A great advantage of animal over artificial mechanism is that the animal frame adapts itself to the kind of work required of it; the muscles that come into play grow more and more capable of performing it. This point is well observed by comparing those whose labors affect one set of muscles chiefly with those accustomed to a great variety of motion—the hod carrier and the gymnast, for example.

The force of inertia is constantly experienced in every motion we make. We cannot even rise from a chair without leaning forward first, *i. e.*, placing our bodies in a position favorable for overcoming their inertia. In leaping, flying, etc., the initial effort is always the greatest, much less force being afterward required to keep up the motion. All these efforts result in fatigue proportional to their intensity. Thus, in walking on a level plane, the body is raised on an average 1·2 inch from the ground at every step. In walking up stairs the force expended is much greater. By the time a lady has ascended three flights of stairs, she experiences more fatigue than after walking around two blocks in New York. The study of animal mechanics may be productive of great advantage to us, by leading us to a better understanding of the laws of fatigue and rest.

Professor Trowbridge's paper was followed by a discussion in which Messrs. Newberry, Warner, and Martin took part. Attention was drawn to the wonderful instinct by which birds so adjust the resisting surfaces of their bodies as to be able to sail across and even against powerful currents of air with apparent ease, and to another cause of superiority of animal over artificial mechanism, namely, the mysterious nerve communication by means of which the different organs transmit their sensations to the brain of the animal, and in return receive instantaneous commands, enabling them to adapt themselves to every emergency. C. F. K.

Correspondence.

Alum in Baking Powders.

To the Editor of the Scientific American:

SIR: In your issue of the 7th inst. I noticed an article on the above subject by Henry Pemberton, Jr., as also some editorial remarks by yourself. With respect to Mr. Pemberton's remarks, I would state that it is evident he formed his opinion on entirely a theoretical basis. His opinion is one which would very probably be expressed by any number of persons who rely on theories instead of on facts. Mr. Pemberton states that when an alum baking powder is used in baking, the alumina of the alum is precipitated and becomes insoluble by heating. A very distinguished scientific man writes to me, and says: "This is a matter of experiment, and facts thus obtained are undoubtedly worth far more than conclusions derived from theoretical considerations." This last paragraph has embodied in it my views on this subject, and it strikes me it would have been proper for Mr. Pemberton to have made a few experiments with bread or biscuits made with an alum powder, to see if the alumina was really in an insoluble or in a soluble condition, before expressing so decided an opinion. I am perfectly well aware that when an alum baking powder is used in baking, the alum is transformed into another alumina salt, provided the constituents of the powder are combined in exact chemical equivalents. If, however, the constituents are not in exact equivalent proportion (which is more probable than otherwise, as chemical weights are seldom, if ever, adopted by manufacturers), there will be a certain per cent of alum left unaltered. There would, therefore, be present in the baked product in either case an alumina salt; and in the last, or more probable case, in addition to the alumina salt, some unaltered alum. So that, supposing a portion of the alum was transformed into an insoluble alumina salt (which has not been proved as yet in the baked product), it is evident persons eating the baked product would run the risk of taking into their stomachs the unaltered alum. It is true the per cent of this would probably be small, but by its continued use would certainly bring about serious disorders in the system. As regards the alumina salt, let us stop a minute. Wagner states: "The active principle of alum is evidently the sulphate of alumina, not the sulphate of potassa and ammonia." That alumina is the poisonous element of alum, I think the following provings clearly demonstrate, which I take from my Encyclopædia of Materia Medica: "It destroys the appetite, produces sour eructations, heartburn, pain in the abdominal ring, the rectum is rendered inactive, constipation or loose bloody discharges are produced." From these provings it will be seen that the effects of alumina on the system are substantially the same as alum. That is to say, that alumina bears the same relation to alum (being its active principle) as morphine does to opium or nicotine does to tobacco. Supposing, again, that the alumina salt formed in baking was in an insoluble condition (which I have already stated has not been demonstrated), and not considering the amount of alum left unaltered, I doubt if the public would be willing to run the risk of eating the baked product, for fear that the heat of the oven was not in the proper condition to render it all insoluble. Supposing, on high scientific authority, I should state that a salt of antimony (take for example tartar emetic) if added to a cup of tea would be completely neutralized by the tannin or rendered "insoluble" for instance. How many persons would I find willing to drink the tea? Not many, I am quite positive; and this is the view I think the public will take about alum baking powders. When they can obtain a number of powders on the market composed of wholesome constituents, I think they will not care to run the risk with alum powders. As to the alumina salt being in an insoluble condition, I shall, in a future article, have something more to say, to satisfy the scientific men; but I think the public will have received, after carefully reading the above, sufficient satisfaction or explanation to convince them that alum baking powders are most dangerous to use.

In answer to "Pro Bono Publico," I would state that my intention was in the beginning to expose injurious baking powders: not to advertise baking powders. It was necessary for me to select a good baking powder for comparison, which might have been any of the other powders other than the one selected, if I found it composed of wholesome elements. For me to publish the whole list and have my name on every baking powder can in the country, as I have been asked to do by a large number of manufacturers already, is more than I am willing to do, and also, I think, more than the public would think of asking of me. Respectfully,

HENRY A. MOTT, JR., Ph.D., E. M.

New York, November 28, 1878.

P. S.—Mr. Dooley insinuated to you that my analysis of his powder was not correct. Now, in justice to me and the public who wish only the truth, I suggest that Dooley publish in your paper a correct analysis of its composition. I found over 26 per cent of burnt alum in one sample.

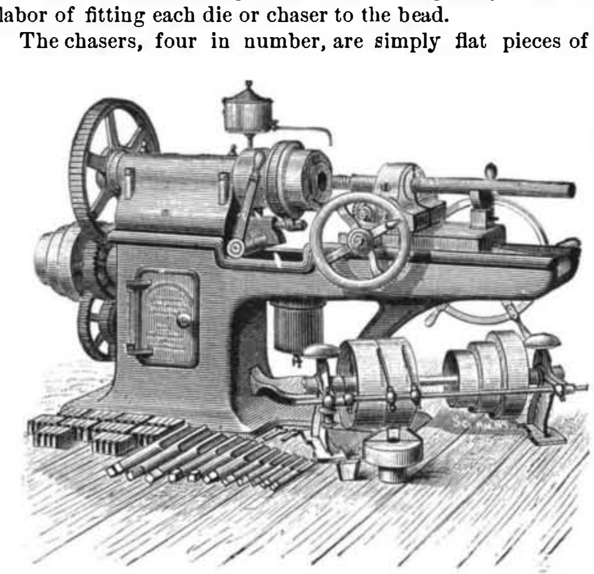
H. A. MOTT, Jr.

IMPROVED BOLT CUTTER.

The annexed engraving represents a machine for cutting screw threads on bolts, and is one of superior design. It is named the No. 5 National Bolt Cutter, and is adapted for cutting threads on bolts from one inch to two and a half inches in diameter. Among other good features claimed by the manufacturers the following may be mentioned as the most prominent ones.

The die head is constructed to receive blocks or cases, with inserted chasers, forming the dies, thus doing away with the labor of fitting each die or chaser to the bead.

The chasers, four in number, are simply flat pieces of



THE NATIONAL BOLT CUTTER.

steel, averaging about an inch and a quarter in length, and which may be either planed or fitted in with a file from the rough stock. A small screw in the end of the case sets the chasers forward as it becomes necessary to dress over the dies. Another style of chasers is constructed upon the interchangeable system, with threads at each end, and are held in the cases by studs, thereby becoming as serviceable as two sets of dies. Broken or damaged chasers can be replaced by duplicates at little expense.

The adjustment of dies to the proper size is accomplished by merely turning a screw in the front of the head. The die head can be quickly stripped without removing it from the machine. One set of case dies can be removed and another inserted in the head in less than one minute by changing a stop pin, projecting from the sleeve, from its position when the machine is working, to a point opposite a hole in the flange at the rear of the head, then, by means of the lever, pushing the sleeve back to the flange, uncovering the cases, and permitting their removal and replacement by hand. The machine can be quickly converted into a nut tapper by removing the case dies and putting in their place a steel block to which is secured a universal chuck for holding taps that is furnished with each machine. All the working parts of the die head are protected from chips or dirt. The locking device is positive and requires but one movement of the lever for unlocking and opening the dies or closing and locking.

The die blocks are held rigidly by the inclosing sleeve when locked, and consequently cut bolts of more uniform diameter than is the case when the chasers or cutters can spring away from the bolt when cutting.

Machines of this description are made of various sizes, and for special purposes with the necessary modifications in gearing and proportions. They are supplied with all necessary adjuncts and facilities for lubricating the parts, and are constructed with the care and extreme accuracy for which this company are so well known.

Further information may be obtained from the makers, the Pratt & Whitney Company, of Hartford, Conn.

ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, December 28 1878.

The following calculations are adapted to the latitude of New York city, and are expressedin true or clock time, being for the date given in the caption when not otherwise stated:

PLANETS.

	H.M.		H.M.
Mars rises	4 51 mo.	Uranus rises	9 16 eve.
Jupiter sets	7 14 eve.	Neptune in meridian	7 52 eve.
Saturn sets	11 12 eve.		

FIRST MAGNITUDE STARS, ETC.

	H.M.		H.M.
Alpheratz in meridian	5 33 eve.	Procyon rises	6 45 eve.
Mira (var.) in meridian	7 44 eve.	Regulus rises	8 48 eve.
Algol (var.) in meridian	8 31 eve.	Spica rises	1 29 mo.
7 stars (Pleiades) in merid.	9 11 eve.	Arcturus rises	0 32 mo.
Aldebaran in meridian	9 59 eve.	Antares rises	5 35 mo.
Capella in meridian	10 38 eve.	Vega sets	8 57 eve.
Rigel in meridian	10 39 eve.	Altair sets	7 45 eve.
Betelgeuse in meridian	11 19 eve.	Deneb sets	0 07 mo
Sirius rises	7 10 eve.	Fomalhaut sets	8 21 eve.

MOON'S PLACE IN THE CONSTELLATIONS AT 7 P.M.

Saturday, *Aqua us*	9°	Wednesday, *Pisces*	27°
Sunday, *Aquarius*	21°	Thursday, *Aries*	9°
Monday, *Pisces*	3°	Friday, *Aries*	21°
Tuesday, *Pisces*	15°		

REMARKS.

Venus is still invisible, setting only 18 minutes after the sun. Saturn will be about 7° south of the moon December 30. The earth will be nearest the sun January 2, 1879.

Prof. James C. Watson, late of Ann Arbor, Mich., and Prof. Lewis Swift, of Rochester, N. Y., are, we believe, of the opinion that the planets discovered by them during the July eclipse are identical. Thus two planets were discovered within 2m. 52 seconds after the commencement of the search for them. Exclusive of comets, there are now 224 members of the solar system known.

There are now 190 asteroids known, unless others have been discovered since October 1. In 1875 there were 17 discovered, the greatest number in one year. Prof. C. H. F. Peters, of the Litchfield Observatory, Hamilton College, has discovered the greatest number—31. Professor Watson follows him in the list, having discovered 23. The following shows the number discovered in the different months, September being the lucky month:

January, 11; February, 15; March, 15; April, 24; May, 14; June, 8; July, 8; August, 21; September, 33; October, 16; November, 22; December, 3.

January 9 Neptune will be 10° 43m. 47 sec. south and 5° 10m. 48 sec. east of *a Arietis*. January 29 Neptune will be 10° 41m. 50 sec. south and 5° 12m. 45 sec. east of *a Arietis*.

A line from *Lambda* (91) *Ceti* through *Mu* (87) *Ceti* produced five degrees northwest, will pass very close to Neptune. *Lambda* and *Mu* form the northern side of a pentagonal figure (sides 3°-5°) in the Whale's head.

New Mechanical Inventions.

Mr. James Griffin, of Mendocino, Cal., has patented an improved Saw Guide, that may be adjusted by the operator when the saw is in the cut, which is of special advantage when sawing long timber, and by which the wear of the parts is taken up in easy manner, so as to keep the guide always in good working condition.

Mr. Charles Galigher, of Cairo, Ill., has patented an improved Millstone Curb and Chop Conveyer. In this contrivance the meal cannot choke up or become clogged, but falls freely from the vicinity of the stones as soon as it comes out from between them. Access of air is thus permitted to the stones, and the flour is not injured by detention between the grinding surfaces or by friction against the stone and curb.

Mr. Harrison W. Holley, of Hale's Ford, Va., has invented an improved Machine for Rolling and Cutting Tobacco, which consists, essentially, of three sets of pressure rolls, arranged successively close together, an endless feed belt passing through the first set of rolls, longitudinal knives on the second set, and transverse knives on the third set, all of said rolls being geared together, so as to press and cut the tobacco as it is carried through the machine by the endless belt.

Southern Factories.

According to a carefully prepared statement of Gen. L. P. Walker, of Alabama, that State has 2,118 factories, working 8,248 hands, with a capital invested of $5,714,032, paying annually in wages $2,227,968, and yielding annually in products $13,040,644. Florida has 630 factories, working 2,749 hands, with a capital invested of $1,679,930, paying annually in wages $989,592, and yielding annually in products $4,685,403. Georgia has 3,846 factories, working 17,871 hands, with a capital invested of $13,930,125, paying in wages $4,844,508, yielding annually in products $31,196,115. Louisiana has 2,557 factories, working 30,071 hands, with a capital invested of $18,313,974, paying in wages $4,593,470, yielding annually in products $24,161,905. Mississippi has 1,731 factories, working 5,941 hands, with a capital invested of $4,501,714, paying in wages $1,579,428, yielding annually in products $8,154,758. South Carolina has 1,584 factories, working 8,141 hands, with a capital invested of $5,400,418, paying in wages $1,543,715, yielding annually in products $9,858,981. Texas has 2,319 factories, working 7,927 hands, with a capital invested of $5,284,110, paying in wages $1,787,835, yielding annually in products $11,517,302. Aggregate number of factories, 14,884; aggregate number of hands employed, 80,948; aggregate capital invested, $54,824,303; aggregate wages paid annually, $17,514,516; aggregate annual value of products, $102,615,108.

The Industrial Development of Cleveland, Ohio.

The rapid industrial development of the West finds no more notable illustration than the recent rapid growth of Cleveland, Ohio, as a manufacturing city. Its first city directory, issued just 40 years ago, enumerated among the manufactories on the east side, 4 iron foundries and steam engine manufactories, 3 soap and candle manufactories, 2 breweries, 1 sash factory, 2 ropewalks, 1 stoneware pottery, 2 carriage manufactories, and 2 French burr millstone manufactories. These were all very small in comparison with works of the same nature at the present time. On the west side of the river, then known as Ohio City, there was the Cuyahoga Steam Furnace, a steam boiler factory, a saleratus factory, and a glue factory.

The directory of the current year shows among the iron-working establishments, 16 first-class foundries, any one of which does more business in a year than all the iron works of Cleveland combined in 1837, 23 machine shops, 8 steam engine manufactories, 7 boiler making establishments, 4 agricultural implement manufactories, 3 axle manufactories, 2 boiler plate works, 6 bolt manufactories, 2 chain works, 2 cast steel works, 9 iron fence and railing works, 2 spring factories, 2 iron pipe factories, 3 car wheel factories, 2 car journal manufactories, 1 architectural iron works, 16 iron works of general character, 1 steel screw factory, 5 bridge building works, 1 car building works. There are also 4 brass foundries, 15 planing mills, 3 white lead factories, 3 woodenware works, 1 woolen mill, 4 chemical works, 6 flouring mills, a number of oil refineries of large capacity, including the immense Standard Oil Company's establishment, and manufactories of various other descriptions, with innumerable smaller workshops.

Handsome as Cleveland is, and justly as it bears the title of the Forest City, remarks the *Graphic*, which devotes the major part of an edition to the pictorial illustration of the city, it is, nevertheless, one of the great manufacturing points of the country. It has earned for itself the title of the Pittsburg of Ohio by the number and importance of its iron works. The odors of its great oil refineries are borne upon the breeze in all directions. Dense clouds of smoke are carried from the numerous foundries and factories far out upon the lake, so that the voyager from Buffalo is apt to see the smoky sign of Cleveland's whereabouts some time before the city itself is visible. Along all the five railroad lines entering Cleveland, but especially along the two principal coal roads from Pittsburg and the Mahoning Valley, are stretched manufactories of various kinds, and the Cuyahoga Valley is a busy hive of industry, while factories, large and small, are scattered through other parts of the city.

The development of the iron mines of Lake Superior, largely by Cleveland enterprise, and the easy access to the vast coal fields of Northeastern Ohio by the Ohio Canal and branches, and the Cleveland and Pittsburg and Mahoning railroads, encouraged the development of the iron making industry, which, together with manufacturing generally, received a sudden and extraordinary stimulus from the demands growing out of the war. Cleveland enterprise, also, was largely instrumental in the development of the petroleum fields of Pennsylvania, the consequence being the transfer of the greatest share of the refining industry to Cleveland, which has remained the headquarters of the refining trade. The opening of a railroad to the Tuscarawas Valley, and the connection of the railroad from Columbus with the Hocking Valley Railroad, placed Cleveland in communication with two new coal fields of inexhaustible extent, and the completion of the Valley Railroad next year will open an independent route to still another coal field, and furnish increased advantages for manufacturing.

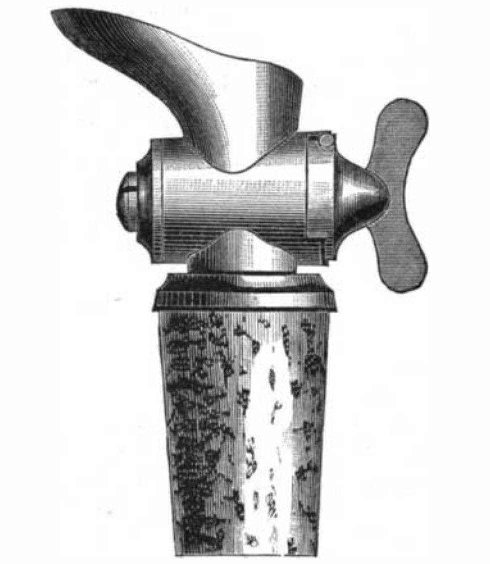
While Cleveland is thus favorably situated for obtaining the raw materials, it is no less so for the distribution of the manufactured articles. Its railways radiate east, west, and south, like the ribs of a fan, with innumerable branches from the main lines, reaching every part of the country. To all principal points there are two or more competing lines. In addition, the lake affords unlimited facilities for shipment to Canada on the north, and to most points west and east. Under these favoring circumstances it is no wonder that Cleveland has become, within a few years, one of the most important manufacturing cities west of the Alleghanies.

Concentrate your Effort.

When Agassiz was asked to give his opinion on a question in chemistry, he persistently declined. "I am no chemist," was his only reply. This resolute concentration of his power in a few well defined channels was one of the secrets of his eminence. In this age, when knowledge goes on adding province after province to her vast empire, one can hope to explore but a little space. There are no longer any universal conquerors. Goethe and Humboldt have left no successors, and if they themselves were to return, they could not possibly take the positions they once held. Half the intellectual failures come from a lack of definite aim and an unflinching devotion to some special pursuit. When so many interesting fields of inquiry are open, it requires a Roman fortitude of mind to purposely give up all save one or two. But this is precisely what you must do if you mean to make your power tell in the world. To concentrate is to master something eventually, while to diffuse your time and energy is to acquire a great mass of imperfect knowledge, and to hold superficially a multitude of disconnected facts. There isn't a part of the human body, or a branch of any science, upon which one could not spend a lifetime of work, and yet leave much untouched. The Greek scholar who died lamenting that he had not confined his work to the definite article, instead of taking up in addition the indefinite, and so leaving both incomplete, is an example of what is demanded of one who means to master any one thing. Herbert Spencer is doing an immense work in the way of collecting facts that have a bearing upon each other in the various departments of science; but familiar as he is with all these subjects, he cannot do the work himself. Human life would not be long enough. Other brains and hands must serve him. And even when a scholar sets himself to do one thing, and nothing else, he finds himself unable to get everything at first hand. He is forced to take something from other workers in the same field. This is the experience of all life as well. You can do well only a few things, and the fewer they are the better you will do them. The Admirable Crichton type of man is very interesting to read about, but in actual life he is likely to raise great hopes, be very entertaining, and die without doing anything. The man who concentrates must often admit his ignorance, and he need not be ashamed to do so, for he knows that on his own ground he can accept the challenge of every comer.—*Christian at Work.*

A NEW BOTTLE STOPPER.

The accompanying engraving illustrates a device by which any quantity of liquid, even single drops, can be drawn from a bottle without incurring any loss by spilling. The device consists of a stopper and a faucet provided with a spout on one side. The whole apparatus is made of Britannia metal, and is covered with cork on the part inserted into the bottle. By opening the faucet more or less the flow of the liquid may be regulated.



POCHTLER'S BOTTLE STOPPER.

This stopper is the invention of Mr. Carl Pochtler, of Vienna. Several stoppers similar to this have been patented in this country.

Our National Surveys.

The United States coast survey steamer, Blake, left Washington, November 28, for the West Indies. She will be gone six or eight months on a scientific cruise. Professor Agassiz, of Cambridge, joined the Blake, and will remain aboard her throughout the cruise. The work of the Blake will consist principally of deep sea soundings and dredging. The following is a list of her officers: Commander J. R. Bartlett, commanding; Lieutenant W. O. Sharrer; Lieutenant J. P. Wallace; Master, H. L. Jacobs, and Engineers, George H. Peters and E. L. Reynolds.

Professor F. V. Hayden and Major J. W. Powell have reported to the Secretary of the Interior the general results of their topographical and geological services the past season. The former says the results have been on the whole very satisfactory. About 12,000 square miles of very difficult country were surveyed, much of it in minute detail. The Yellowstone Park and the Wind River range of mountains formed a part of the region covered by Professor Hayden's survey.

The work under Major Powell has been prosecuted south and east of the grand cañon of the Colorado river, and little irrigable, but extensive grazing lands have been discovered. He reports having collected much ethnological material, and states he has nearly completed a map showing the distribution of the various Indian tribes within our present boundaries at the dates they were first known to Europeans.

The annual report of Lieutenant George W. Wheeler on the surveys west of the 100th meridian shows that nine districts and three astronomical parties were sent into the field this year. Their field labor will continue until some time in December. The survey this season embraces areas in California, Colorado, Nevada, Oregon, Texas, New Mexico, Utah, and Washington, connecting intimately with those of former years. A geological survey of portions of Colorado and New Mexico, by Professor J. J. Stevenson, was also carried toward completion, supplementing work of a former season by the same gentleman. During the winter and spring a topographical and hydrographical survey of the Great Salt Lake basin was carried forward. The detailed surveys of the interesting Lake Tahoe region and the Washoe mining district receive special notice. During the year ten topographical atlas sheets have been completed and published, several of which show land classification, and to all of which that important feature will ultimately be added. The second volume of the quarto reports of the survey, entitled "Astronomy and Barometric Hypsometry," and "Catalogue of the Mean Declination of 2,018 Stars," has also been published during the year, and other important works are in progress, of which Volume 6, "Botany," of the quarto reports, is in press. The area which will be surveyed by the parties in the field during this season is, approximately, 40,000 square miles in extent.

Last spring, in the original draught of the Sundry Civil Bill, containing the appropriations for these surveys, appeared a paragraph directing the American Academy of Science to prepare a plan before the next session of Congress under which the Interior Department Surveys should be consolidated, with a view to greater efficiency and economy. It is charged that this emanated from those interested in the War Department survey. At all events, as drawn it did not touch the Wheeler survey. The Hayden and Powell survey people were on the alert, however, and had the clause so amended as to include the entire lot of Government surveys. The amendment was passed, and the Academy of Science met November 5, to complete its report. Since then General Humphreys, chief of the engineers, has resigned his seat in the Academy, it is said because the report reflects so severely on the surveys made by his corps. However this may be, it is known that it recommends a sweeping change by proposing to consolidate the Wheeler, Hayden, and Powell surveys with the Coast Survey (now connected with the Treasury Department), transfer it to the Interior Department, giving it the new title of Coast and Interior Survey, equip it with a geological bureau for closet work, placing the topographic and geodetic work in the hands of civil engineers appointed for life, and turning over to this survey all appropriations made for geographical purposes, as well as those for the survey of public lands preparatory to sales. It is also recommended that the duties of the Surveyor General and of the General Land Officer be limited to the sale of the public lands.

Windmills.

Windmills are so constructed that the sails move in a nearly vertical direction. Motion is by this means communicated to the wind shaft, the brake wheel, and the center wheel that conveys the motion to the spur wheel driving the burrs. It is of importance that the sails be made in such a manner that the wind may have the greatest possible effect on them; for the wind does not act perpendicularly on the sails of a windmill, but at a certain angle, as the sail varies in its degree of inclination at different distances from the center of motion. As early as 1759, Smeaton made experiments upon the inclination of the sails in windmills. The inclination of the sail to the plane of revolution he found should vary in the following ratio, where the radius is supposed to be divided into six equal parts, and the angle of the sail given at each point:

	Angle with the axis.	Angle with the plane of motion.	
0		—	center.
1	72°	18°	
2	71	19	
3	72	18	middle.
4	74	16	
5	77½	12½	
6	83	7	extremity.

This inclination of the sail to the plane of revolution is known as its weather.

The velocity of the windmill sails, whether loaded or unloaded, so as to produce a maximum, is nearly the velocity of the wind, their shape and motion being the same. A windmill with 4 sails, the circle described by them being 72 feet in diameter, can raise 1,000 lbs. 230 feet in a minute. It is generally calculated that the millstones in a windmill should make five revolutions to every one made by the sail. The sails do not begin to turn until the velocity of the wind is about 12 feet per second. When the wind has a velocity of 19 feet per second, the sails will make from 10 to 12 revolutions per minute, and the burrs will grind from 880 to 990 lbs. per hour. When the wind reaches a velocity of 30 feet per second, a mill will carry all sail and make 22 revolutions per second, grinding 1,984 lbs. of flour in an hour. Following is a table of the velocity of wind:

Character.	Feet per second.	Pressure per square foot in pounds.
Scarcely sensible	1·5	1·005
Gentle wind	3	·123
Moderate breeze	6	·133
Brisk breeze	18	1·21
Good breeze	22	2·85
Brisk gale	30	4·44
High wind	45	9·96
Very high wind	60	17.71
Storm	70–19	30·49
Hurricane	100 or more.	

The tips of the sails in a windmill often move at the rate of 30 miles an hour, or 44 feet per second.

It is of great importance in windmills that the wood and iron work be of the best possible description. The brake wheel should be strongly constructed and covered with hard wood, and of ample length. The backs for straightening and carrying the sails should be made of the best timber, free from imperfections; and, consequently, pine or oak is generally employed for this purpose. The sails are attached to these backs by means of strong iron screw bolts. If the sails are 38 feet each in length, the backs should be made 40 feet in length, or two thirds the length of the sails. The