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THE BOOK OF BREAD

Printed by

Turnbull & Spears

Edinburgh

THE
BOOK OF BREAD

BY

OWEN SIMMONS, F.C.S.

(OWEN AND OWEN)

Highest Possible Medallist in the United Kingdom in Bread-making in 1886
Technological Examiner (1888-9) *to the National Association of Master Bakers and Confectioners of Great Britain and Ireland*
Certificated by Examinations under Government (*Science and Art Department*) *in Chemistry, Mechanics, Machine Construction and Hygiene, and in Bread-making under the City and Guilds of London Institute* (*with* "*Honours*")
Expert since 1888 *to* "*The British Baker*"
Bread Judge at the International Exhibitions
Juror to the Universal Food and Cookery Association
Lecturer on Bread-making Technology at the International Exhibitions, at the Borough Polytechnic, and "*The National School of Bakery*"
etc., etc.

Maclaren & Sons

Offices of "*The British Baker*"

37 and 38 Shoe Lane, London, E.C.

CONTENTS

PREFACE

ALTHOUGH almost incredible, it is now just upon twenty years since the first contribution from the author's pen appeared in the Trade Press. For fifteen years, since 1888, when first approached by the publishers of *The British Baker* and of this present work, the author's articles in that prominent journal have been quite continuous, as many as three having occasionally appeared in one weekly issue. During that long connection, a phenomenally large correspondence of many hundreds of letters, containing almost every conceivable inquiry concerning difficulties in the bakery business, have been received from throughout the British Empire, and these correspondents have many times suggested and requested the writing of a book. These requests have been followed by distinct offers from the present publishers, which in turn had to be refused, because the very secret of the success, as others say, attending these contributions, namely, the close association with the commercial side of the subject, has militated against obtaining the necessary time and opportunity for treating sufficiently well a matter of such importance, and entailing an immeasurably greater strain than the usual weekly article. Even the recent invitation to produce this "Book of Bread" as a suitable companion to the most excellent "Book of Cakes," was, after great consideration, declined with regret; but the truth, the whole truth, and nothing but the truth, is that, not until the author saw his repeated refusal was endangering the continuance of a long and valued connection, did he reluctantly yield to persuasion, and then proceed with all his might to arrange for doing thoroughly that which he had undertaken. Thus the origin of this book.

After reference to the extent of the Trade Press contributions, a word of explanation is due, concerning the name of the author of this work as given on its title-page. Anonymity is distinctly repulsive in all matters personal, but in matters technical it has considerable advantages. Both by correspondence and by many positions held, the author has been thrown into contact, in different capacities, with a large number of all sections of the trade, and, although always having the courage of his opinions when necessary, he has preferred privacy and reserve, not wishing to force them personally upon others, or to appear egotistical. He has also experienced great pleasure in discussing, and hearing opinions concerning his own articles, which, of course, could not have been so freely done had their authorship been recognised. The author's work has mostly been done under three distinct names, as of individuals, a unity in trinity, and although one of them had become known in well-informed circles, and is now announced on the accompanying title-page, the reputation of another is affording the author much satisfaction, pleasure, and amusement, especially when, as occasionally, some of the subject matter is quoted authoritatively to himself.

Amongst about 350 distinct books and pamphlets on this trade contained in *The British Baker* office alone, there are many excellent contributions by gentlemen who have been good enough to mention the author therein, such as those, taken at random, of Messrs Jago, J. & A. Kirkland, Blandy, Vine, Gribbin, Cobley, Vass, and Chidlow. On a different system to the above, it was originally intended to produce the author's own twenty years' contributions in the form of an Encyclopedia. The author started to read his own contributions and letters, classifying the various subjects in alphabetical order, which was rendered more possible by the excellent services of his assistant, Mr Frederick Pile : the extent, however, of the task being then

A PRIZE TIN LOAF.

more thoroughly realised, further reading of those contributions had to be discontinued, and others could barely be commenced, therefore the Encyclopedia idea had, for the present, to be abandoned. The various headings had to be rearranged into their present sections, and the book, already most expensive in production, and voluminous, now consists of an exhaustive treatment of merely the questions suggested by the author's own correspondents, which, however, by extending over so long a time and so wide an area, may be fairly taken as representing, and including, practically all, as seen by the index, the baker, in his ordinary avocations, would find useful or would desire to know.

The contents will be seen to include full information on the various ingredients and mechanical appliances used by bakers, concerning which the author is most constantly consulted. The good and bad points in a loaf of bread, and how they should be respectively obtained and avoided, are fully discussed. The two most important and unique features, however, clearly distinguishing this book from anything hitherto produced, are, firstly, the most expensive illustrations, which fulfil a promise arising from the publication of diagrams of exhibition prize loaves in *The British Baker* four years ago; and, secondly, the tabulated results, in the concluding section, of over 360 experiments, and different methods of bread-making, together with the results and the concentrated information of many years of close observation and experience.

Most of the loaves, that are photographically reproduced in colours, have been selected from those winning prizes at competitions, but others have been specially supplied for the purposes of this book by well-known gentlemen engaged in the family and wholesale trades; the author's thanks are therefore specially due for such loaves to Messrs Spiking & Co., London, bakers to the Royal Family, Messrs W. Skinner & Sons, Ltd., the well known firm of Glasgow, Mr A. L. Johnston, Wimbledon, the Chairman of the Educational Board of the National School of Bakery, Mr Peters, London, and Mr R. Marshall, of Bellshill, Scotland, the two latter gentlemen being also particularly known as prominent prize-winners.

In conclusion, the author hopes, by reason of his having performed the duties of an apprentice of an operative sufficiently long for his purpose, and of an employer, subsequently to his classical and scientific training, to have succeeded in here supplying the link between the bakery and the laboratory, in driving right home in simple language, to the needs of the baker and of the miller, when flour is too often blamed for other faults; and, further, the author hopes this humble effort will earn a reception by his clientele no worse than that accorded to his other productions of a more evanescent and desultory character.

OWEN SIMMONS.

360, Coldharbour Lane, London, S.W.

THE ILLUSTRATIONS

THESE illustrations which are distributed throughout the book are largely self-explanatory. We have before published diagrams of exhibition prize loaves, and at the time, four years ago, asked for photographs such as these, but were told that such would be far too expensive for the usual journal, and, moreover, at that date the present excellence could not have been attained. However critical readers may be, they will be forced to admit that never before have they seen such a complete collection of prize loaves illustrated in such an excellent manner. The author had originally no conception of the number of experiments with different processes, conducted at great expense of money and time, that would be necessary to produce the plates in their present condition. Trial after trial and proof after proof has been rejected as insufficiently satisfactory. One of the highest authorities on colour photography in the kingdom undertook to produce these illustrations by an entirely new process, but the great expense incurred had to be sacrificed, the result being less perfect than anticipated. It may seem strange to those unaccustomed to this work, that one of the chief difficulties has been to reproduce the whiteness of the crumb of the loaves, and that being so, preference for nearly all of the sections has been given to the ordinary photography. The loaves are now produced photographically correct, of exactly full size, and the colours are as nearly perfect as it is possible for them to be by any process at present known. The representations will at any rate answer a very large number of correspondents, who do not appear to visit the exhibitions, and write to know the style of loaf required in various classes, and as to whether their own is anywhere near the standard.

The 1st illustration is that of an excellent tin loaf to which we recently, in agreement with other judges, had the pleasure of awarding a first prize.

The 2nd is a section of the same loaf.

The 3rd is a section of a 2-lb. loaf from South Wales, being worse than the above only in texture.

The 4th illustration is that of a pan loaf with crumby and greased ends from Scotland.

The 5th is a section of a similar loaf.

The 6th is a prize English crumby loaf from Liverpool.

The 7th is a section of the same.

The 8th is a prize batch loaf from Belfast (Ireland) with greased sides.

The 9th is a typical Scotch square—the national loaf of Scotland.

The 10th is a section of the same.

The 11th is a section of a Scotch square, or crumby, or plain, that won the championship at one of the London Exhibitions.

The 12th is a splendid "Crusty Cottage" from London; made by one of the most regular of prize-winners.

The 13th is a coloured section of the same loaf.

The 14th is a beautiful bromide photograph (in the Edition de Luxe) of another champion cottage, after being exposed in the prize case all the week.

The 15th is a cottage loaf from Wales. It is, like all the other plates, a photograph in full size, and the peculiar appearance is due entirely to the tilting, so as to show the top.

The 16th is an English Coburg or Brunswick, selected as the best of its class in a recent competition.

The 17th is a section of same. In spite of the hole, which in a photograph is rendered exceedingly conspicuous, the loaf totalled more points than other poor loaves sent.

The 18th is a fancy or crusty brick. Observe the notches.

The 19th is a section of a typical French loaf from Scotland baked in a shallow pan.

The 20th, 21st, and 22nd are photographs taken at *The British Baker* office, by its own photographer, of various shapes of bread that were recently received from all parts.

The 23rd is a disreputable so-called fancy brick taken at same time.

The 24th is a typical Irish batch, plain or turnover loaf, that was awarded a prize at last year's London Exhibition. Originally taken full size, but reduced now to exactly half, because too large for the page.

The 25th is a section of the loaf that won first prize in the "Malted Brown" class at last year's London Exhibition.

The 26th is the usual wheatmeal loaf supplied by a gentleman of distinction doing a first-class family trade.

The 27th is a section of a milk loaf supplied from the same establishment.

The 28th is a collection of Vienna bread ordinarily supplied by a first-class London firm, which is also distinguished in this department at exhibitions.

SECTION I

INGREDIENTS AND THEIR USES

"Content, if here th' unlearn'd their wants may view,
The learn'd reflect on what before they knew."

POPE.

MALT AND MALT EXTRACT

MALT consists of barley or other grain, such as maize and rye, that has been steeped in water till it germinates or sprouts, then dried as on a kiln; and is interesting to bakers because of its use for making home-made or patent yeasts or barms, and, more particularly of late, because of the various kinds of extracts from it that are supplied to the baker in a concentrated form.

Although the use of malt by the baker has greatly lessened in some districts owing to the admirable supply of ready-made yeast, it is still much used in others, such as in Scotland and the colonies, with which the author has much correspondence. Not only is the quantity of malt, when making patent yeast, of importance,—the more the malt the better, all things equal, and the stronger the yeast,—but also the quality and character. The best for bakers is a short, crisp, and pale malt, and not one that is hard, steely, dark, or highly coloured; the latter often contains less extract, and is worse colour for the bread. A baker requires a malt that has been slowly dried or kilned, not being overheated, but well ventilated, so that its moisture would be well removed by the draught, enabling it to break up in the hand easily. If too quickly dried, and without a good current of air to carry off the evaporating moisture, it will be hard; but if the superfluous water be driven off from the start, and the heat be gradually and slowly raised, it will be more mealy, as it should be, whereby more small granules of starch, in proportion to large ones, are present, and also more diastasic properties, the strength of the latter varying very much in different malts.

If the malt should not be good the subsequent mashing must not be above 158 or 166 degs. F., and the heat must rise slowly, otherwise the starch would become scalded, which takes place at 10 degs. below this, and the barm immature. Some prefer the malt ground coarse, because the mass would more easily keep porous; but we have noticed that some distilleries that we have visited use a finely-ground malt, and consider it better for yeast growth. About a ton namely, 2240 lbs., of malt extract can be obtained from 10 quarters, namely 3360 lbs., of malt. When making malt extract, the malt should be moistened for two or three days, the water being thoroughly mixed with the malt; then should be spread out and kept fairly warm, whereupon it sprouts, that is, its germ begins to grow in the same way as it would if sown in the fields, and pushes a sprout through the side of the grain, feeding on the interior starch and other bodies. Something of the same thing happens when wheat at harvest time is left in the fields after being cut, and cannot be carted because of wet weather; and the growth and the damage will be more if the weather be warm and sultry than if colder. During the malting or sprouting, special ferments are developed and convert the starch of the grain into sugar. The ferments and sugar are wanted in malt, but their formation and the growing of the germ must be stopped at the right moment, or else the products formed will be consumed. This growing is stopped by heating which, however, must be high enough to kill the germ without killing or weakening the ferments, the one with which we are concerned being called diastase. When the growing of the germ is stopped and the conversion of the starch into sugar is complete, the originally raw grain has become commercial malt, and must then, for the purpose of extracting all the soluble matters thus formed, be well steeped in water, this then, after being strained, would be an extract of malt. The pro-

Section of Prize Tin Loaf.
(ACTUAL SIZE.)

portion of water present, however, by reason of its bulk is naturally inconvenient and expensive for purposes of transport, and such would render it unprofitable or else bad value. This would finally, in spite of advertisements, interfere with its sale in the same way as similar circumstances have done in the case of patent yeast, that used often to be brewed at a central place and carted round to bakers, as the brewers' thick and the dried yeasts now are. It is necessary therefore to concentrate the extract by driving off much of the water by boiling, but boiling in the usual way, which would be at a temperature of 212 degs., would kill all the ferments and diastase contained therein, therefore this thin extract is placed in a vacuum pan, in which, by the air pressure being reduced, it will boil and concentrate at a low temperature, which should not exceed 130 degs. F.

There are really two separate classes of malt extract obtained according to the details of mashing or manufacture. One is more expensive than the other, even when made from the same malt, and should be used by the baker in different quantities and for different purposes. The one is, where the mashing of the malt has been conducted at a low temperature, say at 65 degs. F., whereby good colour is obtained and also a good amount of the ferment diastase in its most active condition; the other is where the mashing has been conducted over a longer period, at a higher temperature of, say, 130 to 150 degs. F., whereby practically all the constituents of the malt are rendered soluble. In the latter case the diastase becomes exhausted by being required to convert or change all the starch into soluble matters such as maltose, but in the former the starch is practically unchanged. It is obvious that the former, or cold water extract, namely, extracting at a low temperature, will yield very much less bulk of material, therefore costs more to manufacture and sell. It is strong in diastase and proteids, or nitrogenous matters, and lower in maltose or sugar, and the extract obtained at the higher temperature, although from the same quality of malt, is low in diastase and proteids, and high in maltose or malt sugar. As to which is better value to the baker depends on the purpose for which it is purchased, and it will at once be seen how ludicrous it is to indiscriminately buy these comparatively modern products without knowing their constituents, and using them, as many do, without settled purpose, merely hearing that malt extract is a good thing, and without any consideration concerning the process of fermentation employed, or the character of the flour.

A little knowledge is a dangerous thing, and we cannot help again mentioning a rather old joke, because the circumstance has happened again to us during the last few days, namely, of a correspondent asking how much diastase he should use as he was going to give it a trial instead of yeast. It is true that both yeast and diastase are called ferments, and are also used in what, by its action, is called in the bakehouse a ferment; but yeast is a living plant, whereas diastase is merely a soluble albuminoid, and a result of germination, possessing digestive properties. It is the strongest and best known of the family of unorganised and hydrolytic ferments called enzymes. It is present naturally in malted grain, being largely and chiefly produced by the germination of barley, and to a less extent in wheat. It is present in barley in quantities of less than 1 per cent., yet is supplied in tins, with other products, as a concentrated solution of a syrupy nature, of sufficient strength to necessitate the use of only 4 to 8 ozs. to a sack of 280 lbs. flour, according to the make, at a total cost of fourpence-halfpenny to sixpence. These quantities do not refer to some commercial malt extracts that contain very little of the active principle diastase. Contrary to some other ferments of its family, such as invertase, diastase acts on the starch of bread in a very marked degree, one part of diastase in good condition being able to convert about 2000 parts of starch. Under favourable conditions of temperature it will succeed in converting most of the starch exposed to its influence into maltose sugar and dextrine or gum. Its ability to thus digest starch, whereby a great portion of the product is maltose, and also the close similarity of its action to that of the digestive ferment, ptyalin, contained in human saliva, is the main cause of its importance.

The formation of maltose sugar, with small quantities of dextrine, gives a characteristic flavour and moistness, and indirectly improves the size and colour (as noticed in some instances) by reason of the stimulating action which maltose has on yeast, which therefore more quickly and thoroughly (where the time is limited) does its work of aëration. During the stages of fermentation yeast feeds on maltose for the purpose of supplying alcohol and carbon dioxide, as is seen by the decrease in the specific gravity during the progress of a malt wort. It is therefore evident that if yeast, instead of obtaining its maltose by starch conversion, has it supplied ready for use, much work is saved. On the other hand diastase, unless accompanied by yeast, is unable to have action on starch cells that are not cracked, nor have their contents scalded or gelatinised. Starch is not gelatinised at a much less temperature than 149 to 153 degs. F., therefore, except as regards the few starch cells that become cracked or fissured by other means than hot liquor, diastase has generally been considered as being little use as a yeast stimulant, beyond the amount of saccharine matter that might often accompany it. Although starch gelatinises as above, and thus allows the diastase to attack it at that temperature, we must remember that diastase itself is killed, or ceases to act, when above the temperature of 175 or 180 degs. F., and, moreover, works at its height in a temperature of 40 to 50 degs. less. It is therefore seen that the margin of time at the disposal of diastase for this conversion during baking, is the time that would be necessary for the loaf to ascend from the temperature of about 145 degs. F. to that of about 180 degs. F., or through a minimum of 30 degs.

We have referred above to the different constituents of malt extract according to the method of preparation, and also to the period at which diastase can attack the starch—subjects on which questions are frequently asked. Although one does not see much on these points in the bread-making press, we have an immense amount of papers concerning them, written by the most eminent men, and produced in the Chemical Society's Journal. We have just been reading some of these papers by Morris and Ling, and the following short particulars give good information on several points that have just been discussed.

When diastase from well-grown, low-dried malt is allowed to act on starch paste or soluble starch, the starch is hydrolysed in about 1½ hours, whilst after forty-two hours the products are substantially those of maltose, and in such a solution nothing but maltose can be detected. Diastase prepared from malt grown under abnormal conditions (such as small quantities prepared in the laboratory) and diastase which has been slowly heated to 115 to 120 degs. do not hydrolyse the starch completely to maltose, even if allowed to act in large excess : diastase which has been rapidly heated to 115 to 120 degs. produces a more pronounced effect.

Neither the final temperature at which a sample of malt has been kilned (considered alone), nor the "diastatic power" determined in accordance with Kjeldahl's "law of proportionality" by Lintner's method, is a criterion of its behaviour towards starch. When a diastase solution is heated above 65 degs., its reaction with starch paste appears to be quite different to that of a solution which has not been heated above 60 degs. ; this is shown, not only by the specific rotatory and cupric reducing power of the dissolved matter, but also by the presence of dextrose among the final products of hydrolysis.

A number of estimations of the "diastatic power" of malt were carried out in order to test the accuracy of Kjeldahl's "law of proportionality." It was found that the law does not hold either for green malt or for low-dried malt when their extract is allowed to act on a solution of starch at the ordinary temperature. The "diastatic power" as usually estimated may be misleading, since in order to meet the requirements of the "law of proportionality" only very dilute solutions of diastase should be employed.

When yeast is allowed to act on a solution of starch-conversion products in the presence of active diastase, the quantity of matter fermented is greatly in excess of that which can be fermented by the yeast alone ; and when active diastase and yeast are allowed to act conjointly on the so-called stable-dextrine, which, under ordinary conditions, is neither degradable by diastase nor fermentable by yeast, it is entirely fermented.

It is now shown that a similar action takes place when certain ungelatinised starch-granules are submitted to the joint action of malt extract and yeast, the quantity of starch decomposed by the joint action being about three times that dissolved by malt extract alone. The increased action in the presence of yeast is not due to the removal of the soluble product, maltose, from the field of action, and the consequent greater activity of the diastase. No increased diastatic action takes place in the presence of yeast if the fermentative power of the latter is checked by chloroform, neither does any increase of action take place when the malt extract is submitted to fermentation, and the yeast-cells removed, before the addition of the starch-granules.

Precipitated diastase behaves in the same way as cold water malt extract, but to a less extent.

The combined action of diastase and yeast only occurs with those starches which are attacked in the ungelatinised form by diastase, such as barley or malt starch. The granules of potato starch, according to the same authors as above referred to, are not acted on by diastase even in the presence of yeast.

It is therefore seen that the constituents of malt-extract vary, but the following is an analysis of one that has attained popularity :—

Nitrogenous matters (including diastase) . .	13.39
Maltose and glucose	50.95
Dextrine	6.61
Ash	5.36
Water	23.69
	100.00

When a malt extract contains a large degree of diastasic strength, 4 ozs. per sack of flour, as sometimes used, will have as much effect, as regards mellowing the flour, as would 1 lb. of another sort, which was low in diastase and high in maltose. The former, by acting on the flour, is best in the later stages of fermentation ; and the latter, by being directly fermentable by yeast, is best, as a rule, in the prior stages. If only one stage, the user must be careful to add no excess, whereby there would be undesirable quantities of maltose and dextrine, which would make the bread sticky and clammy and difficult to bake. This stickiness, however, would often decrease as fermentation was allowed to proceed further, being consumed by the yeast, as can be proved by adding excess and baking portions of the dough at varying periods. Practically all the extracts on the market have an effect on the degrading of the flour or the feeding of the yeast, and are therefore quickeners of fermentation. As such, they have mostly been found useful in mellowing or peptonising and ripening harsh and strong flours, but with soft flour and a long process there is usually quite enough, if not too much, weakening already. Instead therefore of any further weakening it would be better, on the contrary, to give more salt, more labour, and something of an astringent nature, such as was once supplied by alum when the wheat was soft and malted in the fields.

The ferments produced in wheat when sprouted or malted in the field, or in any raw or imperfectly malted grain, are of a weaker and lower order than properly prepared diastase, and cannot be placed quite in the same class by having less action on soluble starch, but they have action on gluten. In soft flours there is thus sufficient soluble matter without further adding about 6 to 10 per cent., as would be done by malt extract during the bread-making process, some of which would be consumed by the yeast. Flours at one time were nearly all too soft ; a few years ago many were too harsh ; now, at the present moment, they are about normal. When too harsh, they can be improved by a judicious use of malt extract in flavour and moistness and also sometimes in bloom, because they can well do with the characteristic action of malt extract, namely, having their starch reduced and their soluble matters increased. The statement, as sometimes made, that malt extract prevents sour bread is risky, because with speed increased, and the time not shortened, the opposite would be the case. With harsh flours and short processes, the best way to use malt extract is to add it to a little scalded flour, and then stir in yeast and strain into trough for incorporating with rest of batch. With long processes, it is best to keep the malt extract out until last or dough stage, because in such processes as in Scotland any such quickener, where there is already a lot of soluble matter, would require much watching, or would be likely to produce harm. If used earlier, the proportion of flour in those stages should be increased, and the quickening allowed for subsequently.

Although distillers' yeasts are quicker than barms, it is frequently found that in the Scotch process they will stand more malt extract with less effect, because when used the process is often considerably decreased in time, and has not the soluble and malt principles as would be the case with the barm. And also more can often be used in the case of Parisian barm than compound. Although in the greater portion of England, with most of the malt extracts on the market, it is customary to use about $\frac{3}{4}$ to 1 lb. per sack of 280 lbs., we were recently concerned with some tests that were made for the purpose of demonstrating the value of a kneading machine, and conducted by American bakers, who added 3 lbs. to the batch of one barrel (196 lbs.) or less than three-quarters of a sack. The two cheapest constituents of malt extract are glucose and water, and the amount used per sack and the value must depend largely on these. A rough guide concerning concentration and quality can be obtained by seeing to what extent it will run to fine threads when pouring. Glucose being a cheap sugar, and a yeast food of less cost than malt extract, is in some cases added largely, and should not exceed about one-quarter or one-fifth the amount of maltose; the amount that would be naturally present being less rather than otherwise, but according to the process.

One is often asked if malt extract is a good substitute for potatoes. As in the case of the advantages or disadvantages of malt extract, according to the class or the manner of its use, so is it with potatoes. In the case of a sponge or dough they can be easily discontinued with or without a substitute, but in the case of a ferment (not the modern short one of just half an hour or so merely to start the yeast, but the larger and longer one for the purpose and absolute necessity of increasing a small quantity of yeast in order to do subsequently the work of a larger quantity), it is not reasonable to suppose that 1 lb. of liquid material will, under those conditions, be the same all round comfort as, say, the previous 14 lbs.

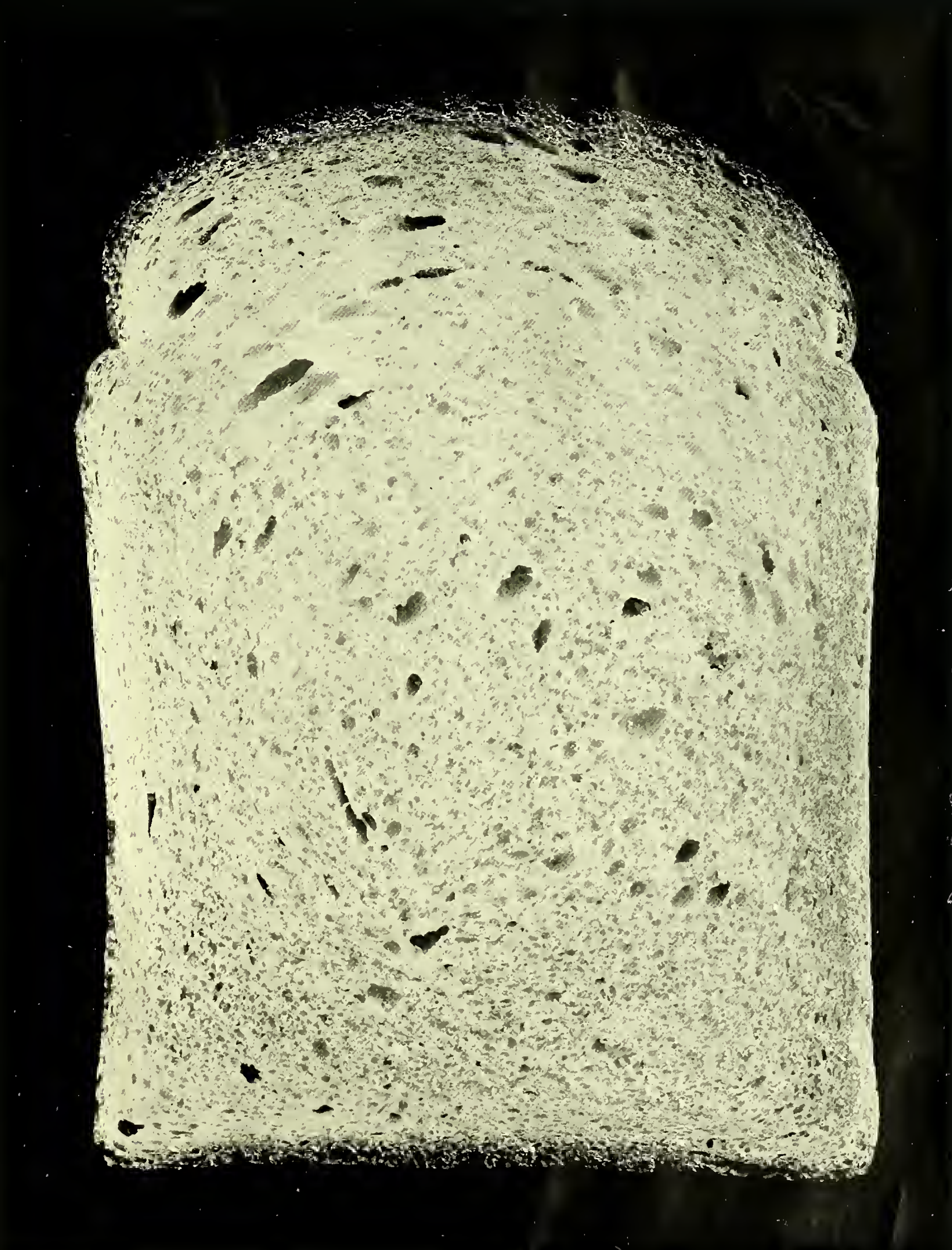
of potatoes. It is just the difference between a piece of beefsteak and a cup of Bovril. One may be an extract from the other and possess all the nutriment, stimulant, and good constituents in a handy and more convenient form, but it has not the bulk of matter, it is more readily consumed, digested and forgotten; and has not the same amount of stay or lasting effect. An extract of potato or an extract of flour would not make so good a ferment when required to be long and steady and progressive, as would the bulk of potato or bulk of flour, and an extract of malt on the same lines will not take the place of the crushed or entire malt, or other bulks of material. The extracts should be made more steady and filling in their effect, by having added to them portions of scalded and also raw flour, in order to represent the cells of the potato that had been scalded during cooking.

The principles affecting flavour, moistness, and yield of bread are discussed under their respective headings.

Malt, and the matters extracted from it, is a very old acquaintance of the bakehouse, and should therefore be better understood by the average baker than it appears to be in its new form. When first it came under notice in its new form the baker was asked to pay a royalty to the patentee, and to buy the utensils for the purpose of making it himself under the patented process, but the manufacture, although easy enough when understood, requires skill, plant, space and knowledge, and like wheat buying, yeast brewing and biscuit making, all of which were once in the hands of the baker to a very much greater extent, has passed largely into the hands of more distant specialists.

During the interval between writing the above and the reading of proofs, we have come across three very long articles, which we wrote over ten years ago, in a very much more advanced style than is considered politic for the present book. Some of the same ground has been covered in the present contribution, but a summary of those articles in so far as it adds to what has already just been said, can be advantageously appended, as follows:—

The embryo (germ) derives its food from the endosperm (starch), the



Section of Good Commercial Tin Loaf.

(ACTUAL SIZE.)

latter being merely a dead storehouse of reserve material. The resting embryo contains no diastase ("of secretion"), but the latter appears during germination, and is secreted by the epithelium cells—by them only—and accumulated for the most part in the endosperm (from the nitrogenous matters of which it is first produced) in proportion to the development of the grain. The enzymes (diastase, etc.) of the embryo degrade the starch cells, making them "mealy" in the same manner as the diastase of malt, and the resistance to their action depends on the "condition" of the grain. Embryo can be easily separated from the endosperm, showing there is no organic connection. The aleurone cells (sometimes called gluten cells) under the bran contain fat and oil, therefore much nutriment, but resist human digestion. The starch and its envelope of cellulose are dissolved respectively by two distinct enyzmes or ferments, the amylo-hydrolyst (diastase) and the cyto-hydrolyst. The word diastase, like the word gluten, is often used ambiguously. The more highly active form of diastase should be called "diastase of secretion," and the other less active form should be distinguished as "translocation diastase." The resting embryo, unlike the germinating embryo, is often said to contain "no diastase" by reason of its containing none of the powerful diastase of secretion, but it nevertheless (although for a long time overlooked) possesses the properties of the less active translocation diastase. During the developing of the embryo (as opposed to, and, of course, preceding its germinating) translocation diastase is produced, and the unused residue of it constitutes the diastase of the resting embryo. The difference between these two diastases is that the diastase of secretion is easily able to liquefy starch paste and to erode the starch granule, whereas the translocation diastase is unable. These two diastases might also be respectively classed as the diastases of raw and germinated grain, or also barley diastase and malt diastase; the former works worse at high temperatures, but better at low temperatures than the latter. When cane sugar is present the epithelium cells secrete no diastase; the embryo must first use the cane sugar or any other easily absorbed food before secretion takes place. Cane sugar promotes better plant growth than dextrose, maltose, or milk sugar in the order named. The amount of sugars increase, but starch decreases during germination.

POTATOES

THE potato tuber, which is often spoken of in the trade as "fruit," has been a friend to the baker for generations, and although being now, with good reason, rapidly forgotten has still some supporters. The author, practically throughout his life, has been strongly against their use and well remembers an insistence on their discontinuance costing him services of an excellent foreman, who was the first he ever employed. They are not convenient and are not as cheap as they seem, they have no properties that cannot be as well supplied in other ways, in fact modern methods are such that there is no need for them. Where substitutes are tried and not found as good, it is because they are not properly understood, and an instance of this is considered under the heading of malt extract. Whatever advantages potatoes may be considered to have are outweighed by disadvantages. Millers spend thousands of pounds in order to remove all dirt and impurities from the flour, yet the users of potatoes, even if they carefully clean them themselves better than the odd boy would do, put in a considerable amount of dirt, as can be seen by comparing the colour of the potato liquor with that of clean water. Dirt is always present and oftentimes disease as well, especially in bad years, and the most careful overhauling will not always eliminate it. The supposed cheapness does not pay the trouble and labour. The best that can be bought, such as one would use for the table, are the cheaper, as there is less waste, and better result. They should be of good size and mealy, and not too watery or spotty, and should not be of the class known as "Bakers' Potatoes."

Let us see the difference in price and convenience between scalded potato starch and scalded wheat starch or flour. Do raw potatoes per pound cost more than flour per pound to buy? There is not the difference there used to be. The potato consists of about 75 per cent. water, 17 per cent. starch and sugar, 5 per cent. albuminoids, and about 1 per cent. each of fat and ash. The flour, on the other hand, consists of about 12 per cent. of water, 73 per cent. of starch and sugars, 12 per cent. of albuminoids, and similar quantities as the potato of fat, ash and cellulose. The starch, sugar and albuminoids are not only useful foods, but also are more profitable to buy than water, and it is clearly seen above how much water is bought in a potato. Not even the 25 per cent. of solid matter in the potato all finds its way to the bread, as there is the skin to come out of it, and if insufficiently cooked there will be a quantity of potato left adhering to the skin after straining, and this waste and skin all come off that 25 per cent. In addition, some potatoes get bad and are discarded, or, worse still, are not, and the price of the dirt bought with them, and the cost of removing it when bought, shows a great contrast to the pure, clean flour, which arrives all ready for use without waste and with but little water, and can be instantaneously cooked. The slight advantage the potato has over flour as regards the soluble albuminous matter is nothing, under the circumstances of to-day, compared to the advantage of flour over potato as regards starch and everything else.

The way to see the truth of the above is to let the matters extracted from the potato settle, pouring off the superfluous water or evaporating the whole to dryness and weighing the sediment, which will be found to be much less than anticipated. This sediment can be bought already prepared in this manner under the name of potato flour, and contains the whole of the matters of the potato, the starch as well as the nitrogen, as against potato starch which contains only what its name implies. Potatoes vary in strength according to season and also according to age, but the solids of such a potato flour when refined and purified would contain nearly 99 per cent. of starch, and about ½ per cent. of mineral matter and ¼ per cent. of albuminoids. A pound of it would equal fully 10 lbs. of potatoes as ordinarily purchased and would absorb about ½ a gallon or 5 lbs. of water. With the addition of raw flour, scalded flour and malt extract, no better yeast food for ordinary purposes would be wanted, and the saving in colour and trouble and risk would be great.

The boldness in the loaf attributed to potatoes is only due to an increased vigour of fermentation by the food they supply, which in some cases, according to conditions, might be missed if not supplied in another way. If a sufficient quantity of yeast is used it will find plenty of opportunity of getting food and making gas, which, in conjunction with gluten and proper management, is what makes boldness or bulk. When yeast could not be bought cheaply in a concentrated form, but had to be grown more largely in the bakehouse, the circumstances were different. The moistness claimed is due to their scalded starch cells during cooking. A wheelbarrow is a handy thing in which to carry a man home when he cannot walk, but it is not needed if a better conveyance can be obtained ; the simile applies with force to the purpose once served by potatoes and for which they have now been superseded.

Not only are potatoes said to have deteriorated in quality because they are cultivated from tubers and not from seed, but there have recently been traced to them cases of poisoning, and one begins to wonder if by-and-by any food will be left unassailed. This poisoning is attributed to an active principle known as solanine which can be extracted from the potato fruit and belongs to the poisoning class. It is certainly present in the potato fruit but it is more difficult to say if it is present in the potato itself. It may occasionally develop in the skin, and is found also just under the skin, and will sometimes give a rank and bitter taste. We have known many cases where there was a bitterness in the bread, that has been traced to the ferment being left too long, and where brewers' yeast or hops had not been used, and where the bread was the picture of health and did not show the slightest signs of over-fermentation, such as referred to in another place. We have also known on the other hand ferments, especially at Bank holiday times, that have stood a surprisingly long while without taking any harm or bitterness, but the precaution, be it noted, was taken to strain the potatoes and set the ferment without the skins.

SUGAR

THIS well-known sweet crystalline substance is obtained from the sugar-cane, and also the beet, maple, and other plants. These canes are about an inch thick, and grow to a height of 10 or 20 feet, the hottest places producing the best canes, and 100 of them will yield about 70 lbs. of sugar.

The canes are first crushed and the juice squeezed out. The extracted juice is mixed with quicklime, and also boiled; during boiling the impurities float to the top and are skimmed off; the crystallised is separated from the uncrystallised. The crystallised or crystals are ground, in much the same way as wheat is ground and refined into flour, into various grades of commercial sugar, one grade differing in colour very much from another from the same crystals, such, for instance, as castor sugar and icing sugar, merely from increased fineness. As in flour, the whiter or lighter the colour the purer would be the sugar. The uncrystallised, or the sugar that crystallises with difficulty, is sold as treacle, or golden syrup, and is very sweet, containing sometimes as much as one-third glucose to two-thirds cane sugar. Small quantities of treacle, or golden syrup, can be added to brown bread. The sugar known as "pieces" is a lower grade, corresponding to a low grade flour, containing more water and being worse colour. The highly refined sugars contain as much as 99 per cent. of sugar.

So-called cane sugar is not necessarily sugar from the juice of the cane, but refers to any sugar of a high class with the same characteristics, irrespective of its source. Moreover, it is practically impossible to distinguish between the pure sugar from the beet of France and that from the cane of the West Indies; it is only when the beet sugar is not sufficiently highly refined that any difference can be noted, and then by the taste. Cane sugar is very stable, and not therefore directly fermentable by yeast, but must be inverted into glucose. Glucose, as discussed under a separate heading, is a lower form of sugar, and can be produced from soluble starch, etc., by acid as well as yeast, and is then cheap. There is a difference of opinion as to whether glucose or cane sugar is the sweeter. Sweetness is not necessarily an indication of sugar, because saccharine, which is often used for sweetening, being very much sweeter than cane sugar, is associated with coal-tar, and has no connection whatever with the carbohydrate family of which sugar is so important a member.

The cheaper grades of cane sugar sometimes have rather considerable portions of glucose added, and the presence of the latter can easily be discovered by its well-known action on Fehling's solution, whereby a red coloration or precipitate is formed, according to the amount present, whereas pure cane sugar gives no such coloration. This glucose, sometimes called grape sugar, when bought at glucose price, is one of the best sugars for adding to bread, and 1 lb. per sack is suitable for average results. There is sugar contained in malt, known as malt sugar or maltose, also sugar contained in milk, known as lactose, therefore the amount of other sugar added per sack must depend on whether malt extract or milk be used at same time, and also on the process of bread-making, and the quality and character of flour. Anything from ½ lb. to 2 lbs. of total sugar per sack can be added, according to the above conditions, but too much will often make the ferment or sponge fret, and 1 lb., as in the case of glucose, will usually be found enough. In the case of making buns, the whole of the sugar required for the bun when put in the ferment will sometimes have a restraining instead of a stimulating effect, by reason of being in excess, and it is best to divide the sugar equally between ferment and dough. A quart of water, when cold, will dissolve and hold in solution about 5 lbs. of sugar, and more when heated, the specific gravity of sugar being about 1.6; but a solution containing anything like 30 per cent., or one-third, will hinder yeast sown in it, and should not exceed 5 or 10 per cent.

The sugar naturally present in good average flour is from 2 to 3 per cent., in about equal proportions of cane sugar, sometimes called sucrose, and maltose; the softer and less stable flours will contain more maltose, and, in some cases, also glucose, and the harder and stronger flours will often contain less maltose and more cane sugar. For the purposes of bread-making it is not necessary to consider the various changes that take place in the character of sugar during boiling to different degrees, as required for the various goods of the confectioner, but while boiling, as in the case of the original juice, a scum will often rise, and the greater the amount of it, the worse will be the quality of the sugar. When heated to about 400, as in an oven, sugar produces caramel, or caramelises; that is to say, a dark brown substance is formed.

GLUCOSE

GLUCOSE is a low stage of crystal sugar, and is made from flour during fermentation; but it can also be converted or made from starch, maltose, and dextrine, by acid without yeast. The acid usually employed is sulphuric or hydrochloric (or muriatic, as it is sometimes called), and this acid sometimes contains arsenic, as has been the case in the recent north-country beer-poisoning cases. It is cheaper to make this fermentable substance—glucose—by acid from ordinary commercial starch, from maize, or rice, than to make it from wheaten flour or barley malt by the gradual action of yeast. Glucose being a substance produced by change, is therefore, according to its percentage in a substance, a guide as to the amount of change that has taken place. When tested with Fehling's solution, the precipitate formed is of a bright red or brick colour, more so than in the case of maltose, the amount of precipitate being in relation to the amount of glucose. In the volumetric estimation of glucose, and also of invert-sugar, the author finds that the final point can be observed much more readily if the saccharine solution is alkaline and not acid. It is therefore advisable, after the inversion of cane-sugar by means of hydrochloric acid, to neutralise it, or render it alkaline, with potash before titrating with Fehling's solution. This substance is very soluble in water, and being directly fermentable, is a good yeast food. It has a similar effect, as regards moisture, to malt extract, but it is sugar only, containing none of the nitrogenous matter or ferments, such as diastase, of the malt. It is sold in solid or liquid state, and is very cheap. The liquid, although a higher price, is preferable to the solid.

SCALDED FLOUR

FLOUR, or starch, is said to be scalded or gelatinised when, by the application of water of certain specific temperatures, its cellulose or outer covering swells and then bursts, liberating the interior and becoming soluble so as to form, when cool and sufficiently concentrated, a jelly-like mass. This change of state is familiar to most people in the form of blanc mange, which is merely the starch of maize, commonly known as corn-flour, after being scalded, and is altogether different from the result of mixing starch with water of a moderate heat. Ground rice, or whole rice, after being soaked, and several other starches, used in special instances, can also be likewise treated so as to become a yeast food or be added to the bread for other purposes. The range of temperature within which the substances likely to be used for this purpose becomes scalded, is from 120 to 160 degs. F., according to the class of substance, and its quality and condition, the larger cells or granules bursting, as a rule, sooner than the smaller. Potato and rice, however, both burst before flour, the first being larger and the second smaller. In order to avoid a very frequent disadvantage, namely, lumps, the flour or other material that we know to be used, in the Midlands especially, should be sifted, then mixed to a perfectly smooth batter with warm water—no more of it than necessary—and not hot enough to scald, but as near the scalding point as possible, so as to simplify what follows. Divide the water with which about to scald into three portions, adding to the batter in three instalments, stirring vigorously all the time ; and this stirring and gradual adding of water is the important part which is often neglected by those not accustomed to it, but never by the Scotchman who understands this work. The first portion of water should certainly be

SQUARE TIN LOAF.

boiling, and, perhaps, also the others, but if the quantity and heat of the batter be known, the remaining water can be regulated to keep the whole nicely above 160 degs., and beyond that there is no advantage; but, on the other hand, the soluble albuminoids, or the diastasic properties of the flour, become coagulated, like the white of an egg, and lose their action, and the whole degraded more than necessary. When well stirred, so that all the starch becomes burst and the whole smooth and cool, some malt extract can be dissolved in other water and added, whereby the whole will become sweet. Raw flour would help to cool and also have some small effect like malt extract. By the time it has stood a little it will be cool enough for the yeast to be dissolved in other water and added. When added to the other liquor of batch, it should be strained through a fine sieve, so that nothing, unless thoroughly dissolved, can find its way to the loaf. Other details must be arranged according to the utensils and process employed and the amount requiring to be prepared.

We like 2 lbs. or 3 lbs. of scalded flour to a sack of flour, and should not recommend anyone to exceed 10 lbs., which is too much for most circumstances, although we recently had 13 lbs. per sack in a tin loaf that was good, light, and sufficiently soaked. The amount advisable depends on the care and skill exercised and individual circumstances, and should always be very small at first trial, being increased gradually. The larger amounts require more care than usually given as a permanency, and if they do not show in the crumb in respect of lumps, they must, especially in conjunction with malt extract, reduce the quality and strength of the flour. Where the flour has no quality to spare, and the whole process is conducted with no more care than often-times, and also with the least possible labour, the crust, as well as the crumb, will show the added material, when in good quantity. Although short eating when well baked, this crust will be grey, dull, and poor, as in the case of over-ripe bread. With a short process, best grade of flour, plenty of yeast, and gas to ærate, extra salt to toughen, and the dough made up into tins, one, of course, can more easily get the advantages of scalded materials as regards moistness, whiteness, and increased yield without the disadvantages, according to quantity used, of heaviness, general poorness, and crumbliness. We once received a most satisfactory loaf from merely average country flour from an inventor of a special method in this connection, who, as advertised at the time, had succeeded in perfecting his process so as to avoid the pitfalls. The scalded material should be used fresh, and not allowed to get sour. Further information bearing on this subject will be found under the headings of dryness, colour, crumbliness, and yield.

GLUTEN—THE CHIEF CONSTITUENT OF FLOUR

THE gluten of a flour is its most valuable and important constituent, as it is the one substance that distinguishes the characteristic properties of wheaten flour from the flours of other cereals. It is not only the substance that is chiefly responsible for the bulk and the lightness of a loaf, but it is also of a very nitrogenous or nutritive value. It exists throughout the interior portion of the wheat berry, but it does not seem to be present in flour in its characteristic state until water is added and the flour made into dough. It cannot be separated from flour as an adhesive and sticky substance without being wetted, although the indication of its presence can be obtained by ascertaining the nitrogenous ratio in the flour by chemical reagents. There is a layer of cells just immediately inside the bran, or outer coating of the wheat grain, which are called gluten cells; these, however, do not contain gluten in the same sense of the term as it is now universally used. At one time it was customary to class all albuminoids or nitrogenous matters together, under the term of gluten, whether they were soluble or insoluble. These so-called gluten cells, sometimes called cerealine cells, contain phosphates, fat, cerealine, and soluble matters, but none of the insoluble.

When flour is wetted into a moderately slack dough, and allowed to stand about an hour, and then washed between the fingers under water, the starch of the flour will flow away, leaving in the hand the adhesive and tenacious substance known as gluten. If this be squeezed so as to free it from its loose water, a good average and suitable bread-making flour will be found to contain about 35 per cent. (30 to 40). Within certain limits, the higher the percentage, the better the flour for bread-making purposes, but sometimes there is found a very abnormal percentage of 50 or even 55 per cent., which is not desirable. A big quantity can sometimes be obtained from badly-matured grain, but its quality is such that it soon gets soft and sticky, and has not the elasticity as desired for good bread-making purposes. This lump of gluten, when freshly extracted from the flour, is known as "wet gluten." In order, however, to ascertain its percentage, apart from the water absorbed, it should be put into a slow oven, preferably one heated, as in laboratories, by a jacket of boiling water at ordinary pressure, whereby the heat does not vary, and does not get excessive. In about twenty-four hours the gluten will be entirely freed from its water, and then be known as "dry gluten," which is always about one-third of the wet, but varying slightly according to its water capacity. Dry gluten in flour can vary from 6 to 15 per cent., and represent flours that are serviceable for various purposes. There are wider differences than these, as mentioned in the case of the wet gluten, but a fair average for soft flours would be from 6 to 9 per cent., and for strong flours from 9 to 16 per cent.

Quality, however, of the gluten in flour is just as important as the quantity, and the quality depends largely on the percentage of its constituents. It was at one time considered that gluten was an elementary substance, having no constituents of which one need take particular notice. The percentage of these constituents is now found to account for practically all the differences in the bread-making qualities of flours, although of similar percentages of total gluten. These constituents are usually now named gliadin and glutenin, which are comparatively new terms. The students who, some years ago, attended the early classes in bread-making, will remember the author drawing special attention to them as glut*i*n and fibrin. Not only are there wide differences in the percentage of gluten in different flours, but, according to the skill and method of the operator, varying results will be given for one and the same flour. This is particularly noticeable when people first begin to use this test, and think they know all about it. The differences noted, according to the time the gluten stands and the amount of its washing, when estimating the total gluten, are, however, wider and more important when separating total gluten up into its constituents. Many of the analyses conducted by recognised authorities and men of the highest skill are conflicting, as the following will show. Fleurent's estimations of glutenin and gliadin differ remarkably from those of Osborne and Voorhees, who were the first to make this separation in this particular form, and to use the terms "glutenin" and "gliadin." While Fleurent looks upon one part of glutenin to three of gliadin as being the normal for flour, Osborne and Voorhees give the following figures for spring and winter wheats respectively :—

	Glutenin.	Gliadin.
Spring Wheat Flour . . .	4.683	3.963
Winter Wheat Flour . . .	4.173	3.910

That is to say, in both varieties of wheat the glutenin is in excess of the gliadin. In some determinations made by Jago, and published in the *British Baker*, the gliadin was extracted direct from the flour by treatment with alcohol, and gave the following results :—

	Glutenin.	Gliadin.
Spring Wheat Patent . . .	5.23	4.81
Spring Wheat Bakers . . .	7.29	6.08
Winter Patent	3.69	3.63
Winter Bakers	5.12	4.43
English Wheat Patent . . .	3.07	3.33
Hungarian Patent . . .	4.79	5.37

Again, in both varieties of American flour the glutenin is the higher of the two, while in both English and Hungarian wheat flours it is a little