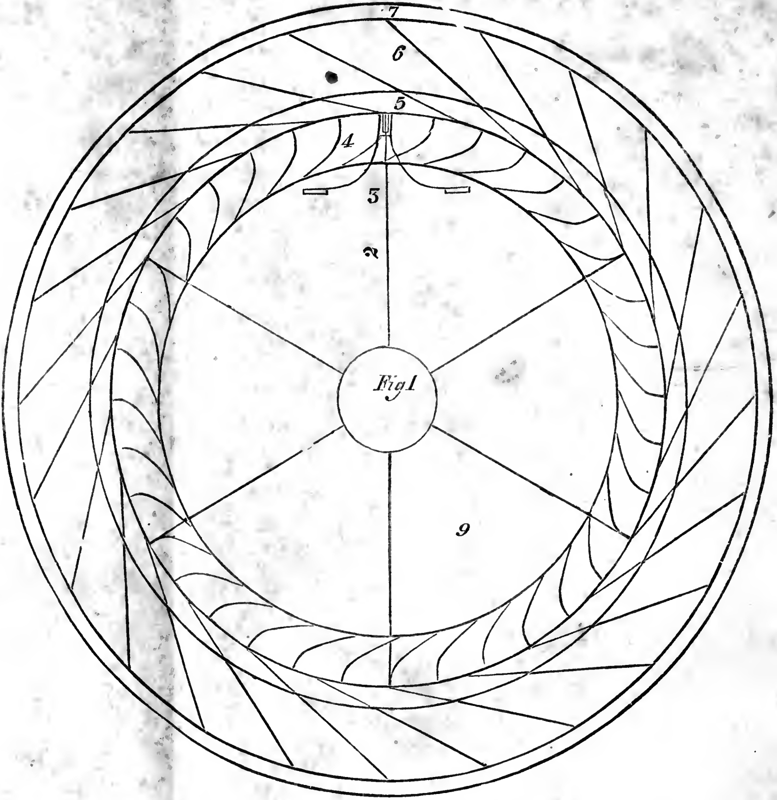
PRACTICAL SERIES

MILLER
AND
MILLWRIGHT'S
ASSISTANT.



HOWD'S PATENT DIRECT ACTION WATER WHEEL.

This draft represents the top view of a Re-action Central Discharging Water Wheel. No. 1 represents a Perpendicular Shaft; No. 2, the Arms; No. 3, the Hangers to suspend the Rims; No. 4, the Rims and Buckets; No. 5, Bulk Head; No. 6, Spouts to conduct the water into the Wheel; No. 7, Circular Gate; No. 9, Apron.

Plate 1.

Gabriel Howells Book
Bought Dec 16^{a} 1852 of
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THE
AMERICAN MILLER,
AND
MILLWRIGHT'S ASSISTANT.

"He who does not keep himself on the line of knowledge, will soon find this world ahead of him, and his associations belonging to a past generation."—*Extract from a Speech delivered in the Senate of the United States, January*, 1850, *by*

SENATOR CASS, OF MICHIGAN,

TO WHOM THIS WORK IS MOST RESPECTFULLY DEDICATED BY THE AUTHOR.

By WILLIAM CARTER HUGHES.

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CONTENTS.

PART FIRST.

PART SECOND.

INTRODUCTION.

THE motto which we have adopted on the title page of this work, is purely American in sentiment, and one of those original ideas of our distinguished Senator, emanating from the depths of profound intellectual greatness, and standing as the star of the nineteenth century, to illuminate the path of the down-trodden and oppressed. And when time has passed with those of this generation, these immortal sentiments will ever stand out in bold relief, to perpetuate his name with the sovereignty of the American people. And, although expressed on a very different subject from which it is here introduced, as a doctrine which we fully believe in, we cannot observe any reason to forbid its adoption into the science of mechanics, as well as that of politics, or any other science beneficial to mankind.

In its practical application to this work, we have been guided entirely by its principles, drawn from an advanced state of improvement which marks the age in which we live; and by contrasting the past with the present age, we can recognise that march of improvement, stamping as it does all branches of our national industry; and none with more satisfactory results than the Milling business of the United States. The Milling business occupies a respectable portion of our national industry, and gives employment to a large investment of capital in all the principal wheat-growing States of this Union, which contributes largely to the benefit of our American farmers, in making a home market for Wheat and Indian Corn, the two principal staples of American produce.

The author of this work, having spent the best portion of his life in the pursuit of his calling as a practical Miller, begs to say, in preparing this work for the milling public, that his object is to establish a correct guide to a business which so little is known about, in a shape of substantial reference, instead of speculative theories, and that confined to the minds only of those who are attached to the business, either by the employment of capital or otherwise.

Special regard has also been paid to most of the essential improvements which have, of late, been introduced for the benefit of the miller. And we can also say, that we have omitted a large number of late inventions, from the belief of their utter worthlessness for a great many of the purposes for which they were designed; and those of our friends who furnished us with drafts and long statements of their peculiar views on milling, will please accept our thanks for the same, and this, our apology for not giving them a place in these pages.

We have thought proper to insert in this work a Report made to the Commissioner of Patents of the United States, in the year 1848, on Breadstuffs, their relative value, and the injury which they sustain from various causes, by Lewis C. Beck, M. D., an article which, of itself, highly sustains that gentleman's character, for the task he had to perform; and also reflects much credit on the Commissioner of Patents, Mr. Burke, for the selection he made of a person fully competent to perform the same.

The Report contains a scientific chemical analysis of wheat and wheat flour, with other important information, highly useful to all engaged in milling, as well as dealers in breadstuffs; and we consider it one of the most useful and important public documents ever distributed from the Patent Office of the United States.

With a full assurance and hope that this work may prove useful to all engaged in milling,

I respectfully subscribe myself,

Wm. C. Hughes.

EXPLANATION

OF TECHNICAL WORDS USED IN THIS WORK.

Aperture, the opening or passage through which water is received or discharged.

Area, the plain surface of superficial contents.

Cubic, equation in algebra, an equation in which the highest or only power of the unknown quantity is a *cube.* *Cube root* is the number or quantity which, multiplied into itself and then into the product, produces the cube. A cubic foot of water weighs 62½ lbs.

Equilibrium, equipoise, equality of weight or force; a state of rest produced by the mutual counter action of two bodies.

Friction, the act of rubbing the surface of one body against another.

Gravity, weight, heaviness—the tendency of matter towards its central body. Weight is the measure of gravity.

Specific gravity means the weight of a body compared with another of equal bulk, taken as the standard. Water is the standard for solids and liquids, and air for gas.

Hydronamics, that science which treats of the properties and relations of water and other fluids, either at rest or in motion.

Hydraulics, the science of fluids in motion; pertaining to hydronamics.

Impulse, force communicated instantaneously.

Impetus, force of motion.

Momentum, the quantity of motion in a moving body proportioned to the product of the quantity of matter, multiplied by its velocity.

Percussion, the shock produced by the instant striking of bodies; the centre of percussion is that point in a moving body about which the impetus of the parts is balanced, and when stopped by any force, the whole motion of the revolving body is stopped at the same time.

Quiescence, a state of rest.

Radius, in geometry, a right line drawn from the centre of a circle to the periphery, the semi-diameter of the circle.

Right Angle, in geometry, an angle of ninety degrees or one-fourth of a circle.

Squared, is any number multiplied by itself.

Theory, an exposition of the general principles of any science; the science distinguished from the art, and without practice.

Urgent, pressing with necessity.

Velocity, is that effection of motion by which a body moves over a certain space in a certain time.

Viscosity, a glutinous tenacity which inclines soft bodies to stick closely together.

THE
AMERICAN MILLER,
AND
MILLWRIGHT'S ASSISTANT.

PART FIRST.

ON THE FIRST PRINCIPLES OF MECHANICS.

THE science of mechanism is founded on the true principles of natural philosophy, and of these principles we shall here treat in a plain, simple manner; as a perfect knowledge of principles of truth and certainty, in mechanical science, is as essential to the practitioner of the mechanic arts, as a perfect knowledge of the human frame is to the skilful anatomist.

The theory of mechanics is essential to all intelligent minds; and, as far as it relates to the cultivation of the mind of the practical mechanic, for whose benefit this work is designed, we shall contemplate the mechanical powers to be *three* in number, namely: the lever, the inclined plane, and the pulley. Some authors of our acquaintance denominate them as *six* in number: the three latter as the wheel, axle, and screw. But it is clearly evident that the three latter are derivatives of the three former, as the wheel and axle, properly considered, is a revolving lever, the screw being a revolving inclined plane.

The mechanical powers are known by the following terms: as *weight* and *force,* or *power* and *resistance,*—weight being the resistance necessary to overcome, power the force requisite to overcome that resistance. When they are equal, they are said to be in equilibrio, which implies that no motion can take place. But when the force becomes greater than the resistance, they are not in equilibrium, as motion takes place. Then power being a compound of weight, may be determined by being multiplied by its relative velocity.

That which gives motion is called power, that which receives it is called weight.

Mechanical powers are the most simple of the mechanical inventions, as applicable to increase force and overcome resistance.

The first of those powers which claim our attention being, in effect of mechanical utility, the most essential to the millwright, namely,

THE PRINCIPLE OF THE LEVER.

THE lever may be considered, by all mechanics, as the leading power of the whole science of mechanism. For example, look at the formation of the entire animal creation, the superstructure of which is a beautiful illustration of those powers so largely developed in all animal creation,—every limb acting as a lever, mechanically arranged by joints, as the fulcrums of central motion.

There is no description of machinery, formed by the machinist, but of which the principle of the lever is the governing mechanical power; the effect of which may either increase or decrease its relative power, according to the manner in which it is applied. Then, we say, millwrights particularly should be well acquainted with the natural laws by which the powers of this engine are *accurately* demonstrated.

The lever we must suppose to be composed of some inflexible body, as wood or metal; and although differing in form in the various mechanical machines, is always governed by the same laws of central motion. This central motion, in the common lever, is calculated from where the press or fulcrum is attached, which is called the centre of motion, the lever being capable of turning easily on that point.

When the lever projects on either side of the fulcrum, the projections are mechanically called arms, from which we derive the power of the engine. When the fulcrum stands between the weight and the power, by the following simple rules we can easily determine the mechanical advantage gained; for divide the weight you wish to raise by the power you have to apply, and the quotient is the difference of leverage; or,

Multiply the weight by its distance from the fulcrum, and the power from the same point; then the weight and power will be to each other as their products.

Example: A weight of 1440 lbs. you wish to raise by a force of 70 lbs.; the length of the *short arm* of the lever being *one foot* from the fulcrum, what must the length of the *long one* be? The answer is $20\frac{4}{7}$ feet in length, where the power is applied to one foot, the weight being attached.

For the sake of brevity, we omit the working of the question, and simply state the answer, as it saves the introduction of algebraic signs, which would only tend to lengthen the subject without facilitating our main object, namely, a proper illustration of computing the power, which is the mechanical advantage gained by the use of all levers, of whatever form, in a plain manner.

Therefore, for ascertaining the relation which exists between power and weight in the lever, the general rule is to multiply the power by its distance from the fulcrum; being equal to the weight multiplied by its distance from the same point, the fulcrum acting as the centre of motion in all engines of this description.

The analogy that exists between all machines whose power is obtained from the principle of the lever, is very great; such machines being all governed by one simple principle, which should be considered as the general law of mechanical power: namely, the momentums of the power and weight are always equal when the engine is in equilibrio.

Momentum means the product of the weight of the body multiplied into the distance it moves; or the power multiplied into its distance from the centre of motion, or into its velocity, is equal to the weight multiplied into its distance moved. Or the power multiplied into its perpendicular descent, is equal to the weight multiplied into its perpendicular ascent.

The next law of mechanical power shows the power of the lever and velocity of the weight moved are always in an inverse proportion to each other; as, the greater the velocity of the weight moved, the less it must be; and the less the velocity, the greater the weight may be.

The lever is of four kinds; the one above described is the first and common kind, by which the greatest mechanical effect is obtained, as the fulcrum or centre of motion is placed between the weight and power; the nearer the weight, the greater the power.

The second kind of lever is where the fulcrum is at one end, and the power at the other. Its effective power is simply as 3 is to 1, where, in a lever of the first kind, the effective power is as 12 to 1.

The third kind of lever is where the fulcrum is at one end, the weight at the other, and the power applied between them.

The fourth is the curved lever, which differs only in form from the others, its properties being the same.

The first and second are engines of real power; while the third tends to decrease power in the same ratio that the others increase it, and are only useful to the mechanic in obtaining velocity where the first mover is too slow, as is the case in the construction of mills propelled by water, where over-shot breast, or under-shot water-wheels are used. All wheels are constructed on this principle of the third kind of lever. But in the construction of mills of modern date, they may be, in nine cases out of ten, all used on the principle of levers of the first kind; which we shall clearly and simply illustrate in this work, under the head of water-wheels.

THE INCLINED PLANE.

THIS mechanical power gives existence to a variety of useful machines of recent invention, and is used in combination with the lever of the first kind, which makes it a compound machine of extensive use.

The wedge is simply an inclined plane, and may be considered, for many purposes, as one of the most useful of the mechanical powers. The next is the screw, which is a revolving inclined plane, and is used for pressure and raising heavy weights. The screw is a spiral groove cut round a cylinder, and everywhere describing the same angle with its length of thread, and, if unfurled and stretched, would form a straight inclined plane, the length of which would be, to its height, as the circumference of the cylinder is to the distance between two threads of the screw; for in making one round, the spiral rises along the cylinder the distance between two threads. The length of the plane is found by adding the square of the distance between the threads, and extracting the square root of the same. As the length of an inclined plane is to the pitch or height of it, so is the weight to the power; or if the height of the plane be one-third its length, then one-third of the power will raise a body up the plane by rolling, that it would take to raise it up perpendicularly; but it would travel three times the distance. The general principle is—as the height of the plane is to the height or angle of inclination, so is the weight to the power, invariably.

THE PULLEY.

A Pulley is a mechanical assistant by which a great deal of power is obtained in a small compass, but more convenient in accommodating the direction of power to that of resistance, as, by pulling downwards, we are able to draw a weight upwards; the advantage gained being twice the number of movable pulleys. The system of pulleys is very simple, and may be ascertained as follows:

To find the weight that may be raised by a known power and a given number of pulleys, fixed or stationary, multiply the power by twice the number of movable pulleys, and the product is the weight the power equals. Example: To find the weight that a power of 180 lbs. will raise by a block and tackle, the bottom or movable block consisting of four pulleys,

multiply 180
by 8

Answer—equal to 1440 lbs.

A single pulley may be constructed so that the weight will be as three times the power. When more than one rope is used, in a system of pulleys where the ends of one rope are fastened to the support and power, and the ends of the other to the lower and upper blocks, the weight is to the power as 4 to 1. The principal objection to this machine is the loss of power by friction of the pulleys.

MOTION.

MOTION always is the effect of impulsive force, or the act of changing place. In mechanical engines it is understood as the act of transmitting power, or the means by which power is distributed. Equality or inequality of motion is as the diameters of the wheels by which it is transmitted. The relative velocity of wheels is as the number of cogs contained in each wheel. To find the relative velocity or number of revolutions of the last wheel to one of the first: Rule, divide the product of the cogs of the wheels that are drivers by the product of the driven, and the quotient is the number.

To find the number of cogs in a train of wheels to produce a certain velocity: as the velocity required is to the number of cogs in the driven, so is the velocity of the driver to the number of cogs in the leader. To find the proportions that the velocities of the wheel in a train should bear to each other: Rule, subtract the less velocity from the greater, and divide the remainder by one less than the number of wheels in the train; the quotient is the number, rising, in arithmetical progression, from the less to the greater velocity.

Before we dismiss the subject of motion, we shall now consider the first principles by which motion is obtained and governed, namely, *absolute* and *relative.*

Absolute motion is that pertaining to the removal of material bodies from place to place, and governed entirely by the principles of natural philosophy, and pertaining only to the *theory* of mechanics; for in practical mechanics we have to do with relative motion only, which consists in the difference of time occupied by the motion of different bodies, as time is the specific measure of its velocity. There are but few branches of the mechanic arts which are so essential to the millwright, as a proper knowledge of the laws which govern, and on which the principles of mechanical motions are based; as the trade consists in the use, construction, and arrangement of engines of moving power, which in mills is the force to move and facilitate the different manufactures for which they are applied.

Then the first thought of the practical mechanic should be, how to construct and arrange his machinery, so that the power which he has to apply, may be used in the best possible mode of construction and arrangement of his machinery, on combined scientific and practical principles of mechanical economy.

The next idea to be considered is one of mechanical importance, namely, that as motion increases power decreases. This is what may be considered one of those self-evident facts apparent in the very nature of all engines that can possibly be constructed; and which is also evident from the first principle of the lever, when in equilibrium, as the power multiplied into its velocity or distance moved is equal to the weight multiplied into its velocity or distance moved.

From these facts we see the necessity of guarding ourselves, as much as possible, against every absurd and unphilosophical practice of many millwrights of the present day, to wit, building mills with double gearing when single would be better; for single-geared mills are always cheaper in their construction, easier kept in repair, and, when properly constructed, are as powerful as the best double-geared mills in the most favourable situations.

We suppose there are many who may differ with us in this opinion, and that we shall be obliged to present authority, to convince and establish our peculiar views in this particular. This we hope to do under its appropriate head of water-wheels.

All must admit that double gearing diminishes power, by the increased resistance to motion, as that of friction; as the more machinery used for a given purpose, the more it tends to complication, and the increasing power-destroying agent, friction. It must be admitted, also, that no power can be obtained by the addition of engines, while the velocity of the body moved remains the same. And machinery requiring a different velocity, where the driving power is the same, (as is the case in flouring mills, the motion being as varied as the different useful machines required in manufacturing grain,) should be attached as near as possible to the first moving wheel, as the greater the distance from the first driving wheel, the greater the force of resistance to motion, and produces a constant tendency to equilibrium, in all machines requiring a great velocity.

CENTRAL FORCES.

Bodies moving round a central point have a tendency to fly off in a straight line. This tendency is called the centrifugal force. It is opposite to the centripetal force, or that power which maintains a body in its curved state. Centrifugal force flies from the centre, centripetal force to the centre, and are called central forces.

There is no real power attached to those forces called central forces, they being only the effect of the power which gives motion to all bodies, and can neither add to nor diminish the power of any mechanical or hydraulic engine, unless it be by friction, when water is the moving power, and the machine changes its direction. The centrifugal forces of two unequal bodies, moving with the same velocity, and at the same distance from the central body, are to one another as the respective quantities of matter in the two bodies.

The centrifugal forces of two equal bodies which perform their revolutions around the central body in the same time, but at different distances from it, are to one another as their respective distances from the central body. The centrifugal forces of two bodies which perform their revolutions in the same time, and whose quantities of matter are inversely as their distances from the centre, are equal to one another. The centrifugal force of two equal bodies moving at equal distances from the central body, but with different velocities, are to one another as the squares of their velocities.

The centrifugal forces of two unequal bodies moving at equal distances from the centre, with different velocities, are to one another in the compound ratio of their quantities of matter and the squares of their velocities.

The centrifugal forces of two equal bodies moving with equal velocities, at different distances from the centre, are inversely as their distances from the centre.

The centrifugal forces of two unequal bodies moving with equal velocities, at different distances from the centre, are to one another as their quantities of matter multiplied by their respective distances from the centre.

It should be considered that this central force communicates no real power, it being only the effect of power which gives motion to a body, and can neither increase nor diminish the power of any mechanical engine.

FRICTION, OR RESISTANCE TO MOTION.

THE greater part of all that is yet known with certainty respecting the laws and properties which govern friction, is founded upon practical experiments, instituted on a large scale, and submitted to a great variety of trials, by some of the most eminent philosophers of the last century.

M. Colomb, member of the Academy of Science at Paris, and Professor Vince, of the University of Cambridge, have written the most scientific and accurate treatises on the natural laws of friction; by which we are informed that friction does not increase with the increase of rubbing surfaces; or, in other words, however the magnitude of the surface of contact may vary, the friction will still remain the same, so long as the pressure is unchanged.

Friction supposes moving or tending to move on the surface of another, or, in words more explicit, occasioned by the uniting of bodies whose velocity is sufficiently great to produce friction. There are three ways in which one surface can move upon another, in each of which friction acts differently:—

1. When one body slides upon the plain surface of another body.

2. When one body, being cylindrical, rolls upon the surface of another body.

3. When a solid cylinder is inserted in a hollow

cylinder of greater diameter, and being pressed in any direction with a certain force, revolves with it.

Colomb has satisfactorily established, by repeated experiments, all of which are confirmed by the experiments of others, that, under the same circumstances, the friction of one surface moving upon another is in exact proportion to the pressure used and with which the surfaces are urged together.

Colomb, Ximenes, and Vince, in their experiments respecting the laws and properties which govern friction, assert, that when any substance has several faces of different magnitudes, the friction will be the same on whatever face it is placed, except in an extreme case, when they found a slight deviation from the law; when the pressures used were extremely intense, it was found that the friction did not increase in quite so fast a proportion as the pressure. The deviation from the law was so inconsiderable, and happened only in such extreme cases, that it might be for the most part unnoticed.

When one cylinder rolls upon the surface of another body, the friction is in proportion to the pressure; while with cylinders of the same substance, having different diameters, but equal pressures, the friction is inversely as the diameters. Again: cylinders of the same substance, differing both in diameter and pressure, the friction is directly as the pressure, and inversely as the diameters, or in a compound of the direct ratio of the pressure and the inverse ratio of the diameters.

When a solid cylinder is inserted in a hollow cylinder of a greater diameter without rolling, if the hollow cylinder be supposed to revolve around the axle, as happens in the case of a carriage wheel, every part of the surface of the box will be exposed to the effect of friction, while no part of the axle will suffer this effect except the side which comes in contact with the box, which is the side that is operated upon by the force of draft or pressure.

Then the friction being equal to this force that overcomes friction and produces motion, multiplied by the radius of the wheel and divided by the radius of the hollow cylinder which plays upon the axle, then it appears that the friction is greater than the preponderating weight; in the proportion of the radius of the wheel to the radius of the cylinder.

In the years 1831, 1832, and 1833, a very extensive set of experiments were made at Mentz, by M. Morrin, under the sanction of the French government, to determine, as near as possible, the laws of friction, and by which the following were fully adduced and established.

1st. When no urgent was interposed, the friction of any two surfaces, whether of quiescence or of motion, is directly proportioned to the force with which they are pressed perpendicularly together; so that, for any two given surfaces of contact, there is a constant ratio of the friction to the perpendicular pressure of the one surface upon the other. While this ratio is thus the same for the same surfaces of contact, it is different for different surfaces of contact. The perpendicular value of it, in respect to any two given surfaces of contact, is called the co-efficient of friction in respect to those surfaces.

2d. When no urgent is interposed, the amount of the friction is, in every case, wholly independent of the extent of the surfaces of contact; so that the force with which two surfaces are pressed together being the same, their friction is the same, whatever may be the extent of their surfaces of contact.

3d. That the friction of motion is wholly independent of the velocity of the motion.

4th. That where urgents are interposed, the co-efficient of friction depends upon the nature of the urgent, and upon the greater or less abundance of the supply.

In respect to the nature or supply of the urgent, there are two extreme cases: that in which the surfaces of contact are but slightly rubbed with unctuous matter, as, for instance, with an oiled or greasy cloth; and that in which a continuous flow or stratum of urgent remains continually interposed between the moving surfaces of contact.

Professor Morrin found, that with urgents, hog's-lard and olive oil, in a continuous stratum between surface of wood on metal, wood on wood, metal on metal, when in motion, have all of them very near the same co-efficient of friction, being in all cases included between 07 and 08.

The co-efficient for the urgent, tallow, is the same, except in that of metals upon metals. This substance seems to be less suited for metallic substances than the other, and gives for the mean value of its co-efficient, under the same circumstances, 10. Hence it is evident, that where the extent of the surface sustaining a given pressure is so great as to make the pressure less than that which corresponds to a state of perfect separation, this greater extent of surface tends to increase the friction, by reason of that adhesiveness of the urgent, dependent upon its greater or less velocity, whose effect is proportioned to the extent of surface between which it is interposed.

Such is a description of the experiments founded by M. Morrin, under the orders of the French government, to determine those laws of friction above alluded to.

The following Table shows the result of those experiments on the friction of unctuous surfaces; meaning surfaces without artificial means reducing the friction. By M. MORRIN.

SURFACES OF CONTACT.	CO-EFFICIENT OF FRICTION.	
	Friction of motion.	Friction of quiescence.
Oak upon oak, the fibres being parallel to the motion	0.108	0.390
Oak upon elm, fibres parallel	0.136	0.420
Beech upon oak, do.	0.330	
Wrought iron upon brass	0.160	
Do. wrought iron	0.177	
Do. cast do	....	0.118
Cast iron upon wrought iron	0.143	
Do. oak	0.107	0.100
Do. cast iron	0.144	
Do. brass	0.132	
Brass upon cast iron	0.107	
Do. brass	0.134	
Yellow copper upon cast iron	0.115	
Leather, well tanned, upon cast iron, wet,	0.229	0.267
Do. brass, do.	0.244	

TABLE

Of the Results of Experiments on Friction with Urgents interposed. By M. MORRIN.

SURFACES OF CONTACT.	CO-EFFICIENT OF FRICTION.		URGENTS.
	Friction of motion.	Friction of quiescence.	
Oak upon oak, fibres parallel,	0.164	0.440	Dry soap.
Do. do.	0.075	0.164	Tallow.
Do. do.	0.067	....	Hog's lard.
Do. fibres perpendicular,	0.083	0.250	Tallow.
Do. do.	0.072	....	Hog's lard.
Do. do.	0.250	....	Water.
Do. elm, fibres parallel,	0.036	....	Dry soap.
Do. cast iron	0.080	....	Tallow.
Do. wrought iron	0.098	....	Tallow.
Elm upon cast iron	0.066	....	Tallow.
Wrought iron upon oak, fibres parallel,	0.256	0.649	Grease & water.
Do. do.	0.214	....	Dry soap.
Do. do.	0.085	0.108	Tallow.
Do. elm, do.	0.078	....	Tallow.
Do. cast iron	0.103	....	Tallow.
Do. wrought iron,	0.082	....	Tallow.
Do. brass	0.103	....	Tallow.
Do. do.	0.075	....	Hog's lard.
Do. do.	0.078	....	Olive oil.
Cast iron upon cast iron	0.314	....	Water.
Do. wrought iron,	....	0.100	Tallow.
Do. brass	0.103	....	Tallow
Do. do.	0.075	....	Hog's lard.
Brass upon brass	0.058	....	Olive oil.
Do. cast iron	0.086	0.106	Tallow.
Do. wrought iron	0.081	....	Tallow.
Yellow copper upon cast iron,	0.072	0.103	Tallow.
Steel upon cast iron	0.105	0.108	Tallow.
Do. do.	0.079	....	Olive oil.
Do. wrought iron	0.093	....	Tallow.
Do. brass	0.056	....	Tallow.

Professor Morrin does not state the amount of pressure used in the state of quiescence by which he found those results, or the motion used; consequently, we may safely infer them to be the same in each particular case, for both tables, with the urgents and without.

The extent of the surfaces in these experiments bore such a relation to the pressure, as to cause them to be separated from one another throughout, by an interposed stratum of the urgent.

Those experiments prove of great advantage to the mechanic, particularly the machinist, as by them we find the mode of regulating the different substances which produce the least friction.

By referring to the first table, we discover the best kinds of metals which should be used for journals and journals bearings, as brass and cast iron, by experiment, prove to produce the least friction without any urgent. And, by reference to the second table, we find the urgent which, by its use, we can reduce the friction to the lowest point in all kinds of machinery—namely, olive oil. Another important point, which must naturally be considered by the machinist, in connection with the subject of reducing friction in all kinds of machinery, to produce the best results, a due regard should be paid to the size of the bearings or journals, as the strength of all revolving shafts are directly as the cubes of their diameters, and inversely as the resistance they have to overcome.

Mr. Buchanan, in his essay on the strength of shafts, gives the following from several experiments, viz. :—

That the fly-wheel shaft of a 50 horse-power engine, at 50 revolutions per minute, requires to be 7½ inches in diameter, and the cube of this diameter, being equal to 421,875, serves as a multiplier to all other shafts in the same proportion; and, taking this as ascertained, he gives the following multipliers, viz.: for the shafts of steam-engines, water-wheels, and all others connected with the first power, as 400 for shafts, in mills, leading from the water-wheel or first mover; to drive small machinery, 200; for the smaller shafts which lead from the main uprights, 100. The rule being that the number of horses' power a shaft is equal to is directly as the cube of the diameters and number of revolutions, and inversely as the above multipliers, so should the size of the journals be.

Some employ 340, instead of 240, as the multipliers, which gives too great a diameter to journals of second movers; and it should be remembered that these rules relate entirely to the size of the journals where the power applied is not more than 50 horse. The diameters of second movers may be found from those of the first, by multiplying by 8, and those of the third movers, by multiplying by 793, respectively.

One kind of material may resist much better than another one kind of strain, but expose both to a different kind of strain, and that which was weakest before may now be strongest. This, for illustration, is the case between cast and wrought iron; the cast being stronger than the wrought when exposed to twisting or torsional strain; but malleable iron is the strongest when exposed to lateral pressure.

We here give the results of a few experiments on the weight necessary to hoist journals of an inch in diameter close to their bearings:—

Metals.	Pounds.	Ounces.
Cast steel	19	9
Cast iron	9	7
Blister steel	16	11
Wrought iron	10	2
Swedish iron, wrought	9	8
Hard gun-metal	5	0
Brass vent	4	10
Copper, cast	4	5

The above rules are worthy the notice of all machinists, as much of that beauty pertaining to mechanical structure, depends on the proper proportioning of the magnitude of materials to the stress they have to bear, and what is of far more importance, its absolute security. It is a well-known fact, that a cast-iron rod will sustain more torsional pressure than a malleable iron rod of the same dimensions. When the strength of a malleable iron rod is less than that of cast iron to resist torsion, it is stronger than cast iron to resist lateral pressure; and that strength is as the proportion of 9 to 14.

From these rules, it is easy for any millwright to make his shafts of iron best suited to overcome the resistance of friction, or any other material impediment to which they may be subject, and to proportion the diameters of the journals according to the iron of which they are made. The diameter of a malleable iron journal, to sustain an equal weight with a cast iron journal of 7 inches in diameter, requires to be 6.04 inches in diameter.

Square bars, with a journal of one inch in diameter and one-fourth of an inch in length, gave the following results: Wrought iron, Ulster Co., New York, twisted with 326 lbs., and broke with 570 lbs. Wrought iron, Swedes, same length of lever in all cases, being thirty inches, twisted with 367 lbs., and broke with 615 lbs. Cast iron broke with 436 lbs. The diameters for light journals should be found by multiplying the diameters ascertained by the above rules, by 8 and 793, respectively.

The rules embraced in the following table will be found of incalculable value to the millwright, in ascertaining the proper size of all journals, beginning with the smallest size first movers, of the power of from 4 to 60 horse, and revolving from 10 to 100 revolutions per minute, and having 400 for their multiplier:

Table of Diameters of Journals of First Movers.

Horse power.	REVOLUTIONS.																	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
4	5.5	4.8	4.5	4.	3.7	3.8	3.5	3.3	3.2	3.1	3.	2.9	2.9	2.8	2.7	2.6	2.6	2.6	2.5
5	5.9	5.1	4.7	4.4	4.1	3.9	3.7	3.6	3.5	3.3	3.3	3.2	3.1	3.	3.	2.9	2.9	2.8	2.7
6	6.3	5.5	5.	4.6	4.4	4.1	4.	3.9	3.7	3.6	3.5	3.5	3.4	3.2	3.2	3.2	3.	3.	2.9
7	6.6	5.8	5.2	4.9	4.6	4.4	4.2	4.	3.9	3.7	3.6	3.8	3.7	3.5	3.4	3.3	3.4	3.3	3.2
8	6.9	6.	5.5	5.	4.8	4.5	4.4	4.2	4.1	4.	3.9	3.8	3.7	3.6	3.5	3.5	3.4	3.3	3.2
9	7.2	6.3	5.7	5.5	5.	4.8	4.5	4.4	4.2	4.1	4.	3.8	3.7	3.7	3.6	3.6	3.5	3.4	3.3
10	7.4	6.6	5.9	5.6	5.2	4.9	4.7	4.6	1.4	4.2	4.1	4.	3.9	3.8	3.7	3.6	3.6	3.5	3.4
12	7.9	6.9	6.3	5.8	5.6	5.4	5.2	5.	4.8	4.6	4.4	4.3	4.2	4.1	4.	3.9	3.8	3.7	3.6
14	8.3	7.2	6.7	6.2	5.9	5.6	5.4	5.2	5.	4.5	4.4	4.4	4.3	4.2	4.1	4.	4.	3.9	3.8
16	8.7	7.6	7.1	6.6	6.2	5.8	5.6	5.4	5.2	5.	4.8	4.7	4.6	4.5	4.4	4.4	4.3	4.2	4.1
18	9.	7.9	7.5	7.	6.6	6.2	5.8	5.6	5.4	5.2	5.	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2
20	9.3	8.1	7.4	7.2	6.6	6.4	5.9	5.7	5.6	5.4	5.2	5.1	5.	4.8	4.6	4.6	4.5	4.5	4.4
25	10.	8.5	8.	7.4	7.1	6.8	6.3	6.	5.9	5.6	5.4	5.5	5.4	5.3	5.2	5.1	5.	4.8	4.6
30	10.7	9.3	8.4	7.9	7.4	7.1	6.8	6.6	6.5	6.3	6.1	5.9	5.7	5.6	5.4	5.3	5.2	5.2	5.
35	11.4	9.8	8.9	8.4	7.9	7.4	7.1	6.9	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.5	5.4	5.3	5.2
40	11.7	10.5	9.3	8.8	8.3	7.8	7.4	7.1	7.2	6.9	6.7	6.6	6.4	6.2	6.	5.9	5.8	5.7	5.6
45	12.	10.6	9.7	9.2	8.7	8.1	7.6	7.4	7.	6.8	6.7	6.5	6.3	6.2	6.1	6.	6.9	5.8	5.7
50	12.6	11.	10.	9.3	9.	8.5	8.	7.8	7.4	7.3	7.2	6.9	6.8	6.7	6.5	6.4	6.2	6.	5.9
55	13.4	11.4	10.4	9.8	9.1	8.8	8.4	8.	7.5	7.4	7.3	7.2	7.	6.7	6.6	6.5	6.3	6.2	6.1
60	13.6	12.	10.8	10.	9.3	9.	8.6	8.2	7.7	7.6	7.4	7.3	7.2	6.9	6.8	6.7	6.6	6.4	6.2

This table is calculated in inches and 12ths of an inch, and suited for mills and steam engines of all descriptions.

We have thought proper, in this place, to insert a correct table of the diameters and circumferences of circles, in inches, from 1 foot to 30, together with the area and side of equal square, which the millwright will find very convenient for all practical purposes:

Table of the Circumferences of Circles, Areas, and Side of Equal Square.

Diameters.	Circumferences.	Area.	Side of Equal Square.	Diameters.	Circumferences.		Area in feet, and of 1000	Side of Equal Square.	
Inches.	Inches.	Inches.	Inches.	Feet.	Ft.	In.	Feet.	Ft.	In.
12	37.699	110.097	10.634	8	25	1½	50.265	7	0⅛
13	40.840	132.732	11.520	9	28	3¼	63.617	7	11⅝
14	43.982	153.938	12.406	10	31	5	78.540	8	10¼
15	47.124	176.715	13.293	11	34	6⅝	95.003	9	8⅞
16	50.265	201.062	14.179	12	37	8⅜	113.097	10	7⅝
17	53.407	226.980	15.065	13	40	10	132.732	11	6¼
18	56.548	254.469	15.951	14	43	11¾	153.938	12	4⅞
19	59.690	283.529	16.837	15	47	1½	176.715	13	3½
20	62.832	314.160	17.724	16	50	3⅛	201.062	14	2⅛
21	65.793	346.361	18.610	17	53	4⅞	226.980	15	0¾
22	69.115	380.133	19.496	18	56	6½	254.469	15	11⅜
23	72.256	415.476	20.384	19	59	8¼	283.529	16	10
24	75.398	452.390	21.268	20	62	9⅞	314.160	17	8⅝
25	78.540	490.875	22.155	21	65	11⅝	346.361	18	7¼
26	81.681	530.930	23.041	22	69	1⅜	380.133	19	5⅞
27	84.823	572.556	23.927	23	72	3	415.476	20	4½
28	87.964	615.753	24.813	24	75	4¾	452.390	21	3¼
29	91.106	660.541	25.699	25	78	6⅜	490.875	22	1⅞
30	94.248	706.860	26.586	26	81	6⅞	530.930	23	0½
31	97.389	754.769	27.472	27	84	8¼	572.556	23	11¼
32	100.531	804.249	28.358	28	87	9⅜	615.753	24	9⅞
33	103.672	855.30	29.244	29	91	10	660.521	25	8½
34	106.814	907.92	30.131	30	94	3	706.860	26	7
35	109.956	962.11	31.017						
36	113.097	1017.87	31.903						
48	150.796	1309.56	42.537						
60	188.496	2827.44	53.172						
72	226.195	4071.51	63.806						
84	263.894	5541.78	74.440						

GEOMETRICAL DEFINITIONS OF THE CIRCLE AND ITS PARTS.

1. A CIRCLE is a plain figure bounded by a curved line, called the circumference, every part of which is equally distant from a certain point, called the centre.

2. The diameter of a circle is a straight line passing through the centre, and terminating at the circumference.

3. The radius, at semi-diameter, is a straight line extending from the centre to the circumference.

4. A semi-circle is one-half of the circumference.

5. A quadrant is one quarter of the circumference.

6. An arc is any portion of the circumference.

7. A chord is a straight line joining the two extremes of an arc.

8. A circular segment is the space contained between an arc and its chord; the chord is sometimes called the base of the segment. The height of the segment is the perpendicular from the middle of the base of the arc.

9. A circular sector is the space contained between an arc and the two radii, drawn from the extremes of the arc.

10. A circular zone is the space contained between two parallel chords, from their bases.

11. A circular ring is the space between the circumferences of two concentric circles.

12. A lune, or crescent, is the space between two circular arcs which intersect each other.

13. An ellipsis is a curved line which returns into itself, like a circle, but having two diameters of unequal length, the longest of which is called the transverse, and the shortest the conjugate axis.

Problem.—To find the circumference of a circle, the diameter given :—Multiply the diameter by 22, and divide by 7. Or, for greater accuracy, multiply by 355, and divide the product by 113.

Example :—What is the circumference of a circle, whose diameter is 40 feet? Answer, 125 feet, 6 inches and $\frac{6}{8}$ths. See table of circumferences of circles, page 36.

CENTRE OF PERCUSSION AND OSCILLATION.

The centre of percussion and oscillation is the point in a body revolving around a fixed axis, so taken, that when it is stopped by any force, the whole motion, and tendency to motion of the revolving body, is stopped at the same time. It is also that point of a revolving body which would strike any obstacle with the greatest effect, and from this property it has received the name of percussion. The centres of oscillation and percussion are generally treated separately; but the two centres are in the same point, and therefore their properties are the same. As in bodies at rest, the whole weight may be considered as collected in the centre of gravity, so in bodies in motion the whole force may be considered as concentrated in the centre of percussion.

HYDROSTATICS.

INTRODUCTION.

In treating of the science of millwrighting, it has been thought proper, by some authors, to merely notice the science of hydrostatics, by simply pursuing the subject under the head of hydraulics, with the assertion that hydrostatics treats of fluids in a state of rest only, and hydraulics of fluids in motion. The author of this work has thought proper to treat of the principles which govern both, under separate heads, as pertaining to water as a fluid only; it being the only fluid, in connection with air, which relates particularly to the millwright.

Hydrostatics is a word formed from two Greek words, which signify water and the science which treats of the weight of bodies, and, as a branch of natural philosophy, treats of the nature of gravity, pressure, and mode of weighing solids in water.

Water may be defined as a perfect fluid; and the less force that is required to move the parts of a fluid, the more perfect is that fluid, defined as a body. Philosophers agree, that the particles of the body which compose water are too small to be examined by the best glasses, but that those particles are round and smooth: as all experience proves that water is composed of small globular particles. This fact is further proved by some experiments made by one of the ablest philosophers that ever lived, and one of the best mathematicians of antiquity, Archimedes. He made a globe of gold, and filled it with water, and closed it so accurately, that none could escape; the globe was then placed into a press, and a little flattened at the sides; the power of compression was applied to force the water into a smaller space: but the result was, the water was forced through the pores of the gold, and stood upon the surface like drops of dew; which fact induced the philosopher to establish the idea that water was *incompressible.* Which fully establishes the fact, that the particles of which water is composed are very hard; for if they were not so, you can easily conceive, that since there are vacuities between them, as we assert there are, they must, by very great pressure, be brought closer together, and would evidently occupy less space, which is contrary to fact.

ON THE UPWARD AND DOWNWARD PRESSURE OF WATER.

HAVING examined the nature of the fluid, water, the next subject of importance is the upward and downward pressure of the fluid being equal. This principle may be easily explained, by the fact that two reservoirs of 18 feet deep each may be connected by a pipe of 10 inches in diameter; by filling one of the reservoirs with water, opening the pipe so as to allow a free communication of the water between them, the pipe being inserted in the bottom of each, the water will pass from one to the other till it stands at the same depth in each. Fluids always tend to a natural level, or curve similar to the earth's convexity, every point of which is equally distant from the centre of the earth; the apparent level, or level taken by any instrument for that purpose, being only a tangent to the earth's circumference. The pressure of water is not in a straight line, but is propagated in every direction,—upwards, downwards, sideways, and oblique; from which property it always tends, when at rest, to a *true level.*

The next point of importance, in relation to the pressure of water, is the influence which exists between water and air, and which we denominate as atmospheric pressure.

It is by the affinity which exists between the fluids, water and air, that we can use them as the motive power in assisting mankind to accomplish by their use what would require the application of animal force for mechanical purposes. It is by this principle of the pressure of air on water, by which water is raised to the height required by means of the common pump.

The pressure of the atmosphere on the surface of the earth rates from 12 to 15 pounds per square inch. To illustrate our subject more clearly, we will take up the principle of the common pump, the principle being ruled by the pressure of the atmosphere on the water, by which we are able to raise a given quantity of water to the height of that limited point; which is, if the water in a well be more than 32 or 33 feet from the valve, you might pump continually without effect; as a column of water 33 feet in height is equal to 15 pounds, the pressure of the atmosphere on every square inch, which results in a perfect equilibrium of the fluids; and in constructing this kind of pump, the valve should never be placed to exceed 28 feet beyond the level of the water, owing to the change which continually takes place in the pressure of the atmosphere. It may be proper here to state the comparative difference that exists between the specific gravity of water and air: one cubic foot of fresh water is 800 times heavier than the same quantity of air at the surface of the earth, supposing the barometer to stand 30 inches in height.

Without this principle of natural philosophy, which treats of the pressure of the air, there would be no such thing as the downward and upward pressure of fluids, by which we are able to use them beneficially in all mechanical operations.

SPECIFIC GRAVITY.

Before we enter upon the methods of obtaining the specific gravity of bodies, it will be right to premise a few particulars, which it is necessary should be well understood. We must first understand that the specific gravity of different bodies depends upon the different quantities of matter which equal bulks of these bodies contain. As the momenta of different bodies are estimated by the quantities of matter when the velocities are the same, so is the specific gravity of bodies estimated by the quantities of matter when the bulks or magnitudes are the same. As the relative weight of any body of a certain bulk is, compared with the weight of some body, taken as a standard, of the same bulk,—the standard of comparison being water, one cubic foot of which is found to weigh 1000 ounces avoirdupois, at a temperature of 60 degrees Fahrenheit,—so the weight expressed in ounces of a cubic foot of any body, will be its specific gravity.

To determine the specific gravity: If a body be a solid heavier than water, weigh it first in air, note the weight; then immerse it in water, and note this weight also; then divide the body's weight in air by the difference of the weights in air and water, and the quotient is the specific gravity of the body. If it be a solid lighter than water, tie a piece of metal to it, so that the compound may sink in water; then, to the weight of the solid itself in air, add the weight of the metal in water, and from this sum subtract the weight of the compound in water, which difference makes a divisor to a dividend, which is the weight of the solid in air; then the quotient will be the specific gravity. If the body be a fluid, take a solid, whose specific gravity is known, that will sink in the fluid; then take the difference of the weights of the solid in and out of the fluid, and multiply this difference by the specific gravity of the solid; then this product, divided by the weight of the body in air, will give the specific gravity of the fluid.

On this principle, we have inserted a table of specific gravities. The columns, "specific gravity," represent the weight of a cubic foot in ounces avoirdupois.

Table of Specific Gravities.

	Specific gravity.		Specific gravity.
Distilled water	1.000	Elm	0.600
Sea water	1.026	Cork	0.240
Platina	23.000	Cast steel	7.833
Standard gold	17.486	Wax	0.897
Mercury	13.560	Tallow	0.943
Standard silver	10.391	Olive oil	0.915
Lead	11.352	Vitriol	1.841
Brass	8.396	Apple tree	0.793
Copper	7.788	Mahogany, Span.	0.852
Tin	7.291	Boxwood	0.912
Cast iron	7.207	Logwood	0.913
Bar iron	7.788	Ebony	1.331
Zinc	7.191	Lignumvitæ	1.333
Flint glass	3.290		
Marble	2.700	OF GASES.	
Ivory	1.825		
Coal	1.250	Hydrogen	0.0694
Oil	0.940	Carbon	0.4166
Oak, American	0.900	Steam of water	0.481
Oak, English	0.925	Carburetted Hyd.	0.9722
Ash, white	0.800	Azote	0.9723
Ash, black	0.812	Oxygen	1.1111
Maple, hard	0.755	Nitric acid	1.218

The specific gravity of atmospheric air, at a temperature of 60 degrees Fahr., and barometric column 30 inches, is, according to experiments, proved to be 1.22, which shows water to be 800 times heavier—the air being at its greatest density.

HYDRODYNAMIC POWER OF WATER-WHEELS.

UNDER the head of that science called Hydrodynamics, we shall discuss the most important principles of water, as applied by the millwright for propelling machinery, in the various modes of application, by the use of the water-wheel—an engine of real mechanical utility. To construct a water-wheel by which we may use water to its greatest effect in propelling mills of various kinds, a thorough knowledge of the sciences of hydrostatics and hydrodynamics is indispensable to the millwright; and without the knowledge of those laws of natural philosophy which these sciences illustrate, the millwright is incompetent to use water on principles of scientific economy. For a more definite and accurate illustration of our subject, we shall denominate those important principles as first, second, and third. First principles of all fluids, more particularly water, are governed by natural laws; second principles are governed by the application of the degree of science used in those principles; and the third consists in the inventive genius of mankind, as developed in the various machines constructed by his hands, by which he uses water as the propelling power of those machines.

Before we speak of the construction of any of those machines, we shall first illustrate two powers, when used as such, which are innate principles of the non-elastic fluid, water—namely, action and reaction. The latter principle, as a power, has been established and acknowledged by all writers on the subject, whether mechanics or philosophers; but its use, in connection with the first or direct action of water, is as yet but little known to the most enlightened on the subject of hydraulics.

ON THE ACTION AND REACTION OF WATER, AS APPLIED TO WATER-WHEELS.

What we mean by the action of water is, the first impulse communicated to either a water-wheel or other body by being exposed to the force of a column of water from any perpendicular height; and if that force be communicated with that body at right angles, the effect by impulse will be the greatest. It is by the action of impulse alone, undershot water-wheels are propelled. The reactive power of water is obtained by the whirling vortex of the water, and only obtained by a wheel made suitable to the motion of the water, when used in connection with the direct action of water on a wheel made expressly to suit those two actions of the fluid. For all purposes where motion is required in the various mechanical engines, the greatest power possible can be obtained by water applied in this manner. The direct action of water by impulse, when applied to a wheel, receives a change of motion by the resistance of the burden to be overcome. As the stroke by impulse is communicated to the bucket of the wheel, only one-half of the power of the column of water is received, until the other action is communicated from the wheel to the body of water in which it stands. But as soon as the wheel moves, it forms a whirling vortex, which acts in a contrary direction to the first action of the water by impulse; consequently, by this means we receive a double action of the same water, which gives a double power.

But the only difficulty existing is the want of proper knowledge, by the millwright, how to construct a water-wheel so that those two powers may be united, as they should be, to form a perfect action on two separate sections of the water-wheel. As it is impossible to combine direct action and reaction on the same section or bucket, hence the reason why so many have failed in their purpose in the use of the reaction water-wheel. Within the last ten or fifteen years, a numerous tribe of reaction water-wheels have sprung into existence, all aiming at the main object, if possible, to supersede each other in using the least complement of water to perform the greatest amount of work. But, from a personal examination of their construction, I have found that the reaction principle is more fully perfected in the most of them, without the slightest appearance of a knowledge of any other principle but reaction alone. Such wheels are only adapted to streams where there is no necessity for economy in the use of water. I have seen other wheels, again, where the opposite principle was the only one used; and, in back-water, could not be used at all. The latter kind is acted upon by the impulse of the water only, and only produces, like the undershot wheel, half of the effect due to the water used. To unite direct action and reaction on the same wheel, the buckets require to be shaped as different as the action of the water is different and contrary; for the action by impulse of the water should act on the wheel in a manner which will communicate the greatest force, on the section on which it acts, by its stroke; and in all cases the surface of the upper buckets should be equal in area to the column of water acting against them.

The reaction principle is purely an American invention for using water on wheels, and was exported from America to Europe about the year 1828, according to an account of the introduction of this principle of reaction, as we find it noticed at some length in a scientific journal published in Paris; and, from the description, we suppose it to be the first American model, as invented by Ferguson about the year 1828. The wheel is extensively used in France, and called there the *tourbillion*, or turbine water-wheel, and derives its name from the principle by which the power is obtained—namely, the whirling vortex. But I discover they continue the same error in France, as well as in America, in applying the water to act on those wheels by reaction only, and also in applying the water at the centre of the wheel, and having the discharge at the verge. This is wrong, and contrary to the mechanical principle of using the wheel as a lever of the first kind, where the power should be used at one end, the weight being at the other, and the axis being the fulcrum of central motion.

We also wish to notice what must be seen by every person in its proper light, who will take time to examine the subject and test it by experience, as we know it to be unphilosophical. It is the mode that many of the inventors and vendors of reaction water-wheels have, of placing them to work on *horizontal shafts, instead of vertical.* We presume all should be aware, that when a water-wheel is working horizontally, the motion tends to destroy, to a great extent, the reaction power of the water. Skeptics to this doctrine very naturally ask, Why? We answer by saying, experience and practice on the subject tell, that it is the direction in which the wheel runs that the greatest amount of surface of contact is operated upon by the water. Those who favour this horizontal mode of application tell us, that the distance from the centre of the axis on which the wheel is hung, is just sufficient to produce the greatest maximum effect of the reaction power of the water. To this we say, that only having one-half of the wheel submerged, you can obtain but one-half of the effect of what we call the action of the current of the water; passing, as it does, through the drat-boxes or casing in which the wheel runs; and the power of which would be simply in proportion as the wheel comes in contact with the water. It must also be remembered that the water on those wheels never changes its direction, except where the wheel carries it back, which is more or less generally the case when the bucket on which it acts is constructed on a very short curve. This is the case with nine-tenths of the wheels of this description. In applying the water to the wheel, its action is in a tangent with the issue, so that the vortex must be also in the same line, and nothing of the whirling motion that would take place if the wheel was working in a vertical position. To make this subject plainer, we say that a horizontal wheel running in a tangent, the water can have no other direction (except in the case above referred to) than that of a straight line, which the position of the wheel describes to contrary lines, which completes the formation of the whirling vortex motion given to the water by the wheel after the wheel has received the percussion stroke of the water. This principle makes the reaction power perfect, if the wheel is placed to work properly, which should be as follows.

ON THE CONSTRUCTION OF THE COMBINATION REACTION WATER-WHEEL,

And the method of applying the water for propelling it, to produce the greatest effect.

The great mechanical effect of reaction water-wheels is in proportion to the principles of scientific knowledge displayed in their construction. To enable us to rank them in the order of first-class wheels, from our remarks on the hydrodynamic power of reaction wheels, we have endeavoured to explain all the leading principles which seem to us to be absolutely necessary for the millwright to understand; so as to give him an adequate idea of the groundwork or root of those principles; and also pointing out all erroneous forms of construction and application of what might be useful, if applied as science dictates, in those wheels alluded to in our previous remarks.

The great superiority of the combination of power, in applying water on reaction wheels, requires but to be seen to be universally adopted and established, in preference to the combined and effective power of water used on the overshot wheel, the defects in which we shall establish under its proper head. In the overshot water-wheel, there are but two mechanical principles which can be depended upon as effective in their application—namely, that of the lever of the second kind, and the use of the water by its gravity; while the reaction wheel combines *three*—that is, when the water is applied, like the overshot, at the verge. Although differing from the overshot in the principle of the lever, as the reaction wheel acts as a lever of the first kind, which, according to the principle of the lever of the first kind, as explained in Mechanics, page 15, whose power is as 12 to 1, and the former wheel, according to the lever, as explained in Mechanics, page 17, is but 3 to 1. So much for the advantage gained in favour of reaction wheels on the first principle—namely, the lever.

The second principle is the application of the water by its gravity and pressure; the third, the combining of the reaction force of the water with the first or direct action, as explained on page 46. The proper method of constructing a reaction water-wheel to act on those principles is as follows:

First, let the millwright consider what direction is best for him to conduct the water on his wheel; (we recommend it to issue from the head at right angles with the buckets.) Then we ask, what position should the bucket of the wheel be in with the axis of the wheel, to receive the greatest effect of the stroke by the direct action or percussion power of the water? We answer, transversely; so that the surface of the bucket next the water should describe a perpendicular plane, measuring the same width as the aperture through which the water issues on the wheel; then the bucket would meet the water at right angles. But the reaction bucket must be attached and stand in the form of an inclined plane, gradually inclining from its connection with the transverse bucket, from the lower edge of the top bucket to its terminus. The angle of inclination requires to be in accordance with the length of the bucket. The greater the length of bucket, the greater the angle of inclination; but in no case should the inclination be less than 45°.

When the wheel is completed, its bottom should resemble an ordinary screw, the bottom tier of buckets forming the thread; and in placing them to work, they should be set over a pit, connecting with the tail-race, at least two feet in depth, and the tail-race requires to be sufficiently deep that the water from the wheels may not be impeded by any unnecessary resistance. For mills of four run of stones, where it would be necessary to use five of these combination and reaction wheels, the tail-race ought never to be less than twelve feet wide, and two feet eight inches in depth. From what we learn of the nature of water under the head of Hydrostatics, page 39, we find it necessary to construct water-wheels out of material that will resist the water's penetrating into the wheel, as it is the case where wood is used in their construction. The introduction of cast iron is a most essential improvement, inasmuch as the resistance from friction is about one-third less than wood, besides its great durability; and where the wheels are well protected, by racks placed in the flumes to keep out all obstructions, they will last a lifetime.

This wheel, as described, is the one patented by Mr. Lansing, of Indiana, some few years since, and is well known to the author of this work as being a superior first-class wheel, infinitely superior to the overshot for many reasons. We regret exceedingly not being able to furnish drawings of it in time for this volume.

A TABLE

Of the Velocities of the Combination Reaction Water-wheels per minute, from heads of from four to thirty feet, calculated at the maximum point of effect, or what is generally called the "working point," being one-third less than the greatest velocity of the water, for wheels of the following size:

Head.	Diameters, in feet and inches.												
	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
4	122	98	81	70	61	54	49	44	40	37	35	33	30
5	137	109	91	78	68	60	54	49	45	42	39	36	34
6	149	120	100	85	75	66	60	54	50	46	42	40	37
7	160	129	107	92	81	71	64	58	53	49	46	43	40
8	173	138	115	98	86	76	69	62	57	53	49	46	43
9	184	147	122	105	92	81	73	66	61	56	52	49	46
10	194	154	128	110	97	86	77	70	64	59	55	51	48
11	203	162	135	115	101	90	81	73	67	62	57	54	50
12	212	169	141	121	106	94	84	77	70	65	60	56	53
13	220	176	147	126	110	98	88	80	73	67	63	59	55
14	229	183	153	131	114	102	91	83	76	70	65	61	57
15	237	189	158	135	118	105	94	86	79	72	67	63	59
16	245	196	163	140	122	109	98	89	81	75	70	65	61
17	252	201	168	144	126	112	100	91	84	77	72	67	63
18	260	207	173	148	130	115	103	94	86	80	74	69	65
19	266	213	177	152	133	118	106	97	88	82	76	71	66
20	274	219	182	156	137	121	109	100	91	84	78	73	68
21	281	224	187	160	140	124	112	102	93	86	80	75	70
22	288	229	191	164	143	127	114	105	95	88	82	76	72
23	294	234	195	167	146	131	117	107	97	90	84	78	73
24	300	239	199	170	149	133	119	109	99	92	85	79	74
25	307	245	204	175	153	136	121	111	102	94	87	82	76
26	313	249	208	178	156	138	124	113	104	96	89	83	78
27	318	254	212	182	159	141	127	116	106	98	91	85	79
28	324	259	216	185	162	144	129	118	108	100	92	86	81
29	330	263	219	188	164	146	131	120	110	101	94	88	82
30	335	268	223	191	167	149	134	123	112	103	95	89	84

A TABLE

Of the number of inches of Water necessary to drive one run of Stones, with all the requisite machinery for grist and saw mills, which will be found convenient for all practical purposes. Under heads of water from 4 *to* 30 *feet.*

Height of head, in feet.	Size of stone, in feet.		Horse power.	Horse power.	Number of saws being one.
	4½	4			
4	558	460	6	5	The same quantity of water that is here used for a four-foot stone is sufficient for one saw; and where a greater number of either saws or stones are required, you should double the quantity in proportion to the number, as in the case of four run of stones; you require four wheels, with the same number of inches for each size stone, as per table. But, in all cases, for merchant flouring mills, you require an extra wheel, which all the machinery should be attached to, with about one-half the power as calculated for one run of 4½ feet stones.
5	363	300	...	...	
6	311	250	...	...	
7	245	200	...	...	
8	190	160	...	...	
9	163	130	...	...	
10	137	112	...	...	
11	122	102	...	...	
12	107	89	...	...	
13	95	80	...	...	
14	83	70	...	...	
15	75	62	...	...	
16	68	57	...	...	
17	62	51	...	...	
18	57	47	...	...	
19	52	44	...	...	
20	48	41	...	...	
21	45	37	...	...	
22	43	35	...	...	
23	39	32	...	...	
24	37	30	...	...	
25	35	29	...	...	
26	32	27	...	...	
27	31	26	...	...	
28	29	24	...	...	
29	28	23	...	...	
30	26	22	...	...	

NOTE.—A horse power is considered equal to 33,000 lbs. raised one foot high.

OVERSHOT OR BREAST WHEELS.

The following table shows the required length of overshot or breast wheels, on falls from 10 to 30 feet, to drive from one to four run of four and a half feet stones, with all the necessary machinery for a merchant flouring mill. The column marked "Fall" shows the number of feet fall on the breast wheel, or the diameter of the overshot.

Diameter of overshot in fall.	Number of run of stones.			
	1	2	3	4
	Length of wheel in feet.	twice.	3 times.	4 times.
10	7			
11	6¼			
12	5¾			
13	5½			
14	5			
15	4½			
16	4¼			
17	4			
18	4			
19	3¾			
20	3½			
21	3¼			
22	3¼			
23	3			
24	3			
25	2¾			
26	2⅔			
27	2½			
28	2½			
29	2½			
20	2¼			

Multiply the number of run required by the length as stated in the table.

Example:

What should the length of either a breast or an overshot wheel be, to drive 3 run of stones, on a fall of 18 feet? Look at 18 feet, the height of the head; then we have opposite 4 feet for 1 run, which, multiplied by 3, produces 12 feet, the length required.

The same quantity of water used on the combination reaction wheel will suit the breast and overshot, beginning at 10 feet head.

It is desirable that the millwright should possess easy rules, which will answer the purpose of practice rather than theory. The first table will be found acceptable; as it gives the velocity for all the wheels of the reaction and combination principle, where the water is discharged, as it should be, at the centre.

HOWD'S IMPROVED DIRECT ACTION WATER-WHEEL,

With directions for using the same, by S. B. Howd.

This is a wheel which, when properly located, is admirably adapted for mills of all kinds, working the water on the *tourbillion* principle, being the whirling vortex, or better known as reaction principle.

Its superiority over the old-fashioned reaction wheel consists in applying the water on the wheel at the verge and discharging it at the centre, by which you use the wheel as a lever of the first kind, instead of applying the water at the centre and discharging it at the verge, as by the old-fashioned reaction, by which its power is reduced to the lever of the third kind, and, as a natural consequence, takes as much more water to perform the same business as the difference in the mechanical principles of the lever vary from each other.

This wheel can be used to good advantage on low sluggish streams, where back water is prevalent. We here give a draft of the wheel, made by *Stephen Ales*, and used by him, with directions for making the same, by Mr. Howd, the original inventor.

DIRECTIONS

For making the several parts of Howd's Latest Improved Water-Wheel, and setting it up.

SUBMERGE the wheel so that no part of it will be above the water in low water. The stepping should be concave and convex, the concave in the shaft. The stepping should be from 4 to 6 inches in diameter, the convex should be made of hard maple, well seasoned; make it in a proper shape, then let it soak in tallow at least three days, blood warm; let the tallow cool before you take it out; then bore several three-eighth holes, beginning without the knot, in two or three places, upon a curvilinear line running to the periphery of the step; fill them with bar lead; make the concave of cast iron highly polished.

The disk should be made of two-inch plank, double-face it on both sides, and firmly pin them together. Spot it on the under side in the centre, bolt it fast to the flange of the eye on the upper side, then hang it on the shaft, on a false step; scribe the top and bottom, work off the top, strike your circle for the out edge of the risers, work it off bevelling under half inch; lay out the places for the risers, unhang it, turn it over, work off the bottom, turn it back, put on the risers; let in the laps of the lower rims of the water-wheel; bore for the bolts that hold the wheel to the risers, mark the cants, and let them by.

The directions given above are intended where an iron shaft, iron eye and flange are used, whereby the disk is attached to the shafts.

When a wooden shaft is used, the form of making the disk and attaching it to the shaft should be varied. Dress your planks on one side and pin them together slightly, then work on some plank from four to six inches thick, on the under side in the centre, at least one half the diameter of the disk, bevelled up to an edge, and firmly pin the whole together.

Hang the disk with reference to the under side. It is necessary that the disk should be hung as low down on the shaft as possible, and in such a manner as will prevent it from working up and down; in order to do this efficiently, four or more straps of iron with a hook on one end, should be firmly spiked on to the shaft with hooks as low down as you wish to hand the bottom of the disk, then wedge it from the upper side and fasten the wedges in by means of pins inserted into the shaft through the upper end of the disk and through the wedges on an angle of about forty-five degrees, then work off the top and periphery, as above described.

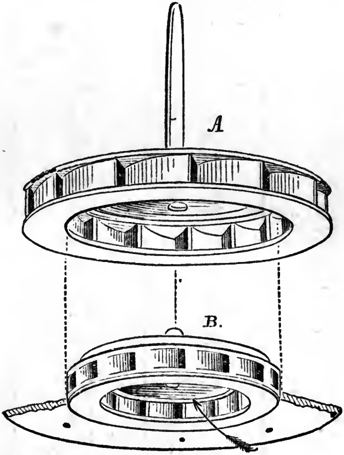
The above directions would require a model of the wheel and its parts, to give an adequate idea of constructing it, without which no millwright who may not be acquainted with the wheel should be expected to construct one perfectly.

The draft accompanying this article gives a full view of the wheel with the exception of the disk or top part. As to the number of buckets necessary for a wheel, it is left entirely to the option of the millwright, as experience teaches that the more water you wish to discharge, the more buckets will be necessary—from eight to twenty-four. Mr. Howd recommends the number of schutes in a wheel of seven and eight feet in diameter, to be twenty-four.

HENRY VANDEWATER'S WATER-WHEEL.

This wheel is offered to the milling public at Jagger, Tredwell & Perry's Eagle Foundry, Albany, New York, who manufacture it to order, suiting all kinds of water-powers, from heads of five to twenty-eight feet fall. This invention of a water-wheel, for either flouring or saw mills, is of great importance to the milling public, as it will be seen, by the accompanying table, that it equals in power the overshot wheel in locations where many, who have no knowledge of this wheel, would place the overshot with the supposition that they had the best kind that could be used. By examining the hydrodynamic principle of the wheel, they will readily admit the correctness of this statement. From the operation and practical working of this improvement, we feel assured of our own correctness on the subject. The power of water by direct action, combined, as it is, with the turbine principle, renders a combination of the two greatest known powers of water as a fluid in the science of hydrodynamics. This wheel is made in the most durable manner, being constructed entirely of cast and wrought iron. Having personally examined the pattern-list of the Eagle Foundry, I found it well supplied with all kinds of patterns, particularly suited for millers and millwrights to select from.

All those wishing information respecting the right to use this wheel, may address the inventor, 147 Pearl street, Albany, New York.



This is a perspective view of the wheel. A, showing the outside and inside of the buckets; and B, the inside form, or schutes. The arrow indicates the course in which the water is taken to the wheel.

HENRY VANDEWATER'S WATER-WHEEL.

Head of water.	4 foot wheel, using 61 inches of water, will grind,	5 foot wheel, using 108 inch. of water, will grind,	6 foot wheel, using 225 inches of water, will grind,	7 foot wheel, using 400 inches of water, will grind,
Feet.	Bushels wheat per hour.	Bushels wheat per hour.	Bushels wheat per hour.	Bushels wheat per hour.
5	3	5	12	21
6	4	7	16	28
7	5	9	20	35
8	6	11	24	42
9	7	13	28	49
10	8	15	32	56
11	9	17	36	63
12	10	19	40	70
13	11	21	44	77
14	12	23	48	84
15	13	25	52	91
16	14	27	56	98
17	15	29	60	105
18	16	31	64	112
19	17	33	68	119
20	18	35	72	126
21	19	37	76	133
22	20	39	80	140
23	21	41	84	147
24	22	43	88	154
25	23	45	92	161
26	24	47	96	168
27	25	49	100	175
28	26	51	104	182

PART SECOND.

REMARKS ON THE CULTURE OF GRAINS,

Which form the Staple Breadstuffs of the United States.

THERE is no country on this globe which is so well adapted for the cultivation of wheat and Indian corn as the fertile soil of the United States,—the quality of which seems to be highly impregnated with those nutritious substances so necessary to the production of these two cereal grains. Consequently, the high reputation which American breadstuffs sustain in foreign markets enables the American miller to rival all competition in the manufacture of breadstuffs, either in quality or quantity; as the surplus quantity of grain, annually grown in the United States, bids fair to surpass all the dependencies of European cultivation.

Not many years ago, and as late as the year 1839, large quantities of grain were imported from Europe to the United States, and sold to good account,—being manufactured in the Atlantic cities. At the period referred to, the "Great West" was comparatively unknown, and the boundary of western civilization was supposed to exist, by our Eastern brethren, in rather a limited degree, somewhere within the confines. of the state of Illinois—it being but about four years previous that it was exchanged from savage wilds to the beautiful and cultivated home of the agriculturist, which it now presents. But, such is the progress of American enterprise, with the advantages held out by the general government to the actual settler, in disposing of the public lands at the low price of one dollar and a quarter per acre, in the different states, those lands, in a few years, have increased from 100 to 500 per cent. from first cost, according to their location. This is what enables the American farmer not only to drive all competition from our shores, but to compete successfully in the markets of Europe with our foreign rival; and settles the fact, beyond a doubt, that America is destined to be the granary of the world.

The advantages to the miller are also very great. The Western states, whose luxuriant soil produces the finest quality of grains in the world, also afford ample water-power for the manufacture of the same, which constitutes a mutual benefit both to the farmer and miller,—as it makes a home-market for the grain of the latter; and there is no branch of business which the farmer receives so much benefit from, as he does from that which always pays him the full equivalent, in cash, for his produce, when delivered at the mill. And all improvements in the construction of flouring-mills tend, also, to the benefit of the producer of the soil, as it requires less wheat, by one bushel, to the barrel of flour now, than formerly, which makes a profitable saving to those of our farmers who have their grain manufactured on their own account, as many of our Western farmers do.

We here insert a statistical table, showing the amount of grain grown in the principal wheat-growing states of the Union, for the year 1848 :—

TABLE OF GRAIN GROWN IN THE UNITED STATES.

States.	Wheat.	Indian Corn.
New York	15,500,000	17,500,000
Pennsylvania	15,200,000	21,000,000
Virginia	12,250,000	38,000,000
Maryland	5,150,000	8,800,000
Ohio	20,000,000	70,000,000
Michigan	10,000,000	10,000,000
Indiana	8,500,000	45,000,000
Illinois	5,400,000	40,000,000
Wisconsin	1,600,000	1,500,000
Missouri	2,000,000	28,000,000
Iowa	1,300,000	3,500,000
Texas	1,100,000	1,800,000
Oregon	1,300,000	1,000,000

The foregoing table is from the Report of the Commissioner of Patents for the year 1848. In connection with this statistical table, of the amount of grain grown in the states referred to, we have also prepared a like table, showing the amount of capital invested in this one branch of business, which will serve to give the reader some conception of the interest the milling business creates in the following states:—

States.	Capital.	States.	Capital.
New York	$8,000,000	Illinois	$1,800,000
Pennsylvania	4,000,000	Wisconsin	1,070,000
Virginia	3,000,000	Missouri	1,000,000
Maryland	1,000,000	Iowa	300,000
Ohio	5,800,000	Texas	175,000
Michigan	4,060,000	Oregon	20,000
Indiana	2,100,000		

ON THE QUALITY OF FRENCH BURR, AS BEST ADAPTED FOR GRINDING WHEAT AND CORN.

THERE is no description of stone, within our knowledge, that affords so much variety of texture, or that is so well adapted for grinding, as that known as the "French Burr." It varies from the closest of quality to the openest and poorest of the stone species.

We shall now, in this chapter, give the necessary directions, which, if attended to strictly, will always insure the miller, who should always be the person to select the quality of mill-stones which will enable him to make the best yields, as well as a better quality of flour than he can otherwise do on any other description or selection of this kind of stone. In the first place, I here remark, that every well-informed, practical miller, of at least ten years' experience in the business, must be well versed in the different qualities of the French burr, which, from long practice, his experience tells him that which is likely to do the best work, when set in order for grinding; he must be acquainted, also, with what is termed the best stock for making mill-stones, as the stone is imported from France in blocks of various sizes, which blocks of stone differ as much in colour as they do in quality. The first thing to be done, on going to the mill-stone manufactory, is to select those sized stones you want. By examination, you will soon be able to discover whether they suit these directions or not; if the stone is of a close appearance, and of a white colour, without any yellowish spots in the seams, or where the blocks join each other closely fitted, and the said seams must be parallel with the diameter, as by being so they do not break off the edges of the seams, by interfering with the furrows; also, do not forget to take a mill-pick, and go over every block, which you may do in a few minutes, and if they prove of an equal hardness, then we should recommend that run as being a good run of stones for grinding wheat expressly. If they should prove, after trying them in this manner, that some parts of the different blocks of which the stone is composed are rather softer, and incline to be open about the eye, do not take them, as it will take up more time in dressing them, to keep them in a good face, than two such run as we have first described. The clear white and sometimes variegated stock, resembling marble, is the best description of

French burr, for all uses; as that kind of stock is always free and hard, and holds an edge as long as any other colour. For grinding corn expressly, stone of a different colour may be used best for this kind of grinding; I say best, because it is of a keener temper, and not so subject to soft, open places, as the stone first described. This kind of stock is of a pale, bluish cast, and more particularly known to millers for its resistance of right good steel; but, after being dressed, will grind more hard corn than any other kind of stone in use. Of stone of this quality, we have dressed a large number of run for different mills, expressly for flouring, which, with judicious management, answer a very good purpose; but I do not recommend this kind, as it requires a miller of good judgment to superintend in dressing them; for, in the first place, if they are allowed to get at all smooth, they are apt to heat, as well as grind wheat oily. In the next place, if they are dressed at all rough, they will make very specky flour, and grind harsh,—two evils not to be tolerated about a flouring-mill; further, the nature of this kind of burr is of a dead, heavy texture, and entirely unfit for steam-mills. Where the power is at all varying or unsteady, this kind of burr imparts to the flour a kind of grayish cast.

There is also another description of burr-stock which I shall here notice, and the worst of all others to the miller who has been so unfortunate as to purchase such stones with the least reasonable hope that he has got good ones. This is a burr of a yellowish colour, called by some the Fox burr, and not at all badly named, as it is very deceptive in its appearance. In dressing this kind of stone, it resembles a knotty nature, with a good inclination to curl as you strike it with the pick. After you have ground with it for the space of twenty-four hours, take it up, and it has all the appearance of being varnished with the best copal varnish, which makes the miller sigh for "the good old days of Adam and Eve," when the gray Laurel Hill Rock Stone were in fashion, or what the Virginian miller calls "Nigger Heads," either of which is preferable to the last described French Burr.

Having treated of the French burr, we shall now direct our remarks to that of our American production, the Raccoon Burr.

ON THE RACCOON BURR STONE.

THIS description of stone is of American production, and its geological nativity is confined to the State of Ohio, not being known elsewhere. Its locality is in Muskingum and adjoining counties, known by the name of the "Flint Ridge." This stone is a description of burr, and makes a very good substitute for the imported or French burr. During my residence in the State of Ohio, I was employed by the Messrs. Adams, of Muskingum county, who do a large business in flouring, being the most extensive millers in that part of the

State. One of their mills, in which the author was employed, was of six run of stones, all of them of Raccoon burr, and, having dressed them, the only conclusions I drew, from the work the stones made, was, that they required to be dressed oftener than the generality of the French burr. The reputation of this mill then stood high in New York for making a good article of superfine flour. The difference in the price between the Raccoon and imported being from 35 to 45 per cent. cheaper. They are put together in blocks and fitted up as the French burr, and will answer a good purpose for grist mills, or for grinding coarse grains, such as grist-grinding generally consists of, for the use of the farmer.

DIRECTIONS FOR PREPARING NEW STONES FOR GRINDING.

WHILE the mill is in progress of building, the stones may be prepared by the miller who is to have charge of the running of the mill when completed, as no other than the head miller should direct the operation of putting in the dress; and any fault in their operation he should be held individually accountable for.

It being necessary to take the stone out of wind before the dress is laid out, it may be done in the following manner: First, prepare yourself with a good tram staff of the following shape; have your staff dressed four inches wide, with a hole through it exactly in the centre;

then frame two posts, two by three inches wide, at equal distances from your centre hole, and then place a cap on the posts in which your elevating screw is inserted, for the purpose of allowing the staff to come in contact with the stone. In addition to this, there is a plan different in its construction, which is to use a bar of flat iron, of any suitable size, say half an inch thick, by one inch wide, or one and a half inch wide; bend it in a circular form, and let it into the staff with screws; drill a hole through the centre, exactly in range with the hole through the staff for the elevating screw. This description of staff is easier made than that first mentioned, and much more easily kept in repair. The spindle that the staff works on requires to be an inch and a half in diameter and nine inches in length; one of this size will work without springing. It will be necessary to have these screws, which are to be inserted into the staff, in three different sections of the hole which the spindle passes through. The object of these screws is simply to allow the staff to be trammed or centred to the face of the stone, by altering any three of those points which the screws represent. By placing your spindle properly in the eye of the stone, the screws may be dispensed with, and also a great deal of trouble in using the screw to train the staff, as every time the staff is taken off the spindle, in replacing it, the points require to be examined and trammed over. If the spindle is properly placed in the eye, no objection can be found in using the staff without screws, as the main centre for taking the wind out of the stone is entirely dependent on the spindle which the staff is suspended on; then the miller must centre his spindle from the circumference of the stone, instead of centreing it by the eye, as many do, supposing that the eye is always in the centre of the stone, which is not always the case.

Being prepared now to use paint for the staff, which may be prepared by mixing 2 ozs. of either Spanish brown or Venetian red; the latter is preferable, as it shows on the stone better with spirits of turpentine or soft water. By means of the screw at the top of the spindle, you allow the staff to come down so as to slightly touch the stone, by which you work off all the high places, until the stone is perfectly out of wind, and may be known to be so when it paints the face all over exactly alike. For new stone, the eye blocks should be worked about a sixteenth below the rest of the face. The next part of the work, being to lay out and draft a proper dress, may be done as follows: Before we dismiss the subject of taking millstones out of wind, we will just refer to another mode; namely, the using of three angles laid out on the surface of the stone, and each angle intersecting the other, which forms a centre by working the lowest angle shown on the stone first to a good face, and working the others down to it. This is a mode we cannot recommend, as it consumes nearly as long again to prepare a stone with this plan as it does with the tram staff, consequently is much more expensive, and its principles belong to a past generation, but are mechanically correct, and answers in places where a tram staff cannot be got readily.

DIRECTIONS FOR LAYING OUT THE DRESS IN MILLSTONES.

The first thing we shall notice under this head is the amount of draft necessary for your leading furrows. This must be varied according to the size and quality of your stone. Stones that are close require more than open ones, consequently the miller's own experience must direct him to define the difference between close and open millstones, knowing that open stones have a greater amount of draft than close ones. But I have found, from my own experience, that there is also another essential point to be considered, that is, the particular dress you use, as in no quality of stone, either close or open, should as much draft be given to a stone of any size where a circle dress is used, as may be given where the dress is straight. My rule is, for a straight dress, in close stone, an inch to the foot of the diameter, and three-quarters of an inch with a curve. After you have made up your mind on the amount of draft which you intend to use, set a piece of board in the eye of your stone, which for convenience we will call a draft board; then if you wish to use four inches draft, set your dividers four inches, and after you have found the exact centre of your stone, place the point of your dividers in that centre, and strike a circle on the board, called the draft circle. This is the first preparatory step of importance, the next being to know what way your stone is to run, whether with the sun or contrary: if with the sun, you turn your face towards it, going the contrary way round the stone, and by placing one end of your pattern to the draft circle, and the other end on the periphery of the stone, you obtain the desired draft for your leading furrows. The proper rule for finding the distance for each of the leading furrows, is to divide the number of quarters wanted, by the circumference, and the product is the distance the leading furrows are apart. Set your dividers according to the product, and space off your quarters before striking out your leading furrows, which will show at once whether your calculation is right or not. When your furrows are all made, you may then complete the face of your stone for grinding grain, by making a perfectly true face on the stones before they are turned down.

If your stones require to be driven contrary to the sun, you lay out the dress by going around the stone in the same direction with the sun. This rule is very simple, and capable of saving many mistakes usually made by millers, in carelessly drafting the dress to run the wrong way.

A SPECIAL TREATISE ON THE DIFFERENT MILLSTONE DRESSES NOW IN USE, WITH PRACTICAL REMARKS ON THEIR DIFFERENT ACTION.

The millstone dress is that draft given to the furrows, for the purpose of discharging the meal from the stone, when properly ground.

The proper draft or dress, to be used for this purpose, is a matter which involves a great difference of opinion, both with millers and millwrights. Generally, the former shapes his ideas from personal observation in the grinding of the millstone, and the latter from theory only; whereas, by uniting both of these essential principles, more conclusive evidence would be obtained, as to the proper dress or draft necessary for the millstone.

The first principle is the discharge; the next is the way to draft that discharge so that the stone, when grinding, shall receive its proportional quantity on its entire surface, from the eye to the skirt. The difficulty to contend with, in this particular, is the variation of circular motion that the grain encounters, in passing from the eye to the place of discharge; for, in every superficial inch of surface from the eye to the periphery, the circular motion increases as the circumference grows larger, until the meal is discharged from the stone. So, from my own personal experience, I have found this the most difficult part of our trade to improve, from the fact that the proper draft of the dress, in a millstone, is of more importance to the miller than it is generally supposed to be, for the following reasons: in the first place, mills built on light streams suffer more for want of a perfect knowledge of this important part of the miller's art, than those situated on large streams. All kinds of millstone dresses that curve, require more power to drive them than furrows that have no curve; and the more curve or circle, the greater amount of power you want to drive the stone. As millers who use circle dresses in preference to all others, will require abundant proof on this subject, we hope to give it to them; and if we succeed in enlightening them on the main error of all circular dresses, all we ask of them is to adopt what science and practical experience prove to be the better mode.

To illustrate this subject more fully, we take a millstone of four and a half feet in diameter, with a motion of 175 to 180 revolutions per minute, and prepare it for flouring with a circular dress, with furrows on a circle of once and a half the diameter of the stone. I pitch on this particular dress to illustrate my views, as eight-tenths of all the circular dresses I have examined are drafted on this curve. Suppose, then, that this stone has a draft at the eye of the lowest number of inches generally given, being three and a half inches at the centre, I ask, what will the angle be, that the furrows will pass each other, from the eye to the periphery? We suppose, that in such a draft above described, the angle of the furrows are equal; this should not be the case, when we consider that the central force increases as the distance from the centre increases, caused by the circumference of every superficial inch of the stone increasing. We ask, then, how are you to bring the same amount of meal on this increasing velocity of the skirts of the stone, that you have at the centre, when your draft, in both parts of your stone, are alike demonstrated by purely scientific principles, being governed by the laws of circular motion, on the same principle as above described? We affirm, that at least one-twentieth of the pressure used on a stone of four and a half feet diameter, making 175 revolutions per minute, grinding 15 bushels per hour, might be dispensed with, or avoided, if the draft or dress was applied in such a manner as to decrease as the central force increased, which would allow the angle of draft with which their furrows cross each other, in inverse proportion to their diameters. If the twentieth of the pressure need not be used; that is just one-twentieth of the power saved, with at least an equal advantage gained of five per cent. in the quality of the flour; as the less pressure used in manufacturing, the better the flour after it is manufactured. This most all will admit.

With this dress, more time is consumed in keeping your stone in proper order, than should be, as all experienced millers will readily admit. The skirts of the stone with circular dresses are always lower than either the breast or eye; and the smaller the circle used, the greater this difficulty will exist, it being impossible to give the skirt as much of the meal, with this dress, as its relative proportions require. Where a stone four and a half feet in diameter is grinding, say 15 bushels per hour of wheat, and running night and day, in twenty-four hours from the time it was started, the heat caused by the great pressure used becomes intense, as it forms a scalding temperature, which greatly affects the quality of the flour. To test this principle more fully, I have compared the degrees of the temperature of the meal with this dress, and what is called the old-fashioned straight quarter, as the meal issued from the stone, and found the following result:—

The circle dress ground the warmest by ten to twenty degrees of Fahrenheit; both the same kind and sized stone grinding about the same quantity. On two separate examinations of the heat of the meal, the stone with the circle dress had 18 leading furrows, and the straight quarter 16 ditto.

Now, by this experiment alone, I do not say that this quarter, or straight dress, is the one I should recommend all millers to use. No, by no means; as the disproportion in the draft of its short furrows condemns it also. But the experiment went to prove its superiority over the circle, which was readily discovered in the lively, rich colour of the flour, and the clean appearance of the offal.

The different dresses, as represented on plate 2, are all got up from those two,—the circle and straight quarter dress; and I must say, that their inventors were actuated more by a love of variety and novelty, than from the dictates of practical experience. For that reason, we shall not take time to notice them at further length than described in plate 2, — considering it no advantage to the miller, although there may be some who will value it more than any other dress represented, because they have spent more time in getting them up, than they have taken to examine the error they have made by introducing a combination of artificial drafts for millstones, contrary to those laws of circular motion

Fig 1

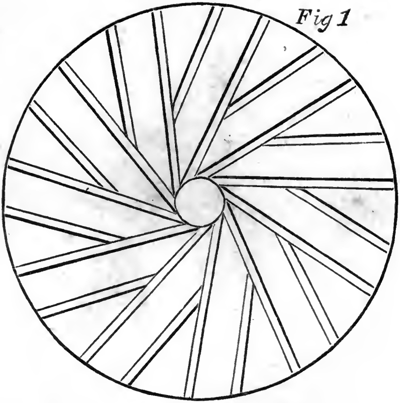
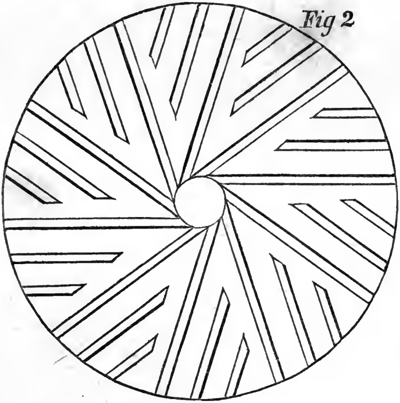


Fig 2



MILLSTONES—QUARTER DRESS.

Plate 2.—p. 78.

and central forces which govern all kinds of millstone dresses, of whatever kind used.

We shall now present that dress for millstones that science and experience show to be best for all sizes of stone and varieties of central motion occasioned by the revolutions made per minute of the stone. These dresses are seen in plate 2. Figs. 1 and 2 represent a perfectly straight furrow, one inch and one-eighth in width, for a stone four and a half feet in diameter. The number of leading furrows should be from 16 to 20, or 21, if the stone is more than ordinarily close; I prefer 21. Then divide those quarters equally with another furrow each, which will give 42 whole furrows, allowing the short furrows to enter the leading ones in close stones. This dress may be called, properly, the "new quarter dress;" its superiority over the old 16 quarter dress is apparent to all, when we examine the drafts in plate 2, figs. 1 and 2.

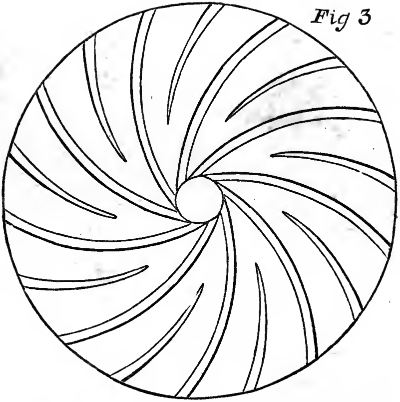
Millers who may think that there is too much face on the skirt, may safely increase the size of their furrows one-eighth of an inch on the skirt, and in very open stones may decrease it accordingly, as well as the number of furrows. I have the opinion of several of the best millers in the United States, all agreeing on this dress as being the best in use. By the use of it, we entirely dispense with that short furrow necessarily used in the old 16 quarter dress, by giving the short furrow in the new quarter dress about the same draft as the second furrow in the old, which serves to make the flour better, as less pressure is used with the new quarter dress than with the old. The short furrows in the 16 quarter dress, the angle at which they cross each other being too obtuse to admit of their cutting, as may be seen by fig. 2; the angle being 84 degrees of draft, they push the meal out, and cannot act otherwise.

With the new quarter dress, as described, I should not recommend more draft at the eye of the stone than three and a half inches, where its motion is from 160 to 180 revolutions per minute, for a stone of four and a half feet in diameter, with the same proportion, according to the size of the stone. Fig. 1, four and a half feet stone, 21 quarters. Fig. 2 represents a stone equal to four and a half feet, 16 quarters. Pl. 3, stone same size, dress on the circle of the stone, with 40 furrows.

DIRECTIONS FOR MAKING FURROWS ON THE MOST APPROVED PLAN.

The manner in which furrows are shaped is very important, as, in discharging the meal, they will, if not properly made, make too many middlings, and allow the bran to pass out thicker than it ought to be.

The proper form, I have found, for them, is a perfectly true taper. From the first edge, commonly called the track edge, up to the second, called the feather edge, and of a depth of three-eighths of an inch at the back or first edge, up to a sixteenth part of an inch at the feather edge of a new stone, and not deeper than the depth of a



MILLSTONE—CIRCULAR DRESS.

Plate 3.—p. 80.

good heavy crack, when your stones are in perfectly good face for flouring.

Now, much pains in the mechanical construction of them may be saved to the young miller by the use of a gauge and staff. To dress his furrows by the gauge is simply the size and shape of the kind of furrows you want to make, cut on wood, which will assist you. To make all your furrows precisely the same depth, the staff is a small, flat rule, four or five inches long, by which you can apply paint to your furrows to work them even, by which much time is spared, for the paint shows you all the high places, so that not one stroke of the pick need be lost.

For flouring, your furrows require to be as smooth as the face, as rough furrows make the flour specky. I have heard millers object frequently to their bolts not being right, when the whole cause lay in the rough manner in which their stones were dressed.

DIRECTIONS FOR STAFFING AND CRACKING THE FACE OF THE MILLSTONE.

Every three months is as often as necessary to dress the furrows, but in a mill that does a good business, the face of the stone requires cracking as often as every four days, the stone running night and day.

Cracking the face, as it is termed, is an artificial mode of cutting the face of a millstone in parallel lines with the furrows by which the bran is cleaned; consequently, when well done, a stone will grind a third faster than without the cracked face, and the flour is far superior. With stones cracked with about from 26 to 30 in every superficial inch of the face, reason tells us that they need not be pressed so close together. It requires a good deal of practice to be perfect in this part of the miller's art, but by the use of practice we become perfect in this, as well as any other branch of the business.

After the stones are taken up for the purpose of sharpening them, the first thing the miller should do is to take a soft sandstone, which should be kept for the purpose, and rub the face of the millstones all over with it. The object of this is to scour the face, which leaves it in better order to receive the work you are going to put into it. Sweep them off clean, and then apply your staff. If your stone should be higher about the eye and breast, skin off those places until the staff fits tight all over the face of the stone, and crack the balance; then your stone is ready for grinding. If you should find your stones in good face when you take them up, with the paint equally distributed all over the face of the stone alike, being the highest about the eye, then the stones are considered to be in good face; then crack them all over nicely, without breaking the face, which must be done with a sharp pick; then apply a little tallow around your spindle-neck, and if the spindle is loose, tighten it, and tram your spindle; then you may put your stones down, as they are in good order for grinding.

ON THE BEST SIZE OF MILLSTONES FOR DIFFERENT WATER POWERS.

The proper size of millstones is a subject of as much consideration and interest to the miller as any other improvement in his business; and the improvements which late years have discovered in this particular are worthy of notice in this work. When we look back to the days of our youth, and see what other days have brought forth in this particular, we are astonished that the many simple improvements of the present day were so long unknown.

Not many years since, the size of millstones, as thought best by the first millwrights and millers in our country, was from five to seven feet; and numbers of those same stones are still in use, and not grinding as much per hour as stones of less than one-half their diameters, in mills constructed on the scientific principles of the age.

Stones four and a half feet in diameter are large enough for any description of water-power, and larger than I should recommend for any water-power over ten feet head and fall, as four feet four inches is large enough to make, without crowding, 50 barrels of flour per run a day, which is a good amount of business for mills of four run of stone.

The great improvement in the difference of the size of millstones—first, consists of reducing the amount of power used to drive such large sizes of stone, by cutting off that great amount of leverage we had to contend against in stones of from five to seven feet in diameter. Also, by applying the power so much nearer the centre, by increasing the weight of the running stone, by which means from twice to five times the amount of grain is ground with a less quantity of water. This improvement, of increasing the weight of the running millstone, is more in accordance with true mechanical principles of science, and of more value to the miller, as it saves a large amount of capital in the purchase of millstones and the necessary machinery to put them in motion on the old plans of mill-building.

The advantages of increasing the weight of the runner, have been fully tested at Chinton, in the State of Michigan, where there is a mill in successful operation; the stones being but four and a half feet in diameter, and the amount which they grind per run being also stated.

PRACTICAL REMARKS ON GRINDING WHEAT AND CORN.

To be a good judge of grinding wheat for flouring, the miller must be endowed with one of the five blessings or senses which nature has endowed mankind with generally,—that is, an acute sense of feeling; for, without this sense, the miller is destitute of a guide to grind wheat for merchant work, in such manner as to realize the greatest possible amount of flour from the wheat, as it requires but an alteration of two degrees to make a difference of from one to three pounds of flour in the bushel. So it is in the different qualities of wheat which the miller may have to grind, as some qualities of wheat will grind from one to five degrees closer than others, owing, first, to the order that each sample may be in when ground, and secondly, to the particular species of wheat. All those causes must be examined by the miller; he will then be prepared to form a correct judgment, how close the stone requires to be set on each kind of wheat; as the yield required from every 60 lbs. of good clean wheat should be such as to produce a barrel of superfine flour (capable of passing inspection laws) from every 240 lbs. of merchantable wheat, being 49 lbs. of superfine flour for every 60 lbs. of wheat. This is a closer yield than the average of the different qualities of wheat will run; and to manufacture on this yield, the stones require to be kept in perfect order. As the *millstones* are the entire *key* which regulates the profits of the miller, we think much attention cannot be expended more profitably, than that bestowed in keeping them in proper order.

Much as I have said on the subjeet of millstones, I will also, before leaving the subject, lay down a few rules for the benefit of the young miller, as I have once been of that class myself, which will enable him to acquire a more perfect knowledge of keeping the millstone in proper order. The worst and most easily detected state a millstone can be in, is when small round and hard pieces are discharged, with parts of the meal ground close enough; this is evidence enough that your stones are out of face, and working entirely on some high places, which prevent the stones running close enough together to grind the meal all alike; they should be instantly taken up, and by laying on the staff dry and moving it gently over the face, you will soon find those high places, which should be skinned off until the staff shows the face to be even, by fitting the stone tightly all over its surface; which, after a good rubbing with the burr-block, your stone will be ready for grinding.

If, on taking up the stone for examination, you should find no high places, but the stone staffing an equal face all over, then the fault lies in the furrows being too deep, which you can remedy by filling up to a proper depth with cement made for that purpose. By reference to the index of this work, you will be informed how to prepare it.

To grind corn, you want a very heavy crack in the face of the millstone, which shows the necessity of having stone expressly made to order for this particular business. Also, furrows answer better by being a little rounding, and double the depth of the feather-edge that you require for wheat.

REMARKS ON INDIAN CORN AS AN ARTICLE OF FOREIGN CONSUMPTION.

CORN is now becoming an article of food for thousands of the poor class of people of European countries, taking as it does the place of their principal food, the potatoes, which of late years have suffered from decay so much so as to reduce thousands of them to famine, disease, and death. These, for want of other food, were obliged to use the diseased potato until relieved somewhat from suffering starvation by the timely and charitable aid rendered by the people of the United States of America.

We say that the corn of America will undoubtedly take the place of the potatoes of Ireland, as food for the poorer classes,—it being, according to learned judges, a more wholesome and a stronger diet than potatoes. This will benefit the American farmers of the Western States, who raise such large quantities of corn, and also the American miller—as it will pay always a better profit than the manufacture of wheat into superfine flour. The author of this book has recently invented a simple mode of drying Indian corn so that it will keep two years in meal, barrelled. For a full description, reference may be had to the article, under its proper head.

ON THE CONSTRUCTION OF THE MERCHANT BOLTS FOR SUPERFINE FLOUR ON THE OLD PLAN.

THE arrangement that is necessary in the constructing of bolts for the merchant flouring mill being such as the generality of millwrights do not investigate closely, is apparent to those who examine this subject. When we consider the fact that wheat is composed of a very thin skin, filled with flour, which, if manufactured properly, ought to produce the following qualities: superfine flour, seconds, ship stuff, and bran, in the first place. Once is enough to grind the meal all must admit, but in the common way of arranging and constructing the merchant bolts, a second grinding becomes necessary. Of that quality called middlings, which, when ground a second time, the flour is called fine, and is unfit for bread, as it is too dry to be palatable, which, if manufactured as it should be, the middlings will be too poor to be fit for any other use than feed. We will now describe a full chest of merchant bolts on the general arrangement, or old plan.

What is called a full chest, consists of two superfine reels, which are both fed from the cooler; then, what meal is left passes into two other reels, immediately under, called the return reels. But I will here notice, that only part of those reels are returned back to the cooler, the rest of the reels being all there, are to complete the entire separation and cleansing of the different qualities. The numbers of the cloth used in this chest are as follows:—The superfine reels are about 32 inches in diameter, covered with No. 9 cloth; the lower or return reels, the numbers vary from No. 8 (being the finest) down to No. 7, and sometimes less, for the middlings, which are ground over again, which will come from No. 6 or 7, will be too rich unless they are ground and bolted over, and even then they will make nothing better than fine flour; the length of the reels is about 18 feet, with a pitch of about a quarter of an inch to the foot. Such is a description of the merchant bolts on what is called the old plan. We shall now give our opinion on this mode of constructing bolts. We must condemn the plan, as the middlings are too rich, and it also requires more wheat for a barrel of superfine flour than is necessary.

In condemning this arrangement of the merchant bolts, we have constructed a chest with the addition of but one reel more, which cleans the offal much better than the chest above described, and saves a second grinding.

A DESCRIPTION OF A NEW ARRANGEMENT OF THE MERCHANT BOLTS ON THE MOST APPROVED PLAN.

The principal improvement of this arrangement of the merchant bolts to the miller is its doing away with the necessity of grinding over a second time.

Our chest consists of four reels, with a separate duster for the offals. The mechanical proportions of it are as follows: Length of reels, 20 feet; diameter of four reels, 3 feet each; diameter of duster, 40 inches.

The No. of the cloth to be used as follows: On the first two superfine reels, Nos. 8 and 9, the nine being on the head, one-half of each on the next two being the return reels, Nos. 7 and 8, No. 7 being on the head; on duster first, six feet, No. 7; on next, 12 feet, No. 5; next, two-feet wire of 12 or 16 meshes to the inch. The length of the duster being 20 feet on the inside, each reel must have a conveyer, with the flights all drafted for the same way. The two return reels should return the whole length, with a slide left in the bottom of the superfine conveyer to draw as far as five feet, for the purpose of returning, according as circumstances may require. There should be a spout at every six feet of the duster, to receive each quality separated by this arrangement. The fine cloth on the return reels will dust the middlings of the other bolt perfectly clean, which will make them too poor for any other use than good feed. By the time they arrive in the duster, their name is changed from that of middlings to seconds. Merchant bolts of this description are capable of dressing from 150 to 200 barrels of flour per day with the greatest ease, which will be large enough for mills of four run of stones. The pitch given to the reels should be but one-eighth of an inch to the foot.

DIRECTIONS FOR MAKING CLOTHS FOR BOLTS OF ALL DESCRIPTIONS.

Bolting cloths should not be cut in making, as they last much longer when economy is used in this particular. The wide German old anchor brand is the best for millers' use, and is always known by the deep yellow tinge and square mark, which the French or American manufacture does not show. The width of the ribs which the cloth rests on should be lined with coarse heavy cotton cloth, and also sewed nicely on to the bolting cloth; also the head and tail end should have a piece of the same kind of cloth as above, for nailing them fast. The best white sewing-silk should be used, instead of thread. In making, they ought not to be made to fit the reel too tight, as a tight cloth is apt to suck the flour.

ON THE PROPER SIZE OF MILL-PICKS FOR DRESSING STONE.

Much has been attempted, within the last few years, to improve this important tool for the convenience of the miller, but all attempts that I have seen I have pronounced as worthless, in comparison with a pick made from the cast-steel bar, as generally used. The size of the steel bar ought to be one and one-eighth of an inch square; cut your bar six inches long, and draw it with a true taper from the centre each way. The best cast steel should be used for mill-picks; and when your picks are done, they should be an inch and a quarter to three-eighths wide. At each end the steel should be hardened till they show a straw-colour for two inches. The blacksmith who sharpens them requires to pay a good deal of attention, to prevent the steel from getting too hot, as it is easily detected when done; and also to hammer them on an anvil that is smooth, to prevent the edges from cracking. I have taken a good deal of pains to get a recipe for making a composition for tempering cast steel, which may be found useful.

COMPOSITION FOR TEMPERING CAST STEEL MILL-PICKS.

It is generally very difficult for the miller to get the blacksmith to give the steel its proper temper, from a want of a sufficient knowledge on the part of blacksmiths generally what that temper should be. We here insert a composition for the purpose, which assists the process of tempering cast steel, by assisting the steel to retain its natural qualities and fineness of temper in opposition to the great degree of heat used for drawing and tempering, as the oftener steel is heated, the more brittle become its fibres, which renders it worthless to the mechanic, and more particularly to the miller.

To 3 gallons of water, add 3 oz. spirits of nitre, 3 oz.

of spirits of hartshorn, 3 oz. of white vitriol, 3 oz. of sal ammoniac, 3 oz. alum, 6 oz. salt, with a double-handful of hoof-parings; the steel to be heated a dark cherry-red. Every miller should keep a large jug of this preparation in the mill, for tempering his picks in; also, it must be kept corked tight to prevent evaporation.

ON THE USE OF THE PROOF STAFF.

The proof staff is made of cast iron, with a perfectly true face, and set in a case with a cover to it. It is for the purpose of keeping the wood staff, that is used to work the stone by, in order; as, by applying one on the other, you will soon detect any error in your stone staff. A little sweet oil should be applied on the proof when about to try the order which your stone staff is in. Rub the face of the iron staff gently with a woollen cloth, with a small quantity of oil; then apply the wooden one: the oil of the iron staff will adhere to the wood, so as to guide to the highest spots. You can face your staff much better with this instrument than it is possible for a plane to do it, as, in finishing, you use a scraper of steel or glass. A proof staff is an article that should lie in every flouring mill; it is as necessary as a half-bushel measure or toll-dish. In my examinations of some of our best flouring mills, I have found this instrument wanting, and was much surprised when many good practical millers have told me they never used one.

The proof staff requires but to be seen and used once, to be the miller's favourite. They are made all sizes, to suit all descriptions of millstones, the general price being $25.

In those mills that have the prooff staff in use, the offals are from two pounds to five pounds lighter per bushel than mills that have not.

ON THE AMOUNT OF HELP NECESSARY TO BE EMPLOYED IN A MILL OF FOUR RUN OF STONES, WITH THE DUTY OF EACH RESPECTIVELY.

It requiring mechanical skill and art to conduct a flouring mill as it should be, we here give the proper management for conducting the same with propriety. It should have a head miller, who should act as superintendent of the establishment and all pertaining thereto; also, a second and third miller, whose duty it is to perform all the duties assigned them by the head miller, or superintendent. The second miller should be capable of taking charge of the affairs of the mill in the absence of the head miller. When the mill runs steady, a run of stone should be dressed every day. The second miller, and third, if capable, should perform that duty, which should be done by three or four o'clock each day. In the morning, as soon as the head miller returns to the mill, which should be after breakfast, he should first examine how each stone is grinding, and then the offal, by which means he is able to ascertain how the grinding was performed since he left the mill in the evening, when his watch was off at eleven o'clock. If he detects any alteration, he should inquire into its cause, and give the necessary instruction how it might have been avoided. By so doing, he performs his duty as an instructor, and saves any further occasion for neglect; or otherwise, then he should continue in charge of the grinding and other business, such as may come to his knowledge during the day, allowing the other miller to perform the stone-dressing, sweeping, &c. When the stones are dressed and put down, one of the hands there employed should take the oil-can and supply every journal in the mill with a fresh supply, which will last all night; then, early in the morning, it should be renewed before taking up the stone, which will last all day. Under management of this description, all things will move with a degree of order, so necessary to the conducting of the business as it should be. Mills that do a large retail business, should have a person for that purpose, who is also competent to take in wheat. The flour should be packed by a careful person, expressly for that employment alone. The night should be divided into three equal parts, of four hours each—the head miller's watch first, &c.

HYDRAULICS AS PERTAINING TO THE PRACTICAL MILLWRIGHT.

A knowledge of the natural laws which operate on fluids, particularly water, is a matter of importance to the millwright, which he should be well versed in. Learned theory is not of much use in this particular, as observation and practical experience go further to the attainment of making the practical millwright more perfect than years of learned superficial theories can or do ever effect. For the truth of this assertion, let us examine some of the improvements made in the application of water for driving mills within the last thirty years. Thirty years ago the undershot wheel was the principal wheel used for low heads, by which only, according to learned authors, one-half of the effective power was attained, it being by impulse or percussion. This we will admit; but where the undershot wheel was used for driving millstones, in the days of such wheels, we will not admit that even one-half of the effective power of the water was obtained, as demonstrated by recent improvements. We are told also, that the specific gravity of water as applied to the overshot wheel for driving millstones, is the best possible mode of application, as double the power or effect is obtained on the overshot by specific gravity, that is attainable by the application on the undershot by impulse or percussion only. This we shall admit, as our own experience, as well as that of others better versed in science and practice, have fully demonstrated.

But the inventions and improvements of the last few years have brought new light in the application of water for driving mills, which was not known or thought of thirty years ago. And may I ask to whom are we indebted for this valuable light? To the man of scientific knowledge, or the practical mechanic? We say to the latter, as those names enrolled on the list of inventions in the United States Patent Office will attest. Learned theoretical investigations have never accomplished much for our advantage in the improvements of the mechanic arts of our country; for practical science is that science which is based on truth only for light alone. We have been taught that in uniting what has been applied as separate powers in years gone by, specific gravity, percussion by impulse, and reaction, which is nearly equal with either of the other powers, as to affect it, being the after effect of all the others, that water, as a fluid, can create, and so beautifully demonstrated for the purpose of propelling mills by the inventors whose names are attached to the list of those who have accomplished great benefits to all those who are daily using their inventions, by propelling their mills in various parts of our extensive country. We shall here notice the names of the two inventions in water-wheels which may be considered as first-class wheels:

First, is the Lansing Spiral Percussion and Central Discharge Wheel, constructed with two sets of buckets, and called in this work the Combination Wheel.

Second, is S. B. Howd's Direct Action. This wheel operates well on low heads, and in that situation is a first-class wheel.

Now, as regards the subject of the combination of gravity, percussion, and reaction, applied as they are to form one great power by having a water-wheel properly constructed to receive this combination and in applying it to the propelling of mills, I do aver it to be as powerful as the overshot in the most advantageous position for business, and more so in a great many locations where flouring mills are the purpose used for. This opinion may appear paradoxical to the mere theorist—those only theoretically acquainted with the power or action of water as a fluid; but to the millwright, whose experience leads him to look and examine into that way of application which produces the best results, he will find that our calculations are right when we assert that the combinations of power obtained by water being applied on the principle of uniting those essentials which form this combination of gravity, percussion, or impulse, with the powerful auxiliary of reaction which could not be attached to either the overshot or undershot wheels, the auxiliary power of the reaction of water is asserted by Oliver Evans to be equal to the action.—(Millwright's Guide, Art. 45, Law 11.)—This we believe to be true.

That action and reaction are two different qualities of power in the application of water all must admit, for the active verb which expresses action is only applied to that mode of action known to the operator as specific gravity, and action by impulse or percussion, which was the only power applied to driving mills by Oliver Evans and Elicott. These were practical millwrights, and authors of a good practical work for the age in which it was written, being some forty years or more ago since the first edition made its appearance, for instructing those of our trade. Many of us should be grateful for the benefits received by the compiling of the only work we have had as a miller and a millwright's guide, and we fully concur in the remarks of Thomas P. Jones, editor of the last edition of the Millwright's Guide, in hoping that in the history of American inventors, posterity may accord Evans that place which he justly merited. But the change which time has effected in the improvements of mills and all other machinery, renders Mr. Evans's work comparatively useless, as far as the mechanical construction of the present age relates to mill-building. But we propose to illustrate our remarks on the application of water when used by those combined powers.

POWERS OF GRAVITY, PERCUSSION, OR IMPULSE, WITH THE REACTION ATTACHMENT.

THAT a water-wheel, made and constructed to receive the water with this combination for driving millstones or saw-mills, is more effective than the overshot, we shall here show to the satisfaction of the most fastidious or skeptical theorist, according to Oliver Evans' theory. He asserts, Art. 42, Young Millwright and Miller's Guide:

That one-third of the power of water, acting on a wheel, either under or overshot, is, he says, necessarily lost to obtain a velocity or overcome the inertia of matter; and that this will hold true with all machinery that requires velocity as well as power. Every millwright's own experience ought to teach him that, if it was possible to gear the overshot water-wheel into the stone pinion, then this one-third of lost power, that Oliver Evans speaks of, would be advantageously saved. This could not be done; for, without double gearing, the necessary motion could not be obtained on the millstone. Then, let me ask, how is it with our combination wheels? Reason and practical experience show us quite the reverse; for, to drive a run of stones of 4½ feet diameter, our water-wheel does not require to be over four feet in diameter, under a head of water of 12 feet head and fall, giving the stone a motion of 168 revolutions per minute, or as many more as is required, by altering the size of the wheel. This I call working on the right end of the lever, where the stone pinion is a few cogs larger than the spur-wheel. Oliver Evans' Young Millwright and Miller's Guide, page 81, second note on the page, gives more evidence on this particular. He says: A fluid reacts back against the penstock with the same force that it issues against the obstacle it strikes, founded on the laws of striking fluids. This fully corroborates our previous statement, when we said the effective power of water by reaction was equal to its effective power by gravity and percussion. This very day that I am writing this article, my own experience fully convinced me of this fact. I went to my usual avocation in attending the business of my mill. I have one of Howd's Patent Direct Action Water-Wheels; my head and fall is usually about five feet. This day, November 26, 1848, I had high water setting back on my wheel 36 inches, (3 feet.) I drew what we millers call a full gate, without any perceptible motion of the mill. The thought struck me, that by taking hold of the spur-wheel, I could assist the wheel to start, as the impulse from the head was not sufficient to create the slightest motion, the buckets of the wheel being immersed in back water. I succeeded in turning the wheel a few feet, which, by so doing, allowed the wheel to clear itself sufficiently, and from the combination of percussion or impulse from the head and reaction from the bottom, which was instantaneous from the time the wheel first moved, I ground as much with but three feet of water from the surface of the back water, this day, as I have generally done without any back water, or any perceivable inconvenience from it, the only difference being the use of more water to do the same amount of work. The advantages of these combination wheels to the miller, as regards the durability and large amount of capital saved by the difference in the cost of building mills where they are used and building with overshot wheels, are very great. We here give some idea of the difference, as follows:—For a mill of four run of stones, requiring five combination wheels, one for each run of stones, and one machinery in operation. The five, $800 it would require to overshot wheels at the lowest estimate of the naked wheels, $800 each, with two large cones, 2 pits, 2 crowns, 4 pinions, at $800, not including millwright's wages for putting the same in operation, which supposing the difference to be about one-half, as we allow eight hundred dollars to furnish the wheels and materials for starting, to the stone, with the combination wheels. Eight hundred dollars each for the construction of the overshot is low. I have myself been engaged in the construction of mills, where the water-wheels, two in number, overshot, averaged one thousand dollars each. Now, to construct the mills as far as the stones—I speak only of the machinery this far—supposing a saving of one-half to the stop of the husk. The next point of interest, we consider, is the difference in durability. The combination wheels, being made of iron, will last as long as any other part of the mill; the overshot wheels, with a great deal of care, may last from nine to twelve years without renewing; and in the cold climates, such as New York and the Canadas, they require a great deal of protection from the frost, which, if allowed to collect in ice, soon weakens the joints of the wheels, and renders them useless. The manner in which the combination wheel is placed protects it, in any climate, from frost. Then, for convenience, it is preferable, as, when the miller wants to take up his stone, all he has to do is to shut the gate and take up the stone, without the burthensome task of raising and shifting pinions, as is the case in breast undershot or overshot wheels. The term combination, in this article, is our own language, and we apply it to water acting in the following manner: By percussion or impulse, united with reaction power, and Lansing's invention.

REMARKS TO THE MILLWRIGHT ON THE NECESSITY OF ECONOMY IN PLANNING AND ARRANGING THE MACHINERY OF FLOURING AND GRIST MILLS.

I HOPE millwrights who may chance to look over the pages of this work, will fully appreciate our remarks on this subject; sufficiently, at least, to justify us in saying that we have had experience enough to fill a volume alone on this subject, having devoted the best part of our lifetime to the milling and millwright business, and that in mills constructed by different mechanics, where we have had the opportunity of contrasting the amount of genius and skill displayed by each, and also the objectionable blunders that have been committed by millwrights claiming a name for close workmanship and acute mechanical skill as draftsmen. The first essential we shall notice, as requisite to a good mill of any kind, is power; the next is proportional strength in all its parts; the next being an economical arrangement of all its parts. This is the entire of what constitutes the name of a good millwright. We shall now point out what we call the objectionable blunders of some of our trade. The first we shall notice is an inordinate love for display in erecting buildings of too costly a finish, as expensive and showy cornices, a large amount of the inside work cabinet and panel, made such as the useless panel-work exhibited in some of our mills on the custom and flouring bolting chests, doors, &c. &c. Again: the shafts turned and polished, and, worst of all, a display of complicated machinery, where about one wheel would answer when three are used. This is wrong, and should not be the case, as you are foolishly wasting a large amount of capital, that might be much better invested in the purchase of wheat.

And not the least important matter to which we shall now call your attention more particularly, is the husk.

A great many millwrights connect the husk with the main building. This is wrong. The husk should be a separate frame for two considerations, namely: First, it is the main support of most all the machinery; second, when separate the stones work better, as they are not so likely to get out of level as where the husk is connected with the main building. Too many millwrights run into this error by framing the husk and building together, and the consequence is, when the mill is loaded with grain, the building settles,—as right over the husk the most weight is generally placed, and the stone keeps getting out of place daily, as well as all the other machinery attached thereto, which soon decreases the power of the mill, and gives the millwright who constructed the mill a name of slighting his work, when the whole cause originated in this one particular,—of framing the husk to the main building.

Another objection, which is quite discernible in too many good merchant-mills of our acquaintance, is an unnecessary tremour, which gives the machinery a vibrating motion. This is easily discerned by the practical machinist, as soon as his ear comes in contact with that ringing sound which all machinery has that is working irregular, as some of the wheels work deeper than their relative pitch circles, and others not deep enough for the pitch circle. This may all be avoided by not making your husk too long posted. As a general thing, where your husk-posts are over 12 feet in length, there is a tremour, which has a tendency to keep the machinery continually working out of its centre.

ON BEDDING THE STONE.

Another difficulty exists with many millwrights, in regard to bedding the stones, and that is in laying them down in what I call a temporary manner, by laying boards or pieces under them, which keep shrinking and swelling, and making it difficult to keep the bed-stones level, with an attendant evil to the bush, as it also gets out of place by the same fault. The proper mode of bedding the stone is, to joint their beds in the husk-timbers to a perfect level, then gauge the back of your stone to a size, and joint the same to a true face, having it a little hollow next the eye, and when placed will be perfectly level; then case around with two-inch plank, and there will be no trouble in your mill with the stones getting out of level, and the bush will not be half the trouble as in the old way of bedding stones. A proper attention to our observations,—in remedying the evils first pointed out, in arranging the machinery of mills to the best possible advantage,—is what makes a good practical millwright; and, also, it is the sum total of the trade. Good calculation and close work is as necessary to the millwright as the handling of the tools which he daily uses. He must not think, in drafting mills, how much machinery he can place in the building, which only adds more capital that might be better engaged, as we have previously shown; but how little machinery it will possibly take to complete the mill in a skilful manner, should be the main object in view. And when we think of the many mills which have been built in various States of this Union, without any regard to those principles as just laid down, where thousands of dollars have been lavished by head millwrights, to the injury of their employers, we think ourselves fully justified in extending this caution to those of our trade who may need it.

We have attached a number of jobs of different sized mills to this work, for the use of those millwrights who, in the language of friend Fowler, have got constructiveness sufficiently large, but whose organ of order is below mediocrity. By these he may be able to obtain all the necessary information from our collection of jobs, which have been drafted especially for this work by the author and millwrights of more acknowledged ability, to suit all locations for steam and water-mills whose head and fall is from 3 to 30 feet, with a full calculation of the amount of water necessary to drive from one to ten run of stones, on different heads, as shown in our jobs. All our plans for conducting mills of all descriptions, are drafted with due regard for that phrenological organ, called order, in the arrangement of the machinery on the most approved modern style of mill-building, both flouring, grist, and saw-mills. We have also annexed a catalogue of the different patterns of machinery, from some of the best foundries in the United States, as to perfect proportions in the different sizes and assortments of castings, both for quality and price, not to be undersold by any other establishments in the Union. It is for the benefit of the millwright, as it serves as a guide to direct him in all his plans,—as the patterns are all numbered in different sizes, and will serve the purpose of aiding the millwright in selecting the different articles of machinery suitable for the different kinds of mills, and in proportioning his own work accordingly.

TO FIND THE NUMBER OF REVOLUTIONS OF THE WATER-WHEEL PER MINUTE.

We annex a table of rules for finding the revolutions of any sized water-wheel, which the millwright will find oftentimes useful in his practice, namely:

First, find the circumference of the wheel by multiing the diameter by 22, and divide by 7, and the quotient is the correct answer.

TO FIND THE VELOCITY OF THE STONE PER MINUTE.

To find the velocity or number of revolutions of a 4½ foot stone per minute, multiply the diameter in inches, which is 54, by 22, and divide by 7, which gives a fraction less than 170 inches, the circumference. As the lowest calculation we give stones now, being 2063 feet, or 24,756 inches, the skirt moves per minute, which would give the stone 146 revolutions per minute. This motion is much too slow for this size stone; we only insert it for the use of those who like slow motion for stones.

A RULE TO FIND THE DIAMETER OF ALL PITCH CIRCLES.

The proper method is to multiply the number of cogs in the wheel by the pitch, as

24 cogs and 2 inches pitch,
2 pitch,
gives 48, which is the circumference;
multiplied by 7, and divided by 22,
thus, 22) 336 ($15\frac{6}{22}$ diameter in inches.
22
116
110
6

To reduce to feet, divide by 12) $15\frac{6}{22}$
$1.3\frac{1}{4}$, which gives one foot three inches and a quarter.

TO FIND HOW MANY REVOLUTIONS THE STONE MAKES FOR ONE OF THE WATER-WHEELS.

Divide 146 revolutions of the stone by the number of revolutions of the water-wheel, and the quotient is the answer.

ON MACHINERY.

A correct knowledge of those fundamental principles of the power and use of machinery should be the chief study of both the miller and the millwright, but more particularly the latter. The millwright's trade is different now from what it was thirty years ago. Then the millwright had all his own gearing to make, and could not be expected to build so complete and well-arranged mills as he can now, where he has every thing furnished in the shape of machinery from the large machinery establishments with which our country abounds, all of the best description, fitted and finished in a superior style of mechanical contrivance, from the water-wheel to the smallest wheel in use about the mill, from which the millwright may select the requisite gearing to suit any water power capable of propelling mills of any description. For full particulars, look at the index of this work, for mill-gearing and catalogues of the different patterns of machinery furnished.

A RULE FOR CONSTRUCTING THE CONVEYOR.

The conveyor is that useful piece of machinery which forms an artificial screw for conveying either wheat, flour, or any other stuff, from one part of the mill to any desired part. It is simple in its construction, the shaft being from 4 to 6 inches in diameter. For a shaft of 4 inches diameter, the flights should be about 1½ inches wide, with two inches in length for the blade, and a stem of one inch, to fill a hole in the shaft from seven-eighths of an inch to one inch in diameter. This size answers for flour and meal best, it requiring a more substantial one for the moving of grain. To a shaft of six inches diameter, the flight should be two inches wide on the blade. To lay out the shaft to receive them, dress it eight-square, put in the journals, and band them substantially; then lay out with the square for your flights in the following manner:—Scribe for the first one on the end of the shaft; then measure with your dividers one-fourth of an inch from your first, and scribe your line on the next square of the shaft, which continue to do till you get to the other end; then go back and begin with the first point of your first flight to the first point of the scribe you made, for the second flight is called the pitch line, to set the flights at the proper angle.

ON THE CONSTRUCTION OP MILL-DAMS.

Mill-dams are generally a source of great expense, in keeping them in repair, when constructed out of poor materials. There are as many opinions on the proper way to build them as there are mill-dams in use. Some prefer stone, some clay, and others brush, logs, and every conceivable material of such nature. But, in building mill-dams, the first thing to be looked at is the location where the dam is to set, of what kind of a foundation it is to set on, whether a soft bottom or hard; in other words, clay or stone foundation by nature. If stone, the expense is not half as great as clay or other soil.

But in the Western States, stone are not sufficiently plenty to construct dams of, so that on foundations of soft bottoms the expense is greater to build dams than many wish to go to.

In the first place, a good foundation is necessary to protect the dam from breaks, accidents by the burrowing of musk-rats, which occasion the destruction of so many mill-dams.

As to the description of dams which we should recommend where stone are not handy, would be a frame dam, they being more permanent and capable of resisting the attacks of musk-rats and high water. We shall here give a plan for building such a dam as we should recommend for all mill sites of soft foundations. The bottom where you are going to erect the dam, should be levelled quite level, then mud sills should be sunk level with the surface, crossways of the stream, about 10 or 12 feet apart, and of a width of 35 or 40 feet from bank to bank. The two outside sills should be piled with 2 inch plank driven down to a depth of 4 or 5 feet, with the joints as close as possible, and they would be the better of being lined with some light stuff ¾ of an inch thick. Posts of 12 inches square should be framed into the first row of outside sills, on both sides, all the way across the dam, from bank to bank, and a distance of six feet apart. They should each be locked with braces extending two-thirds of the length of the posts where they should be joined together with a lock instead of a mortice and tenon, with an iron bolt of an inch in diameter going through both and fastened with a nut. I prefer a lock joint to mortice and tenon for the following reason: The tenon soon becomes rotten, and the brace becomes useless in a few years. This brace should be set at an angle of about 55 or 60 degrees, with the other end morticed into a sill with a two inch mortice; being covered with the dirt, it will not decay, as the air is excluded. The braces require to be about 8 by 6 inches and 15 feet long. The posts should be capped from one to the other, plate fashion; then the posts should receive lining of 2 inch plank on the inside next the dirt of both sides, pinned fast to the posts.

If the stream afford a great deal of water, I should recommend the dam to be built in two sections, as above described, which should be divided by a waste way for the surplus water, which should be located in the centre of the dam and of about sixty feet wide. For its construction, I should recommend the depth to be from the bottom of the dam in the following manner: Let each section of the dam form a butment next the waste way, by placing sills four feet apart the length of the waste way; in each of these sills posts should be framed, with a brace for the sides. These rows of posts standing right across the dam, will form two sectional butments of the dam, and the middle one may be constructed by being braced lengthwise of the stream with short braces to avoid being in the way of drift wood passing down stream, it being necessary for string pieces for a bridge. Then those sills should be covered with an apron of two inch plank, joined perfectly straight, extending at least 40 feet below the dam, to carry off the water at such a distance to prevent an undermining of the dam, by having the foundation washed away, which the water will certainly do if allowed to fall on the soil too near the dam. The planks which are used for the purpose of lining the posts which form the butments of each section of the dam and the ends of the waste way, should be jointed, tongued, and grooved, to prevent the slightest leakage.

Every thing of importance being completed, the dirt should be filled in with teams, as the more it is tramped the better. Clay or coarse gravel is the best soil to use. Proper sized gates may be put in on the upper side of the waste way, about 3 or 4 feet wide, to a level with low water mark, not to be raised except in times of very high water, as the proper height of the mill-pond should be regulated by boards placed over the gates for the desired head, as the water should be allowed to pass at all times freely over them.

This is the description of a frame dam which the author built. It gives the greatest satisfaction, it being proof against the attacks of musk-rats, which prove such an annoyance to the miller. Located in a country where those animals abound in great numbers, my dam has been built about seven years, and has not given way once in that time.

ON THE DIFFERENT KINDS OF SMUT MACHINES IN USE, WITH RULES FOR MAKING THE SAME.

THE smut machine is used for separating smut and all other impurities from the wheat, and is a necessary machine for all mills making good flour. But the kind of smut machine which should be used for that purpose, is difficult to find among the hosts of recent inventions, as every late invention seems to be got up more with the view of a *shaving* machine than for the purpose of separating smut from wheat, for which they are disposed to the miller.

The most of those inventions that I have seen in use, are constructed of cast iron, which soon wear smooth, and are then rendered useless, for the want of a sufficiently rough surface to scrape off the smut from the grain.

Another great difficulty exists with those kind of smut machines. They all require too great a velocity, which produces more friction than there ought to be produced, where there is so much light combustible material, as chaff, &c., eight hundred revolutions per minute being the motion they require.

I have constructed a smut machine which is very simple, and safe from fire occasioned by friction, as the motion does not require over 500 revolutions per minute for the smallest size, and 400 for the largest size. It is nothing more than an improvement on the old cone machine, the only difference being, that in my machine the cylinder differs by its being made so as to produce a strong current of air, which acts on the wheat as it passes through the machine, and forces it through the concave, which is made of Russian sheet iron, perforated with an oblong punch. We here give the dimensions of a machine that will clean about 30 or 40 bushels per hour.

The bottom should be 30 inches in diameter, and the top 18 inches in diameter, and 36 inches deep, which gives the proper sized concave. The cylinder should be constructed on an iron shaft, which should be turned at both ends, one end to a proper point, which should be pointed with a good cast-steel point, fitted to run perpendicularly. The shaft should be two inches square. The cylinder should be solid, in the following proportions: The bottom 20 inches in diameter, and the top 12 inches; then fit on 15 beeters, or wings, made out of heavy band iron, wide enough to fill up the remainder of the concave, giving each wing about one-half inch from the concave, which would leave each wing 4¾ inches at the bottom, and 2¾ inches at the top. In putting on the wings, one edge should be turned so as to form a right angle with the wings, and about an inch wide, with holes sufficient to screw them on to the cylinder with the flanges screwed on the opposite way from which the cylinder runs. The band pully should be on the top of the machine. When the machine is ready to set up, it should bolted down on a square frame, made to receive it, two feet from the floor, and this frame should be enclosed with No. 12 wire, so as to allow the air to the machine. I prefer having the top and bottom segments made of cast iron instead of wood, with 3 sockets cast iron, in each half of the top and bottom segments. The sockets should be about 2 inches square, to receive the ribs that form the concave that the sheet iron is screwed to, which would be six in number. Cast iron will last much longer than wood, and is made in one-half the time. After the patterns are made for the castings, the cost of one of these smut machines is not over fifty dollars, and can be made by any millwright. They are used in some of the best merchant flouring mills in the States of New York and Ohio. The wheat ought to pass through a blower before it arrives in the garner over the stone. If the wheat passes from the smut mill through the spout into the garner, then it will do to have a small blower directly under the smut mill, but if taken from the machine by elevators, the blower ought to be erected right over the garner that feeds the stone, as dust is always settling about the elevators.

This smut machine is the cheapest for all kinds of mills, from the smallest grist to the largest flouring mill, being free from all unnecessary friction, and when smooth is easily sharpened by punching over, until the sheet iron is worn out, which will last three or four years, and can be replaced in a short time when worn out. From an eighth to a sixteenth is wide enough to punch the sheet iron for the concave.

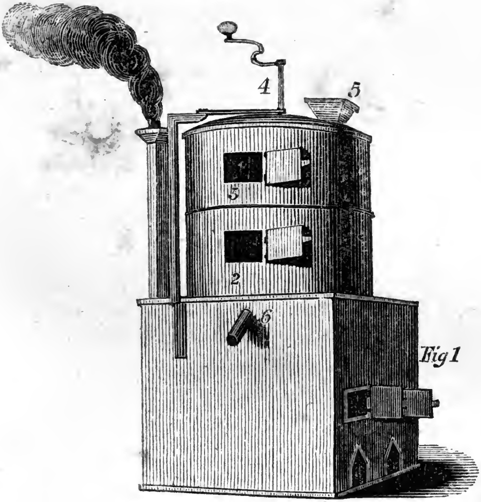
REMARKS ON A LATE INVENTION, OF INTRODUCING AIR BETWEEN MILLSTONES, WHEN GRINDING.

THIS invention was patented a few years ago, by a miller, in the State of Ohio; and from the ingenuity displayed in the contrivance, promised a flattering hope of its utility as an assistant means in having the meal cooled in the operation of grinding; but this artificial means of using air between the millstones must prove a failure, and the reason is, it comes in contact with two essential principles of natural philosophy,—the first being that of friction, and the second, the natural and only element of friction, heat. The inventor should have first examined the natural laws by which friction is produced, and then he could have clearly seen the impossibility of suppressing the heat of millstones while performing the operation of grinding; as every intelligent miller must know, that pressing grain between two millstones creates the very agent that performs the grinding, being friction, and as heat is the element of friction, the amount of friction produced by a millstone when grinding, is as the square root of the amount of pressure used; consequently, the amount of air necessary to repel the heat produced by the friction of grinding, would have to be great enough to blow the stone off the cock-head. Our remarks on this subject are based on natural philosophy, together with an examination of the invention in operation. The mode of using this artificial air between millstones, as applied by the patentee, is extremely simple, a good feature in this principle, as the expense of the contrivance is small. A large bellows is placed in the cog-pit, conducting a given quantity of air into four attached pipes which enter the millstones through the corners of the bush, the pipes being sunk as deep as is necessary in the four leading furrows nearest the corner follower of the bush in the head stone, and open at the ends of the pipes to admit the passage of the air. This is only an outline of the principle, being sufficient for our purpose, to convey a proper idea of the application and use of the invention, for the use of all those millers who have not examined the invention personally. The author refrains from passing any decided opinion on this invention, out of motives of delicacy to the patentee, as well as other proprietors; but we consider that this invention would be more useful as a means of cooling the flour or meal, by having it applied in the cooler instead of the stone. We think that one-fiftieth part of the air applied in the cooler, or hopper, would effect the cooling of the meal more than it is possible for it to be done as applied through the stones; and we see no reason to prevent its being useful in moist sultry weather, when applied in the cooler, by making the temperature of air below that of the surrounding air outside, and the meal must bolt cleaner, and in some cases better, than without this artificial mode of conducting the air to the cooler.

A DESCRIPTION OF THE AUTHOR'S GRAIN-DRYER, PATENTED 1850.

THIS machine is constructed in the following simple manner:—It consists of two or more stationary cylinders, one above the other; and by the use of double transverse rakes, the grain is passed from the top cylinder to the bottom, and from that to the millstone, from which, after being ground, it passes into a bolt made expressly of fine brass wire. This machine is heated by an ordinary common furnace, on which the machine is built. The machine is constructed of iron entirely, and in the most durable manner.

Having examined various machines for the same purpose, the author feels assured that his machine will extract the oil and moisture from Indian corn better than any other contrivance for a similar purpose, for the following reasons, namely: That, owing to its peculiar construction, a great heat can be brought to act on the grain in the last stage of drying, or, in other words, the different degrees of heat which the grain encounters, on this principle of stationary cylinders, is more beneficial than if the degrees of heat on each cylinder was equal, as the heat on the bottom cylinder is always the greatest, and which acts on the grain last. This is a principle which my machine commands over all others. Next, the combination of stationary cylinders being such as to allow the heat to act on each other, as the number of cylinders above the bottom are all punched so as to



HUGHES'S GRAIN DRYER.

Plate 4.—p. 120.

admit the heat to operate on each in succession; also, it being constructed out of material which renders it fire-proof.

It is entirely an original invention of the author, perfectly simple in its construction, and will make a decided improvement in that great staple production of the soil of most of the States of this Union: as, from the nature of Indian corn, without being properly dried, it becomes an article of dangerous investment in commercial trade, for either the miller or merchant. In warm weather it will heat and sour before it reaches market, which prohibits the merchant from operating largely in the purchase of this grain until late in the coming season; consequently, our farmers receive no return from this crop until so late a period in the following season, that the country generally, does not realize one-half the benefit from this extensive crop. A knowledge of the importance it would be to those States that raise large surplus quantities of this grain, so much wanted in other countries, induced the author to construct some means for accomplishing what he conceives to be a great end or improvement in this particular, which will dry from one hundred to one thousand bushels of corn per day, with one machine. Every intelligent farmer will acknowledge the benefit derived from my invention, which will enable him to receive the full value for his corn crop, by making it an article of immediate demand, either by the merchant or miller, who buys it for export. The price of Indian corn, in all our western markets, is always, in the fall and winter, lower than western farmers can afford to raise it for; and always will be, until it can be properly manufactured at home, and sent to our commercial cities for export in a situation that will warrant capital being employed in the purchase of it. For such is our machine intended.

According to chemical analysis, corn contains a proportion of moisture double that of any other of the cereal grains, and retains it during its natural existence. As oil is a large portion of its component parts, it prevents the moisture from evaporating, except by artificial means.

My invention may also be profitably used in drying wheat, as well as corn, and save a large amount of capital frequently lost by those who deal largely in this kind of produce. Wheat should unquestionably be dried before it is ground, if the flour is wanted to keep any ordinary length of time, particularly for export. It will also yield much more flour per bushel, and require about one-half the machinery to manufacture it that it otherwise does where it is not dried. The quality of the flour is improved at least ten per cent., as, by drying the wheat, all impurities of a vegetable nature are entirely consumed; and by extracting its natural moisture, the flour will consume, when baked, more water than it would before the grain was dried, which makes the bread much more palatable, it being more spongy than bread made from flour of any climate; and if proper care is taken to dry the barrels over a charcoal fire previous to packing, the flour, will remain sweet for years, and stand the salt water equally as well as a barrel of beef or pork.

For further information on this subject, the reader is referred to an article in this work by Professor Burke, taken from his Report to the Commissioner of Patents of the United States, for 1848.

RULES FOR THE PURCHASE OF WHEAT FOR MILLERS' USE.

THIS is a subject of much importance to both the miller and farmer, as well as all others dealing in wheat —the standard weight of which is held at 60 pounds per measured bushel of 32 quarts. But the deleterious effects to which this crop is so often subject, cause frequent disappointment to both miller and farmer, by wheat crops frequently falling short, (per measured bushel, of this referred-to standard weight,) and renders necessary some plan for the benefit and protection of both parties.

In a great many of our milling establishments a rule of *dockage*, as it is termed, prevails, in the following proportion: For every pound that the measured bushel falls short of 60, one pound is added to make up this shrinkage, as in the case of wheat weighing but 56 pounds per measured bushel, 64 is required, and in like proportion as the case may be. Now this plan of dockage I should not at all recommend, from the fact that it raises a prejudice, in the minds of farmers generally, against the mill, wherever this plan prevails. As the difference in judgment of the buyer and seller of this article conflicts so frequently, the deduction, according to the foregoing rules, does not at all suit the views of farmers generally.

To obviate this difficulty, I should recommend the miller to deal in the article of wheat as the merchant does in the article of calicoes, broadcloths, or any other description of goods, whose relative value is fixed according to its quality. This I deem to be the true and general rule which should be adopted by all merchant millers. The only exception which should be taken to this plan is when the miller does custom flouring; that is, where farmers have their wheat floured by the barrel on their own account; and in this case, only where the farmer has the miller restricted as to the number of bushels of wheat allowed for each barrel of flour. There are many seasons that wheat overruns its standard weight, and as frequently it falls short of it. When the grain is well filled, it is to the advantage of the farmer more than the miller, as good plump wheat, well cleaned, generally overruns some two or more pounds per bushel, measured according to the species.

The different species of wheat require also to be considered in the profits of millers, as the yield of flour of each is as varied as the different samples. This is the result of simple experience, which millers are all more or less acquainted with. That sample of wheat which weighs heaviest does not always make the most flour. For, as a general thing, the sample of wheat called Mediterranean, for actual weight, exceeds by some pounds any other sample. In this particular, now, most millers know that this is not the description for merchant flour, from the fact that it is of a coarse, hard nature, difficult to grind, and always bolts so very free that the flour is quite specky, and partaking entirely of the farinaceous substance more than any other of the kind, besides containing less starch than most other samples of wheat. But, as regards its nutritious qualities, it is inferior to none of the wheat species. It contains about 20 per cent. of gluten, which makes it a desirable sample for family flour and home use. But being so far below other samples in the quantity of starch, which tends to give the berry a dark appearance, renders it comparatively useless for transportation, the flour having a coarse, specky appearance, which tends very much to injure its sale.

As regards the best quality of wheat for millers' use, I recommend the Michigan White Flint, it being superior in richness, containing much less water and more gluten than other qualities grown in the Western States. There are of this species two distinct kinds—namely, the large White Flint and the Michigan Dwarf; the latter being of a more delicate and rich quality of wheat, and producing flour of the best quality. At the exhibition of agricultural specimens by the Michigan State Agricultural Society, in 1849, at the city of Detroit, these two last-mentioned samples of wheat took first and second premiums, in preference to all others exhibited—the author being the exhibitor of the Dwarf White Flint, and received the premium for the same.

This seems to be particularly adapted to the luxuriant soil of Michigan; and if it were possible to deliver it in the New York market in the same state of neatness that Oswego and Genesee flour is brought to that market, Michigan flour would justly merit the preference. But the distance being so much greater, and reshipping so frequent, by which the barrels become racked and soiled to that extent, that the western miller has those difficulties to contend with, that are entirely unknown to millers in western New York. For it is a notorious fact, that the heaviest milling establishments in New York are almost exclusively supplied with western wheat, and principally of mixed qualities, from spring wheat upwards, and from which the Genesee flour is principally made. But its going to market in such a nice clean manner is the sole reason of its generally commanding a better price; which fully corroborates the old proverb: A man is known and respected in proportion to the quality of the cloth in the coat that he wears; and a maxim of philosophy extensively countenanced by all city flour inspectors, whose judgment is more frequently guided by the outward appearance of a barrel of flour, than by the contents and quality of the interior, which, for some years past, has operated very much to the disadvantage of all western millers who had not, until recently, a flour agent to receive and dispose of their flour for them, which was actually necessary in New York markets. By a wise legislative act, the office of public flour inspector is now abolished, which tends to place western fancy brands on a par with stately Genesee, which, previous to this, was not the case.

See article on the inspection of flour.

THE PROPER METHOD FOR FITTING THE BALE AND DRIVER TO THE MILLSTONE.

THIS operation of fitting the irons in millstones requires a great degree accuracy in the millwright. In the first part of the process, the gains should be laid from the exact centre of the stone, for both bale and driver. If the old-fashioned transverse driver is used, it is better to have boxes to drive against. After these gains are ready to receive their irons, the bale should be first inserted, and fastened to the centre. Before the bale is inserted to its place, great care should be taken that the gains which receive it are smooth at the bottom, and exactly of the same depth; for if the bale is not perfectly level at each end, the stone cannot be made to drive true, and will always get out of balance as soon as it is set in motion, which causes a great deal of trouble to the miller to keep the spindle-neck tight. Then place the bale in the gains. The stone being level, fasten a small board in the eye of the stone—called the centre-board; then find the exact centre of the stone on the board, bore a hole large enough to admit a plumb-line through, with a ball and fine point; then move the ball until it agrees exactly with the plumb-points; then it is supposed to be in the centre of the stone. Make it perfectly fast with iron wedges, tapered a little for the purpose; then fasten the boxes to the driver by means of four wood wedges, allowing at least one inch at each end, and one inch on the reverse side from which it drives, for play room. Then insert the driver and boxes into the gains prepared to receive them. Place the spindle into the irons, as when running, and make a tram to go from the spindle-neck to the periphery of the stone, similar to the one used for tramming the spindle to the centre of the bed-stone, with a piece long enough to go through the sweep and extend perpendicularly to the spindle point, where it should go through a small transverse cap, that plays on the spindle point, seven inches long, with a hole through it to receive the point of the spindle.

This is what is called a tram for placing the driver in its proper position. To drive the stone by them, turn the sweeps, moving the driver by iron wedges driven between the stone and boxes, until the quill touches alike all around the stone. The spindle should be held perfectly plumb until completed. Take some dough or clay and plaster it well on the outside of the bale and driver, to prevent the bed from running out, as it is poured in around the irons. There is another kind of driver used, which drives by the bale, called a swallow-tail driver. This kind is the best, as it saves cutting away the stone from the eye, where it is so much wanted, and is trammed to drive just as the other kind, by chipping away the touching parts till it trams perfectly with the driver and the bale. It requires room for play, just as the other kind, and is much better as a driver, by its not taking up so much room.

REMARKS ON PACKING FLOUR, WITH A PACKER'S TABLE FOR THE SAME.

As one branch of the business connected with the flouring mill, the packing requires some attention to its department; in particular, cleanliness on the part of the packer cannot be too strictly recommended. The next point in connection, is the necessity of properly preparing the flour barrels, by setting all the hoops before nailing, and then using just enough of nails in each barrel, which should not be less than one dozen. Then, before the flour is put into the barrel, each mill should be furnished with a portable coal furnace, and each barrel should be well aired over this fire previous to its being packed. This will purify the barrel of all acids, and gaseous substances, which tend to sour the flour, by lactic acid fermentation, which is generated from substances in oak timber if not thoroughly dry. In marking the tare on the barrel, it should be done on the scribed end that is taken out. In weighing the barrels, some mills make a rule of deducting one pound for the shrinkage of the same, but in all cases the full amount of flour should be allowed, with one and one-fourth pound for waste. This will tend materially to the credit of the mill in establishing a straight brand. Flour barrels packed in the

Western States require to be somewhat heavier than those used nearer market, and well hooped, with the chime hoops one and a quarter inches wide, weighing from eighteen to twenty pounds.

PACKER'S TABLE.

Weight of bbls.	Tub weight.	When packed.
15 lbs	0	211 lbs.
16 lbs	0	212 lbs.
17 lbs	0	213 lbs.
18 lbs	0	214 lbs.
19 lbs	0	215 lbs.
20 lbs	0	216 lbs.
21 lbs	0	217 lbs.
22 lbs	0	218 lbs.
23 lbs	0	219 lbs.
24 lbs	0	220 lbs.
25 lbs	0	221 lbs.

REMARKS ON BRANDING FLOUR IN BARRELS.

THIS part, although frequently done carelessly, without sufficient attention to its neatness, requires the miller's attention, to see that the quality of the flour is equal to the insignia it bears. This is an essential which every respectable mill should keep inviolate. All good mills of first class should have at least two brands, superfine extra, and superfine. First quality wheat, if manufactured properly, will bear the extra. Inferior wheat will not, and second grinding should never be branded higher than fine in any case. I also recommend two colours for the brands of each mill: Venetian red for second brand, and light blue for first brand, mixed with spirits of turpentine, put on with a soft brush, and branded on the opposite end from the one marked with the tare.

The packer should have a similar table to this in front of his scales, with the weight of the tub included.

MAUKS'S PATENT BOLT.

THIS principle of constructing bolts has been but lately introduced to the milling public, and called by the inventor, a hot bolt. The term hot we have omitted. We consider the improvement regulated entirely by a good principle of natural philosophy, as the bolt is placed in a cylinder, air-tight, which prevents any pressure of the surrounding atmosphere on the outside of the bolting-cloth, and forms a draft from the inside of the bolt. As large quantities of air, brought from the stone and elevators into the bolt, give an outward pressure, by which the meshes of the cloth are always kept open; consequently, a bolt constructed in this way will bolt nearly as fast again as the old plan of construction.

But it can make no difference as to the state in which the meal is in, whether hot or cold, if ground properly; and in all cases bolts faster and more freely where the meal is cool than otherwise, as it is known the finer the meal is ground, the more the natural element of moisture, which the grain contains, is extracted, which gives flour that savory feeling when ground too fine, that operates like paste on the bolts. This invention does away with a great many useless wheels, and tends to improve the power thereby. But when adopted for merchant flour, I should prefer the conveyor, which conducts the flour, to be separate from the bolt, as used by the inventor.

ON THE INSPECTION OF FLOUR.

THE duty of the flour inspector is one which requires a vast amount of experience in the different qualities of flour, to perform it properly; and no inspector of flour should be allowed to hold that office, who is not a practical miller; and as public officers of inspection are fast going out of date, much to the credit of those States where this office, as a public one, is abolished, millers generally will stand a better chance in this respect. It is absolute nonsense, to have a person authorized by legislative enactment, to pass his judgment on this great staple of our country. We might just as well say inspectors are necessary to inspect cloth, cotton, or any other article that the merchant has to sell. But almost any man may be his own inspector, if he considers or becomes acquainted with the essentials requisite to be considered in inspecting flour, and they are—first, colour; the degree of fines, next; and these constitute the leading principles of inspection. For all samples of flour that possess a bright-orange cast, and feels lively, and possesses a fine grit on feeling it between the thumb and forefinger,—such a sample as this does not require four cents per barrel for an inspector to say that it is good. If the flour is too specky, it will not possess the bright-orange cast, as described, but exhibit a grayish colour, soon detected. But specks in flour, when it does not change the colour of it to a gray, is no injury, but an advantage,—for the flour contains more nutriment, when made on No. 8 bolting-cloth, than the finer texture,—as the speck of flour is generally composed of the glutinous substance contained in the wheat, and gives that body to flour made on No. 8 cloth, which flour made on finer cloth does not possess. Finer bolting-cloths allow all the starchy part of the wheat to pass through them, being always pulverized finer than the gluten, which is tougher and more elastic; and the less of the latter, the more valuable; and I further lay it down as an established fact, that flour possessing a good rich orange-colour should never deter the purchaser from buying it, specks to the contrary notwithstanding.

For the accommodation of dealers in the staple of flour, a better plan can be resorted to than the old system, of maintaining an officer for that specific purpose, as follows:—The board of trade in each commercial city should have a register of all flour-brands coming for sale to their particular markets. This register should state what State and county said flour came from, the name of the mill, and all particular marks on the same, and also the quality of said flour when registered, in the following style,—as fine superfine No. 1, No. 2, No. 3,—these being the highest, or extra grade. This system would have a desired influence, as by it all persons could have the character of their particular mills fully established, according to the quality of their flour. This register should be established by some municipal law, and monthly report of said register be made and published by the leading commercial papers of the city, or market, where such register is kept.

Any city or market adopting the foregoing observations, would insure a benefit equal to that derived now from the use of the bank-note detector.

REPORT

On the Breadstuffs of the United States,—their relative value, and the injury which they sustain by transport, warehousing, &c.—By LEWIS C. BECK, M. D.

RUTGERS' COLLEGE,
New Brunswick, N. J., Dec. 15, 1848.

SIR :—I beg leave to submit, in as concise a manner as possible, the results of my researches in regard to the breadstuffs of the United States, since April last. The work has been prosecuted in accordance with the instructions which I have received from you: and I hope its execution, thus far, will commend itself to your favour and to that of the public. Being impressed with its importance, I have spared no pains to prepare myself for the faithful discharge of the trust with which you have been pleased to honour me.

I deem it proper to state distinctly, that my constant aim has been to render this investigation useful. My object has been to show, in the simplest manner, and with as few technicalities as possible, how the value of the various breadstuffs may be determined, their injury guarded against, and their adulterations detected. Whilst I am by no means insensible to the importance of accuracy, and yield a willing homage to those who are engaged in minute and careful analyses, I supposed that the purpose which you had in view would be best accomplished by the employment of such processes as may be easily understood, and even repeated, by all those who feel sufficient interest in the subject to read the description which I shall give of them. I concur entirely in the remarks made by a reviewer of the first report on coals suited to the (British) steam navy, "That the neglect of government to aid science is due, in a great measure, to the mistaken views of scientific men. They have too often overlooked or disregarded those matters which have a practical tendency, which politicians alone consider of importance."—"Men engaged in maintaining the balance of power and regulating the complicated machinery of a great commercial and manufacturing commonwealth, however capacious their minds, cannot be expected to entertain the theoretical views of the philosopher, who sacrifices his knowledge of the world to his love of science."

I thought it proper thus to announce the plan which has been adopted in these researches, to render them useful to the *many*, without attempting to make additions to the already accumulated stores of the *few*. As the people, through their representatives, have furnished the means for carrying on this work, they are entitled to receive all the benefits which are to be derived from it.

I have only to add, that my attention, thus far, has been almost exclusively directed to wheat and wheat flour. I propose, during the next year, should the work be continued, to extend the examination to such samples of these as may hereafter be received, and then to proceed to that of maize and maize meal, which have recently become such important articles of export.

I have the honour to be your obedient servant,

LEWIS C. BECK.

To the Hon. EDMUND BURKE,
Commissioner of Patents.

REPORT.

AGRICULTURE, commerce, and the arts constitute the chief business of the industrious portions of our race, and it is to the physical peculiarities of a country that we are chiefly to refer the predominance of one or other of these pursuits. Thus England, with her vast mineral wealth and her dense population, must, almost of necessity, be a manufacturing nation; and, although she is also noted for her extended commerce and her improved agriculture, the great attention which she has paid to the latter may, perhaps, be fairly ascribed to those peculiar views concerning the interchange between nations which have heretofore prevailed. The rich and valuable mines of the central portions of the continent of Europe, and the numerous arts which can flourish only in their immediate vicinity, must ever give occupation to a large portion of their inhabitants. Comparatively few commercial advantages are enjoyed by them, and the produce of their agriculture seldom rises above the amount which is necessary for the supply of their own immediate wants. In all these countries, therefore, the failure of a single crop is the cause of serious apprehension, and in some of them, as in Austria, although a large proportion of the population is engaged in agriculture, there is need of a yearly importation of breadstuffs. This has been ascribed to a defective mode of tillage, but I am inclined to believe that it arises, in part at least, if not entirely, from the high price of the land. It is the large returns which the farmer must extort from the soil in order to meet the interest of the heavy investment, which discourages him in his efforts, and which at length has the effect of diminishing the amount of the agricultural products. All the appliances of science and art may be called into requisition to increase the yield of the soil, but every improvement of this kind only increases the price of the land and amount of rent which must be raised from it. When we look at the contrast which the United States present in this respect, we need not wonder that, while travellers speak in raptures of the agriculture of France and Belgium, Germany and England, the famished population of some of those countries has been fed by the surplus produce of a comparatively rude mode of tillage.

During the year 1847, breadstuffs to the value of $43,000,000 were exported from this country to Great Britain and Ireland alone. The vast agricultural resources of the United States were then for the first time duly appreciated. Notwithstanding the quantity exported during the present year bears no proportion to that of the preceding one, there can be little doubt that our country is destined to be the *granary of the world.* We cannot boast of those mineral riches which are found elsewhere; still, deposits of iron ore and coal, those most valuable products, exist here in great abundance.* But our chief treasure is the soil, and the immense extent of our republic, and the liberal policy which has been pursued in regard to the disposition of its lands, places it in the power of almost every inhabitant to become the owner of a domain, which in Europe could be possessed only by a favoured few.

It is a common mistake that land which is in the

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* We must respectfully dissent from the learned professor in this part of his report, believing as we do, that no portion of the globe, known to either the ancients or moderns, surpasses the United States in the richness and purity of her minerals; not even the gold of Ophir and Tarshish will bear comparison with the products of the El Dorado and Sacramento of California.

highest state of cultivation, and yields the largest crops, is necessarily the most valuable. It is stated by Boussingault, that a field in the neighbourhood of Pampeluna, where the rent of land is extremely low, gave a profitable crop of wheat, although the yield was not more than from six and a half to seven and a half bushels per acre, "An English farmer," says Washington, in a letter addressed to Arthur Young, "must have a very different opinion of our soil when he hears that with us an acre produces no more than eight or ten bushels of wheat; but he must not forget that in all countries where land is cheap and labour is dear, the people prefer cultivating much to cultivating well."

It is this very extent of our country, and the cheapness of the land, which now, as at the date of the letter of Washington, contribute to render our comparatively rude culture the most profitable in the world. Thus, while the average of the produce of wheat in the United States is not probably above 15 or 16 bushels to the acre, that in Germany is more than 25 bushels; in England, 25 or 26; and in France, 24. Still, as has been already stated, the amount of breadstuffs raised here, far exceeds that produced in either of the countries above named. And the same consideration, viz. cheapness of land, together with the rapid and cheap rate at which, by machinery, the crop is harvested and made ready for the miller, must give to the Western States and Territories great advantages for the cultivation of the cereal grain.

As there is no probability that, for many years to come, our population will be over-crowded, and the price of good cultivable land be much increased, it is easy to see what must become the leading occupation of the multitude who will here seek refuge from the poverty and oppression of other countries. The truth of this proposition will probably be quite apparent to those whose attention has been directed to the subject. But a large number of our citizens have no just idea of the agricultural resources of the United States. One object of this report, therefore, is to spread out the facts, and to give them the widest publicity; to show, indeed, that while commerce and the arts must give employment to a great number of persons, our great business is agriculture; and that the true interests of the country will be promoted by giving to this pursuit all necessary encouragement.

I have said that our mode of culture is still comparatively rude. It was quaintly remarked to a traveller, by the gardener of Drummond Castle, that, "If science once gets into the farmer's ground, it penetrates into the very heart of a nation." This is perhaps true; but it must be confessed that, thus far, the influence of science upon agriculture has been very trifling, when compared with the vast improvements which it has effected in the arts. The difference proceeds principally from two causes, assigned by Count Chaptal: "The first is, that the greater part of the phenomena offered to us by agriculture are the effects of the laws of vitality, which govern the functions of plants, and these laws are still, in a great measure, unknown to us; whilst in the arts, which are exercised upon rude and inorganic matter, all is regulated, all is produced by the action either of physical laws only, or of simple affinity, which are known to us. The second cause is, that, in order to apply the physical sciences to agriculture, it is necessary to study their operations profoundly, not only in the closet, but in the field." It will not, therefore, appear surprising that the researches which have been made in regard to plants have often assumed a wrong direction, and have not led to those important results which were promised upon the one side and expected upon the other. Thus most of the analyses of the proximate principles of plants, not having been made upon such as are in a perfectly pure state, are to be considered only as approximations of the truth. The same remark will, in a great measure, apply to the numerous determinations of the quality and quantity of the ash obtained by the combustion of the grains used as breadstuffs. "The grain is an assemblage of various distinct parts, differing from one another in composition, and varying also very much in their relative proportions. So, also, the dried stem of a plant, the entire straw of a cereal grass, may be burned in like manner. But this, too, is an assemblage of many parts. The exterior less vascular portion, the interior full of vessels, the fluids which circulate through them, all contain their peculiar inorganic substances, and all vary almost endlessly in their relative proportions."

Similar objections might be urged against the analyses of soils, which have been so vigorously prosecuted by many chemists. That the facts which have thus accumulated may have some value, is not to be doubted; but they must, after all, be considered as only introductory to researches conducted with a more just appreciation of their true influence upon the improvement of agriculture. It is to be feared that, in many cases, these almost useless labours have been suggested by the crude and hasty generalizations which, unfortunately, within a few years past, have too often usurped the place of patient inquiry. A recent writer has well observed, that, "Of the classes which have been thus led away, there has been none which has been so far misguided as the sober one of farmer. It is to him that the vegetable quack appeals, offering, in the application of chemical manures, electricity, magnetism, and other agents, harvests more golden than the world had ever seen before."

I trust it will not be inferred from any of the remarks which I have made, that I undervalue the importance of physical science in the improvement of agriculture. On the contrary, I doubt not that, with a right appreciation of its objects and a true direction of its labours, it is destined to contribute greatly to increasing the productiveness of the soil. But such results cannot be immediately realized. "Years of experiment must pass by, numerous failures must be experienced, before the real advantages of scientific farming will be evident." It is sincerely to be hoped that the false expectations which have been, from time to time, held out by visionary men, may not have the effect of exciting, in the minds of agriculturists, a prejudice against all the improvements which may hereafter be proposed.

The chief breadstuffs of the United States are wheat, rye, maize, and buckwheat. Of these, the first is by far the most important, and it is to its history, culture, and chemical examination, that particular attention is now to be directed.

Wheat.—Wheat is the principal breadstuff of the United States and of most European nations. This, as well as the other cereal grasses, has probably come to us from the East; but it has been so much changed and improved by culture, that its connection cannot be satisfactorily traced to any species of the genus now known to be growing wild. Of all the cereals, it is that which requires most heat, and its culture first begins to be of importance below 60° north latitude in Europe, and considerably below that line on our continent. From the meteorological observations which have been made, we infer that a mean heat of at least 39° Fahrenheit is necessary for the growth of wheat, and that during three or four months. The mean summer heat must rise above 55° Fahrenheit. It does not, however, bear tropical heat well; in countries within the tropics, it first occurs at altitudes which, in climate, correspond with the sub-tropical and temperate zones.

There is a fact stated by the author just quoted which exhibits, in a striking manner, the advantages our country must possess for raising and transporting the produce of this important cereal. It is, that although wheat is very productive and of excellent quality in Chili and the Republic of Rio de la Plata, and immense quantities are sent to Peru, and even around Cape Horn to Rio Janeiro, yet North American flour is sold at the market of Valparaiso, and the bakers are obliged to buy it, as it is cheaper than the flour made in the country, because there are no roads in the interior, and wages are exceedingly high from want of sufficient hands.

There are few parts of the United States in which wheat may not be raised; but the productiveness of the crop is influenced by various circumstances, as soil, climate, and expense of transport to the great commercial depots. These, and the more profitable cultivation of other articles, as tobacco, rice, cotton, and the sugar-cane, have nearly fixed the southern limit of the wheat-growing region of the United States in North Carolina. The particular districts, however, in which the culture of this cereal is most successfully prosecuted, are the western parts of New York and Pennsylvania, Ohio, and the north western States and Territories. The rich and virgin soil of the western prairies seems to be peculiarly adapted to the growth of wheat; and the great lines of communication which are already established between these and the Atlantic cities afford every facility for the transport of the surplus produce.

It has been already remarked, that the profits of the culture of this cereal do not depend upon the yield per acre, but upon the cheapness of the land and the economy practised in its management. The want of precise information upon these cardinal points renders the statements which have been made, in regard to the productiveness of wheat in various parts of the world, of little practical value. Thus, when we are told by Meyen that in Prussia the average produce of wheat is not more than five or six fold of the seed; that in Hungary and Croatia it is from eight to ten fold; and that in some parts of Mexico the produce in favourable years is from twenty-four to thirty-five fold;—the information is of no use to the farmer, because the relative expenses of the culture and the value of the crop are not stated.

Notwithstanding what has been said concerning the profitable culture of wheat in large portions of the United States, and the probability that the great West will hereafter furnish the principal supply for export, we should by no means overlook those causes which exert an influence upon the productiveness and quality of this grain. It has been ascertained without doubt that the real value of wheat, and of the other cereals and breadstuffs, depends mainly upon the proportion of gluten and albumen which they contain—their starch, glucose, and dextrine, or gum, not being considered nutritive. It appears, also, that wheat exceeds all the other cereals in the quantity of nutritive matter which it yields. Another advantage which it possesses is, that it furnishes also a greater quantity of flour; for fourteen pounds of wheat yield thirteen pounds of flour, while fourteen pounds of oats yield only eight pounds, and an equal quantity of barley but twelve pounds.

That wheat is peculiarly sensible to effects of soil and climate appears to be a well-established fact. It is stated that even in different parts of England, the crops and their produce are very various. The Sicilian and southern wheat generally contains a larger proportion of gluten than that from more northern countries. This, no doubt, arises from its more rapid growth, its harder and tougher grain, and its less proportion of moisture. Hence, also, it keeps better, and commands a higher price in market, especially when required for exportation. I have reason to believe, however, that the superiority of southern wheat has usually been overestimated, and that the proof almost always adduced of its containing more gluten than that from the north, viz. its employment in the manufacture of macaroni and vermicelli, is by no means conclusive.

One of the most important points connected with the subject of wheat and wheat flour is the proportion of water or moisture which they contain. We have the high authority of Boussingault for the statement, that, in France, "it is undoubtedly in consequence of the the large quantity of water which the northern wheats contain, that we meet with such indifferent success when we attempt to keep them for any length of time in our granaries. The wheat of Alsace, for example, frequently contains 16 to 20 per cent. of moisture; and I have ascertained by various experiments, that it is almost impossible to keep it without change in vessels hermetically sealed. To secure its keeping, the proportion of water must be reduced from 8 to 10 per cent., and this is nearly the quantity of moisture contained in the hard and horny wheat of warm countries.

In five analyses of London flours, by Mr. J. Mitchell, the proportion of water varies from 14.10 to 17.40 per cent.

The proportions of water in the above samples range much higher than those given in the analyses of various flours performed by Vanquelin, which are from 8 to 12 per cent. They are also higher than those in the United States flours, the range of moisture being, in the samples which I have analyzed, from 12 to 14 per cent.

This difference in the proportion of water, which seems to be a matter of so much consequence, is undoubtedly, in part, due to the difference in the climate of the region in which the wheat is grown. This, indeed, is so well understood to be true, that the amount of bread obtained from different kinds of wheat flour is referred to the same cause. Thus "it has been shown, by a comparative experiment tried some years ago upon Scotch and English wheat, of apparently equal quality, that a quarter of the latter, though yielding rather less flour, yet, when made into bread, gave 13 pounds more than the former. This is accounted for by the greater strength of sunshine, under the climate of England, having an effect upon the grain when ripening, which occasions the flour to absorb more water in the formation of dough."

From experiments which seem to be trustworthy, it appears that the Alabama, and the southern wheat flours generally, yield more bread than the northern or western. The gain in favour of the Alabama, as compared with the Cincinnati, is said to be 20 per cent. It is also stated, by one of the most extensive London bakers, that American flour will absorb 8 or 10 per cent. more of its own weight of water, in manufacturing it into bread or biscuit, than the English wheat. The English wheat, of the same variety with the American, is invariably a larger and plumper berry. This is attributed to the longer time required for ripening in that comparatively cooler and damper climate. The American, on the contrary, in ripening under a hot sun, evaporates a large proportion of water, and leaves the farina in a more condensed state; and when exposed again to moisture in cooling, it absorbs the additional quantity above stated. This is an important fact, of which the dealer and consumer should be fully aware.

No apology is necessary for the details which will be presented concerning the effect of water or moisture upon this cereal, as it is a subject worthy of the most serious consideration. Although, as has been observed, the proportion of water in the wheat and wheat flour of the United States is generally less than in those of England, France, and the north of Europe, it is often in sufficient quantity to cause great losses, especially when shipped to tropical countries. So early as the year 1814, attention was directed to this in a valuable series of papers published by Mr. Jonas Humbert, of New York, a large dealer in flour, and at one time a deputy inspector of that article. He states, that since the Revolution, the price of the New York wheat flour, in the markets of Europe and the West Indies, had been gradually falling below that of Pennsylvania and Virginia. He asserts, as the result of his own experiments, that the New

York flour* is equal to that obtained from wheat raised in any other State or country; and he attributes the deterioration in the price of the former to carelessness on the part of those who are engaged in its preparation and shipment. Among the points which he enumerated are, a want of attention to the ventilation and proper drying of the grain before it is ground, the rapid and improper mode of grinding, re-grinding the middlings, and mixing therewith the portion first ground, and also the still more objectionable practice, perhaps still followed, of mixing old and spoiled flour with newly-ground wheat.

It is stated that in Poland, where the ventilation and drying are continued for some time, wheat has been preserved sound and good for half a century; its age never does it injury, and such wheat is said to yield handsomer and better flour than that obtained from the grain more recently harvested. In Dantzic, the preparation for keeping wheat continues for a year, and sometimes

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* We entirely concur with Mr. Humbert in the statement—New York flour being equal to that obtained from wheat raised in any other State; knowing, as we do, that at least one-half of the flour made in that State is manufactured from wheat grown in the western States, Ohio, Michigan, Indiana, Wisconsin, and Illinois; and also the want of proper attention to properly drying the grain before grinding, by which it might be cleansed from all impure substances, occasioned by exposure to dampness, which creates decomposition of the grain, and renders it useless for manufacturing into good flour, without some instantaneous remedy; and drying stops further decomposition.—THE AUTHOR.

longer; after this period, it is often kept for seven years perfectly sound in the large granaries of that place, although surrounded by the sea.

In regard to American wheat and wheat flour, it may be remarked, that the proportion of water naturally existing in them is often increased by carelessness in harvesting the grain, and in its transport and storage. In one sample of Indiana wheat flour recently analyzed, which was sour, and had but little more than one-half the usual quantity of gluten, the injury was probably caused by the hurried mode of packing, for the changes above noticed occurred before the opening of summer. Sometimes, however, our flour is spoiled by being stored in damp, warm, and ill-ventilated warehouses. The books of one inspector of the city of New York shows that, in 1847, he inspected 218,679 barrels of sour and musty flour. He certifies that in this amount he is of opinion that there was a loss sustained of $250,000. But, as no flour that is known to be sour or bad is inspected, this statement gives a very imperfect idea of the loss incurred, even in that city. The total amount of loss for the whole United States, arising from chemical changes in breadstuffs by internal moisture, has been estimated at from $3,000,000 to $5,000,000.

Some remarks upon this subject, recently published by Mr. Brondgeest, of Hamilton, Canada West, deserve to be here introduced. This gentleman has paid much attention to the preservation of food, both as a merchant and as president of the board of trade of Montreal and of Hamilton. He notices an article on the "Preservation of Food," in the January number of the Westminster, the author of which proposes the exclusion of air, by an air-pump or otherwise, as a remedy for injuries sustained by breadstuffs; and very justly observes that these extreme measures are wholly unnecessary, as arrangements perfectly feasible will answer the purpose. He admits the necessity of something being done, as the present system is wasteful, and contrary, in many respects, to common sense; the warehousing of grain is defective in every point of view. The common mode of shipping wheat or other grain in bulks is the cause of injury with American grain, and, I doubt not, also with the European. The emptying of grain loose into barges not over dry; spray and moisture on the voyage to the shipping port; exposure to the weather while being shipped, damp lining boards, damp vessels, damp during the voyage, and then again being exposed in a lighter, and put away in a damp warehouse, or in a low situation on the bank of a river;—all tend to the destruction even of the finest particles of grain.

As remedies for all these injurious influences, Mr. Brondgeest proposes the shipment of grain in barrels, like flour, and the proper kiln-drying of such varieties as are known not to keep well. The souring of flour, either on the river or sea voyage, or after warehousing, he adds, "can be perfectly prevented by the use of the kiln, either to the flour, or the wheat prior to grinding;*

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* In all cases, the drying and extracting of moisture should be done before the grain is ground.—AUTHOR.

one-third to one-fifth of the wheat being highly dried, makes the whole keep perfectly for years; and that third or fifth may be of the cheap spring grain, making much stronger and better flour, but which, if not kiln-dried, would sour the whole."

In the Report of the Commissioner of Patents, dated March, 1844, there are some statements of interest in regard to kiln-dried flour and meal. From these it appears, that Ohio flour, after having been subjected to the drying process, was kept in the southern and South American ports in good merchantable order, and in weather in which other flour not thus prepared invariably spoiled. The process of drying here noticed was conducted by the employment of hot air; and Mr. Gill, who claims the invention, states that 18 pounds of water are thus expelled from a barrel of flour.

There can be no doubt, therefore, that the removal of a portion of the water which wheat flour and maize meal naturally contain, is the easiest and best means of preserving them. But the drying process, simple as it may seem, requires to be carried on with great care. The passage of the grain or flour, however rapidly, over highly-heated surfaces, is apt to scorch, and thus give them an unpleasant flavour. From the rapid evolution of the moisture, in the form of steam, by the heat thus applied, unless proper ventilation be also secured, further injury will probably result. The steam, again condensing into water upon the cooling of the flour, may accumulate in particular parts of the mass operated on, and thus, perhaps, render it at least equally as liable to injury as it would have been without the employment of this process.

Another fact, which I have observed in those samples of wheat flour that have been exposed to a degree of heat high enough to expel all the water, is, that the gluten is less tough and elastic—a proof that its quality has been impaired. It is probable that the proportions of dextrine and glucose may thus also be increased at the expense of the starch. Under these circumstances, a subsequent exposure to moisture and a slight elevation of temperature, establishes the lactic acid fermentation, which, I suppose, is the chief cause of the souring of flour.

The advantages to be derived from artificial drying are more fully attained by the invention patented by Mr. J. R. Stafford, in 1847, than by any other plan with which I am acquainted. It is based upon the process for drying organic bodies usually adopted in the laboratory. The grain or flour is brought into contact with a surface of metal heated by steam, and a due degree of ventilation, so important to the completion of the drying, is secured. As the heat is not raised above that of boiling water, there is no danger of injuring the quality, colour, or flavour of the substances subjected to its action. The heat is, moreover, uniform, and the expense is said to be less than that of the mode of drying heretofore generally adopted. By Mr. Stafford's apparatus, 16 or 17 pounds of water are expelled from each barrel of flour; this reduces the proportion of water to four or five per cent., an amount too small to be productive of injury. Absolute dryness cannot be easily attained, except by a long exposure of the flour to the heat, and it is not required for its preservation; a reduction of the amount of water to the small per centage just stated, has been found to be amply sufficient to secure this object. I cannot, in my opinion, render a more important service to dealers in breadstuffs, than to recommend strongly the employment of this or a similar process of drying.

After the proper ventilation and drying of the grain has been effected, there is still another point deserving of some consideration. This is the absorptive power of the different kinds of flour, which I have found by experiment to be subject to considerable variation. The amount of moisture absorbed by the various samples which have been tried, after having been brought to a state of absolute dryness, ranges from 8 to 11.65 per cent., by an exposure to the air of a room for from 18 to 24 hours. This difference in the hygrometic character of flours must, I think, have an influence upon their preservation, and will perhaps account for the fact, that with the same degree of carelessness and the same exposure, some kinds are more liable to spoil than others. The remedies for all the difficulties to be apprehended from this source, are the employment of tight barrels, and the avoidance of all unnecessary exposure of their contents to the air.

Some remarks may be added, more definitely to explain the various modes in which flour, especially, is injured by the presence of an undue proportion of water, under the influence of a warm climate. The general result is a diminution in the quantity of gluten, or such a change in its quality as renders it unfit to produce good panification. It sometimes also favours the formation of sporules of different kinds of mushrooms, which are afterwards developed in the bread.

Dumas states, that the wheat of 1841 exhibited, in 1842, during a very warm summer, this defect in a very great degree. When these mushrooms were developed, the temperature was much elevated, and the bread soon disappeared, leaving only a reddish and disgusting mass.

The number of sporules was much diminished by the thorough washing of the infected grain, followed by prompt desiccation. By reducing the proportion of water, increasing the dose of salt, and finally by raising the temperature of the oven, the development was in a measure prevented.

A few years since, I observed reddish sporules, similar to those above noticed, in a sample of New Jersey flour. The change took place in twenty-four hours after it had been made into paste with water. On repeating the experiment, the same result followed.

According to Dumas, moisture and heat, which often cause such changes in the most important constituent of wheat flour, produce very little effect upon the starch which it contains. Although it is with some hesitation that I dissent from such high authority, the following facts appear to me to show that this idea is an incorrect one :—

Starch is known to be composed of particles which are insoluble in cold water; but when exposed to a heat of 180° F., the pellicle of the grain bursts, and the contents are liberated. In a state of solution, it is quickly converted into dextrine and glucose, or grape-sugar, by the addition of a small quantity of diastase.* If this mixture be kept in a warm place for a few days, it acquires a new property, viz., that of converting the glucose into lactic acid. This is denominated the *lactic acid fermentation;* and, as I have before suggested, it is probably one of the causes of the *souring* of flour, when exposed to high summer heats in its ordinary moist condition. Hence, it will be found that, while in sour flour the quantity of gluten is usually diminished, or its quantity injured, the proportions of glucose and dextrine are also, in many cases, increased at the expense of the starch—a change which precedes the development of the lactic fluid.

One of the best modes of determining the real value of wheat and other flours, is to examine the bread made from them. The process of panification brings out all their defects; and as the researches upon breadstuffs are conducted chiefly with the view of ascertaining their suitableness for the manufacture of bread, it affords a good standard of comparison for the various samples subjected to experiment. It should be remembered, however, that bread is sometimes adulterated for the very purpose of enabling those who are engaged in its

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* This is a peculiar nitrogenous principle, which exists in the grain of the cereals after germination commences.

fabrication to use the poorer kinds of flour. Thus, Dumas states that in Belgium and the north of France, sulphate of copper (blue vitriol) has long been introduced into the manufacture of bread. By the employment of this salt, the bakers can use flour of middling and mixed quality; less labour is required in its preparation, the panification is more speedy, and by its addition a larger quantity of water is taken up.

The use of alum, in the fabrication of bread, seems to have been practised from a remote period. This, it is said, also secures to the baker the advantage of employing inferior kinds of wheat flour, and even of mixing with the farina of beans and peas, without apparently injuring the quality of the bread.

The alkaline carbonates, the carbonate of magnesia, chalk, pipe-clay, and plaster of Paris, have all been used either to correct the acidity of damaged flour, to preserve the moisture, or to increase the weight and whiteness of the bread. But it need scarcely be observed, that all these substances, with perhaps the exception of small additions of the alkaline carbonates, must render the bread unwholesome. Fortunately, however, the presence of most of them can be quite easily detected.

Other frauds which have been resorted to, are more difficult of detection; but these are, happily, less prejudicial to health, although not always perfectly harmless. Among these may be mentioned the adulteration of wheat flour with potato starch, the flour of leguminous plants, buckwheat, rice, linseed, &c. Mareska, in a recent paper, states that he has had occasion to examine several samples in which these frauds had been practised, and he describes several processes by which their occurrence may be ascertained.

According to a statement made by a quarter-master in the United States army, one barrel of flour, or 196 lbs., when in dough, contains about 11 gallons, or 90 pounds of water, 2 gallons of yeast, and 3 pounds of salt,—making a mass of 305 pounds, which evaporates in kneading and baking about 40 pounds, leaving in bread about 265 pounds; the bread thus exceeded in weight the flour employed, by about 33.50 per cent.

Dumas informs us, that 130 pounds of the common white bread of Paris are obtained from 100 pounds of flour. To this he adds, that the flour contains 17 per cent. of water, the produce being then equivalent to 150 pounds of bread from 100 pounds of flour. As the American wheat seldom contains more than 14 per cent. of water, the statement of the quarter-master corresponds very nearly with that of the French chemists. The increase of weight in the bread over that of the flour, viz., 33.50 per cent., ought to afford an ample remuneration for its manufacture. But it is not unfrequently the case, that larger demands are made by those who are engaged in this important branch of art.

The deficiency in the weight of bread, and the extent of the imposition practiced in the sale of loaves at a certain price, can, in general, be very easily ascertained. For example, the proper weight of the shilling loaf (New York currency) may be determined by reducing the price of flour to shillings, and then dividing 196 by this amount. Thus, the price of flour being $7 a barrel, (which is a sufficiently high average for even the best brands during the year past,) the shilling loaf should weigh three and a half pounds. For,

7 times 8=56; 196÷56=3.50.

This will leave twenty loaves of the same weight, or $2.50 as the profit on the manufacture.

Although the whiteness of bread is considered as a mark of its goodness, it has been ascertained by Professor Johnston, that fine flour contains a less proportion of nutritive matter than the whole meal. The correctness of this view has been confirmed during present investigation; for in two or three samples of wheat which I have analyzed, it was found that the amount of gluten in the fine flour was less than in the flour passed through a coarser seive and containing a larger proportion of bran.

These results, according to Professor Johnston, are to be accounted for on the supposition that the part of the grain which is most abundant in starch crushes better and more easily under the millstones than that which, being richest in gluten, is probably also tougher, and less brittle. They are also consistent with the greater nourishment generally supposed to reside in household-bread, made from the flour of the whole grain. But such is the controlling influence of custom, that it is perhaps in vain to attempt a change, even though its benefits may be clearly proved by the researches of science, and by an extensive experience.

Analyses of Wheat Flour.

Before presenting the details of my analyses, it may not be amiss to offer a few explanations in regard to some researches of a similar kind, which have heretofore been made. The discrepancies in the published results of various analyses arise principally, I apprehend, from the different processes which have been employed.

The table published in Davy's Agricultural Chemistry gives the proportions of gluten or albumen in English Middlesex wheat at 19.00 per cent.; in Sicilian wheat, 23.90 per cent.; in Poland wheat, 20.00 per cent.; and in North American wheat, 22.50. The mode pursued by this celebrated chemist has not, so far as I know, been published, but the amount of nutritive principle is larger than that usually obtained; a circumstance which may, perhaps, be ascribed to its being imperfectly dried.

In the table containing the results of Vanquelin's analysis of wheat flours, the proportions of gluten are generally much lower than those obtained by Davy. Thus, in common French flour, the gluten is 10.96 per cent.; flour of hard Odessa wheat, 14.53 per cent.; flour from the bakers of Paris, 10.20 per cent.

Boussingault, adopting the plan of determining the amount of azotized principles by immediate ultimate analysis, has obtained a larger per centage of the nutritive principle than either of the above-named chemists. Thus, he states that the hard African wheat contains of gluten and albumen, 26.50 per cent.; Sicilian wheat, 24.30 per cent.; Dantzic wheat, 22.70 per cent.

He gives reasons, which, to a certain extent, account for the larger quantity of azotized principles which he found in the samples of flour, and adds, "that the varieties of wheat, the flour of which was analyzed, were all grown in the rich soil of the garden, a circumstance which, as Hermbstadt has shown, exerts the most powerful influence in increasing the quantity of gluten in wheat."

Dr. Robert D. Thomson has also published the results of several analyses of wheat flour. The proportion of the nutritive principle was deduced from the quantity of ammonia formed from the azote contained in the sample. According to this chemist, Canada flour contains 13.81 per cent. of the nutritive principle, (gluten and albumen;) Lothian flour, 12.30 per cent.; United States flour, 11.37 per cent., and another sample of the same, 10.99 per cent.

It is not easy to understand why Canadian flour should rank so much higher than that from the United States. The sample named Canadian flour in the table may have been, in fact, brought from this side of the line, for it is stated that our wheat is carried to Canada, there ground into flour, and taken to England under Canadian duty. One house at Cleveland is said to have shipped, during the last summer and fall, 36,000 bushels of wheat, which was ground at St. Catharine's, on the Welland Canal, and sent to London under contract.

Mr. Mitchell, in his analyses of various London flours, obtained the following proportion of gluten, viz.: in fine flour, No. 1, 9.50 per cent.; in No. 2, 11.40 per cent.; in second flour, No. 1, 8.50 per cent.; in No. 2, 7.70 per cent.

After mature consideration, I determined to adopt the mode of analysis which shortly consists in separating the gluten by washing with cold water, and then subjecting the remaining constituents of the flour to other operations. I preferred this process, as being more easily executed, requiring less apparatus, and less skill and nicety of manipulation, than are demanded in the ultimate analysis. I have little doubt, moreover, that, for the practical purposes of this investigation, it is equally, if not more accurate; for, with all the improvements which have been made in the method of determining the amount of nitrogen in organic substances, it is not yet free from difficulties. I may also add, that the ultimate analysis fails to give us any information concerning the peculiar nature of the gluten—a point which is, perhaps, of as much consequence in settling the real value of flour, as the amount of that principle.

The different steps of the analyses have, in all cases, been conducted with as much uniformity as possible; one important object being to furnish a table of results which should, at least, show the *relative* value of the different samples subjected to trial.

All the samples from abroad were received in tin boxes or glass bottles, carefully closed so as to prevent the access of external air. Thus, whether damaged or not, they were probably in nearly the same condition, when they came into my hands, as they were when put up.

In proceeding with the analysis, 100 grains of the flour were put into a small Berlin-ware capsule, which had been previously counterpoised in a delicate balance. The capsule, with its contents, was then placed in a water-bath drying oven, and subjected to a heat of about 212° Fahrenheit for from three to six or seven hours, or until, after rapid weighing, there was found to be no farther diminution of weight. The proportion of water in the sample was thus determined by the weight required again to balance the capsule and its contents.

A weighed portion of the flour, usually 100 grains, was next carefully kneaded into stiff paste or dough, by the cautious addition of pure water, and the dough thus formed allowed to remain in the cup for a few minutes. A fine linen cloth was stretched over the top of a bolting-cloth sieve, and this again placed in a large Berlin-ware dish. The dough was now washed on the hand, over the sieve and cloth, with a small stream of water, and gently kneaded, from time to time, until all the starchy particles and the soluble matters were removed. The tough gluten was washed until the water ceased to become milky, and, after being carefully pressed out by the fingers, was subjected to the heat of a water-bath until perfectly dry; an operation which sometimes occupied 10 or 12 hours. It was then weighed warm, and the amount noted.

A sufficient quantity of water was now poured upon the linen cloth to carry down the starch, while any small particles of gluten, washed off during the operation, were added to the mass. In those cases where the flour contained any considerable proportion of bran, the latter substance was found upon the linen cloth.

The turbid washings were allowed to remain in the vessel, until the whole of the starch was deposited. The supernatant liquor was then removed by a pipette, the starch again washed, and the wash-water removed as before. The starch was now dried, subjected to the heat of the water-bath to expel all the water, and then quickly weighed. The clear liquor, removed from the starch, was evaporated at a boiling heat to near dryness, the complete desiccation being effected at a temperature of 220° or 230° Fahrenheit. In some cases a few flocks, probably albumen, were observed floating in the liquid during the evaporation, but the quantity was usually so small, that I did not attempt to separate it. The residuum thus obtained was principally a mixture of sweet and gummy matter, with a small proportion of woody fibre and saline substances. As I ascertained that the sugar was the variety called glucose, or grape-sugar, and the gummy constituent was supposed to be dextrine, I have placed all the results of the evaporation of the clear liquor under these two heads.

I may remark, that the gluten obtained by this process contains a small quantity of an oily matter, which I supposed to be about equal to that of the albumen in the clear solution separated from the starch. The proportions of gluten given in the following analyses will, therefore, very nearly represent the amount of nutritive matters contained in the various samples.

In most cases, I carried out the analysis to the end, obtaining and weighing the several substances; but as the principal object was to determine the quantity and quality of gluten, the process was occasionally stopped at this point. In a few other instances, the proportion of gluten, glucose, and dextrine were determined directly, while the quantity of starch was estimated by difference.

For convenience of reference, the analyses are arranged under the head of the several States from whence the specimens were obtained. I regret that the number received from the South is so small, as I was very anxious to exhibit, in one view, the relative quantities of nutritive matter in the northern and southern flours. Should the investigation be continued, this point will claim my earliest attention.

Several varieties of wheat sent from Amsterdam have been analyzed, (after being ground to fine flour,) principally for the purpose of comparing the results with those obtained from the samples from the United States.

RESULTS OF THE ANALYSES,

Beginning with the States separately, where the various Samples of Wheat were grown and manufactured.

NEW JERSEY.

Water	12.75
Gluten	10.90
Starch	70.20
Glucose, dextrine, &c.	6.15
	100.00

NEW YORK.

The Analysis from pure Genesee Wheat.

Water	13.35
Gluten	12.82
Starch	68.00
Glucose, dextrine, &c.	6.50
	100.67

OHIO.

Wheat Flour from Beaumont & Hollingsworth's Mills, Zanesville.

Water	12.85
Gluten	14.25
Starch	67.06
Glucose, dextrine, &c.	5.98
	100.14

INDIANA.

Wheat Flour from Forrest's Mills, Logansport.

Water	12.85
Gluten	11.90
Starch	67.00
Glucose, dextrine, &c.	8.25
	100.00

ILLINOIS.

The Wheat floured in Oswego.

Water	12.90
Gluten	11.25
Starch	66.00
Glucose, dextrine, &c.	8.60
Bran	1.25
	100.00

This sample is said to be of a dark colour, and scarcely fit to pass inspection; but the gluten being rich, the chemist pronounced it, in proportion, as above the average of western samples.

MICHIGAN.

Wheat Flour from Bruce Mills.

Water	13.20
Gluten	11.85
Starch	65.60
Glucose, dextrine, &c.	8.60
Bran	.45
	99.70

Wheat Flour from Monroe, Michigan.

Water	13.10
Gluten	10.40
Starch, glucose, dextrine	76.30
Bran	.20
	100.00

[This I consider about the average of wheat grown in the State of Michigan, of all samples, except Mediterranean wheat, which appears to exceed all others in superior richness of glutinous substance, generally weighing from 62 lbs. to 67 lbs. per measured bushel, and entirely resembling the sample of Russian wheat called Kubanka, and imported by Russia from the Mediterranean. It grows well in Michigan, but is not much liked by our merchant millers, from the fact of its possessing less starch than other samples of wheat; and in perspective view, the flour does not show that white and delicate appearance that Michigan flour is so noted for. But in the loaf, it is very superior—the bread being very rich and moist, from the greater quantity of gluten and less quantity of water than in other samples.

Analysis of Mediterranean Wheat, grown in Michigan.

Water	11.54
Gluten	16.24
Starch	56.90
Glucose, dextrine, &c.	10.24
Bran	5.08
	100.00

Its berry is in colour a dark-reddish cast, and very large in size and of great length; for family flour, it is superior to any other. It is also of a very hard nature, and requires to be ground very closely and passed through a very fine bolt. THE AUTHOR.]

WISCONSIN.

Flour from Wisconsin Wheat, manufactured there.

Water	13.80
Gluten	10.85
Starch	67.00
Glucose and dextrine	8.83
	99.98

GEORGIA.

Wheat from Floyd County, Georgia.

Water	11.75
Gluten	14.36
Starch	68.93
Glucose and dextrine	4.96
	100.00

[The advantages to be derived from this able and scientific analysis are of the utmost importance to the miller and all dealers in breadstuffs, and show, at a glance, the component substances, as well as the physical nature, of this great staple of domestic consumption, wheat flour, not inappropriately called the "staff of life."

From the quantity of water which we are shown it contains, we must conclude on the necessity there is for extracting it from the grain, for its preservation. The use of the kiln for drying all kinds of grain before ground cannot be too highly recommended, both for the preservation of the flour or meal, as well as a preventive from insects called weevil, which abound in all warm climates.

THE AUTHOR.]

A TABLE RECKONING THE PRICE OF WHEAT, FROM FIFTY CENTS TO ONE DOLLAR PER BUSHEL.

FOR the convenience of millers, we subjoin the following tables. The price will be found at the top of the page and in the columns headed "value of bushels" and "value of pounds;" and directly opposite the number of bushels and pounds in the left-hand column will be found the value, in dollars, cents, and mills, of 1 bushel or 1 pound to 100 bushels or 100 pounds.

No. bushels & pounds.	Wheat at 50 cts. per bushel.		Wheat at 51 cts. per bushel.		Wheat at 52 cts. per bushel.		Wheat at 53 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	50	8	51	9	52	9	53	9
2	1 00	1 7	1 02	1 7	1 04	1 7	1 06	1 8
3	1 50	2 5	1 53	2 6	1 56	2 6	1 59	2 7
4	2 00	3 3	2 04	3 4	2 08	3 5	2 12	3 5
5	2 50	4 2	2 55	4 3	2 60	4 3	2 65	4 4
6	3 00	5 0	3 06	5 1	3 12	5 2	3 18	5 3
7	3 50	5 8	3 57	6 0	3 64	6 1	3 71	6 2
8	4 00	6 7	4 08	6 8	4 16	6 9	4 24	7 1
9	4 50	7 5	4 59	7 7	4 68	7 8	4 77	8 0
10	5 00	8 3	5 10	8 5	5 20	8 6	5 30	8 8
11	5 50	9 2	5 61	9 4	5 72	9 5	5 83	9 7
12	6 00	10 0	6 12	10 2	6 24	10 4	6 36	10 6
13	6 50	10 8	6 63	11 1	6 76	11 3	6 89	11 5
14	7 00	11 7	7 14	11 9	7 28	12 1	7 42	12 4
15	7 50	12 5	7 65	12 8	7 80	13 0	7 95	13 3
16	8 00	13 3	8 16	13 6	8 32	13 9	8 48	14 1
17	8 50	14 2	8 67	14 5	8 84	14 7	9 01	15 0
18	9 00	15 0	9 18	15 3	9 36	15 6	9 54	15 9
19	9 50	15 8	9 69	16 2	9 88	16 5	10 07	16 8
20	10 00	16 7	10 20	17 0	10 40	17 3	10 60	17 7
21	10 50	17 5	10 71	17 9	10 92	18 2	11 13	18 6
22	11 00	18 3	11 22	18 7	11 44	19 1	11 66	19 4
23	11 50	19 2	11 73	19 6	11 96	19 9	12 19	20 3
24	12 00	20 0	12 24	20 4	12 48	20 8	12 72	21 2
25	12 50	20 8	12 75	21 3	13 00	21 7	13 25	22 1
26	13 00	21 7	13 26	22 1	13 52	22 5	13 78	23 0
27	13 50	22 5	13 77	23 0	14 04	23 4	14 31	23 9
28	14 00	23 3	14 28	23 8	14 56	24 3	14 84	24 7
29	14 50	24 2	14 79	24 7	15 08	25 1	15 37	25 6
30	15 00	25 0	15 30	25 5	15 60	26 0	15 90	26 6
40	20 00	33 3	20 40	34 0	20 80	34 7	21 20	35 3
50	25 00	41 7	25 50	42 5	26 00	43 4	26 50	44 2
100	50 00	83 4	51 00	85 0	52 00	86 6	53 00	88 4

No. bushels & pounds.	Wheat at 54 cts. per bushel.		Wheat at 55 cts. per bushel.		Wheat at 56 cts. per bushel.		Wheat at 57 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	54	9	55	9	56	9	57	1 0
2	1 08	1 8	1 10	1 8	1 12	1 9	1 14	1 9
3	1 62	2 7	1 65	2 8	1 69	2 8	1 71	2 9
4	2 16	3 6	2 20	3 7	2 25	3 7	2 28	3 8
5	2 70	4 5	2 75	4 6	2 81	4 7	2 85	4 8
6	3 24	5 4	3 30	5 5	3 37	5 6	3 42	5 7
7	3 78	6 3	3 85	6 4	3 94	6 6	3 99	6 7
8	4 32	7 2	4 40	7 3	4 50	7 5	4 56	7 6
9	4 86	8 1	4 95	8 3	5 06	8 4	5 13	8 6
10	5 40	9 0	5 50	9 2	5 62	9 4	5 70	9 5
11	5 94	9 9	6 05	10 1	6 19	10 3	6 27	10 5
12	6 48	10 8	6 60	11 0	6 75	11 2	6 84	11 4
13	7 02	11 7	7 15	11 9	7 31	12 2	7 41	12 4
14	7 56	12 6	7 70	12 9	7 87	13 1	7 98	13 3
15	8 10	13 5	8 25	13 8	8 44	14 1	8 55	14 3
16	8 64	14 4	8 80	14 7	9 00	15 0	9 12	15 2
17	9 18	15 3	9 35	15 6	9 56	15 9	9 69	16 2
18	9 72	16 2	9 90	16 5	10 12	16 9	10 26	17 1
19	10 26	17 1	10 45	17 4	10 69	17 8	10 83	18 1
20	10 80	18 0	11 00	18 3	11 25	18 7	11 40	19 0
21	11 34	18 9	11 55	19 3	11 81	19 7	11 97	20 0
22	11 88	19 8	12 10	20 2	12 37	20 6	12 54	20 9
23	12 42	20 7	12 65	21 1	12 94	21 6	13 11	21 9
24	12 96	21 6	13 20	22 0	13 50	22 5	13 68	22 8
25	13 50	22 5	13 75	22 9	14 06	23 4	14 25	23 8
26	14 04	23 4	14 30	23 8	14 62	24 4	14 82	24 7
27	14 58	24 3	14 85	24 8	15 19	25 3	15 39	25 7
28	15 12	25 2	15 40	25 7	15 75	26 2	15 96	26 6
29	15 66	26 1	15 95	26 6	16 31	27 2	16 53	27 6
30	16 20	27 0	16 50	27 5	16 87	28 1	17 10	28 5
40	21 60	36 0	22 00	36 7	22 50	37 5	22 80	38 0
50	27 00	45 0	27 50	45 8	28 12	46 9	28 50	47 5
100	54 00	90 0	55 00	91 7	56 24	93 8	57 00	95 0

No. bushels & pounds.	Wheat at 58 cts. per bushel.				Wheat at 59cts. per bushel.				Wheat at 60 cts. per bushel.				Wheat at 61 cts. per bushel.			
	Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.	
	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.
1		58	1	0		59	1	0		60	1	0		61	1	0
2	1	16	1	9	1	18	2	0	1	20	2	0	1	22	2	0
3	1	74	2	9	1	77	3	0	1	80	3	0	1	83	3	0
4	2	32	3	9	2	36	4	0	2	40	4	0	2	44	4	1
5	2	90	4	8	2	95	4	9	3	00	5	0	3	05	5	1
6	3	48	5	8	3	54	5	9	3	60	6	0	3	66	6	1
7	4	06	6	8	4	13	6	9	4	20	7	0	4	27	7	1
8	4	64	7	7	4	72	7	9	4	80	8	0	4	88	8	1
9	5	22	8	7	5	31	8	9	5	40	9	0	5	49	9	1
10	5	80	9	7	5	90	9	9	6	00	10	0	6	10	10	1
11	6	38	10	6	6	49	10	8	6	60	11	0	6	71	11	2
12	6	96	11	6	7	08	11	8	7	20	12	0	7	32	12	2
13	7	54	12	6	7	67	12	8	7	80	13	0	7	93	13	2
14	8	12	13	5	8	26	13	8	8	40	14	0	8	54	14	2
15	8	70	14	5	8	85	14	8	9	00	15	0	9	15	15	2
16	9	28	15	5	9	44	15	8	9	60	16	0	9	76	16	3
17	9	86	16	4	10	03	16	7	10	20	17	0	10	37	17	3
18	10	44	17	4	10	62	17	7	10	80	18	0	10	98	18	3
19	11	02	18	4	11	21	18	7	11	40	19	0	11	59	19	3
20	11	60	19	3	11	80	19	7	12	00	20	0	12	20	20	3
21	12	18	20	3	12	39	20	7	12	60	21	0	12	81	21	3
22	12	76	21	3	12	98	21	6	13	20	22	0	13	42	22	4
23	13	34	22	2	13	57	22	6	13	80	23	0	14	03	23	4
24	13	92	23	2	14	16	23	6	14	40	24	0	14	64	24	4
25	14	50	24	2	14	75	24	6	15	00	25	0	15	25	25	4
26	15	08	25	1	15	34	25	6	15	60	26	0	15	86	26	4
27	15	66	26	1	15	93	26	5	16	20	27	0	16	47	27	4
28	16	24	27	1	16	52	27	5	16	80	28	0	17	08	28	5
29	16	82	28	0	17	11	28	5	17	40	29	0	17	69	29	5
30	17	40	29	0	17	70	29	5	18	00	30	0	18	30	30	5
40	23	20	38	7	23	60	39	3	24	00	40	0	24	40	40	7
50	29	00	48	3	29	50	49	2	30	00	50	0	30	50	50	8
100	58	00	96	6	59	00	98	3	60	00	100	0	61	00	101	6

No. bushels & pounds.	Wheat at 62 cts. per bushel.				Wheat at 64 cts. per bushel.				Wheat at 65 cts. per bushel.				Wheat at 66 cts. per bushel.			
	Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.	
	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.
1		62	1	0		64	1	1		65	1	1		66	1	1
2	1	25	2	1	1	28	2	1	1	30	2	2	1	32	2	2
3	1	87	3	1	1	92	3	2	1	95	3	2	1	98	3	3
4	2	50	4	2	2	56	4	2	2	60	4	3	2	64	4	4
5	3	12	5	2	3	20	5	3	3	25	5	4	3	30	5	5
6	3	75	6	2	3	84	6	4	3	90	6	5	3	96	6	6
7	4	37	7	3	4	48	7	4	4	55	7	6	4	62	7	7
8	5	00	8	3	5	12	8	5	5	20	8	7	5	28	8	8
9	5	62	9	4	5	76	9	6	5	85	9	8	5	94	9	9
10	6	25	10	4	6	40	10	7	6	50	10	8	6	60	11	0
11	6	87	11	5	7	04	11	7	7	15	11	9	7	26	12	1
12	7	50	12	5	7	68	12	8	7	80	13	0	7	92	13	2
13	8	12	13	5	8	32	13	9	8	45	14	1	8	58	14	3
14	8	75	14	6	8	96	14	9	9	10	15	2	9	24	15	4
15	9	37	15	6	9	60	16	0	9	75	16	3	9	90	16	5
16	10	00	16	6	10	24	17	0	10	40	17	3	10	56	17	6
17	10	62	17	7	10	88	18	1	11	05	18	4	11	22	18	7
18	11	25	18	7	11	52	19	2	11	70	19	5	11	88	19	8
19	11	87	19	8	12	16	20	3	12	35	20	6	12	54	20	9
20	12	50	20	8	12	80	21	3	13	00	21	7	13	20	22	0
21	13	12	21	9	13	44	22	4	13	65	22	7	13	86	23	1
22	13	75	22	9	14	08	23	4	14	30	23	9	14	52	24	2
23	14	37	24	0	14	72	24	5	14	95	24	9	15	18	25	3
24	15	00	25	0	15	36	25	6	15	60	26	0	15	84	26	4
25	15	62	26	0	16	00	26	6	16	25	27	1	16	50	27	5
26	16	25	27	1	16	64	27	8	16	90	28	2	17	16	28	6
27	16	87	28	1	17	28	28	8	17	55	29	3	17	82	29	7
28	17	50	29	2	17	92	29	9	18	20	30	3	18	48	30	8
29	18	12	30	2	18	56	30	9	18	85	31	4	19	14	31	9
30	18	75	31	2	19	20	32	0	19	50	32	5	19	80	33	0
40	25	00	41	7	25	60	42	7	26	00	43	3	26	40	44	0
50	31	25	52	1	32	00	53	3	32	50	54	2	33	00	55	0
100	62	50	104	2	64	00	106	6	65	00	108	3	66	00	110	0

No. bushels & pounds.	Wheat at 67 cts. per bushel.				Wheat at 68 cts. per bushel.				Wheat at 69 cts. per bushel.				Wheat at 70 cts. per bushel.			
	Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.	
	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.
1		67	1	1		68	1	1		69	1	1		70	1	2
2	1	33	2	2	1	36	2	3	1	38	2	3	1	40	2	3
3	2	00	3	3	2	04	3	4	2	06	3	4	2	10	3	5
4	2	67	4	5	2	72	4	5	2	75	4	6	2	80	4	7
5	3	33	5	6	3	40	5	7	3	44	5	7	3	50	5	8
6	4	00	6	7	4	08	6	8	4	12	6	9	4	20	7	0
7	4	67	7	8	4	76	7	9	4	81	8	0	4	90	8	2
8	5	33	8	9	5	44	9	1	5	50	9	2	5	60	9	3
9	6	00	10	0	6	12	10	2	6	19	10	3	6	30	10	5
10	6	67	11	1	6	80	11	3	6	87	11	5	7	00	11	7
11	7	33	12	2	7	48	12	5	7	56	12	6	7	70	12	8
12	8	00	13	3	8	16	13	6	8	25	13	7	8	40	14	0
13	8	67	14	5	8	84	14	7	8	94	14	9	9	10	15	2
14	9	33	15	5	9	52	15	9	9	62	16	0	9	80	16	3
15	10	00	16	7	10	20	17	0	10	31	17	2	10	50	17	5
16	10	67	17	8	10	88	18	1	11	00	18	3	11	20	18	7
17	11	33	18	9	11	56	19	3	11	69	19	5	11	90	19	8
18	12	00	20	0	12	24	20	4	12	37	20	6	12	60	21	0
19	12	67	21	1	12	92	21	5	13	06	21	8	13	30	22	2
20	13	33	22	2	13	60	22	7	13	75	22	9	14	00	23	3
21	14	00	23	3	14	28	23	8	14	44	24	1	14	70	24	5
22	14	67	24	5	14	96	24	9	15	12	25	2	15	40	25	7
23	15	33	25	5	15	64	26	1	15	81	26	4	16	10	26	8
24	16	00	26	7	16	32	27	2	16	50	27	5	16	80	28	0
25	16	67	27	8	17	00	28	3	17	19	28	6	17	50	29	2
26	17	33	28	9	17	68	29	5	17	87	29	8	18	20	30	3
27	18	00	30	0	18	36	30	6	18	56	30	9	18	90	31	5
28	18	67	31	1	19	04	31	7	19	25	32	1	19	60	32	7
29	19	33	32	2	19	72	32	9	19	94	33	2	20	30	33	8
30	20	00	33	3	20	40	34	0	20	62	34	4	21	00	35	0
40	26	67	44	4	27	20	45	3	27	50	45	8	28	00	46	7
50	33	33	55	6	34	00	56	6	34	37	57	3	35	00	58	3
100	66	67	111	1	68	00	113	3	68	75	114	6	70	00	116	7

No. bushels & pounds.	Wheat at 71 cts. per bushel.		Wheat at 72 cts. per bushel.		Wheat at 73 cts. per bushel.		Wheat at 74 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	71	1 2	72	1 2	73	1 2	74	1 2
2	1 42	2 4	1 44	2 4	1 46	2 4	1 48	2 5
3	2 13	3 5	2 16	3 6	2 19	3 6	2 22	3 7
4	2 84	4 7	2 88	4 8	2 92	4 9	2 96	4 9
5	3 55	5 9	3 60	6 0	3 65	6 1	3 70	6 2
6	4 26	7 1	4 32	7 2	4 38	7 3	4 44	7 4
7	4 97	8 3	5 04	8 4	5 11	8 5	5 18	8 6
8	5 68	9 5	5 76	9 6	5 84	9 7	5 92	9 9
9	6 39	10 6	6 48	10 8	6 57	10 9	6 66	11 1
10	7 10	11 8	7 20	12 0	7 30	12 2	7 40	12 3
11	7 81	13 0	7 92	13 2	8 03	13 4	8 14	13 6
12	8 52	14 2	8 64	14 4	8 76	14 6	8 88	14 8
13	9 23	15 4	9 36	15 6	9 49	15 8	9 62	16 0
14	9 94	16 6	10 08	16 8	10 22	17 0	10 36	17 3
15	10 65	17 7	10 80	18 0	10 95	18 2	11 10	18 5
16	11 36	18 9	11 52	19 2	11 68	19 5	11 84	19 7
17	12 07	20 1	12 24	20 4	12 41	20 7	12 58	20 9
18	12 78	21 3	12 96	31 6	13 14	21 9	13 32	22 2
19	13 49	22 5	13 68	22 8	13 87	23 1	14 06	23 4
20	14 20	23 7	14 40	24 0	14 60	24 3	14 80	24 7
21	14 91	24 8	15 12	25 2	15 33	25 5	15 54	25 9
22	15 62	26 0	15 84	26 4	16 06	26 8	16 28	27 1
23	16 33	27 2	16 56	27 6	16 79	28 0	17 02	28 4
24	17 04	28 4	17 28	28 8	17 52	29 2	17 76	29 6
25	17 75	29 6	18 00	30 0	18 25	30 4	18 50	30 8
26	18 46	30 8	18 72	31 2	18 98	31 6	19 24	32 1
27	19 17	31 9	19 44	32 4	19 71	32 9	19 98	33 3
28	19 88	33 1	20 16	33 6	20 44	34 0	20 72	34 5
29	20 59	34 3	20 88	34 8	21 17	35 3	21 46	35 7
30	21 30	35 5	21 60	36 0	21 90	36 5	22 20	37 0
40	28 40	47 3	28 80	48 0	29 20	48 8	29 60	49 3
50	35 50	59 2	36 00	60 0	36 50	60 8	37 00	61 7
100	71 00	118 3	72 00	120 0	73 00	121 7	74 00	123 3

No. bushels & pounds.	Wheat at 75 cts. per bushel.		Wheat at 76cts. per bushel.		Wheat at 77 cts. per bushel.		Wheat at 78 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	75	1 2	76	1 3	77	1 3	78	1 3
2	1 50	2 5	1 52	2 5	1 54	2 6	1 56	2 6
3	2 25	3 7	2 28	3 8	2 31	3 8	2 34	3 9
4	3 00	5 0	3 04	5 1	3 08	5 1	3 12	5 2
5	3 75	6 2	3 80	6 3	3 85	6 4	3 90	6 5
6	4 50	7 5	4 56	7 6	4 62	7 7	4 68	7 8
7	5 25	8 7	5 32	8 9	5 39	9 0	5 46	9 2
8	6 00	10 0	6 08	10 1	6 16	10 3	6 24	10 4
9	6 75	11 2	6 84	11 4	6 93	11 5	7 02	11 7
10	7 50	12 5	7 60	12 7	7 70	12 8	7 80	13 0
11	8 25	13 7	8 36	13 9	8 47	14 1	8 58	14 3
12	9 00	15 0	9 12	15 2	9 24	15 4	9 36	15 6
13	9 75	16 2	9 88	16 5	10 01	16 7	10 14	16 9
14	10 50	17 5	10 64	17 7	10 78	17 9	10 92	18 2
15	11 25	18 7	11 40	19 0	11 55	19 2	11 70	19 5
16	12 00	20 0	12 16	20 3	12 32	20 5	12 48	20 8
17	12 75	21 2	12 92	21 5	13 09	21 8	13 26	22 1
18	13 50	22 5	13 68	22 8	13 86	23 1	14 04	23 4
19	14 25	23 7	14 44	24 1	14 63	24 4	14 82	24 7
20	15 00	25 0	15 20	25 3	15 40	25 7	15 60	26 0
21	15 75	26 2	15 96	26 6	16 17	26 5	16 38	27 3
22	16 50	27 5	16 72	27 9	16 94	28 2	17 16	28 6
23	17 25	28 7	17 48	29 1	17 71	29 5	17 94	29 9
24	18 00	30 0	18 24	30 4	18 48	30 8	18 72	31 2
25	18 75	31 2	19 00	31 7	19 25	32 1	19 50	32 5
26	19 50	32 5	19 76	32 9	20 02	33 4	20 28	33 8
27	20 25	33 7	20 52	34 2	20 79	34 6	21 06	35 1
28	21 00	35 0	21 28	35 5	21 56	35 9	21 84	36 4
29	21 75	36 2	22 04	36 7	22 33	37 2	22 62	37 7
30	22 50	37 5	22 80	38 0	23 10	38 5	23 40	39 0
40	30 00	50 0	30 40	50 7	30 80	51 3	31 20	52 0
50	37 50	62 5	38 00	63 3	38 50	64 2	39 00	65 0
100	75 00	125 0	76 00	126 7	77 00	128 3	78 00	130 0

No. bushels & pounds.	Wheat at 79 cts. per bushel.		Wheat at 80 cts. per bushel.		Wheat at 81 cts. per bushel.		Wheat at 82 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	79	1 3	80	1 3	81	1 4	82	1 4
2	1 58	2 6	1 60	2 7	1 62	2 7	1 64	2 7
3	2 37	3 9	2 40	4 0	2 43	4 1	2 46	4 1
4	3 16	5 3	3 20	5 3	3 25	5 4	3 28	5 5
5	3 95	6 6	4 00	6 7	4 06	6 8	4 10	6 8
6	4 74	7 9	4 80	8 0	4 87	8 1	4 92	8 2
7	5 53	9 2	5 60	9 3	5 69	9 5	5 74	9 6
8	6 32	10 5	6 40	10 7	6 50	10 8	6 56	10 9
9	7 11	11 8	7 20	12 0	7 31	12 2	7 38	12 3
10	7 90	13 2	8 00	13 3	8 12	13 5	8 20	13 7
11	8 69	14 5	8 80	14 7	8 94	14 9	9 02	15 0
12	9 48	15 8	9 60	16 0	9 75	16 2	9 84	16 4
13	10 27	17 1	10 40	17 3	10 56	17 6	10 66	17 8
14	11 06	18 4	11 20	18 7	11 37	18 9	11 48	19 1
15	11 85	19 8	12 00	20 0	12 19	20 3	12 30	20 5
16	12 64	21 1	12 80	21 3	13 00	21 7	13 12	21 9
17	13 43	22 4	13 60	22 7	13 81	23 0	13 94	23 2
18	14 22	23 7	14 40	24 0	14 62	24 3	14 76	24 6
19	15 01	25 0	15 20	25 3	15 44	25 7	15 58	26 0
20	15 80	26 3	16 00	26 7	16 25	27 1	16 40	27 3
21	16 59	27 6	16 80	28 0	17 06	28 4	17 22	28 7
22	17 38	29 0	17 60	29 3	17 87	29 8	18 04	30 1
23	18 17	30 3	18 40	30 7	18 69	31 1	18 86	31 4
24	18 96	31 6	19 20	32 0	19 50	32 5	19 68	32 8
25	19 75	32 9	20 00	33 3	20 31	33 9	20 50	34 2
26	20 54	34 2	20 80	34 7	21 12	35 2	21 32	35 5
27	21 33	35 6	21 60	36 0	21 94	36 6	22 14	36 9
28	22 12	36 9	22 40	37 3	22 75	37 9	22 96	38 3
29	22 91	38 2	23 20	38 7	23 56	39 3	23 78	39 6
30	23 70	39 5	24 00	40 0	24 37	40 6	24 60	41 0
40	31 60	52 7	32 00	53 3	32 50	54 2	32 80	54 7
50	39 50	65 8	40 00	66 6	40 62	67 7	41 00	68 3
100	79 00	131 7	80 00	133 3	81 25	135 4	82 00	136 6

No. bushels & pounds.	Wheat at 83 cts. per bushel.		Wheat at 84 cts. per bushel.		Wheat at 85 cts. per bushel.		Wheat at 86 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	83	1 4	84	1 4	85	1 4	86	1 4
2	1 67	2 8	1 68	2 8	1 70	2 8	1 72	2 9
3	2 50	4 2	2 52	4 2	2 55	4 3	2 58	4 3
4	3 33	5 6	3 36	5 6	3 40	5 7	3 44	5 7
5	4 17	6 9	4 20	7 0	4 25	7 1	4 30	7 2
6	5 00	8 3	5 04	8 4	5 10	8 5	5 16	8 6
7	5 83	9 7	5 88	9 8	5 95	9 9	6 02	10 0
8	6 67	11 1	6 72	11 2	6 80	11 3	6 88	11 5
9	7 50	12 5	7 56	12 6	7 65	12 7	7 74	12 9
10	8 33	13 9	8 40	14 0	8 50	14 2	8 60	14 3
11	9 17	15 3	9 24	15 4	9 35	15 6	9 46	15 8
12	10 00	16 7	10 08	16 8	10 20	17 0	10 32	17 2
13	10 83	18 1	10 92	18 2	11 05	18 4	11 18	18 6
14	11 67	19 4	11 76	19 6	11 90	19 8	12 04	20 1
15	12 50	20 8	12 60	21 0	12 75	21 2	12 90	21 5
16	13 33	22 2	13 44	22 4	13 60	22 7	13 76	22 9
17	14 17	23 6	14 28	23 8	14 45	24 1	14 62	24 4
18	15 00	25 0	15 12	25 2	15 30	25 5	15 48	25 8
19	15 83	26 4	15 96	26 6	16 15	26 9	16 34	27 2
20	16 67	27 8	16 80	28 0	17 00	28 3	17 20	28 7
21	17 50	29 2	17 64	29 4	17 85	29 7	18 06	30 1
22	18 33	30 6	18 48	30 8	18 70	31 2	18 92	31 5
23	19 17	31 9	19 32	32 2	19 55	32 6	19 78	33 0
24	20 00	33 3	20 16	33 6	20 40	34 0	20 64	34 4
25	20 83	34 7	21 00	35 0	21 25	35 4	21 50	35 8
26	21 67	36 1	21 84	36 4	22 10	36 8	22 36	37 3
27	22 50	37 5	22 68	37 8	22 95	38 3	23 22	38 7
28	23 33	38 9	23 52	39 2	23 80	39 7	24 08	40 1
29	24 17	40 3	24 36	40 6	24 65	41 1	24 94	41 6
30	25 00	41 7	25 20	42 0	25 50	42 5	25 80	43 0
40	33 33	55 6	33 60	56 0	34 00	56 7	34 40	57 3
50	41 67	69 4	42 00	70 0	42 50	70 8	43 00	71 7
100	83 33	138 9	84 00	140 0	85 00	141 7	86 00	143 3

No. bushels & pounds.	Wheat at 87½ c. per bushel.				Wheat at 89 cts. per bushel.				Wheat at 90 cts. per bushel.				Wheat at 91 cts. per bushel.			
	Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.	
	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.
1		87	1	4		89	1	5		90	1	5		91	1	5
2	1	75	2	9	1	78	3	0	1	80	3	0	1	82	3	1
3	2	62	4	4	2	67	4	4	2	70	4	5	2	73	4	5
4	3	50	5	8	3	56	5	9	3	60	6	0	3	64	6	1
5	4	37	7	3	4	45	7	4	4	50	7	5	4	55	7	6
6	5	25	8	7	5	34	8	9	5	40	9	0	5	46	9	1
7	6	12	10	2	6	23	10	4	6	30	10	5	6	37	10	6
8	7	00	11	7	7	12	11	9	7	20	12	0	7	28	12	1
9	7	87	13	1	8	01	13	3	8	10	13	5	8	19	13	6
10	8	75	14	6	8	90	14	8	9	00	15	0	9	10	15	2
11	9	62	16	0	9	79	16	3	9	90	16	5	10	01	16	7
12	10	50	16	5	10	68	17	8	10	80	18	0	10	92	18	2
13	11	37	18	9	11	57	19	3	11	70	19	5	11	83	19	7
14	12	25	20	4	12	46	20	8	12	60	21	0	12	74	21	2
15	13	12	21	9	13	35	22	2	13	50	22	5	13	65	22	7
16	14	00	23	3	14	24	23	7	14	40	24	0	14	56	24	3
17	14	87	24	8	15	13	25	2	15	30	25	5	15	47	25	8
18	15	75	26	2	16	02	26	7	16	20	27	0	16	38	27	3
19	16	62	27	7	16	91	28	2	17	10	28	5	17	29	28	8
20	17	50	29	2	17	80	29	7	18	00	30	0	18	20	30	3
21	18	37	30	6	18	69	31	1	18	90	31	5	19	11	31	8
22	19	25	32	1	19	58	32	5	19	80	33	0	20	02	33	4
23	20	12	33	5	20	47	34	1	20	70	34	5	20	93	34	9
24	21	00	35	0	21	36	35	6	21	60	36	0	21	84	36	4
25	21	87	36	4	22	25	37	1	22	50	37	5	22	75	37	9
26	22	75	37	9	23	14	38	6	23	40	39	0	23	66	39	4
27	23	62	39	4	24	03	40	0	24	30	40	5	24	57	40	9
28	24	50	40	8	24	92	41	5	25	20	42	0	25	48	42	5
29	25	37	42	3	25	81	43	0	26	10	43	5	26	39	44	0
30	26	25	43	7	26	70	44	5	27	00	45	0	27	30	45	5
40	35	00	58	3	35	60	59	0	36	00	60	0	36	40	60	7
50	43	75	72	9	44	50	74	2	45	00	75	0	45	50	75	8
100	87	50	145	8	89	00	148	3	90	00	150	0	91	00	151	7

No. bushels & pounds.	Wheat at 92 cts. per bushel.		Wheat at 93 cts. per bushel.		Wheat at 94 cts. per bushel.		Wheat at 95 cts. per bushel.	
	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.	Value bush.	Value lbs.
	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.	$ cts.	cts. m.
1	92	1 5	93	1 5	94	1 6	95	1 6
2	1 84	3 1	1 86	3 1	1 87	3 1	1 90	3 2
3	2 76	4 6	2 79	4 6	2 81	4 7	2 85	4 7
4	3 68	6 1	3 72	6 2	3 75	6 2	3 80	6 3
5	4 60	7 7	4 65	7 8	4 69	7 8	4 75	7 9
6	5 52	9 2	5 58	9 3	5 62	9 4	5 70	9 5
7	6 44	10 7	6 51	10 8	6 56	10 9	6 65	11 1
8	7 36	12 3	7 44	12 4	7 50	12 5	7 60	12 7
9	8 28	13 8	8 37	13 9	8 44	14 1	8 55	14 3
10	9 20	15 3	9 30	15 5	9 37	15 6	9 50	15 8
11	10 12	16 9	10 23	17 1	10 31	17 2	10 45	17 4
12	11 04	18 4	11 16	18 6	11 25	18 7	11 40	19 0
13	11 96	19 9	12 09	20 1	12 19	20 3	12 35	20 6
14	12 88	21 5	13 02	21 7	13 12	21 9	13 30	22 2
15	13 80	23 0	13 95	23 3	14 06	23 4	14 25	23 7
16	14 72	24 5	14 88	24 8	15 00	25 0	15 20	25 3
17	15 64	26 1	15 81	26 3	15 94	26 6	16 15	26 9
18	16 56	27 6	16 74	27 9	16 87	28 1	17 10	28 5
19	17 48	29 1	17 67	29 4	17 81	29 7	18 05	30 1
20	18 40	30 7	18 60	31 0	18 75	31 2	19 00	31 7
21	19 32	32 2	19 53	32 6	19 69	32 8	19 95	33 2
22	20 24	33 7	20 46	34 1	20 62	34 4	20 90	34 8
23	21 16	35 3	21 39	35 6	21 56	35 9	21 85	36 4
24	22 08	36 8	22 32	37 2	22 50	37 5	22 80	38 0
25	23 00	38 3	23 25	38 8	23 44	39 1	23 75	39 6
26	23 92	39 9	24 18	40 3	24 37	40 6	24 70	41 2
27	24 84	41 4	25 11	41 8	25 31	42 2	25 65	42 7
28	25 76	42 9	26 04	43 4	26 25	43 7	26 60	44 3
29	26 68	44 5	26 97	44 9	27 19	45 3	27 55	45 9
30	27 60	46 0	27 90	46 5	28 12	46 9	28 50	47 5
40	36 80	61 3	37 20	62 0	37 50	62 5	38 00	63 3
50	46 00	76 7	46 50	77 5	46 87	78 1	47 50	79 2
100	92 00	153 3	93 00	155 0	93 75	156 2	95 00	158 3

No. bushels & pounds.	Wheat at 96 cts. per bushel.				Wheat at 97 cts. per bushel.				Wheat at 98 cts. per bushel.				Wheat at 99 cts. per bushel.			
	Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.		Value bush.		Value lbs.	
	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.	$	cts.	cts.	m.
1		96	1	6		97	1	6		98	1	6		99	1	6
2	1	92	3	2	1	94	3	2	1	96	3	3	1	98	3	3
3	2	88	4	8	2	91	4	8	2	94	4	9	2	97	4	9
4	3	84	6	4	3	88	6	5	3	92	6	5	3	96	6	6
5	4	80	8	0	4	85	8	1	4	90	8	2	4	95	8	2
6	5	76	9	6	5	82	9	7	5	88	9	8	5	94	9	9
7	6	72	11	2	6	79	11	3	6	86	11	4	6	93	11	5
8	7	68	12	8	7	76	12	9	7	84	13	1	7	92	13	2
9	8	64	14	4	8	73	14	5	8	82	14	7	8	91	14	8
10	9	60	16	0	9	70	16	2	9	80	16	3	9	90	16	5
11	10	56	17	6	10	67	17	8	10	78	17	9	10	89	18	1
12	11	52	19	2	11	64	19	4	11	76	19	6	11	88	19	8
13	12	48	20	8	12	61	21	0	12	74	21	2	12	87	21	4
14	13	44	22	4	13	58	22	6	13	72	22	9	13	86	23	1
15	14	40	24	0	14	55	24	2	14	70	24	5	14	85	24	7
16	15	36	25	6	15	52	25	9	15	68	26	1	15	84	26	4
17	16	32	27	2	16	49	27	5	16	66	27	8	16	83	28	0
18	17	28	28	8	17	46	29	1	17	64	29	4	17	82	29	7
19	18	24	30	4	18	43	30	7	18	62	31	0	18	81	31	3
20	19	20	32	0	19	40	32	3	19	60	32	7	19	80	33	0
21	20	16	33	6	20	37	33	9	20	58	34	3	20	79	34	6
22	21	12	35	2	21	34	35	6	21	56	35	9	21	78	36	3
23	22	08	36	8	22	31	37	2	22	54	37	6	22	77	37	9
24	23	04	38	4	23	28	38	8	23	52	39	2	23	76	39	6
25	24	00	40	0	24	25	40	4	24	50	40	8	24	75	41	3
26	24	96	41	6	25	22	42	0	25	48	42	5	25	74	42	9
27	25	92	43	2	26	19	43	6	26	46	44	1	26	73	44	5
28	26	88	44	8	27	16	45	3	27	44	45	7	27	72	46	2
29	27	84	46	4	28	13	46	9	28	42	47	4	28	71	47	8
30	28	80	48	0	29	10	48	5	29	40	49	0	29	70	49	5
40	38	40	64	0	38	80	64	7	39	20	65	3	39	60	66	0
50	48	00	80	0	48	50	80	8	49	00	81	7	49	50	82	5
100	96	00	160	0	97	00	161	7	98	00	163	3	99	00	165	0

STEAM AS APPLIED FOR PROPELLING MILLS.

STEAM, as a power for milling purposes, in locations where fuel can be easily obtained, is quite as good as water, when constructed and arranged properly. The old method of building steam-mills with single engines is always attended with a good deal of difficulty, requiring very nice calculation in proportioning the motion of the machinery, so as to do away with back-lashing, which is impossible, unless the velocity of the balance-wheel exceed that of the stone; which should be borne in mind by all millwrights who undertake to build mills with single engines. But modern improvement in the science of practical mechanics has improved the steam mill, by the application of two engines instead of one. The engines are attached to the main shaft, working at right angles, which gives a very even, steady power, and dispenses with the use of fly-wheels entirely.

The following sized engines may be used in mills to drive two run of stones, viz.:

Size of cylinders, 10 inches bore,—length of stroke, 2 feet; to be supplied with steam from two boilers, double flues, 40 inches in diameter, 30 feet long.

Boilers and engines of that size will drive two run of stones, with all necessary machinery for flouring and custom work. And a mill of that size, when properly constructed, with five cords of wood per twenty-four hours, will put up from one hundred to one hundred and thirty barrels of flour.

ON THE CONSTRUCTION OF THE SAW-MILL, WITH A TABLE FOR MEASURING SAW-LOGS.

THE construction of the saw-mill is something that requires improvement, even in this day of mechanical progress. The old method of building saw-mills, is to attach the water-wheel and saw to the same shaft. That we consider wrong, for the following reasons: The power of the water is so great, it requires every part of all the connecting machinery to be bound very secure, which causes a stiffness which very materially reduces the actual power, when used in connection with a crank. As the power of the water is the same, both off and on the centre, producing an irregularity of motion, the momentum of which racks the frame of the mill, and occasions a great deal of trouble and time in extra repairs. To make this subject more plain, the weight of water, saw-sash, pitman, and crank cannot be equalized, as the length of the crank being the distance from the centre, produces that irregularity of motion, which pertains to all crank motions. Saw-mills of this description are generally driven by horizontal water-wheels, and are simple in their construction, but are less powerful than those mills geared by perpendicular water-wheels as follows:

The first great advantage in gearing saw-mills with perpendicular water-wheels, is, you use the water on a wheel working on the principle of the lever of the second kind, (see, "Mechanics," page 16,) the power being

3 to 1, and the saw being driven by a belt, takes away all that strain which destroys and racks the frame, as all single geared mills. Also, the gig-wheel is done away, as, by a gauge on the main gate, the carriage may be worked with ease, and a good deal of power saved thereby.

For a water power of seven feet head, the following described rules may be used, and a good strong mill obtained:—Size of the frame, 27 by 40—size of water-wheel; 5 feet in diameter, driving a horizontal shaft, with bevel gearing 2 inches, ¼ pitch, driver 64 cogs, leader 32—size of driving-drum on said shaft, 8 feet in diameter, which drives the crank shaft by a pully 2 feet in diameter,—this pully should be made about 2 feet wide, to allow room for the belt which drives the carriage by a drum of 5 feet in diameter. The carriage is worked to the saw by an eccentric rod attached from the crank shaft which runs up to the feed hand, and joins by an elbow. A fly-wheel six feet in diameter is required, and bored for the crank at any required length, from 12 to 30 inches.

This is the best possible mode of constructing the saw-mill, and, where a muley saw is used, is one of the best kind of mills. The size of the belting should be, when made of leather, 12 inches wide, of good band leather doubled, sewed with horse-hide dressed purposely, stitched three times. This belt, if kept dry, will last for many years.

The belting should be made of leather, 12 or 14 inches wide, and for the information of those concerned in mills, and requiring the use of bands, I should recommend them to William Kumbel, the manufacturer and patentee of Kumbel's patent machine-stretched leather banding, who manufactures the same at No. 33 Ferry street, New York. He stretches them very thoroughly by machinery, and rivets them together, and makes them run perfectly straight; and also warrants them to give perfect satisfaction to the purchaser. He may at all times be addressed by mail, and will send prices of any or all the different sizes which may be wanted, and can be forwarded by express. He is a man in whom full confidence can be placed, as he warrants, and will take back any work that does not give entire satisfaction. All millers, as well as others engaged in manufacturing, can attest to the importance of having bands properly made; and I have myself recently visited some of the largest establishments in New York, and, among others, the extensive, and, I might say, model flouring-mill, of the Messrs. Hecker & Brothers, where I saw some 3000 feet of this belting in operation. For driving both the stone and elevators, its performance was most perfect. I should have noticed that the manufacturer sizes and joints by cement, before riveting.

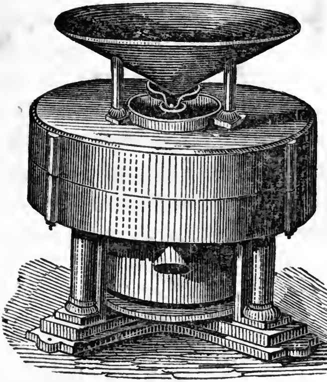
SAW-LOGS REDUCED TO INCH BOARD MEASURE.

Length in feet.	Diameter in inches.																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
10	49	61	72	89	99	116	133	150	175	190	209	235	252	287	313	342	363
11	54	67	79	98	109	127	147	165	192	209	230	259	278	315	344	377	400
12	59	73	86	107	119	139	160	180	210	228	251	283	303	344	375	411	436
13	64	79	93	116	129	150	173	195	227	247	272	306	328	373	408	445	573
14	69	85	100	125	139	162	187	210	245	266	292	330	353	401	439	479	509
15	74	91	107	134	149	173	200	225	262	285	313	353	379	430	469	514	545
16	79	97	114	142	159	185	213	240	280	304	334	377	404	459	500	548	582
17	84	103	122	151	168	196	227	255	297	323	355	400	429	487	531	582	618
18	89	109	129	160	178	208	240	270	315	342	376	424	454	516	562	616	654
19	93	116	136	169	188	219	253	285	332	361	397	447	480	545	594	650	692
20	98	122	143	178	198	232	267	300	350	380	418	470	505	573	625	684	728
21	103	128	150	187	208	243	280	315	368	399	439	495	530	603	656	719	764
22	108	134	157	196	218	255	293	330	385	418	460	518	555	631	688	753	800
23	113	140	164	205	228	266	307	345	403	437	480	542	571	659	719	787	837
24	118	146	172	214	238	278	320	360	420	456	501	566	606	688	750	821	873
25	123	152	179	223	248	289	333	375	438	475	522	589	631	717	781	856	910

SAW-LOGS REDUCED TO INCH BOARD MEASURE, (*Continued.*)

Length in feet.	Diameter in inches.															
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
10	381	411	444	460	490	500	547	577	644	669	700	752	795	840	872	925
11	419	451	488	506	539	550	602	634	708	734	770	828	874	924	959	1017
12	457	493	532	552	588	600	657	692	772	801	840	903	954	1007	1046	1110
13	495	534	576	598	637	650	712	750	836	868	910	998	1033	1091	1135	1203
14	533	575	622	644	686	700	766	807	901	934	980	1053	1113	1175	1222	1295
15	571	616	666	690	735	750	821	865	965	1001	1050	1129	1192	1259	1309	1388
16	609	657	710	736	784	800	876	923	1029	1068	1120	1204	1272	1343	1396	1480
17	647	698	755	782	833	850	931	980	1094	1134	1190	1279	1351	1427	1484	1573
18	685	739	799	828	882	900	985	1038	1158	1201	1260	1354	1431	1511	1571	1665
19	723	780	843	874	931	950	1040	1096	1222	1268	1330	1430	1510	1595	1658	1758
20	761	821	888	920	980	1000	1095	1152	1287	1335	1400	1505	1590	1679	1745	1850
21	800	863	932	966	1029	1050	1150	1210								
22	838	904	976	1012	1078	1100	1204	1268								
23	876	945	1021	1058	1127	1150	1259	1322								
24	914	986	1065	1104	1176	1200	1314	1380								
25	952	1027	1109	1150	1225	1250	1369	1438								

To find the amount of lumber any log will make.—First, find the length of the log in the first or left-hand column; then, on the top of the page, to the right, find the diameter, and under the same will be found the quantity of lumber your log will make: calculated for any length from 10 to 25 feet, and for any diameter from 12 to 44 inches.



HARRISON'S PATENT MILL.

THIS engraving gives a correct view of a mill patented by E. Harrison, of New Haven, Connecticut, and made to suit all orders, for sizes of stone from 18 to 30 inches in diameter. The frame, hoppers, and curbs are of cast iron, and so constructed as to admit of being taken apart for dressing the stone, with the greatest facility. They can be sent to order, packed in a strong case, the weight being much less than stone the ordinary size; and will grind from 5 bushels to 10, per hour, with great ease. For the use of all those millers using Mr. D. P. Bonnell's celebrated process of flouring, those mills of Mr. Harrison's are peculiarly adapted, being what Mr. Bonnell calls his auxiliary mill.

I have examined this patent, at the warehouse of

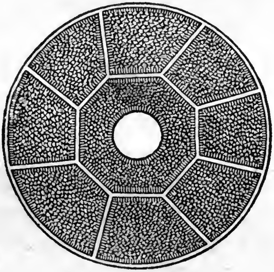
H. E. Warren, No. 44 Cortland street, New York, where they are kept for sale; and all information respecting them will be furnished by applying to this address. They are also well calculated for custom grinding, being much cheaper for grist-mills than large stone on light streams. Mr. Warren sells two kinds of these patent mills; the other being conical in shape. These mills are constructed so that a current of air is continually passing though the stone while running—a matter that adds very much to their importance. The price of the small size is $100; and the large, of 30 inch stone, $200.

FRENCH BURR MILL-STONE MANUFACTORIES.

LAFAYETTE BURR MILL MANUFACTORY,

No. 240 Washington street, New York.

I HAVE personally examined the mill-stones made by this establishment, and found them very much to my liking. They are well made, from choice selected blocks, and are well worthy the patronage of all millers. The bolting cloths kept by this establishment, are of the best German brands, being the old *anchor* stamp, which is in all cases preferable to the new stock of cloths for flouring mills. This establishment does not work up any of the burr stone, called new stock, unless specially ordered by millers; a fact highly credit-able to them as manufacturers of mill-stone. I never did, nor can I recommend this kind of stone to any miller, it being much inferior to the old stock. It is a matter of the greatest importance that millers should know where these different articles can be obtained of the best qualities.



THE TROY FRENCH BURR MILL-STONE MANUFACTORY.

No. 382 River street, Troy, N. Y.

Ethan A. Crandall, Proprietor.

The central position of this manufactory gives millers in all parts of the United States and Canadas an opportunity of dealing on the most favourable terms, for mill-stones and bolting cloths; it being one of the oldest mill-stone establishments in the State, and extensively engaged in the trade; importing all his own stock from France, which gives millers a choice of selecting mill-stones, not to be surpassed in the Union. This establishment is daily engaged in the manufacture of mill-stones from stock of both the *old* and *new quarries*, of French burr, with improved cast-iron balancing *boxes*, &c., in *runners*, so that millers can be easily suited with any description of mill-stones required, at unusually low prices. I have examined his stock of mill-stones on hand, and think they cannot be excelled for quality and workmanship; the seams or joints of the stone showing a great deal of mechanical skill, in their being close, even, and well fitted. His stock of Dutch old and new anchor bolting cloths consists of every description of best quality usually wanted for both flouring and grist-mills. He promptly attends to all *orders* in his line, by mail or otherwise; and sends bolting cloth, by express, to any part of the United States or Canadas, accompanied with a warranty of quality, and instructions as to manner of covering reels, when required.

UTICA FRENCH BURR MILL-STONE MANUFACTORY.

Hart & Munson, successors to M. Hart and Son, in the above establishment, are now prepared to furnish French burr mill-stones of the best quality and greatly improved workmanship and finish; together with the best quality bolting cloths, screen wire, hoisting screws, lighter screws, dansells, and mill picks.

Mr. Munson, who is a practical miller and millwright, has recently invented and patented a machine,

MUNSON'S PATENT MACHINE FOR TESTING THE ACCURACY OF THE BALANCE OF MILLSTONES.

Plate 5.—p. 192

on which the mill-stone, after it is blocked up, is suspended upon its centre, where it is balanced in the course of filling up and finishing, instead of filling up the same without the means of testing the accuracy of its balance, leaving that to be done by the millwright, (as is usually the case,) in hanging the stone for actual use in the mill.

In order that the great superiority of mill-stones finished in this way over all others, may be seen at once, a brief description of the machine and manner of finishing, is herewith given.

An important part of the machine is a heavy circular face plate, which is hung and balanced on a pivot or spindle. This plate has a flange near the outer edge on the under side, which rests on four friction rollers, so that when put in motion, it runs perfectly smooth and true. Around the opening or eye in the centre of the plate, there is raised a flange which receives a hollow cone for forming the eye of the stone. This cone stands perfectly true with the plate, which plate is raised or lowered with a lighter screw. The cut is a representation of the machine, with a mill-stone upon it, in a finished state.

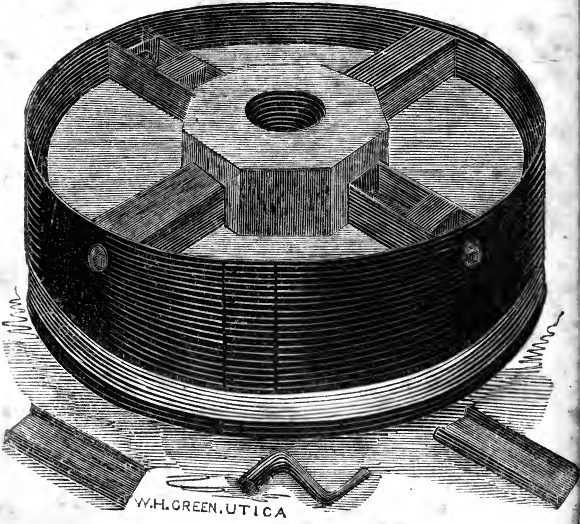
The manner of finishing a stone is by placing it upon the plate and centre it. The skirt is then coated with plaster and turned off perfectly true. The band is then put on hot. This band is wide, (with iron tubes fitted in for the pin holes,) and extends above the edge of the stone in its unfinished state, leaving a vacancy between the eye and the band, which is to be filled up in the finishing. It is in this filling up and finishing of the stone that the balancing of it is performed. The means being here afforded, as described, of raising the stone free from the friction rollers, and holding it suspended on the spindle or cock head, and in that condition observing its balance when at rest, or by application of motive power, communicating to the stone a swift motion, and in that condition, by observing its balance, it can very accurately be ascertained which side of the stone preponderates, and where to apply the heaviest filling.

This test is strictly observed until the necessary thickness is obtained. When the filling is completed, a coat of plaster is put on and the top is nicely turned off, and the stone is complete. During the whole process, the means are afforded of testing its balance both at rest and in motion, so that when the process of construction is complete, and the mill-stone finished, it is not only constructed favourably to the perfection of the stone, but the stone is also thoroughly balanced.

Their bed stones are also finished on the machine, consequently are of equal thickness, which saves the necessity of scribing down or wedging up.

IMPROVED PATENT BALANCE.

The mill-stone, as finished upon the above described machine, is accurately balanced; but as the materials used in forming the stone are put together in a moist state, and the moisture not being equally distributed throughout all parts of the stone, the subsequent season-



PATENT BALANCE.

Plate 6.—p. 194.

ing and drying of the stone may possibly, in some slight degree, destroy that balance. The nature of the improved patent balance is to provide a ready and convenient mode of re-adjusting the balance of the stone whenever it shall become deranged from this or any other cause. To do this, after the stone is blocked up and banded, as shown in the cut, four cast-iron boxes are placed between the band and the eye of the stone, on each of its four sides. These boxes extend from the band to the eye of the stone. In each box is a weight and a screw passing through it. The end of the screw presenting itself at the key hole in the band, is squared and a key is fitted to it, so that by the use of this key, turning the screw to the right or left, the weight, which slides freely within the box, is moved nearer to the centre of the stone or farther from it, at pleasure, and in this way increasing or diminishing the preponderance of the stone at this point. When one weight is pressed nearer to the centre, the opposite one may be drawn out; thus producing a two-fold effect in the relative weight of the two opposite sides of the stone, and as the inequality can rarely be otherwise than trifling after the stone has been accurately balanced upon the machine, a small weight of four or five pounds will be sufficient. The boxes with their weights and screws properly adjusted, the filling of the stone is then put on covering these boxes, and the stone then balanced, turned off, and completed as described above. The means being thus provided of correcting any inaccuracy in its balance which may subsequently accrue from drying, or from any other cause. The improved patent balance will be put into stones only when ordered, and on which an extra charge will be made.

Having visited this extensive manufactory, I feel satisfied in saying that I there experienced great pleasure, as well as received practical information, in the mechanical construction of the French burr mill-stone, which is entirely new. By reference to the engravings, the miller discovers new principles, which are adopted for the purpose of making a mill-stone work perfect. This is an entirely original invention of one of this firm; and I think I can safely attest that no other mill-stone establishment in the United States turns out mill-stones of a finer finish and make than these. Having visited several of the largest establishments in the city of New York and elsewhere, for the purpose of giving millers all the information pertaining to the business, in this edition of my work, I now present to them this establishment, as a model French burr and mill furnishing concern, highly worthy of the patronage of all engaged in our business.

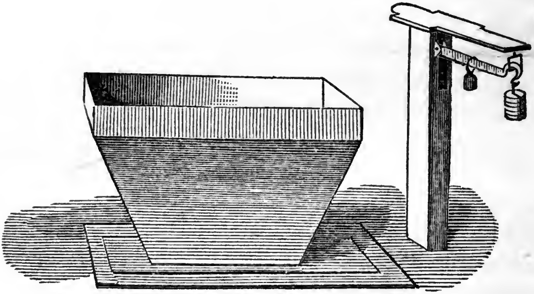
ROCHESTER FRENCH BURR MILL-STONE ESTABLISHMENT.

JOHN F. BUSH, Proprietor.

HAVING visited Rochester, New York, for the purpose of examining the latest improvements in mill machinery, I found this establishment well supplied with all kinds of materials, such as mill-stones of all sizes, together with bolting cloths of all numbers, screen wires of various numbers, smut machines, proof staffs, bran dusters, and every other kind of miller's merchandise, of good quality. I was much pleased in being informed of the manner of preparing that useful machine for the miller, the proof staff. It is made and proved on the most scientific principle, being faced perfectly true previous to casing and sending them away. This is the only firm of our acquaintance where the proof staff is properly made.

REMARKS ON A NEW DESCRIPTION OF BOLTING MATERIAL FOR GRIST MILLS.

This is a late invention of using wire for bolting cloths for mills, and one that gives millers general satisfaction, where custom or grist grinding is the principal use of the same. For the latter kind of mills, wire is preferable to cloth, as there is considerable saving in the difference of the cost of the bolts. Where wire is used, the reels need not be so long by one-third, and for bolting meal made from damp wheat, it is far preferable to cloth. Wire is now manufactured to suit all numbers and sizes, ranging from No. 2 to No. 60. Iron wire cloth, and brass, from No. 2 to No. 70. No. 60 iron wire is fine enough for superfine flour, and 30 for corn meal. All descriptions of wire can be obtained at the manufactory of Sterling Smith, No. 29 Fulton street, New York, where all orders can be forwarded by express, and a superior article of cloth, of either kind of metal, sent. The prices vary from 12½ cents per square foot, for the coarsest numbers iron, to 45 cents, the finest. Brass, from 30 cents to 80, for No. 70, the finest.



BROWN'S WHEAT SCALE, WITH HOPPER.

The same as those used by the Western Mills for weighing Grain.

In compiling this edition of my work, I became convinced of the necessity of pointing to the subject of honest and accurate means of weighing both wheat and flour. As millers frequently have to suffer no small share of imputation in consequence of being imposed upon by venders of fraudulent scales, I wish to call their attention to the fact that they should be very careful in ascertaining that the scales they wish to use are made properly; which may be done by examining whether the bearing points of the scale are made of cast steel, as they should be, instead of being cast iron, roughly fitted, in a cheap style, as some of the scales of this description now offered for sale are. I have taken a good deal of pains to personally examine various scales made by different manufacturers, and have found none that suited my conceptions of what constitutes a good scale, as that at the manufactory of J. L. Brown, No. 234 Water street, New York, as regards their mathematical construction, convenience in weighing, and neatness in appearance. I found them made of the best cast steel for bearings, and carefully adjusted to the standard weight of the United States; and they are used in all the government departments.

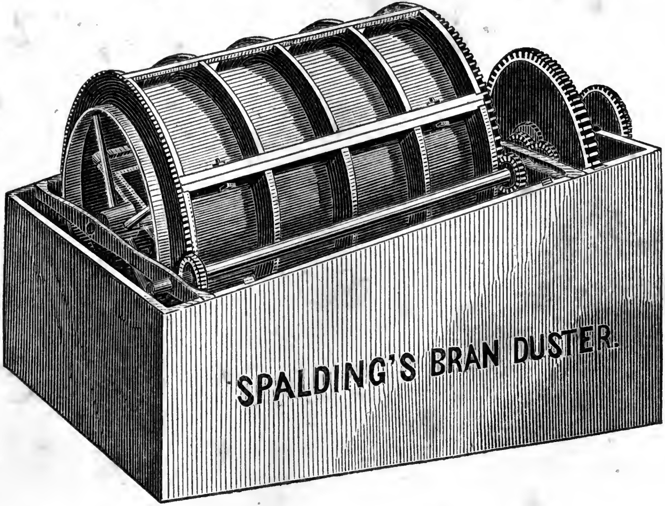
BROWN'S PATENT SMUT MACHINE.

THIS machine was invented by Mr. Brown, a practical miller, of extensive knowledge in milling business generally. He asserts the machine to clean from 10 to 100 bushels per hour, by different applications of speed or motion. In its mechanical construction, it differs from all other smut machines of my knowledge. I made an examination of the working of it at the Kenwood flouring mill, where I found it doing a first-rate business, with a motion of 400 revolutions per minute, cleaning for four run of stones, the size being 30 inches in diameter, and 12 inches deep. Mr. Brown is employed at this mill, as head miller, where he can be addressed by all those in want of his improvement: it is in the county of Albany, New York, where all information relative to the use of the machine should be addressed.

BRAN DUSTERS AND SEPARATORS COMBINED.

The undersigned, being a practical miller, and for three years past engaged in putting into mills bran dusters, is enabled from experience to say that no flouring mill should be without this valuable machine.

The saving by running the bran, shorts, and shipstuffs through the duster, after the bolts usually in mills have taken out all the flour they are capable of, is, in the best arranged mills, from one to two barrels out of the offal from every 100 barrels—and in most mills is from two to five barrels. The enormous loss millers sustain who do not dust their offal, amounts, in this State, to hundreds of thousands of dollars. In Oswego alone, where some 500,000 barrels of flour are turned out yearly, more than ten thousand barrels of flour go off in the offal, without increasing the offal, and is, in fact, throwing away fifty thousand dollars. This bold assertion the undersigned can demonstrate to the satisfaction of any miller who will submit the cleanest of


SPALDING'S BRAN DUSTER.

his bran, shorts, and shipstuffs, to actual trial. Dusting the offal and returning the flour taken out to the hopper-boy, does not speck or injure the flour in the least—this is well known to all millers who have introduced the dusters.

Machines, capable of dusting the offal from any quantity, up to 500 barrels per day, are made in a first rate manner—not liable to get out of order, and easily repaired—either to separate the bran, shorts, and shipstuffs, or not, at L. A. Spalding's machine shop and foundry, in Lockport, New York, at the following prices:—

Horizontal machines, with or without separators, boxed ready to run, about 200 revolutions per minute, requiring but little power—

No. 1, $100, suitable for a mill turning out 100 barrels per day.
No. 2, 150, " " " 200 " "
No. 3, 200, " " " 500 " "

Every flouring mill in Lockport has this machine in use, and certificates, verifying what is said herein, could be obtained, if necessary, from the most respectable and experienced millers throughout Western New York.

Persons wishing machines may address L. A. Spalding, Lockport, Niagara county, New York, (post-paid,) or the subscriber, who will, if required, attend personally in setting them in operation.

F. A. Spalding, Lockport, New York.

N. B.—Directions for setting up will be attached to each machine.

BONNELL'S IMPROVED PROCESS OF FLOURING.

Patented August 14, 1849.

Whatever adds to or improves the quality of any thing which is useful to man, is valuable; and whatever claims to do so, is worthy of attention and examination, particularly when the proposed improvement is directed to the main article of the world's product, breadstuffs.

To the people of the United States, who have annually about 8,000,000 barrels of surplus flour, which seeks the market of the world, and which must come in competition with the produce of the great wheat-growing countries of Russia and Germany, any improvement in machinery or in the process of production, by which American flour can be increased in quantity or improved in quality, without adding to the labour or expense of production, must be of immense benefit. The cost of labour, in the wheat-growing countries of Europe, (aside from that performed by Russian serfs,) is from 11 to 15 cents per day, without board; and, from the government reports of that country, it will be seen that Russia alone, "after a good harvest, is in condition to export about 30,000,000 of chetwerts of grain," equal to about 180,000,000 of bushels of grain; and supposing the cost of transportation equal, as the American producer pays some seven or eight times as much for labour, it is evident he must abandon the foreign market, unless he can, by the richness of his soil, his superior husbandry, and his mechanical skill, combined, produce as cheaply as his competitors. The improvements in the manufacture of flour have, for the last 15 or 20 years, been so great, that many persons engaged in the business suppose that further improvements cannot be made. It is well known, that, but a few years ago, it required, with the utmost economy, 5 good bushels of wheat to make a barrel of superfine flour, and now it is produced, of equally good, or better quality, out of 4 bushels and 15 to 25 pounds; but whatever may be their opinions, and whatever may be the quantity now used, it is no longer a conjecture, but an established fact, that there is a barrel of excellent superfine flour in 210 pounds of good, dry wheat, weighing 60 pounds to the bushel: *i. e.* 3½ bushels. There is, then, a loss somewhere, of 45 to 55 pounds on every barrel of superfine flour; and this loss is mainly from the best and most nutritious portion of the grain, the gluten. This fact is established by the following experiments, extracted from the report of Dr. Beck to the Commissioner of Patents. (See Patent Office Report for 1848.)

ANALYSIS OF WHEAT FLOUR.

New Jersey Flour.

Example 1.—Sample of wheat flour purchased at New Brunswick:

Water	12.75
Gluten	10.90
Starch	70.20
Glucose, Dextrine, &c.	6.15
	100.00

New York Flour.

Example 4.—Wheat flour, branded "Excelsior," manufactured expressly for Messrs. Lay & Craft, Albany, New York, from extra pure Genesee wheat, Rochester, New York.

Water	12.40
Gluten	11.46
Starch	70.20
Glucose, Dextrine, &c.	5.20
	99.26

These two examples are about the medium. There were 23 analyses made by Dr. Beck, from samples furnished by the different States, from which the average yield of gluten was 11.18 per cent. of the whole flour.

The proportion of gluten in *wheat* is generally about double that contained in these samples of *flour*. According to Davy's Agricultural Chemistry, English Middlesex wheat contained 19.00 per cent.; Sicilian wheat, 23.90; Poland, 20.00, and North American, 22.50 per cent. The other half, therefore, of this most precious property of the grain goes into the bran or feeds, and is comparatively lost. On this point, Dr. Beck says: "Although the whiteness of the bread is considered as a mark of its goodness, it has been ascertained by Professor Johnston that fine flour contains a less proportion of nutritive matter than the whole meal. The correctness of this view has been confirmed during the present investigation; for in two or three samples of wheat which I have analyzed, it was found that the amount of gluten in the fine flour was less than in the flour passed through a coarse sieve and containing a larger proportion of bran. These results, according to Professor Johnston, are to be accounted for in the supposition that the part of the grain which is most abundant in starch crushes better and more easily under the mill-stones than that which, being richer in gluten, is probably also tougher and less brittle. They are also consistent with the greater nourishment generally supposed to reside in household bread, made from the flour of the whole grain."

Millers, being aware that they did not save all the flour which the grain contained, have laboured under a great many difficulties in attempting an impossibility, viz. to reduce to the same degree of fineness the different constituent parts of the grain by one grinding.

If they grind high and free, much, and the best portion of the flour, will be lost. Their flour will contain but little else than the starchy property. If they grind close and fine, they glaze their mill-stones, and the heat produced by the friction spoils the flour. The starchy portion of the grain is ground to a paste, filling the meshes of the bolts, and retarding its passage through them. This shows the necessity of a double grinding process, and, in fact, all millers have, in some manner, acknowledged it, by taking up the middlings, or other portions of the ground stuffs, and regrinding them.

I have invented and recently patented an improved process of grinding, which obviates these difficulties. It consists in separating the starch from the glutinous substances contained in the grain, and submitting the latter to a second active grinding or scouring process. This is effected by placing a set or run of auxiliary mill-stones, (under a very rapid motion, from 300 to 500 revolutions per minute,) so as to intercept the whole body of the offal, on its passage from the first or superfine bolts to the return or duster bolts. The auxiliary mill may be adapted in size to the work to be done; a stone 36 inches in diameter being sufficient for a common four-run mill. It should be driven with a spur wheel or gearing of some kind, as a belt is liable to slip and lose motion. The eye of the stone should be made very conical, and the irons put in so as to leave as much room in the eye as possible—the whole of which should be covered with smooth sheet iron or tin. The stones should be strongly banded, hung, and balanced very nicely, dressed true and smooth, with a pretty large proportion of deep furrows about the eye or centre. The feeding is supplied and made very uniform and perfect, by substituting a large funnel for the common "hopper, shoe, and damsel." Around the tube of the funnel is cut a screw, which passes through a nut set immediately over the runner's eye. This tube reaches down in the eye of the runner until it comes nearly upon the top of the bale, which should be formed so as to fit, or nearly so, the opening of the tube; then, by turning the funnel, the screw widens or contracts the opening at the top of the bale, admitting more or less feed, as desired.

In using this improvement, the first grinding should be done with reference to the starch entirely, always being careful to reduce no part of it so fine as to destroy its granular qualities. This done, the bolting is free, and the starch is bolted out in passing through the first or superfine bolts. The remainder of the stuffs is sent directly to the auxiliary mill, where it is ground to any degree of fineness the miller may desire. It is then passed through the lower merchant or duster bolts, and such portion of it sent back to the same as may be necessary, until all the flour is brought out clear from "specula," when it is continually sent to the cooler or first bolts, to be uniformly incorporated with the superfine flour.

In this manner, the miller may put the whole constituent of the wheat, except the bran, into the superfine barrel, or as much of it as, by any possibility, is susceptible of being made into flour. He may make his flour a superior article, in point of colour and texture, or he may make the best "Graham" imaginable, by one straight, continuous operation. The following are some of the advantages and economies which the improvement combines:

1. As the whole body of the grain is reduced to the same fineness, it facilitates the bolting and simplifies the bolting machinery; three bolts, properly adjusted and adapted to the process being sufficient for a four-run mill.

2. It saves the time, trouble, and expense of grinding over middlings, and makes the proceeds of the middlings into superfine flour, and thus avoids the loss heretefore sustained in the sale of "fine flour."

3. It catches and reduces to flour all the partially ground or whole grain, which, by stopping or starting the mill, or from any other cause, escapes the first grinding, and which, by the ordinary mode of grinding, is lost in the feeds.

4. It is admirably adapted to the grinding of the wet or damp wheat, so much of which comes to our markets in unfavourable seasons. The first grinding warms the product, and, on being passed up the elevators, through the cooler and first bolts, the offal is comparatively kiln-dried, when it is subjected to the rapid motion of the auxiliary mill, and, on being bolted, is readily divested of almost every remaining particle of flour. It also exhausts the moisture in wheat comparatively dry, and, at the same time, adds more gluten, both

of which have a direct tendency in preserving the flour from souring in warm weather and hot climates.

5. As the flour is drier, richer, and of better quality, it will absorb more liquid in bread-making, and of course make more bread, and that of more nutritious and wholesome quality, than ordinary superfine flour. This the bakers in our Eastern markets, where this flour has been sold, have already ascertained.

6. It saves enough from the bran, shorts, shipstuffs, and middlings, besides the great saving in bolting arrangements, regrinding middlings, &c., to enable the miller to make his barrel of excellent superfine flour out of 15 to 25 pounds less wheat, on the average, than by any mode heretofore practised.

Perhaps it may be objected that "there is nothing new in grinding over the offal, or bran, but, on the contrary, that it has long been practised." This, of course, I would not deny, as I do not claim to be the discoverer or inventor of any new *principle.* I only claim to have *adapted the grinding process to the practical and continuous operation of scouring or cleaning the offal with an auxiliary mill, adapted to that purpose, and running very rapidly*, and, by a simple construction and arrangement, *to have made the feeding of the offal uniform and perfect*, and that by these means all the difficulties heretofore encountered in attempting to grind offal are entirely overcome. Heretofore, in attempting to grind offal, the main difficulty has been in the feeding and motion. If the stones were run at a high speed, the feeding could not be regularly supplied; if run slowly, there being so large a proportion of gluten in the offal, the stones would soon become glazed. But in my plan, the stones may be run at any speed, and the feeding of bran alone will be uniform and equal. It may also be objected that "the proposed process of regrinding the offal will so speck and reduce the standard of the flour, that it will not pass inspection." It would answer this objection to say that there are now no inspection laws in the principal markets for Western flour, and that the time is rapidly approaching when the mere *whiteness* of flour must be considered of secondary importance, and that it will be valuable and esteemed in proportion to the nutriment it contains. But I by no means admit that the colour of the flour is necessarily changed by my process; on the contrary, I assert that it will maintain its colour and texture so as to warrant inspection, and for these reasons:

1. When the whole meal is sent from the first stones to the cooler, the bran is not cut up so fine as when attempting to get all the flour from the wheat by one grinding: this diminishes the chances of specking the flour.

2d. The bolts are fed much fuller than before, as the whole body of the flour is much more uniform, which has a tendency to keep the lighter particles, or "bran speckula," upon the top, until carried off by the rotary motion of the bolts, with the feeds; and,

3d. The "offal," after being reground, is not "returned" to the "hopperboy," or first bolts, but sent to the return or duster bolts, and such portion and quality of the flour bolted out, and sent to the cooler, as the miller's judgment may dictate, and such as will not lower the grade of superfine flour; the brown "speckula" of the lower bolts always being returned to the same bolts, until the flour rendered is sufficiently clear to warrant sending it to the "cooler," or first bolts, to be incorporated with the superfine flour, without danger of specking or injuring its colour. This can easily be done, and scour the offal as fine as you wish, as the same comparative difference is always maintained between the bran and flour : the bran always being coarser and lighter than the flour, there is no trouble in separating the latter from the former,. by proper care in arranging and managing the bolting. But it is quite unnecessary to speculate or theorize upon this subject, as practical tests, made under very unfavourable circumstances for the improvement, have fully and fairly settled the whole question. The fact is, the miller's skill and judgment must always determine the quality of his flour; and with this improvement he may use 6 bushels of wheat for a barrel of superfine flour, or he may make it from 3 30-60, or 3 40-60, or 4 bushels, as the condition of the wheat and the circumstances may warrant.

This "process" may be adapted to any ordinary custom mill in the same manner as specified for flouring, and with an expense of from 100 to 150 dollars, which would enable it to do a respectable flouring business, besides saving to the farmer from 3 to 5 pounds of flour, of an improved quality, on every bushel of wheat ground. A stone from 20 to 24 inches would be sufficient for the purpose, which might be driven with a belt where it could not conveniently be attached to gearing. The whole of the bran and all that is usually taken off for middlings and other stuffs should be ground through the small stones immediately as it is bolted; after which, it should be thrown into a common bolt, and as much of the flour sent continuously to the main custom bolt, as the miller desires, and the residue to the "*bran bag.*" The expenses would be nominal, as compared with the advantages and savings, which calculated at only 3 pounds to the bushel, would amount to 150 barrels of flour upon every 10,000 bushels of wheat ground, which, at $4 per barrel, would amount to the snug little sum of $600 saved to the farming community; and the mill having such an improvement would command an amount of business that would abundantly compensate it for the trifling expense. Addison J. Comstock, of Adrian, (a gentleman who has been steadily engaged in milling during the last 15 or 20 years,) is now making preparation to adapt this improvement to "custom grinding," after thoroughly testing it in his flouring mill.

The right of use for custom mills will be sold extremely low, and the savings made simply in "grinding out the tolls" for retail would be a great inducement for millers to engage in it, as, in grinding out the tolls from every 20,000 bushels of wheat, they would certainly save 30 barrels of flour, besides giving to the community, for which the 20,000 bushels were ground, 300 barrels of good flour more than they now obtain from the same wheat.

I am now prepared to sell rights to the above improvement, for the use of single mills, for towns, counties, or States, having yet the exclusive rights to the following States and Territories, viz.: Ohio, Virginia, Michigan, Indiana, Illinois, South Carolina, Missouri, Georgia, New Jersey, Mississippi, Florida, Arkansas, New Hampshire, Vermont, Rhode Island, Oregon, and California. The remainder of the States are duly assigned to Mr. C. Spafford, of Tecumseh, who is also ready to put the same upon sale. Extra inducements will be offered to those wishing to purchase the right for a State or Territory; and any one who will first adopt and bring the improvement before the public in any one of the above named States, (where not already introduced,) may dictate his own terms. The mill must be first class, and the proprietor bound to properly adapt his bolting in every particular to it. The expense of adopting it, aside from the right of use, will vary, according to circumstances, from $150 to $250, after which it will require no words to prove its durability and economy. It is certainly no objection to it to say that it is very simple, and does not develope any unknown or very extraordinary principles; on the contrary, these should recommend it to all intelligent and practical men. All letters addressed to me at Tecumseh, in reference to the above, will receive prompt attention.

D. P. BONNELL.

Tecumseh, Nov. 17, 1849.

It is but very recently that the patent was issued, and that I have been prepared to sell; yet the improvement is now in practical operation in Messrs. C. Spafford & Co.'s "Tecumseh Mills," Messrs. Comstock & Jackson's "Harrison Mills," (twenty miles west of Adrian,) Messrs. Kennedy & Harris's Steam Mills, at Jackson, and is highly complimented by these last-named gentlemen, in a late number of the Detroit Bulletin. It is also in operation in Mr. Seneca Hale's "Sidney Mills," in Shelby county, Ohio. Certificates from the proprietors of these mills will be seen herein. Also, from Charles Howard & Co., (Mr. Howard is Mayor of Detroit,) who are extensively engaged in the flour trade, and from Mr. John Copland, one of the best and most respectable bakers in that city.

Messrs. Holly & Johnson, of Buffalo, to whom the "Tecumseh Mills" flour is consigned, in remitting account of sales to Mr. C. Spafford, under date of the 7th November, say: "These are low figures, but the sales in both cases were at the 'top of the market.'"

Mr. S. J. Holley, after critically examining this process, in practical operation at the above mill, in writing from Buffalo, a few days subsequently, to Mr. Spafford, says: "You are unquestionably making your barrel of superfine flour from 12 pounds less wheat than any mill in the State of Michigan." [It is proper here to remark that the machinery so examined was the first put up to try the practical working of the invention, and before application for a patent was made, and that the other machinery of the mill was not well adapted to it.]

I make the above extracts to show, that although, in the opinion of Mr. Holley, the yields by my process are from "12 pounds less wheat than by any mill in the State," yet the flour maintains a good reputation, and sells at the top of the market."

A NEW AND PERFECT MACHINE FOR CRACKING CORN IN THE COB.

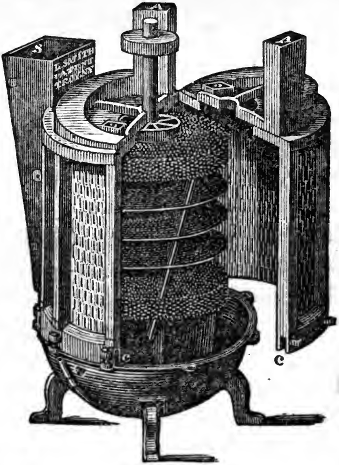
Patented by Mr. Ross, of Pennsylvania.

THIS is the best machine for the purpose I have ever examined. The breaking is accomplished by the application of a new and different principle, consisting of a series of cast-iron cylindrical saws, so framed and arranged as to act on the same corn but once in breaking it for the mill-stones; there being no power lost in feeding the machine, the saws taking an equal quantity of feed at every revolution. It runs perfectly steady, without racking any part of the other machinery of the mill, as is the case with the old-fashioned corn-crusher It is capable of cracking from 20 to 50 bushels per hour, making about 200 revolutions per minute, and is also easily set up, it being driven by a band 5 inches wide; and it takes up but a small space. For grist mills which do a large custom business, it is just the machine wanted. It can be furnished to millers in any part of the United States, by addressing Mr. Ethan A. Crandall, at his mill-stone manufactory, at Troy, New York.

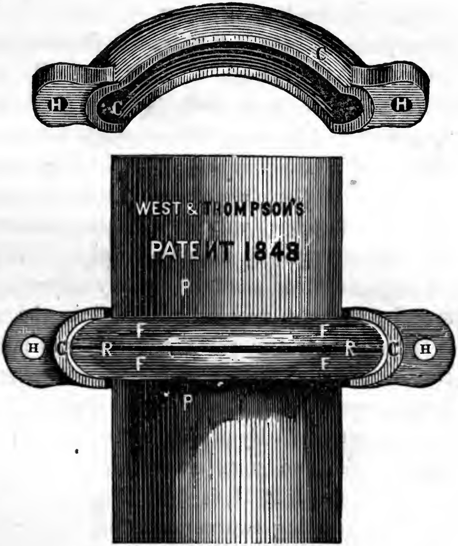
TROY (NEW YORK) MILL-GEARING ESTABLISHMENT,

By Messrs. Starbuck & Son,

Who are also manufacturing steam engines of all sizes, together with mills for sawing lumber, on an improved plan. These saw-mills, for small streams, are an excellent substitute for the purpose designed, being all complete of cast-iron gearing, made in the best possible style. This concern also constructs them to suit all powers, and capable of sawing from 500 to 3000 feet per day, with engines attached.



Starbuck & Son are also manufacturing Leonard Smith's patent smut machine; this is one of the late improved machines, and said to work very well; they are made of nine different sizes, costing from $80 to $200, and will clean from 15 to 150 bushels per hour.



CLASP COUPLING JOINT

West & Thompson's Patent, New York City.—Patented June 27th, 1848.

This is one of the first-class inventions of modern times for coupling steam and other pipes, and shafts, and some other solid bodies, as it greatly facilitates the putting them up, and in making repairs, and at less expense, as it dispenses with drilling of holes, brazing, soldering, and fitting up flanches.

The figure on the preceding page represents two flanches, joined each to one of two pieces of pipe, and its application in conducting steam.

P P are pieces of pipe. F F are two flanches, joined each to one of the pieces of pipe. It will be observed that the form given to the flanches is of such a nature as to retain the clasp in its proper place under any pressure of steam. It will also be perceived that the inner form of the clasp is so constructed as not to bear upon the flanches, only at the parts where the pressure is most required, close to the pipe. R R is a piece of vulcanized India rubber, or any other packing that may be thought necessary. C C is the clasp. This is divided into two parts, and this part is represented with the flanch resting on it. The other part of this clasp is represented by the figure to the right, which shows its concave part. By placing this over the flanches and securing the two parts of the clasp together by bolts passing through H H, is all the operation that is required in connecting two separate pieces of pipe together. Every engineer or mechanic will perceive that the tighter the clasp is screwed up, the faces of the flanches are brought closer together, and the joint is thereby made perfectly tight.

Advantages of this Joint over all others now in use, with a list of prices.—1. The cost is from 25 to 30 per cent. less. 2. The labour and expense of brazing or soldering flanches on pipes is obviated, and not required. 3. There are no holes to drill in the flanches, washers to use, or grummets to put around the bolts. 4. It only requires two, or at most three, bolts for the largest size joint, even if they were seven feet in diameter. 5. The joints are tighter and stronger, as the pressure is exerted at the neck of the flanch, in close proximity to the periphery of the pipe. 6. The cost of packing is one-half less, and cannot blow out, as it is confined by the grooved segmental clasp. 7. Joints of any size may be taken apart, and put together in from five to ten minutes. 8. It enables a defective portion of a feed or blow-off pipe to be cut out, and a new piece to be put in, without involving the stopping of the attached engine, or arresting the operation of the attached boiler. 9. They are more economical in space, weight, cost, and repairs, and are applicable to cylinder heads, bonnets, steam chests, air pumps, condensers, man-hole plates for boilers, stopcocks, nozzles, common and rotary pumps, and all other purposes where joints are required.

It will also be evident from the foregoing, to any engineer or machinist, and experience has shown, that shafts and other solid bodies can be coupled together in like manner as hollow pipes or vessels. The flanches, instead of solid projections, of the bodies to be united, may be made separate, and connected therewith in any manner desired.

In flouring mills, the shafts may be taken down without interfering with the bridge trees or centres. This particular alone, makes it preferable to any other coupling for the purpose, as, in repairing, time and expense is saved, and not having to overhaul the centres, which, in a large merchant mill, is an item of considerable expense on the old plan of either clutch or sleeve coupling.

These couplings are made and kept for sale, and information respecting them may also be had, by application to George D. Baldwin, city of New York.

INDEX.

THE END.

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