakery :	
Arrangement of camp	142, Appendix A
Definition of	127
Instructions for handling equipment	148-153
New equipment, how treated	143
Supplies carried with, to rendezvous	140
Supplies on hand for immediate use	138
Table of equipment	136
When first set up in camp	147
Wood required for	183
Field bread :	
Advantage of rounded loaf	146
Continuous runs	146
Defined	144
Production per unit in 24 hours	146
Recipe for	146
Time required for baking	146
When making continuous runs	146

	Paragraph No.
Field oven No. 1, how to pack in escort wagon-----	170
Fire-trench revetment-----	154
Fixtures-----	124
Flour:	
Adulteration-----	32
Aging of-----	21
Bleaching of-----	31
Blending of-----	29
Color of-----	21
Cracker and pastry-----	29
Definition of-----	8
Ergot in-----	19
Good strong, first essential for good bread-----	97
First clear grade-----	10
First patent-----	10
Gliaden in-----	11
Gluten in-----	11, 12, 13, 14, 33, 34
Glutenin in-----	11
Graham-----	15, 16
Granulation of-----	21
Influence of heat on-----	22
Milling-----	9
Must in-----	28
Nutritive value of-----	35
Objections to use of rye-----	19
Odor indication of soundness-----	28
Protection of, against mice-----	23
Red Dog-----	10
Rye-----	19
Second clear grade-----	10
Second patent-----	10
Self-rising-----	20
Shipment of-----	24
Shorts-----	10
Sifting-----	30
Soft starchy-----	87
Storage-----	22

Flour Continued.	Paragraph No.
Straight patent.....	10
Strength of.....	13, 14, 34
Strong, used in sponge.....	29
Sweating of.....	7
Tests of.....	33
Unsoundness in.....	28
Water-retaining capacity of.....	6
Weevils in.....	26
Wet.....	27
Whole wheat.....	17
Flour and malt yeast (stocked), recipe for.....	68
Flour and malt yeast (virgin), recipe for.....	67
Flour yeast (stocked), recipe for.....	70
Flour yeast (virgin), recipe for.....	69
Flour used in preparation of liquid yeast.....	60
Foundation for field oven.....	155
Freezing effect on yeast.....	50, 53
General classes of bread.....	73
General methods of making bread.....	74
General rule for amount of ingredients used in bread making..	93
Gluten :	
Amount in flour.....	12, 13, 14
Amount in wheat.....	4, 6
Definition of.....	11
Dry.....	12
Flour.....	18
Gliaden in.....	11
Glutenin in.....	11
Separating the.....	12
Wet.....	12
Grading of wheat.....	5
Graham bread, recipe for.....	116
Graham flour.....	15, 16
Granite ware in making yeast.....	64
Heat given off in fermentation.....	79
Heat in fermentation.....	87
Holes in bread.....	111

Hops, color of.....	57
Hops in yeast.....	57
Ingredients used in bread making.....	97
Garrison bread defined.....	144
Garrison bread, recipe for.....	90, 92, 145
Keeping qualities of flour.....	25
Lactic fermentation.....	38, 46(b), 95
Lard.....	94, 97
Leaven.....	39
Left-over dough process.....	98
Liquid yeasts.....	56
Loaf, pale, cause of.....	81
Loaves :	
After removal from oven.....	107
Appearance of.....	82
Formation of crust.....	104, 106
How to stiffen slightly.....	100
Proving of.....	101
Should be stiff enough to retain form.....	100
Long fermentation to be avoided.....	86
Make a dough by sponge and dough method.....	89
Make a dough by straight dough method.....	91
Malt extract used in bread.....	97
Malt extract used in yeast.....	62
Malt, ground, used in yeast.....	61
Middlings.....	9(b)
Milk in bread making.....	97
Milling, high.....	9(b)
Milling, low.....	9(a)
Milling separator.....	9(b)
Mixing doughs.....	80, 89, 91
Mosquito netting used to cover doughs in summer.....	79
Molding bread.....	100
Molding table.....	121, 166
Mold in bread.....	113
Necessity for light spongy bread.....	42
Normal output for one unit, garrison bread.....	145
Nutritive value of flour.....	35

Ovens :	Paragraph No.
Brick	119
Classification of	118
Continuous baking	118(a)
Dampers	119
Draw plate	118
Extemporized	188-192
Firing from rear	119
In a steep bank	190
Intermittent	118(b)
Knockdown, field	148-153
Marshall	119
Material used in jacket for	119
Permanent	118
Portable	118
Preparing field, for transportation	169
Two-barrel clay	191
Packing bread in box car	180
Packing bread in escort wagon	181
Pale loaf	81
Pan holder, how to make	184
Parker House rolls, recipe for	117
Pastry, recipes for	Appendix C
Phosphates necessary to growth of yeast	48
Pie crust, recipe for	Appendix C
Porcelain ware	64
Potatoes used in making liquid yeast	59
Potato water	51
Proof box	102, 122
Proof rack	102, 164
Proof room	102, 122
Products of high milling	10
Proper time to take sponge	89
Proper water temperature, how to obtain	76
Proving bread	101
Recipes for :	
Cakes	Appendix C
Coffee cake	117
Crullers	117

Recipes for—Continued.	Paragraph No.
Doughnuts	117
Field bread	146
Flour and malt yeast (stocked)	68
Flour and malt yeast (virgin)	67
Flour yeast (stocked)	70
Flour yeast (virgin)	69
Garrison bread	90, 92, 145
Graham bread	116
Parker House rolls	117
Pastry	Appendix C
Pie crust	Appendix C
Potato ferment	66
Rye bread	115
Sales bread	114
Salt-rising bread	40
Sweet dough mixture	117
Tea buns	117
Tuba de nipa	71
Red Dog flour	10
Rope in bread	112
Rye flour	19
Salt in making liquid yeast	58
Salt, important element in bread making	97
Scales, dough	165
Scaling	99
Second Clear grade flour	10
Second Patent flour	10
Self-rising flour	20
Shifts, unit divided into, for field bread	146
Shorts	10
Sifting flour	30
Sloppy dough	100
Soft, starchy flours	87
Soft sponge or dough	87
Sour bread	110, 120
Sponge cans	160
Sponge and dough process	74, 89, 90

	Paragraph No.
Sponge, how held back.....	78
Sponge, one-half water.....	85
Spores.....	45, 46
Stale bread.....	109
Starch in preparation of yeast.....	56
Stock added to yeast.....	56
Storing flour.....	22
Straight dough, how held back.....	78
Straight-dough process.....	74, 84, 91, 92, 145
Straight patent flour.....	10
Strength of flour.....	13, 14, 34
Strong flours stand more age in sponge.....	89
Substitutive quantities of yeast.....	88
Sugar:	
During growth of yeast.....	63
Favors mold.....	113
In bread making.....	97
Necessary for growth of yeast.....	63
Temperature:	
Average, for bread making.....	75
Baking in brick or tile ovens.....	103
For baking field bread in field oven.....	146
For baking garrison bread in field oven.....	145
For proving dough.....	89
Important element in fermentation.....	87
Malt is added in making yeast.....	56
Maximum for water in bread making.....	76
Of bake shop.....	75
Of interior of loaf.....	104
Of water for bread making.....	76
Yeast killed at.....	53
Yeast thrives best at.....	50, 53
Tentage.....	159
Tests of flour.....	33
Thermometers, combination.....	167
Thermometers, oven.....	167
Tinware in yeast making.....	64

Transportation of—	Paragraph No.
Bread.....	179, 180, 181
Field bakery.....	178
Flour	22
Trench cover, clay.....	186, 187
Undesirable acid fermentations.....	56
Unfermented bread.....	73
Unsoundness in flour.....	28
Water:	
First consideration in selection of camp site.....	176
Hard, effect on fermentation.....	87
Hot, used to expose starch cells.....	60
In sponge and dough process.....	89
In straight dough process.....	91
Proper temperature of, for bread baking.....	76
Retaining capacity of flours.....	6
Used in bread making.....	97
Used in making yeast.....	87
Weevils in flour.....	26
Wheat:	
Classification of.....	3
Durum.....	3(e)
Germ in.....	6
Hard red winter.....	3(b)
Hard spring.....	3(c)
Scourer.....	9(b)
Soft, red winter.....	3(a)
Spring.....	2(b)
Sweating of.....	7
White winter.....	3(d)
Winter.....	2(a)
Whole-wheat flour.....	17
Yeast:	
Air hastens process.....	45
Amount used (<i>see</i> Recipes).	
Compressed.....	47, 55
Conditions favorable to growth of.....	46, 47
Cultivation of.....	47

Yeast—Continued.

Paragraph No.

Dried.....	47, 54, 72
Feeds largely upon sugar.....	48
Fermentation checked.....	53
Flour and malt (stocked), recipe for.....	68
Flour and malt (virgin), recipe for.....	67
Flour (stocked), recipe for.....	70
Flour (virgin), recipe for.....	69
Flour used in preparation of.....	60
Food for.....	56
Granite and tin ware in making.....	64
Hops used in preparation of.....	57
In bread.....	48
Influence of temperature on growth of.....	53
Ingredients used in preparation of.....	57, 58, 59, 60, 61, 62, 63, 64
Liquid.....	56
Malt in preparation of.....	61
Moisture necessary to growth of.....	47
Not killed by freezing.....	50
Points to remember on fermentation of.....	50
Porcelain, in making.....	64
Potatoes used in preparation of.....	59
Potato water used in making.....	51
Recipes.....	66, 67, 68, 69, 70, 71, 72
Salt in preparation of.....	58
Sugar during growth of.....	63
Spores of.....	45, 46
Starch used in preparation of.....	56
Stock, when added to liquid.....	56
Substitutive quantities for compressed.....	88
Tinware in making.....	64
Water used in preparation of.....	64
When hop tea is added to liquid.....	56
Wild.....	45



**ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
35 CENTS PER COPY
▽**

UNIVERSITY OF MICHIGAN



3 9015 06280 1694

