

Aërated bread : the new system of bread manufacture.

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AERATED BREAD

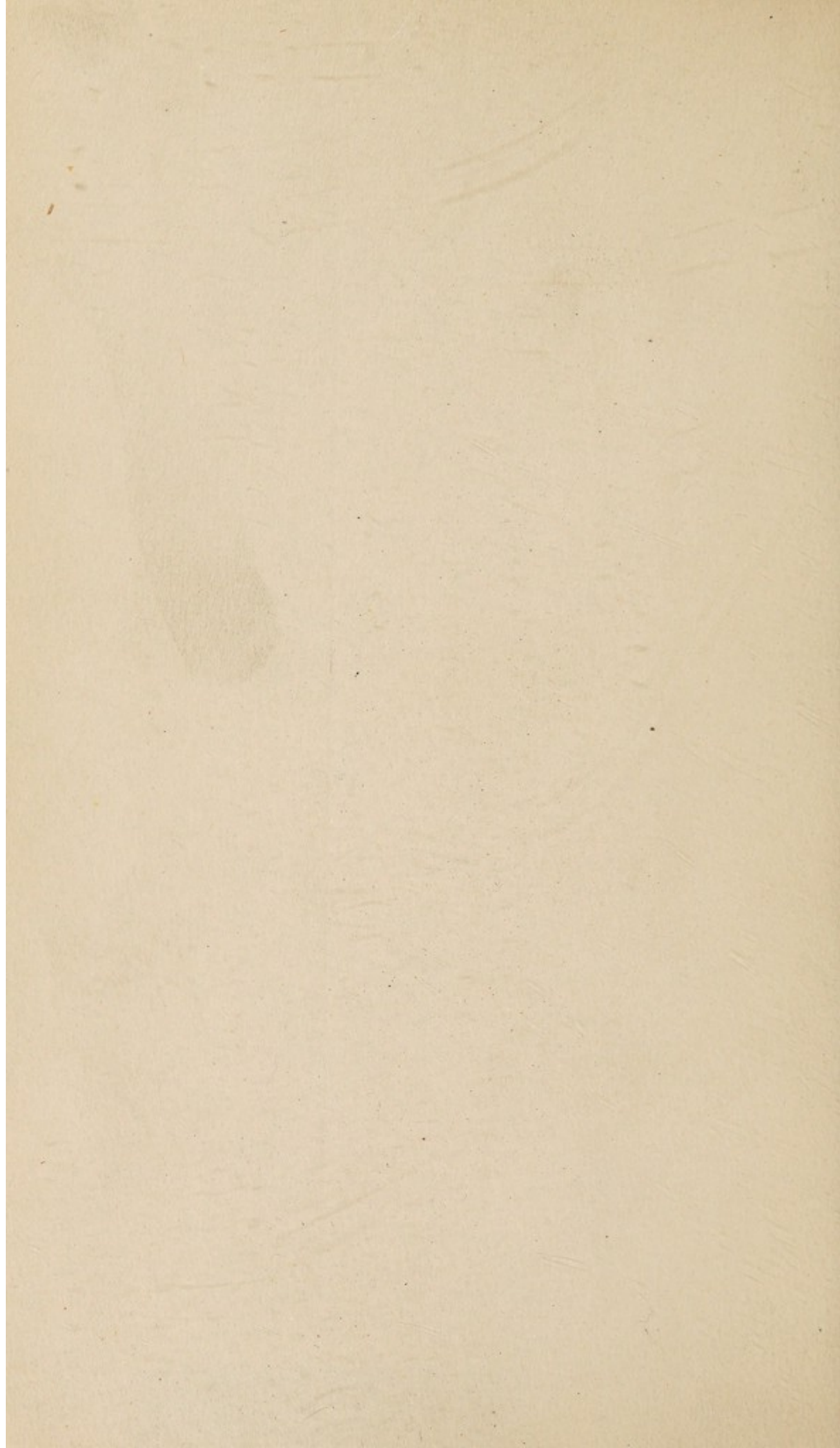


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AËRATED BREAD.

THE
NEW SYSTEM
OF
BREAD MANUFACTURE.

EXTRACTED FROM

“THE HYGIENE OF BREAD,” BY HARRY WILLIAM LOBB,
M.R.C.S.E., ETC.;

AND

A PAPER READ BEFORE THE SOCIETY OF ARTS BY
DR. DAUGLISH, THE INVENTOR OF “AËRATED
BREAD:”

WITH

SUPPLEMENTARY NOTICES.

Printed for and Published by
THE NATIONAL PROVINCIAL AËRATED BREAD
COMPANY, LIMITED.

CHIEF OFFICE, 82, CHEAPSIDE, LONDON, E.C.

1864.

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PREFACE.

AN ABLE PAMPHLET, entitled "The Hygiène of Bread," was published some time since by Dr. H. W. Lobb, embodying some valuable articles which he wrote in the early part of 1860 for the *Medical Circular*. From this pamphlet a few extracts are given, which fully corroborate all that has been said on the value of AËRATED BREAD, and justify the conviction that the time is not far distant when its manufacture, on the principles laid down by Dr. Dauglish, will become all but universal.

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THE NEW SYSTEM OF BREAD MANUFACTURE.

INTRODUCTORY.

SECOND only in importance to the atmosphere inhaled, and the peculiarities of climate, is the bread eaten by a nation. Water should have been placed second, were it not that it is so little drunk by Europeans as it comes from the spring or river; almost all civilized nations boiling their water before drinking it, as in beer, tea, coffee, chocolate, &c., whereby a change in the salts contained in solution takes place, rendering it more suited, in most instances, to the animal economy.

Bread is the "staff of life," the great pabulum which all classes, high and low, rich and poor, look to as the staple article of diet,—eaten at every meal, consumed by all, in smaller or larger quantities, from the Queen to the meanest of her subjects, from the nobleman and princely merchant to the prisoner in his cell, and the poverty-stricken recipient of the meagre dole at the night-refuge.

Large masses of the people exist almost entirely on bread, tasting bacon but once a week, and butcher's meat but once a year; their bones and muscles are formed of bread, their blood is bread and water, and their nerve force the spirit of bread. Such, then, is the paramount importance of bread as an article of diet, and as a question of domestic and political economy, that I feel that to draw the attention of the Medical Profession to the "Hygiène of Bread" will be of service to them individually, and, far more, through them to the great mass of the public.

The English word Bread is supposed to be derived from the Anglo-Saxon Bræd-an, to nourish, and it is in this sense that I purpose looking upon it,—a model food, the only model food, with the exception of the maternal milk, which with water alone will support life. Bread may be defined as a food composed of water, starch—in a state easily converted into gum or sugar—gluten, and oil. These materials undergo various preparations before being eaten; still the ingredients are the same. Bread has been the principal article of diet from time immemorial; the earliest records, sacred and profane, allude to it; no historical work extant, however ancient the times treated of, has failed to recognise the great importance of bread as food for the people.

Amongst ancient authors, the manufacture of bread is frequently spoken of. Hippocrates says:—"And that from wheat, by macerating it, stripping it of its husk, grinding it all down, sifting, toasting, and baking it, they formed bread." "And this I know, moreover, that to the human body it makes a great difference whether the bread be fine or coarse, of wheat with or without the husk; whether mixed with much or little water, strongly wrought or scarcely at all, baked or raw, and a multitude of similar differences." Hippocrates, who wrote about 450 years before Christ, does not speak of fermented bread; he

merely alludes to different forms of cakes, biscuits, &c. Galen, speaking of bread, says the best kinds are such as contain plenty of leaven, have been properly pounded, and exposed to a moderate heat in the oven. He objects to unleavened bread. Celsus, however, places "unleavened bread first among those things that do not spoil on the stomach;" and he says of bread, that it contains more nourishment than any other food. Although the ancients in general made use of leaven, still it is mentioned by Pliny that the Gauls and Spaniards made use of yeast to ferment their bread.

The Bible constantly alludes to bread, both leavened and unleavened; and showing the importance in which the Jews held it, we frequently have such passages as "The Bread of Life," "Wherefore do ye spend money for that which is not bread?" &c. Bread being to them of the greatest value, was made typical in many of their most solemn rites.

Even amongst uncivilized nations, except a few of the most degraded, bread is eaten in some form or other. Normadic tribes eat bread; although they may cultivate no cereal, yet prolific Nature has placed at their command fruits which in their chemical composition resemble most intimately the bread of Europeans. The date of the desert grows aloft at every spring, yielding to the wanderer its pleasant food, grateful to his hand; it affords him the same nourishment that bread does to the inhabitant of a colder clime, it is suited to his wants, and upon it he lives. The South Sea Islanders have their bread-fruit, which when baked resembles in its flavour sweet wheaten bread, and on which the natives live the whole year round, for the tree bears during nine months, and during the remaining three they eat the fruit, which has been harvested in pits, and which, after undergoing fermentation, being baked, yields a bread somewhat sour, still nutritious.

Many of the gramineæ, besides wheat, answer to the definition I have given of bread; still, wheat alone, ground, mixed with water, kneaded and baked, yields the loaf of the shops. Rye and barley give an inferior loaf; but Indian corn, oats, buckwheat, quinoa, and Indian millet, fail altogether to form that peculiar porous mass termed a loaf, and which has been always found to be more easy of digestion, as the fluids are enabled more readily to permeate the sponge to dissolve it.

The subject of bread has been a prolific one: numerous most valuable papers have appeared from time to time, scattered about in various works and periodicals; still, from the contradictory assertions they contain, and from the new processes for the manufacture of bread which have lately appeared, I believe there is plenty of room for the "Hygiène of Bread."

I purpose, therefore, to treat of bread principally as to its dietetic relations; and although I shall enter into the chemistry of the ingredients, and the process of manufacture, yet the various causes for its adaptability to certain states of the system, and not to others—the reasons for the digestibility of fermented bread by some, and unfer-

mented by others—will be the chief aim I shall have in view. I believe I am in a condition to prove incontestably, by many authentic cases in my own practice and in that of others, that unfermented bread alone is a cure for many most serious forms of dyspepsia, in which medicines, &c., are merely palliative.

AËRATED BREAD

Is the invention of Dr. Daughlish, who, having triumphed over all difficulties, has at length perfected his ideas,—brought them into working order, and is now supplying the bread very largely to the public.

The idea Dr. Daughlish wished to carry out was to make the mixture of flour and water spongy, without exciting fermentation in the flour. This, although apparently simple, has been found, on account of the difficulty in adapting machinery to it, to be exceedingly tedious ; and even after the patent for the process was taken out, more than two years expired before the bread could be made in any quantity.

The process of manufacture is as follows. I shall confine myself more to general principles, than enter into the details already so ably done by Dr. Odling and others :—Carbonic acid gas, prepared in the usual way, is forced by powerful pumps, working under a pressure of seven atmospheres, into a vessel containing water, by which it is absorbed. The carbonic acid water passes into an air-tight mixer, into which a sack of flour and three pounds of salt have been introduced beforehand, and in which a vacuum of thirty inches has been produced by an air-pump. A kneading fan is now set to work in the mixer, and this process is easily and rapidly effected ; the flour and carbonic acid water being incorporated under pressure, the dough cannot rise and become spongy to impede the progress. Flours containing well-elaborated gluten take but three or four minutes' kneading ; inferior flours, from five to ten minutes, so that the toughness of the gluten may be developed by working. After the kneading has been completed, a small valve is removed to allow the dough to escape through a pipe, which is trumpet-shaped, to prevent the sudden expansion of the dough as it escapes from the mixer ; the aperture of the trumpet, as it leaves the mixer, is about the size of a shilling, and the mouth about that of the closed fist, the dough gradually expanding to fill this as it is forced out by the pressure from behind of the condensed gas.

Before the opening of the trumpet, a boy sits with a large knife, and as the dough is forced out he receives it in a small wooden trough, holding sufficient to make a half-quartern loaf ; when full, he cuts off the dough with the knife, and passes on the trough to the scale, where it is weighed, and made up to 2lb. 4oz. By this method, from the first placing the flour in the mixer to the moment when it is baked, it is not touched by the hand. The following remarks are extracted from

a paper by Dr. Odling, read before the Chemical Section of the British Association at Aberdeen, and sum up the advantages of the aerated process in comparison with the old method of bread-making by the aid of fermentation.

“1st. *Its cleanliness.* Instead of the dough being mixed with naked arms or feet, the bread, from the wetting of the flour to the completion of the baking, is not, and scarcely can be, touched by any one. 2nd. *Its rapidity.* An hour and a half serves for the entire conversion of a sack of flour into baked loaves; whereas in the ordinary process four or five hours are occupied in the formation of the sponge, and a further time in the kneading, raising, and baking of the dough. 3rd. *Its preventing deterioration of the flour.* In making fermented bread from certain varieties of flour, not in themselves unwholesome, the prolonged action of warmth and moisture induces a change of the starchy matter of the flour into dextrine, whereby the bread becomes sodden and dark-coloured. This change is usually prevented by the addition of alum, which is, indeed, an almost necessary ingredient in the manufacture of bread from glucogenic flour. But in operating by the new process, there is no time for the glucogenic change to take place, and consequently no advantage in the use of alum, even with any description of flour. 4th. *Its certainty and uniformity.* Owing to differences in the character and rapidity of the fermentation, dependent on variations of temperature, quality of yeast, &c., the manufacture of fermented bread frequently presents certain vagaries and irregularities from which the new process is entirely free. 5th. *The character of the bread.* Chemical analysis shows that the flour has undergone less deterioration in bread made by the new, than in that made by the fermented process. In other words, the percentage of extracted matters is smaller. The new bread has been tried dietetically at Guy's Hospital, and by many London physicians, has been highly approved of. It is well known that, for some years past, the use of fermented bread in dyspeptic cases has been objected to by members of the medical profession, the *débris* of the yeast being considered unwholesome, and liable to induce acidity. 6th. *Its economy.* The cost of carbonic acid is alleged to be less than the cost of yeast. Moreover, in making fermented bread there is a small but necessary waste of the saccharine constituents, which is avoided in the new process. 7th. *The saving of labour and health.* It substitutes machine labour for manual labour of a very exhausting kind. The sanitary condition of journeymen bakers was investigated some time ago by Dr. Guy, and found to be most lamentable, from their constant night-work, and from the fatiguing and unwholesome character of their labour, particularly the kneading. In a politico-economical point of view, the process is important as removing bread-making from a domestic manual work to a manufacturing machine-work. From the character of the apparatus, the process can only be used profitably on a large scale, and not in small bakeries.

DIGESTION.

HAVING studied the question of the manufacture of bread, it is necessary to proceed to its digestion, and the way in which it acts, and is acted upon, by the stomach.

Bread, upon entering the mouth, should be thoroughly masticated and mixed with the saliva, as this secretion acts a most important part in the digestion of bread. If bread be first masticated, and kept in a vessel at a temperature of 100 deg., a great portion of the starch will be converted into sugar, and this, again, into lactic acid—requiring time, however, to effect it. In the stomach, bread takes about three hours and a half to become converted into chyme, according to Dr. Beaumont. This, doubtless, is but an approximation, varying with each individual and upon different occasions; still it is probably about the time. Bread being composed of starch, gluten, and extractive, the following changes may be supposed to take place:—"The starch is acted upon by the saliva, the fluid of which tends to separate the particles; the animal ferment contained in it, with the faint alkaline reaction of the saliva, together with the heat of the stomach, causes the chemical conversion of starch into sugar, which is the primary act of healthy digestion, the fluids of the stomach having a faintly alkaline reaction from the presence of saliva. In perfectly normal digestion of bread, it is most probable that this faintly alkaline reaction lasts for nearly half an hour—such is the result of my own experiments on this subject—when the peculiar secretion of the glands of the stomach begins to have the ascendancy, and the pepsine and hydrochloric and lactic acids come into play to act upon the gluten, which is now dissolved, aided by the churning motion of the stomach, slowly rolling its contents along its internal walls, by which means every individual molecule of the food is separated from its fellow, dissolved, and acted upon by the digestive fluids. This solution is the chyme, consisting chiefly of sugar, lactic acid, albumen, and some other proteine compounds, and minutely-divided oil in a saline fluid. This may be looked upon as the normal digestion of bread, but who can possibly paint the innumerable changes which go on in the stomach of the dyspeptic? They are too numerous even to speculate upon. The most distressing are the rapid conversion of starch into abnormal and highly irritating acids, the perversion of gluten into low proteine compounds, with escape of nitrogen gas into the stomach, giving rise to the most painful flatulence; and the albumen itself converted into some proteine state, which will not nourish when absorbed by the lacteals. These three are the chief, and with these I shall be satisfied.

Fermented batch-bread never has the vitality of its yeast in the centre of the loaf wholly destroyed. Yeast, we know, has the power of converting starch into sugar, &c., and gluten into low proteine states; the saliva also has this identical power. The yeast, therefore, undertakes the work of the saliva in the stomach, and the two together

most rapidly effect the process. Now, yeast in batch-bread made of inferior flours converts the gluten into cerealine, which is a low proteine state, rapidly convertible into ammonia, and unfit for nutritive purposes. Is it not a fair inference, therefore, to suppose that the saliva, acting upon fermented breads, easily converts it into this abnormal state in the weak stomach? Dr. Prout has beautifully observed, in his valuable work, that the stomach supervises the process of digestion, and by its vital agency corrects any inclination to abnormal changes; but in a stomach in which the vital powers are weakened, it is unable to prevent these changes, which it deplors, but cannot counteract.

The instinct of the stomach—and this instinct is more marked in the debilitated organ than in the healthy one—is a beautiful provision of Nature. Without any aid from the mental faculties, this remarkable instinct will discover the food which is producing inconvenience. In many cases, without the patient being aware of the fact, the stomach has rejected the objectionable article of diet, and, upon questioning him, he says, “he eats little bread, the reason why he does not know.” I have noticed this in numerous instances.

Infants fed upon fermented bread and milk generally waste away, and, if the diet is not changed, refuse food altogether, and die of atrophy. The little sufferers instinctively know that the food is bad for them, and at last, sooner than undergo the torments produced by the elimination of gas from it, go without; this is instinct. The aid of reason is not here called upon, but it is a knowledge derived from the sympathetic nervous system, from the blood, from the secretions, the tissues; all cry aloud against the poison which is being introduced to them as aliment, and upon which they cannot exist.

A remarkable instance of this instinct of the stomach in domestic animals has been communicated to me by Dr. Daughlish. He says:—“Some dogs that would not touch fermented bread, will eat the aërated with avidity. My little girl told me with great glee, the other day, that her pet cat was very fond of the aërated bread, but that she would not touch the fermented. This may prove of interest, as showing an instinctive repugnance to fermentation in the brute.”

THE AËRATED BREAD AS A DIET.

MYSELF and my whole household having used the aërated bread solely, for upwards of a year, I am in a position to speak of its dietetic value.

1st. The aërated bread sustains the economy longer than an equal quantity of fermented bread.

2nd. A larger quantity of the aërated bread is eaten than of the fermented. The desire for food returns at longer intervals, fewer meals being required.

3rd. Less meat is necessary, a greater quantity of bread being eaten.

4th. Dyspeptics who have been unable to eat any breakfast for years, can now eat a hearty meal of the aerated bread.

5th. Individuals accustomed to complain of "sinking," and a craving for food every two or three hours, find great relief by confining themselves to the aerated bread; in some instances I have found it specific.

6th. Individuals who suffer with acidity, heartburn, and flatulence after meals, and who seek relief by taking soda, magnesia, ginger, &c., are relieved by discontinuing beer and fermented bread, and taking the aerated bread.

7th. I have found it useful in many forms of disease, of which I shall speak further on.

The reasons for this superiority may be thus explained:—The constituents of the fermented bread have been altered; a large portion of its gluten has been deteriorated, or, according to Liebig, rendered soluble; a small portion has been destroyed by the development of the yeast during fermentation; and although these changes do not decrease the weight of the mass of bread, yet, from the deterioration and destruction of the gluten, it is less nutritious. Chemists tell us that the amount of nitrogen is not less in fermented bread than in flour; this is true, but then much of the nitrogen in the bread is found in the yeast itself, which has been abstracted from the gluten during fermentation.

Some of the starch also is converted into carbonic acid gas, a loss to the nutritive quality of the bread. Doubtless the changes produced by fermentation in the flour resemble somewhat the changes produced by the saliva and the gastric juice in the stomach; but then the beautiful harmony, or correlation, so to speak, of the functions of digestion are interfered with, and render insalivation and the gastric secretions non-essential; and, as has been proved by Paget, every secretion being an excretion, so much foreign matter in the economy not being eliminated, must prove prejudicial, and tend to derange the health.

The results of the changes effected in the flour by fermentation will be that the chyme is more rapidly formed, and possesses the acids in excess, as in the analyses of fermented bread small quantities of acetates and lactates are discovered, caused by fermentation: then it will be more rapidly hurried out of the stomach, before the absorption of some of its constituents has taken place. Nitrogen gas is frequently given off in large quantities, causing the most painful form of flatulence; biliary derangements follow, with all that fearful train of symptoms accompanying them. We may thus perceive that, in the strong and healthy, much nervous energy is required to counteract these abnormal changes; and although it is done so that the individual feels no ill-effects at the time, still he is laying up for himself, on some future day, a trouble which will tell upon him when he is debilitated by disease or weakened by exposure. To the weak and delicate,

dyspepsia, like the dead body chained to the living, is the daily, hourly companion, whispering through the nerves the sad complaint, until disease or insanity severs the hated bonds.

I have taken some trouble to ascertain the opinions held by our Profession on the subject of bread, and I have been somewhat surprised to find that the great majority of those I have questioned have, like myself, discontinued the use of fermented, eating some form of unfermented bread. Many of these gentlemen are unwilling that their names should appear, but I may say that some of the highest and most honoured are amongst them.

THE THERAPEUTICS OF BREAD.

BELIEVING, as I do most firmly, that English fermented batch-bread is a most objectionable food, particularly to children, delicate adults, and the inhabitants of cities generally, it cannot be admitted under this head.

The unfermented breads made with soda and acid are much less objectionable, but still with some few are likely to disagree; and, as we now have a perfect bread, the aerated, I shall confine myself to that.

There is a class of cases, well entitled obscure, which puzzle our best practitioners. The unfortunate sufferers wander from one medical man to another, receiving slight and transient benefit here, none whatever there, and, at last, disgusted with medicine, they fall into the hands of the "opaths," perhaps even of the advertising quacks. These unfortunates at first look well and stout, plump and fresh, and get no sympathy from their friends or their ordinary medical attendant; their pulses are good, tongues clean, skin cool, and they eat, drink, and sleep well; in fact, they are pooh-poohed, and are said to be hipped, in spite of which they are always more or less complaining. This may last for years without relief, although "everything has been tried in vain. But I will describe a case which came under my immediate daily notice for a considerable time.

A gentleman, aged twenty-seven, naturally delicate, but enjoying tolerable health, began to suffer from indigestion. About two hours after a meal, he would complain of a sense of fulness in the throat and eyes, as if they were swollen and puffed out: this would gradually extend downwards, until the whole chest and hypochondria seemed swollen ready to burst. If he could rid himself of the gas which was in the stomach, he obtained temporary relief; if not, this would continue until the next meal. Although not hungry, and with no appetite, he was always craving for food, as it afforded him some ease. Occasionally for days together he would be salivated; the saliva would flow in such quantities as to fill the mouth, requiring ejection: this was an

extremely disagreeable symptom, of which he complained bitterly. With all this he got stouter, and looked well; at length the spirits began to sympathise, and there was every promise of his becoming hypochondriacal. Without mentioning the treatment which did him no good, and which was multifarious, it will be sufficient to state that which afforded temporary relief:—Nitro-muriatic acid with strychnia, half-an-hour after meals, slight relief; charcoal, in powder, after meals, slight relief; cod-liver oil, a table-spoonful after meals, great relief. This latter gave us great hopes that it might effect a cure; but in this we were mistaken: the moment it was discontinued, even for a meal the symptoms returned. A series of experiments were now tried as to the diet, and each constituent was, in its turn banished from the dietary, in order to discover the offending aliment; but when we were reduced to bread, “the staff of life,” we were almost in despair, but let it go, and, to our astonishment and delight, the cause of all was discovered—the BREAD. The patient, from the very day he discontinued fermented bread, began to recover. Instead of bread, he ate biscuits; and with no other change in ordinary diet, he soon completely recovered, and has remained so now for three years. Not liking the biscuits, he baked at home, making use of soda and hydrochloric acid, which agreed very well; and when the aerated bread was introduced, he took to that, and has eaten it ever since. Even now, one meal of fermented bread will upset him for twenty-four hours, showing that it is the undestroyed yeast which is the cause of the abnormal fermentation in the stomach.

A more advanced form of the same disease, termed by Watson chronic diuresis, (a very bad name for it, by the way, as the great quantity of water passed is but a symptom, and consequently does not deserve to give a name to the disease,) is more difficult of treatment. The essence of the disease is the formation of water out of the elements of the food; more water is secreted by the kidneys than is taken as drink, without mentioning that passed off by the skin and lungs. If the urine is carefully examined, it will be found to be almost invariably faintly acid, neutral, or even occasionally alkaline; much proteine matter is passed, seldom albumen; but if the urine be kept a few days, and boiled, a large quantity of an oxide of proteine may be obtained from it. The patient wastes, suffers thirst; he is costive, and the skin is dry; and, if he is not treated judiciously, some fatal disease will carry him off, such as phthisis, diabetes, or atrophy.

The treatment I have found specific is unfermented bread, particularly the aerated; brandy-and-water as a drink, and cod-liver oil; with such tonics as are most suited to the patient's constitution.

This disease I believe to be frequently the precursor of diabetes, and I hardly think that the removal of starch from the diet of a diabetic patient is likely to be of any very great advantage; it may for a time lessen the quantity of sugar and water, but does it cure the disease? I think not. I believe that the aerated bread would be of greater advantage to a diabetic patient than the gluten bread, as it is made, at present, with yeast; although I grant that if the gluten bread were

unfermented, it would be the best form of diet to begin the treatment, gradually adding more starch as the patient improved. This is, however, hypothesis, as I have no facts to bring forward in evidence, beyond the success unfermented bread has in curing the earlier stages of diabetes.

We have all had described to us over and over again, by lady patients, what is termed by them "a feeling of sinking," referred to the epigastrium. It is a sense of emptiness, and arises from flatulence; it comes on an hour or two after food, with great depression of spirits and animal strength. They resort usually to some form of stimulant, such as camphor, ether, ammonia, &c., with temporary benefit. The secretions are vitiated, and if not relieved, some serious illness follows, or hysteria is originated. Now, unfermented bread is, with discontinuance of beer, a specific, acting like a charm; the patient rallies from the first day, and with a little judicious tonic treatment, and a few simple hygienic rules, such as regular exercise, cold bathing, &c., a complete cure is effected. No medicine would have had the slightest beneficial effect, as long as the objectionable fermented articles of diet had been continued.

Again, gouty and rheumatic subjects, whose secretions are generally of an acid nature, derive great benefit from discontinuing fermented articles of diet, and taking to the aërated bread.

Those patients who are frequently troubled with diarrhœa upon the slightest provocation, change of temperature, diet, &c., have changed their habit in this respect, and the absence of acidity dependent upon the use of the aërated bread has quite restored them to health, and rendered some almost, and others quite, independent of those strict dietetic rules to which they had hitherto been obliged to subject themselves.

These are some few examples of what I termed the "Therapeutics of Bread;" but as I sincerely believe that all, sick or well, healthy or unhealthy, would be materially benefited by the discontinuance of fermented and the adoption of aërated bread, it hardly requires these examples of successful treatment of disease to strengthen my argument and position; the mere question of economy should be sufficient at once to place the aërated bread in the hands of every one who could possibly obtain it.

RECAPITULATION.

It may, perhaps, be as well summarily to recapitulate the various advantages the aërated has over the ordinary batch-bread of the bakers.

1st. ITS CLEANLINESS.—The aërated bread is touched by no man's hand from the time it is first shot into the receiver, as flour, salt, and carbonic acid gas water, until the time it is removed from the oven a

baked loaf: whereas ordinary bakers' bread undergoes every conceivable method of kneading, according to the idiosyncrasy of the journeyman, and his peculiar muscular development.

2nd. ITS RAPIDITY OF MANUFACTURE.—One hour and a half is ample time for the conversion of a sack of flour into 190 thoroughly-baked loaves by the aërated process: whereas it takes nineteen hours from the time the yeast is mixed with the mashed potatoes until the batch of bread is drawn from the oven baked.

3rd. ITS UNIFORMITY OF MANUFACTURE.—The whole process being conducted by machinery, the bread is always the same: whereas every individual baker has his own peculiar method of manufacture; the amount of potatoes, rice, starch, bean-meal, and alum he mixes with the flour—the kind and quantity of yeast he employs, the number of hours he allows fermentation to proceed, the kind of oven, and the time the batch is baking, differ with each baker.

4th. ITS INFLUENCE ON THE JOURNEYMAN.—By the aërated process, the men have their regular hours of labour, their hours for meals and rest, the same as any ordinary day-labour: whereas the journeyman baker has no time for himself; the twenty-four hours are split up into small divisions—two hours of work, two hours rest, and so on; he is working on and off all night; and the foreman must be awake and vigilant the whole night, otherwise the batch might be spoilt. The journeyman baker is seldom a healthy man or a long-liver, from his being compelled to neglect the ordinary rules of health.

5th. ITS RETAINING THE NUTRITIVE QUALITIES OF THE FLOUR INTACT.—Aërated bread is simply flour, salt, and water, made spongy by the injection of carbonic acid gas into it, and baked: whereas it is quite impossible to say what ordinary batch-bread is. The best, most successful, and respectable bakers cannot be certain how their bread may turn out; according to the electrical and barometric states of the atmosphere, so may the fermentation be correspondingly affected; according to the quality of flour, the activity of the yeast, &c., so may the gluten undergo more or less deterioration, and the starch saccharine change. Then, again, the carbonic acid gas, which in fermented bread causes its sponginess, is derived from the destruction of some portion of its component starch; in fact, fermentation highly deteriorates the nutritive qualities of the flour from which the bread is made.

6th. ITS FREEDOM FROM ADULTERATION.—The aërated bread cannot be adulterated without instant detection; as no change is effected by fermentation, the flavour of the flour is undisguised, and, consequently, if anything were to be added it would be instantly discovered by the palate: then, again, no potato or any other starch is necessary to originate fermentation, as is the case with ordinary batch-bread. The flour remaining unchanged by the process of aëration, the gluten remains as gluten, undergoing no change into corealin; so that the bread is a white bread, and requires no alum, bean-meal, &c., to arrest such change: whereas ordinary fermented bread is open, more or less, to all these objections.

7th. ITS ECONOMY.—Although the price of the aërated bread is the same as that of the ordinary bakers' bread, and although perhaps even more is eaten from the instincts of the economy recognising a suitable aliment to its wants, still is it economical, from its superior nutritive qualities—from its power of sustaining the muscular and nervous strength—from dyspeptics and infants being able to partake of it.

8th. AS A FOOD FOR THE POOR.—As bread is the real "staff of life" to the poor, it should be really a model food, upon which they may be nourished. Now, ordinary bakers' bread, as supplied to the poor, is an exceedingly inferior specimen even of the usual batch-bread—in fact, so bad is it in some parts as to be quite musty when sold. Now, the aërated bread, being only of two qualities, and made alike for rich and poor—in the same manner, with the same flour, and by the same machinery—offers great advantages to the poor; in fact, to them it will be a much greater boon than to the more wealthy classes, who, not being tied down to bread as their only article of diet, can, if they so desire, omit it altogether.

9th. AS A DIET IN HOSPITALS AND WORKHOUSES.—Here, again, is a vast field for its utility. For the sick and convalescent in our hospitals and workhouses to have a wholesome, uniform bread, will be, perhaps, the greatest boon the denizen of these establishments can be granted. The aërated bread has, I have been informed, being introduced into Guy's Hospital, and been greatly approved by the patients, as also the Physicians, of that institution.

Two years ago, Dr. Odling read a paper at a meeting of the Society of Arts, "On some Points in the Chemistry of Breadmaking; from that paper, those who are not practically acquainted with the working of the old system will at once perceive that nearly, if not quite, all the evils at present complained of, viz., the spoiling of the flour, the necessity for using alum, the long hours of labour, and the consequent unhealthiness of the trade of the baker, arise out of the employment of *fermentation for the raising of bread*. The new process removes the whole of these evils at once, by effecting the raising of bread by purely *mechanical means*.

Bread-making essentially consists in completely incorporating flour, water, salt, and carbonic acid with each other, in such a manner as that they shall form a tenacious, elastic, and bulky mass, in which the aëriform constituent bears to the solid a proportion of about three or four to one, and which, on being placed in the oven and thoroughly baked, shall swell to about double this proportion.

Until very lately the mixing and incorporating of the solid constituents have been performed by the hands and arms, sometimes assisted by the feet; but during the last few years, especially in France, there have been some very ingenious kneading and mixing machines introduced for this purpose, that of M. Boland being of especial merit. The mechanical part of bread-making is very easy of accomplishment, and its results, like all mechanical processes, can always be relied upon with certainty. It is the chemical part out of which all the difficulties and uncertainties arise, and which has presented the only

obstacle in the way of bread manufacture participating in that marvellous progress of the industrial arts which is the distinguishing feature of the present age—and of its taking that position as a manufacturing institution of the country which its magnitude and importance really deserve.

Having pointed out the distinctive features of the ordinary process for obtaining the complete incorporation of the essential materials of spongy bread, with which our readers are doubtless well acquainted. Dr. Daughlish thus proceeds to describe his own process:—

This process essentially consists, in doing away entirely with fermentation, and with all those chemical changes in the constituents of the flour which are consequent upon it; and, having obtained the necessary carbonic acid independently of and separate from the flour, incorporating the materials, including the carbonic acid, wholly by mechanical means, so as to secure the bulky elastic mass which is capable of being baked into light, spongy bread.

When wheaten flour, salt, and water are thoroughly incorporated in due proportions, we have a heavy, soft tenacious substance, called dough or paste, the tenacity of which is wholly dependent on the mechanical condition or properties of the gluten of the flour, the starch, when in a sound state, possessing of itself no cohesive properties whatever. The process of kneading or incorporation, then, consists in mixing the materials together in such a manner as that the gluten, becoming well saturated with water, shall form a soft, adhesive mass, as a matrix, in which are embedded and bound together the minute particles of starch; and if the kneading is carried on in a very thorough manner, and for a prolonged period, the dough becomes tough by the particles of gluten being driven close together, and forming a kind of sticky coat or shell around the particles of starch which thus adhere firmly to each other. When this mass is obtained, the point afterwards to be effected is the liberation of minute bubbles of gas within each sticky coat, surrounding each granule of starch.

We have seen that in the ordinary process of bread-making by fermentation, the carbonic acid, which is the agent of distension, is obtained from the decomposition of the starch or glucose, by the action of a ferment, which being thoroughly incorporated along with the other materials into the dough or paste, is thus brought into contact with the starch, and with the gluten with which the starch is surrounded. It is easy, therefore, to understand how, when a mass of dough thus constituted is left for a time in a temperature suitable for the fermentive change, each of the minute particles of starch imprisoned in a covering of gluten is made the centre of a distinct chemical action, and yields up its bubbles of carbonic acid to distend its gluten coat; and how, by the aggregation of such particles, a mass of spongy dough is formed; and how, also, when the materials have not been thoroughly incorporated, and the action of the ferment is not uniform, or when the gluten is not of a firm yet elastic quality, the generation of the gas will be unequal—the minute bubbles will be burst into large ones, and the texture of the dough be impaired accordingly, rendered, as it is

termed, "full of eyes"—instead of being dispersed in minute bubbles, as numerous, or nearly so, as the particles of starch from which it is given off. In the new process, as the gas is not given off by the particles of starch within the gluten coat, it has to be obtained from another source within the mass of dough, in order that the *minute spongy texture may be secured*; and this source is the water with which the gluten which envelopes the starch is saturated, and which is held, as it were, by capillary attraction also around the particles of starch.

It has been long known to chemists that water will absorb its own bulk of carbonic acid, whatever the density, with great readiness when agitated with it: that is to say, supposing you placed water in a closed vessel, along with carbonic acid—in a bottle, for instance—filling it half with water and the other half with the gas, then corking it up; if the water and the gas be pure, and both at a temperature of 62° Fahr., and at the atmospheric pressure of thirty inches of mercury, when the bottle is thoroughly agitated, the gas will be immediately diffused through or absorbed by the water, until there is an exact balance between the quantity of gas held in solution by each cubic foot of water and that contained in each cubic foot of space within the bottle not occupied by the water. This law of absorption is persistent at all pressures, so that, by increasing the density of the gas, the quantity absorbed by the water will be increased in an equal ratio; and so long as the water is retained under the pressure due to the density, so long will it hold the gas in solution; but whenever it is released from the pressure, the gas will escape from it with effervescence, a familiar example of which is that of a bottle of soda-water when the cork is withdrawn.

It will now be apparent that if water, holding in solution the necessary quantity of carbonic acid gas, could be used to incorporate with flour, &c., in the preparation of dough, without any of the gas being allowed to escape from it until after the paste is fully formed, but then allowed to escape, it would cause the formation of the necessary minute bubbles of gas, which would distend the dough into a perfect sponge, even more perfect than that which is obtained by fermentation, since every atom of water would yield its atoms of gas, not only between the particles of starch and their gluten coat, but also within the substance of the coat itself, rendering that porous.

Now, since the water will retain the gas in solution so long as it remains in an atmosphere of the necessary density, it is evident that if the materials of which the dough is to be formed can be brought together in a closed apparatus in an atmosphere superior in density to that at which the water has been saturated, and then thoroughly incorporated, the gas will remain in the water during the incorporation, and until such a time as the dough is released from the pressure; but that directly it is released from the pressure due to such density, the gas will escape from the water, and in so doing will distend the dough into a perfect spongy mass. This, then, is the new process of bread-making.

The apparatus essentially consists of a gas-holder and a generator,

similar in construction and principle to, but larger in size than, what are used by the makers of aerated waters; of pumps suitable for pumping elastic fluids, and of a mixing-vessel, and a water-vessel in connection, both made so that they can be tightly closed to sustain an internal pressure of from 100 to 200 lb. on the square inch. The mixing-vessel is supplied with flour through a shoot, passing from the floor above, and the water-vessel with water through a pipe from a cistern at the top of the building.

The mixer is capable of being closed perfectly tight, and opened by means of a proper mechanical contrivance, with the greatest facility, by one man in a few seconds.

The order of working, and the time required for making a sack of flour of 280 lb. into dough, are as follows:—

Opening lid of mixer and fitting within the neck the end of flour-shoot, and turning water-cock to fill water-vessel . . .	1 minute.
Passing from top of machine to floor above, and shooting down a sack of flour	3 „
Returning, closing water-cock, removing end of shoot, and closing mixer	2 „
Withdrawing atmospheric air from mixer	3 „
Pumping gas through water into mixer, &c.	10 „
Mixing	7 „
Total	26 minutes.

At the end of which time the dough is ready to be drawn into loaves, from a nozzle or mouth, through which it is forced by the pressure within the mixer; and as it expands or rises in the act of leaving the mouth, it is ready to be baked immediately. One boy is capable of drawing the dough from one sack of flour into loaves in fifteen minutes, as fast as they can be weighed and placed in the oven.

Thus, in the short space of *twenty-six minutes, which is subject to no variation*, the baker can always rely upon having his dough ready for the oven, and this *with a certainty*, when the labour is well organised, *which is nearly mathematical*.

Hence this process at once removes all the obstacles which have hitherto rendered a perfect system of machine bread manufacture an impossibility; which obstacles I will definitely state as follows:

1. The length of time (from eight to twelve hours) required by the process of fermentation to prepare dough for the oven, and the great space required for storing the masses of dough whilst undergoing the process.

2. The uncertainty of its results, and the many vicissitudes arising from susceptibility to delicate influences.

3 The degradation or spoiling of the flour produced by fermentation which is equal to a money value of three to six shillings per sack.

4. The necessity for the use of alum with poor flours, and the temptation to use it with all.

In comparison with the above, the new process shows the following :

1. It reduces the time necessary for the preparation of the dough (from eight to twelve hours) to less than thirty minutes, and requires no space whatever for the storage or keeping of dough larger than the mixers themselves.

2. The results are absolutely certain and uniform.

3. No spoiling or degradation of flour taking place, the quality of the bread produced is equal to that made by the old process from a flour three to six shillings per sack dearer.

4. As no change in the flour takes place, against the evils of which alum has hitherto been used, there is no gain whatever by the use of alum. Indeed, alum is absolutely prejudicial, by destroying the cohesive properties of the gluten. Even flour which is made from wheat harvested in bad weather makes a most delicious bread, without any addition of alum.

In the baking trade, as in most trades, there are different grades of respectability and credit, but there are two great divisions—the high-priced and the low-priced, or “cutting,” as they are called. In each of these two divisions there are, of course, many sub-divisions. There are some, but these are comparatively very few, who are men of substance, possessing considerable capital of their own, and are perfectly independent of any system of credit allowed by the millers. They are consequently in the most favourable position possible for the purchase of their flour, both cheap and good. But by far the greater number of bakers trade almost entirely with the capital of the millers, through a most vicious system of credit, which operates most prejudicially in their purchases of flour. It is this system of credit that has given rise to, and perpetuates, most of the commercial evils of which the baker has to complain, and which whilst it exists, will ever oppose the most effectual obstacle in the way of permanent amendment.

If we consider the chief causes that operate to render trades, handicrafts, and manufactures prosperous, we shall find them to be the following, viz.:—1st. Improvements in the methods of manufacture, by which production is greatly enhanced in value, or greatly lessened in cost. 2nd. Great capacity of increase in the ratio of consumption of the article produced. 3rd. The protection afforded to a trade against a rapid increase of competitors, from the difficulty of new ones engaging in or entering it. Now, these are altogether wanting in the baking trade. In the first place, the method of manufacture has remained a common handicraft, in which there has been no substantial improvement since it was first begun. In the second, bread is an article the consumption of which is incapable of being increased in the same ratio as nearly every other commodity; and thirdly, the facilities for entering the trade are so great as to lay it open to the very keenest competition. When a trade is labouring under such disadvantages, it must necessarily follow that the public supplied by it suffer accordingly. For when remuneration cannot be obtained by fair means, the dishonest in the trade will use foul, and in the long-run the honest men will become fewer and fewer, until there be few left, when the race

will remain to those who can bring the greatest keenness and the least conscience to bear in accomplishing the most dishonest thing with the least prospect of detection. It is not for me to point out what description of dishonesty is most prevalent in the baking trade; this has been most fully done by the public press, and consists in supplying bread deficient both in quality and quantity, exposure of the one being prevented by the use of deleterious drugs, and of the other by the excessive trouble which an efficient means of detection would impose on the consumer.

The new process of bread-making promises to effect a complete change in this unhealthy state of things, 1st. Because by improvements in the method of manufacture, and in the value of the article produced it promises good remuneration to, and necessitates the employment of, capital. 2nd. Because such employment of capital, as well as the protection afforded for several years by patents, gives the necessary security against excessive competition. But, whilst it will prevent excessive competition, it will produce none of the evils of a monopoly, because it leaves the consumer at all times in possession of his former means of supply, to be resorted to immediately the monopoly becomes prejudicial.

By erecting, then, the preparation of bread into a system of wholesale manufacture, not subject to the vicissitudes and evils of fermentation, but exact and certain in its results, the trade can be raised from its present degraded and unsatisfactory state to one that will be worthy of engaging the capital, energy, and talent of our best men of substance and enterprise. Nor will the manufacturer alone reap the benefit, for the public and the journeyman will be even more benefited. As the trade itself will be rendered commercially healthy, there will not be the same inducements to resort to fraudulent means to obtain a profit; and as journeymen will be employed in large numbers under masters of capital and social standing, they will be in a far more independent position than at present, whilst the nature of the process will relieve them from the necessarily long hours of labour which the present system necessitates.

I am disposed to think, from the experience I have already obtained that the new process, so soon as its advantages and the profits to be derived from working it are more generally known, will create an entirely new class of manufacturers, more especially since the several years' protection afforded by a patent presents a security and freedom from competition enjoyed by no other article approaching to bread in importance and magnitude of consumption.

There is another method of bringing the new process into general operation, which, I think, would accomplish it most satisfactorily, and with the least injury to existing interests: and that is by the formation of a large central joint-stock company, whose operations should consist in organising a perfect system of wholesale bread manufacture and delivery, and carrying that system by simple multiplication into every important town in the kingdom. Such a company would become a far more substantial customer for the flour of the miller than the

present small baker, whilst the small baker might become a bread-seller instead of a bread-maker. It is commonly urged that public companies can never enter into competition with private firms in trading operations, and this is true decidedly when individual management and skill play the most important part in the determination of profit and loss; but I am prepared to maintain that the manufacture and supply of an article of such extensive and universal consumption as bread, reduced by the new process to one of so much certainty and extreme simplicity, should be undertaken by a public company, in the same manner as gas and water are supplied. In Birmingham there already exist two public companies for the supply of both flour and bread. These pay excellent dividends, the smallest being equal to nearly double the dividends paid by our most prosperous railway companies, and this notwithstanding the difficulties arising from working without machinery and by the old method; difficulties which are felt most severely by the companies, on account of one of their fundamental laws being that they must not use alum to secure to the bread the colour and appearance which the small baker's bread possesses, with which they have to compete. This exclusion of the use of alum from the bread made at large establishments has hitherto been the chief obstacle to the success of most of the co-operative bakeries that from time to time have been started to compete with the small baker, and this has been shown by evidence given before committees of the House of Commons.

The steadiness of the consumption of bread also renders it an article peculiarly suitable to be prepared and supplied by a public company. And since the new process removes all the vicissitudes of manufacture, and the expense of the plant required gives a comparative monopoly, the supply of bread is placed at once in the same category with gas and water.

That wheaten bread has not hitherto entered so extensively into the diet of the poor man of England as oatmeal has done in Scotland is not to be attributed to a deficiency of nutritious matter supplied by wheat, but to the method of preparing and grinding it, for the wheaten grain prepared by simply taking off the external coat by the American process will present a larger amount of nutritious matter than oatmeal and in a form infinitely more fit for digestion by delicate stomachs. Oatmeal, is prepared for food by simply boiling it in water in the form of porridge, so that all the elements are presented to the system uninjured by chemical processes, and the system accordingly assimilates them with ease; whilst our bread has been prepared in a manner which robs it of those essential elements which are necessary to enable the system to appropriate the nutriment which it offers.

Before concluding, I would just touch upon the much-vexed subject of adulteration by alum. In all the discussions that have taken place as to the injurious effects of alum upon the system, I think the most injurious have been overlooked, viz., its effect upon mucous secretions, and its preventing the action of solvents in the process of digestion. Its peculiar action on mucous secretions leads me very much to doubt

whether it is capable of being absorbed from the alimentary canal into the circulation at all, except in quantities so small as to produce no recognisable physiological action. Its effect in the system is principally as a topical astringent on the surface of the alimentary canal, producing constipation and deranging the processes of absorption. But its action in neutralising the efficacy of the digestive solvents, is by far the most important and unquestionable. The very purpose for which it is used by the baker, is the prevention of those early stages of solution which spoil the colour and lightness of the bread whilst it is being prepared, and which it does most effectually; but it does more than is needed; for whilst it prevents solution at a time when it is not desirable, it also continues its effects when taken into the stomach, and the consequence is that a large portion of the gluten and other valuable constituents of the flour are never properly dissolved, but pass through the alimentary canal without affording any nourishment whatever.

It has been both asserted and denied that alum produces an effect upon the gluten of wheat analogous to tanning, so that it is rendered very difficult of solution. Now, I am disposed to believe that the alum does really produce a kind of tanning effect upon gluten. In some of the experiments conducted by Mr. Darby, flour was washed in the ordinary way to obtain the gluten; after the gluten was obtained it was divided into equal parts, from each of which the water was well pressed; to one part was afterwards added alum, and thoroughly kneaded; after a very short period of time the alum caused the gluten to shrink and to give off water, and it became hard and tough, like a piece of india-rubber, losing its elasticity, and breaking short when pulled with violence. After the gluten and alum were kept in contact for several days, the gluten became so altered in character that it could be rubbed down in a mortar.

In another experiment, alum was mixed with the water used to wash the flour for the gluten, and its effect in this case was so completely to destroy the adhesive properties of the small particles of gluten that they formed no cohesive mass at all, and could not be separated from the starch by washing, but passed away with it.

It is scarcely necessary for me to point out the advantages to society which would follow the establishment of an extensive system of machine bread manufacture by the new process. I would mention among the first and most important, that of the restoration to the wheaten bread of that most valuable substance cerealine, and the sweeping away of all those evils which the necessary use of alum entails. If the extraordinary value of cerealine and the evils of alum are such as I have stated, the absence of the one, and the presence of the other, must not only lie at the root of nearly all the diseases which are the result of mal-nutrition in the poor, but of those multitudinous forms arising out of dyspepsia in the more comfortably circumstanced, so that it would probably not be too much to say that disease would be lessened one-half in all our large cities and towns by supplying a bread that is perfectly free from alum, and contains the due proportion of the necessary solvent cerealine.

Arising out of the sanitary and physiological advantages of the new process, is the economical, as tending to substitute wheaten grain for animal food. When we consider the extraordinary and steady increase in the price of meat relatively to that of grain which has taken place of late years, and that in the very nature of things this increase must continue so long as they bear their present proportion to each other in human diet, the importance of the new process in an economical point of view can scarcely be overrated. Of late I have been told that in some districts meat has fetched so high a price, and wheat has been so cheap, that it has paid to fatten cattle with the corn in preference to selling it for human food. In order that the waste attendant upon such a practice may be understood, I would merely point out the fact that the whole of that portion of the food—amounting to some 70 per cent.—which undergoes combustion in the animal, and passes away from the lungs and skin in the form of gas or vapour, is so much absolute loss, which taken as human food, in the form of wholesome bread, might have been saved.

EXTRACTS FROM THE PUBLIC PAPERS.

IN CONTINUANCE OF THOSE IN A FORMER PAMPHLET, ENTITLED
AERATED BREAD *v.* FERMENTED BREAD.

BREAD-MAKING MACHINERY.

From "The Mechanics' Magazine," December 24, 1863.

ONE of the most important trades carried on in London is the baker's; not because great sums are invested, or great numbers employed, in the production of bread, but because of the relation which the baker bears to every other member of the population, from the highest to the lowest. "Bread is the staff of life," says the old proverb; and it behoves us to see that it does not conceal the sharpness of death, or at least a certain amount of misery, which it is very unpleasant to contemplate. The wholesomeness or unwholesomeness of the chief constituent of our meals, rests in the hands of the baker; to his honesty we must trust for the absence of adulteration, and the good quality of the ingredients employed; and, as we all eat bread, and eat it in quantity, the labours of the baker influence the public health and comfort very materially; more so, perhaps, than those of any other trade. A French physician once attributed a goodly proportion of the crimes committed in the world, to the dyspeptic influences of bad food. Without going quite so far, we may point out that the absence of pure food is generally accompanied by crime. It is not those who are utterly destitute, who run away with our plate, garotte us in the streets, or do murder in our quiet English lanes. There is something essentially demoralizing about filth and bad victuals, and therefore we say that it is no means unlikely that the baker exerts a more powerful indirect moral influence, than he receives credit for, from any one save the metaphysician.

Most of our readers have heard of Mr. Tremenheere and his labours in the cause of the journeymen bakers of the metropolis—labours set on foot by desire of the Home Secretary, to investigate a statement made by their men, regarding the conditions under which they carried on their labours. Barely eighteen months have elapsed since Mr. Tremenheere's report, with all its sickening details, was laid at the feet of the London world. The little blue book was called disgusting, because the author spoke of things as he found them; the greatest defect which could be urged was, that Mr. Tremenheere was too explicit. It would have been better, perhaps, had he been more so. We cannot well conceive of any occupation more unhealthy than the baker's. The white face, the ghastly look, the short cough, point out the evil in-

fluences at work, in a shape not to be overlooked. Dr. Guy states that no class of men, save, the Redditch needle-grinders, are liable to so severe and often fatal diseases of the chest. Forty-two years is rather over the usual age when death comes for prey prepared for him among these men. By that time, late hours, overwork, and an atmosphere so poisoned as to prove deadly to the unseasoned, have done their work; and thus the average life of the men, on whose exertions so much of our comfort, not to say our existence, depends, is far below that of any other trade, connected directly with the supply of the more immediate wants of the civilized Englishman.

But if the present system is bad for the operative, what is it for the public at large? We must refer our readers to the blue book for the answer. The details have been often placed before the world. They are far from inviting, and will scarcely bear repetition. The English public is now and then accused of being fastidious. Were it so in the matter of bread, a crusade would have been proclaimed long ago, which would have resulted in the lapidation of the master bakers. John Bull does not so much mind as he ought, the mere aural evidence which may be brought to him of dirt and misery. Unless he see it with his own eyes, he rather refuses to be affected by the testimony of others; and thus our bread continues to be made in such places as these—"The principal fact which struck me" says Mr. Tremenheere, "was the extreme dirt. In many cases the spaces between the rafters were covered with cobwebs, hanging so closely that a heavy footfall above, must bring large fragments down into the dough beneath. Animals in considerable numbers crawled in and out of the troughs in which the bread is made, and on the walls. The smells from the drain &c., were very offensive; the draught of the oven continually drawing the effluvia through the bakehouse; and in every case there was a total absence of ventilation. Rats and mice, of course, abounded." This, be it remarked, is not an isolated case. Mr. Tremenheere met with many such. No man can tell whether he is, or is not, supplied from just such an establishment, and in this lies the real secret of the continuance of the system. The public do not believe that the state of affairs is really so bad, and therefore they eat in faith, instead of regarding food so prepared with loathing.

It is a very remarkable fact that an operation so purely mechanical as the mixing and working of dough should continue to be performed by hand
 From the earliest ages, ferments of some kind have been deemed absolutely necessary to the manufacture of true bread, as distinguished from biscuit and its varieties. There is something still to be explained in the peculiar effect which ferments produce on the flour of wheat and rye, the only true bread-making cereals. A certain destructive action is called into play, which results in the formation of a considerable quantity of carbonic acid, to which the light vesicular quality of good bread is due. In addition to this, all the sugar, or nearly all, contained in the wheat, is converted into alcohol, and attempts have been

made, ere now, to make the baker's oven perform the part of a still as well; but with very limited success. Spirits of good quality has been produced, it is true; but the nature of the process precludes ventilation, and the bread, as a consequence, acquires a peculiar flavour, too decided to permit it to remain palatable. The loss of the sugar always follows as a result of the use of yeast, and the nutritive qualities of the bread are thereby depreciated. Many attempts have been made from time to time to do away with the use of barm, by the substitution of certain acids and alkalies, whose combination should supply the necessary quantity of carbonic acid gas. The use of such materials is however objectionable for various reasons. They all leave neutral salts behind in the bread, which we are better without; and being very subject to adulteration, their use may lead to possibly fatal results without a vast deal of care. The baker's shop is a bad chemical laboratory. Besides none of these things can do away with that process of manipulation which Mr. Tremenhoe has placed before us in such an objectionable light. About three or four years ago. Dr. Daughlish patented a method of making bread by which the use of ferments is totally avoided; the labours of the baker, or rather the bread-maker, reduced to a minimum; and manipulation of any kind entirely got rid of. As a result, the bread produced, is at once clean, pure, and possessed of all its nutritive qualities in the highest degree.

The principle involved, like that in most other good mechanical contrivances, is extremely simple. Taking advantage of the well-known capacity of water for absorbing carbonic acid, whatever its density, in quantities equal to its own bulk, Dr. Daughlish first prepares the water which is to be used in forming the dough, by placing it within a strong vessel, and forcing carbonic acid gas into it by the aid of a pump put in motion by a small steam engine. The gas is formed by the action of very pure sulphuric acid on chalk, placed within the vessel J, shown in the engraving on another page.* The gas is subsequently washed by passing it through water, and ascends into the gasometer A, from which it is pumped, as occasion requires, into either of the vessels marked B, within which it is combined, under a pressure of about 100 lbs. on the square inch, with the water, which absorbs it without any appreciable increase in bulk, and, of course, retains the gas so long as it is kept under pressure, and not one moment longer. The flour, and salt in the form of brine, are conveyed by the shoot C, and in a tube not shown into the hemispherical vessel D. As soon as the necessary quantity has been introduced, the valve is closed through which the flour entered. A cock is turned, and a measured quantity of aerated water admitted, or rather forced, by high pressure, into D. A system of knives rotating within, effectually kneads the mass. After a little time a dough tap, as it is called, at E, is opened, and the contents of the vessel expelled in a continuous stream by the pressure within.

* A pictorial representation of the process, similar to that referred to here, is prefixed to a pamphlet entitled "Aerated Bread v. Fermented Bread," which may be had on application to the Secretary of the National Provincial Aerated Bread Company, Limited.

Here it is that the remarkable part of the process occurs. The close vessels, the gasometers, the pump, have only been means to this end. As the mass leaves the tap it expands, by virtue of the escape of the gas imprisoned in the water the instant before, into frothy dough, which is cut off by an attendant, as shown in the second engraving, weighed, and transmitted to the oven without coming in contact with the human hand for even a second. We have omitted any allusion to minute mechanical details, as it is not necessary to the comprehension of the principle involved, and they only serve to facilitate the operations of the men, without in any way affecting the quality of the product of their labours.

It is impossible to imagine a greater contrast than that which exists between such arrangements as those necessary to Dr. Dauglish's process, and the system of bread-making by hand. The manufacture of aerated bread, as conducted under his patents, is one of the most perfect examples of the adaptation of mechanical means to the attainment of a required end, to be met with in the range of the arts. The great staple of existence reaches the consumer free from contamination, and in the fullest possession of all its good qualities. Were it for no other reasons than these, the application of machinery to bread-making is worthy of serious attention; but when we find that a probability exists that we can thereby materially ameliorate the condition of a hardworking and deserving body of men, Dr. Dauglish's system exerts yet another claim on our good wishes. As to the merely commercial bearing of the question, it would be perhaps premature to speak very decidedly. Hitherto Dr. Dauglish's patents have been worked on an extended scale only by the London Aerated Bread Company. It is beyond our province to enter into strictly pecuniary details, which are devoid of general interest; we may, however, remark, that the report of the Company, recently published, shows that a profit of $12\frac{1}{2}$ per cent. has been realized during the past year. The result of the declaration of such a dividend has very naturally been the setting on foot of another company, which proposes the introduction of Dr. Dauglish's system of manufacture into every town of England and Wales. The capital required is very moderate, and the new company will enter into existence under very favourable circumstances, which should command success. Old Father Time perfects many things now and then by a touch of his powerful hand. The manufacture—for so it deserves to be called—of bread by machinery has not yet felt his powers. Four or five years will do much to improve that which is already very good; and we look to Dr. Dauglish's patents, in the hands of a company which possesses skill and energy, as a most important means of bringing within the reach of every man the first necessary of his existence—good and cheap bread.

PURE BREAD.

From the "Nottingham Daily Guardian," November 2, 1863.

AN irreverent French wit at one time said that the Giver of all good gave us meat, but the father of all evil sent us cooks. A somewhat similar remark might be made, with much more truth, respecting corn and bread. The process of converting the flour of wheat into the staff of life has been long known to be dirty, tedious, expensive, and, to those engaged in it, unhealthy in the extreme. That it is dirty is evident from the fact that the kneading of the dough is effected by the hands and bare arms of the workmen, from whom in many cases, if not all, copious perspiration, caused by the heat of the bake-house as well as the laborious exertion, drops in and mingles with the material of the daily meals of all of us, from the peer to the peasant. Nay more, it is asserted in the sworn evidence of one of the London bakers that "after the dough is made, the journeymen first 'rub their arms out', that is they get off all the dough they can by rubbing, and using dry flour to get off what adheres; after that they wash off the rest in a pail. If they are not looked after they will throw this water away, but a careful master keeps it and compels them to use it in the next batch!" That the process is tedious is clear; that it is expensive is evident from the fact that a considerable portion of the most valuable ingredients of the flour is destroyed, and another process costs twenty five per cent. less; and that it is unhealthy any person who looks at the pallid faces, lack-lustre eyes, and wasted limbs of journeymen bakers, must at once admit. In fact there is no class of men, save perhaps the knife-grinders of Sheffield, who are so liable to diseases of the chest; and the mortality tables put it beyond a question of doubt that forty-two years is the average duration of a baker's life. On every ground then, of cleanliness, economy, healthfulness, and humanity, some better system than that now in use throughout the country should be adopted. We are glad to perceive that an effort is being made by the Nottingham Consumers' Aërated Bread Company (Limited) to remedy the evils above indicated, and from facts which have come to our knowledge we believe the advantages it holds out are by no means overestimated. By substituting aëration for fermentation by means of yeast they preserve all the nutritious properties of the flour, which the present system partly destroys and wholly deteriorates. By using machinery instead of hand labour they prevent pollution and secure cleanliness; and they reduce the whole process of converting a sack of flour into bread to the brief period of an hour and a half. That the undertaking is profitable has been proved by the experience of similar companies in London, Portsmouth, Dublin, Leeds, Bath, and Coventry; and we are fully disposed to believe that the anticipated dividend of twenty-five per cent. per annum amongst the proprietary is not an exaggerated estimate. We may, therefore,

assert that the promotion of this undertaking in Nottingham is incumbent on the inhabitants, mainly, because of the benefit it will confer upon the community by giving cheap and wholesome bread for what is too often dear and unwholesome. In the system adopted only the best flour is used ; neither alum nor any other hurtful element of adulteration can enter into the composition of the loaf ; so that, while the labourer and the artisan get the full supply of muscle-making, health-giving material, the delicate stomach of the invalid will not be irritated by adulterations which the dishonest or needy baker uses to swell the bulk of or to give factitious whiteness to the produce of bad flour. We wish to be clearly understood as intending to cast no aspersion on the bakers of Nottingham. The bread produced here by the present imperfect system is as good as can be obtained in any town in Great Britain, where the improved system has not been introduced, and infinitely better than can be had in many ; but the whole system is bad, and they will find their advantage both in profit and in healthfulness in changing it for one better and less expensive. We know that a leading local physician gets his supply of bread for his own table twice a week from an aerated bakery in London, and has been compelled to order it for the use of several of his female patients. But even if we disregard the sanitary considerations, practical people, who are disposed to look at the pounds shillings and pence side of every question, will admit that the aerated principle of producing the great staple article of the food of the nation merits a trial, when it is asserted on the highest practical authority, that if generally adopted it would effect a saving of the nutritious properties of wheaten grain to the extent of eight millions sterling annually !





