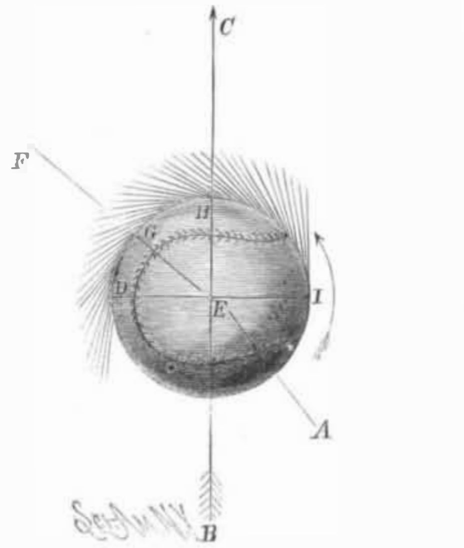
THE ART OF PITCHING IN BASEBALL.

BY HENRY CHADWICK.

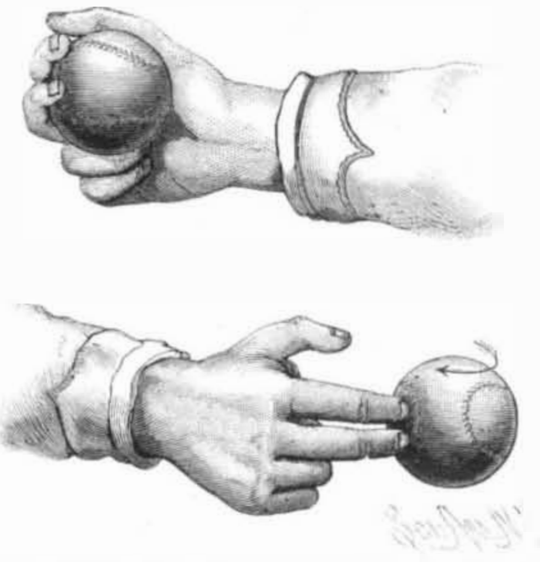
In these days of remarkable exhibitions of skill in playing baseball by professional exemplars of the game, one cannot look back to the early period in the history of baseball without being struck with the great contrast between the work done on the diamond fields at Hoboken, in the "fifties," and that which marks the play of the leading professional teams of the present era. The game has been wonderfully improved since its boyhood days, and in nothing so much as in the great degree of skill now shown in the pitching department. In fact, the pitching of the present day is marked by an amount of skill, dexterity, and the accurate performance of the work experience has taught, which Webster defines as characteristic of an art. Without writing an essay on the subject, I will merely refer to what this art consists of in its application to the pitching of the period. In the first place, modern pitching excels the old method of delivering the ball to the bat in one special feature, and that is in *the horizontal curve of the ball through the air*, something practically unknown in the days of old on the historic Elysian Fields at Hoboken. It is in this one respect, in fact, that its advance has been so noteworthy; for in some other essentials of success in pitching, the veterans of the old school were not so far behind the work of the present day, for they were skillful strategists in the position. But the old pitchers of the period in question literally *pitched* the ball to the bat, they not being allowed the advantage of throwing the ball as our modern pitchers are, the term "pitcher," as applied to the occupant of the "box" in our professional teams of to-day, being a misnomer. This curving of the ball in the horizontal line of its delivery from the hand of the pitcher to the catcher behind the batsman is the great feature of the modern art of pitching. It is not many years ago when the curving of the ball in question was regarded as a physical impossibility; and even now some people question its being done. For instance, the editor of the Grand Rapids *World* recently wrote as follows on the subject: "The editor of this paper came near getting roundly abused by a leading lawyer of this city a few days ago, because he ventured to dispute the correctness of the 'curved ball' theory from a scientific standpoint. The baseball enthusiasts claim for Getzein that he is able to so pitch a ball that it will describe the arc of a circle on a horizontal plane before reaching the catcher, and that therein lies the secret of his marvelous pitching, which has done so much to secure victory to the Detroit Club. Scientifically, this theory is utterly absurd. The forces that act upon a ball pitched by Getzein are not different from those which operate upon a projectile thrown from any other source, and the results must be the same, and governed by the same laws. The curves are in the imagination of Getzein's admirers. When the ball leaves his hand it is beyond his control, and it moves forward from the impulse last given it as it leaves his hand. It is then controlled by the force of propulsion, the resistance of the atmosphere, and gravitation. The tendency of the first is to urge it forward in a straight line, and it so moves until the force of gravitation becomes greater than the force of propulsion, and then it begins to descend. The resistance of the air simply retards its motion or may change its direction; but this change of direction is entirely beyond the pitcher's control ordinarily. Getzein's antic and deceptive motions may deceive the batter, so that he is unable to discover the exact course of the ball in time to strike it, but he cannot throw a ball so as to make a curve on a horizontal plane. We are willing to rest the decision of the case with the editor of the SCIENTIFIC AMERICAN, and abide by his decision."



CUT A.—DIAGRAM OF THE ROTARY MOTION OF THE BALL ON ITS OWN AXIS.

Unfortunately for the statement made by the *World* editor, viz., that "scientifically the theory is absurd," the theory in question is as simple in its rules as it is easy of demonstration practically. It is as follows: The ball, in its horizontal flight through the air from the hand of the thrower—technically known as the pitcher—is retarded in its forward motion by the resistance of the air, which not only exerts a pressure on the face of the ball, but also a resisting force on its sides by friction. Now, if the ball is simply thrown forward without any special bias being given it, the friction of the air is equal on each side of it; but if it be made to rotate on its own axis from right to left or left to right, the conditions are at once materially changed, inasmuch as in the latter case one side of the ball's surface is made to move forward through the air with twice the rapidity of the other side, and to the extent of this increased lateral friction is the ball retarded in its progress on the side on which the increased friction bears. The result of this changed relation is naturally a curve in the line of its delivery in the direction of the side on which its progress has been retarded. This is the simple philosophy of the curve of modern baseball pitching. The application of the theory in practice is to learn to give the necessary bias or rotary motion to the right or left—in order to produce the "in curve" or the "out curve." For instance, the appended diagrams illustrate the lines of direction of a curved ball, the straight arrow (Cut A) indicating the forward direction of the ball, and the bent arrow that of the rotary movement of the ball on its own axis. The bias to the right or the left is imparted by a quick motion of the wrist, the ball being clasped by the fingers in such a way as to give it the required twist.

If the ball (or strictly its center of gravity) is moving forward (let us say at the rate of 100 feet per second), and at the same time it is revolving so that points on its equator are traveling around its center at an equal rate, it is evident that D is traveling *backward* as fast as the ball, as a whole, moves forward; while I is moving forward at its own rate *plus* that of the center—that is, twice as fast as E. As the friction of the air increases with the velocity of the moving object, it must be greatest at I and least at D, being really zero at D under the conditions given. The I side of the ball is therefore retarded more than the center or any other part, while the D side suffers no retardation. The result must be a curve toward the retarded side. When the rotation is on a nearly vertical axis, this effect will be at its maximum, and, according to the direction of its "twist," the ball will curve to the right or to the left—"*in*" or "*out*."

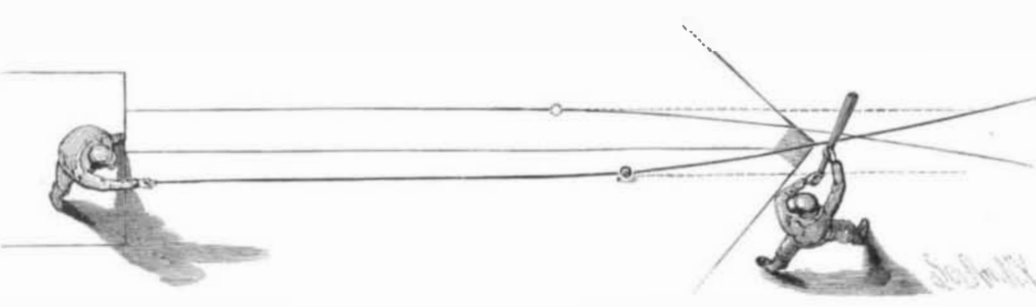


CUT B.—DIAGRAM OF THE METHOD OF GRASPING THE BALL IN DELIVERY.

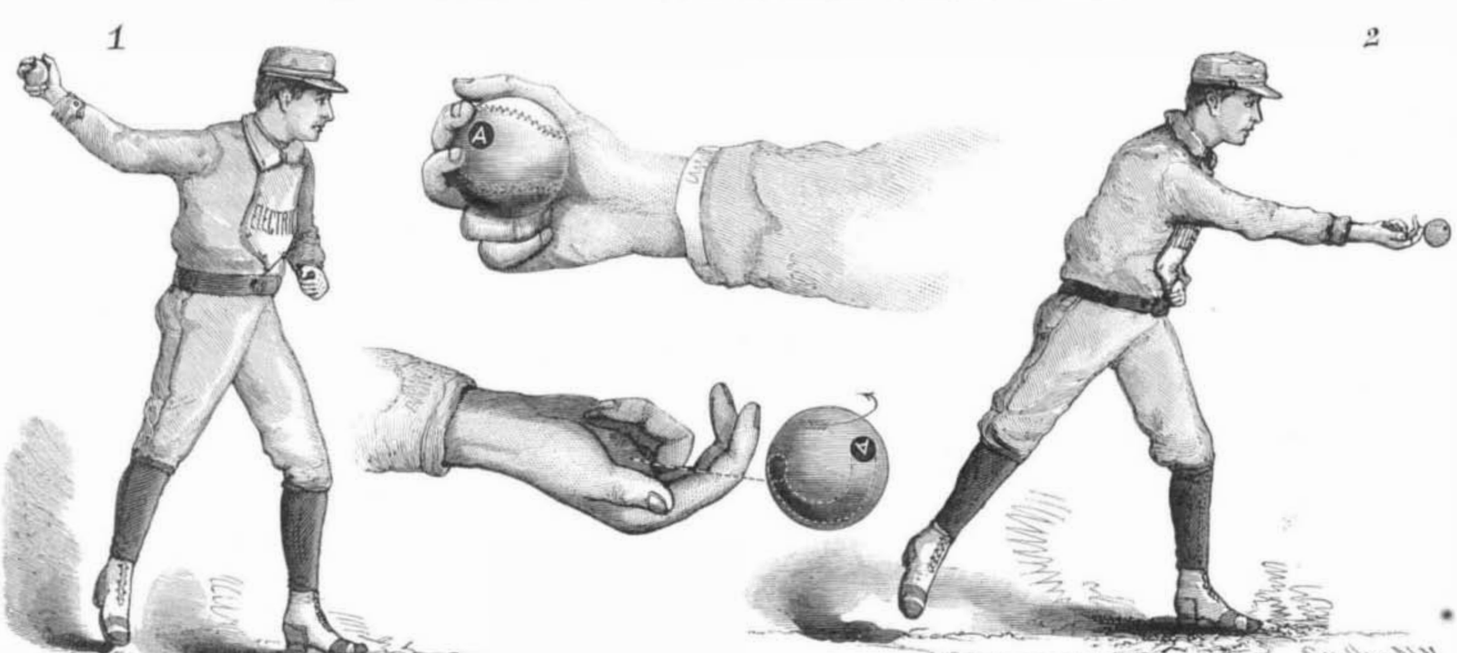
It is almost impossible to fully illustrate the action of the wrist and fingers in imparting the bias to the ball which produces the curves in question, but a curve pitcher gives me the appended illustration of his method of holding the ball when he first takes his position to throw, and when the ball leaves his hand.

He says that in order to produce the out curve, you secure the ball in the hand by pressing it firmly between the first two fingers and the thumb, with the third and little fingers closed in the palm of the hand. In delivering the ball to the batsman, throw the arm forward midway between the shoulder and waist, and at the moment of releasing the ball turn or twist the hand quickly to the left.

The cuts above show how the ball is held just before its delivery, and also its position as it leaves the hand. (Cut B.) In producing the in curve, the pitcher should grasp the ball securely with all the fingers, and with the thumb pressed firmly against the opposite side. Throw the ball at a height equal to the



CUT D.—DIAGRAM OF THE LINES OF IN CURVE AND OUT CURVE BALLS.



CUT C.—DIAGRAM OF THE METHOD OF GIVING THE ROTARY MOTION TO THE BALL.

shoulder, and at the instant of releasing it from the hand twist quickly outward, allowing the ball to twist off the ends of the first two fingers.

These movements are still further shown in the preceding cuts, the ball marked with the black spot and letter A, held in the hand, and the same as it leaves the hand, showing how the ball is made to rotate on its own axis while it is being thrown forward; while the figures standing—Nos. 1 and 2—show the movement of the arm in throwing. (Cut C.)

The accompanying diagram illustrates the lines of the two curves, one of which is developed nearer the home plate than the other. The dotted lines show the direction the ball would take but for the rotary motion imparted to the right or the left, and it will be seen that in both instances but for the curving of the ball it would have passed clear of the base, but the curves take it over the base. (Cut D.)

There are other important essentials of success in the art of pitching outside of the power to curve the ball to the right or the left, and the first of these is thorough control of the ball in delivery, without which strategic skill in pitching is next to impossible; besides which, even the curving of the ball is robbed of its advantages. Of what use is the power to curve the ball in sending it to the batsman unless you can control its direction so as to make it pass over the home plate, and at the height called for by the batsman, at will? Speed in delivery is another essential which is comparatively useless as an element of success unless accompanied by thorough command of the ball. But suppose you possess these essentials of the "curve" and of speed in delivery, in combination with the required command of the ball, so as to secure accuracy of aim in your pitching, you will still be wanting in a thorough knowledge of the "art of pitching" unless you can bring skillful strategy into play in your work in the "box," technically termed "headwork."

It may be naturally be asked, "What is strategy, or 'headwork,' in pitching?" and its elements may be summed up as follows: Primarily, it is to deceive the eye and the judgment of the batsman who faces you as to the character of the ball sent in to the bat; such as making it appear that you are sending in a very swift ball, when, in fact, the pace of the ball is lessened by a well disguised method of delivery. Also to suddenly change the line of the ball's direction through the medium of the "curve" after sending in a straight ball. To these strategic points are to be added that of watching the action of the batsman, so as to catch him standing out of good "form" for effective batting; and lastly, to tempt him to hit a high ball to a part of the field where you have a fielder ready to catch it. These are the main characteristics of strategy in pitching, and together with the "curve" and speed and command of the ball, they comprise the essentials of the art.*

A Field for Inventors.

The *Fireman's Journal* copies from the *Chronicle* the following statistics relative to fire losses, and suggests that the field for the invention of devices for reducing the losses by fires originating from several common causes is a vast one, and thinks no class of persons are more familiar with the dangers to be guarded against, or better qualified to do some useful and profitable thinking on this subject, than fire insurance agents. Accordingly, in the hope that some of our readers, adds the editor of the *Journal*, may make themselves millionaires in this manner, we will proceed to recite a few specifications.

For every dollar of loss on the premises where a fire originates, eighty cents of damage is inflicted through exposure upon contiguous property. Much the larger part of this loss is from external exposure. Wanted, a method to prevent buildings from taking fire from the outside.

Friction in machinery caused the destruction of $1,000,000 worth of property in the United States last year. Wanted, a method of lubrication which will do away with inflammable oils.

Matches carelessly handled burned over $500,000 worth of property in the United States last year. Wanted, a substitute for matches, or a safety match that is as good as its name.

Defective flues burned about $2,750,000 worth of property. Wanted, a flue that cannot be defectively constructed.

Defective heating apparatus burned nearly $500,000 worth of property. Wanted, heating apparatus that cannot prove defective.

Electric wires and lights, a source of increasing danger, burned over $250,000 worth of property. Wanted, a system of insulation that cannot prove faulty.

Explosions of kerosene lamps burned over $1,500,000 worth of property. Wanted, lamps and lanterns that cannot explode.

Lightning burned $1,250,000 worth of property. Wanted, a perfect lightning rod.

Sparks from locomotives and other sources burned $2,000,000 worth of property. Wanted, a spark arrester of genuine merit, or stoves and furnaces in which combustion is more nearly perfect.

Gas jets burned $1,250,000 worth of property. Wanted, a device for preventing the contact of goods and curtains with open gas burners.

These are a few of the most necessary inventions. But others are needed also. For example, there is a demand for a cigar that will extinguish itself before it is thrown away, also a plan for paralyzing incendiaries as soon as they decide to wield the torch. Another required invention is an automatic contrivance to pillory tramps before they enter barns and granaries. Still one more device, perhaps the most necessary of all, should not be forgotten, namely, a device for inoculating careless property owners with the spirit of carefulness, or of trepanning their skulls with the sense of watchfulness.

The Wonderful Things Produced from Our Bituminous Coal.

Few persons have any idea of the wonderful products from a lump of coal—a lump of coal that is placed in the retort of a gas manufactory. Ordinarily burned, the combustion of a lump of coal results in carbonic acid smoke (which is merely soot, or rather the visible portion of smoke is soot), and the ash, in which are found silica, alumina, oxide of iron, phosphoric acid, sulphuric acid, potash, sodium, combined sulphur, sometimes traces of chlorine, titanic acid, and other substances. In the gas retort a variety of products are obtained. The gas as it is carried through the hydraulic main to the purifying rooms takes with it tar and ammonia, the latter evolved from the nitrogen. The ammonia has to be washed out with water in an arrangement by which the ammonia is gathered and saved. Tons and tons of sulphate of ammonia are thus made, and become an article of commerce. The sulphur is removed by caustic lime or oxide of iron. The carbonic acid is also removed by lime, but the sulphurous acid cannot be removed, and, with several others, remains in the gas after all efforts to remove it. The others give the gas its smell.

By distillation, naphtha and asphaltum are obtained. Asphaltum is a dead oil, very useful to preserve wood. From this, too, carbolic acid is obtained, very important in surgical operations as being the most valuable antiseptic known. From naphtha, benzole, eumol, toluol, and cymol are obtained. Naphtha, as is well known, is used as a burning fluid. Benzol is a solvent for grease and oils, very useful in cleaning kid gloves and things of that kind.

Benzole treated with nitric acid produces nitrobenzole. This, singularly enough, is used as a flavoring extract by confectioners and for perfuming soap. When used for this purpose, it is known in commerce as the essence of myrrhbane, which it is not, although it smells and tastes something like essence of myrrhbane or oil of bitter almonds. Nitrobenzole is terribly poisonous, but not more so than some other adulterants used by confectioners.

From nitrobenzole, aniline is obtained. This when first obtained is a perfectly colorless liquid, but darkens as it grows older. From aniline are obtained the coal tar colors, which are so very brilliant. The colors are of all hues. The one known as "Turkey red" is exactly similar to the red that used to be made from the madder root. Since the discovery of this aniline, it has almost completely broken up the raising of madder in Holland. There thousands of acres were devoted to the raising of madder root to get the Turkey red dye. It can be made much cheaper from the product of a gas factory.—*The Coal Trade Journal.*

Tinkers and Their Tricks.

Steam users would undoubtedly have less expense for fuel, and smaller machine shop bills, if their engines were left as they came from the hands of the workers. Unfortunately, some engineers have an itching to alter things, and feel that the only way to show their knowledge of the business is to screw and unscrew, reset valves, and make changes which are prompted by nothing but sheer nonsense; notions, in short, derived from gossip with others. This is particularly true of automatic engines; and when the tinker by trade gets hold of one of these, there is no telling where he will stop. If an engine pounds, from whatever cause, the first thing to do, in the minds of some, is to change the valves; and when the screw wrench is applied to the side rods, eccentric rod, and eccentric itself alternately, or by mere caprice, the adjustment gets into such a condition that it is a wonder the engine runs at all.

Indicator cards, current in various works, on the instrument show the wonderful alterations which can be produced by a man with a screw wrench; and we have seriously felt that the only way to prevent this meddlesome alteration would be to key the eccentric fast, so it couldn't be moved readily, and to press the rocker arms in the valve stems so that they couldn't be budged either. Then, if the side rods from the wrist plate to rocker arm were in one piece, the tinker's occupation would be gone, and the engine would give much better satisfaction. Side rods could be easily made without adjustment, simply by having a pair of adjustable rods for shop use, setting the valves by them, finding the centers, and welding the rods which belong to the engine, so that they have no adjustment. That would settle it so far as tinkering with the valve gear is concerned.

Our remarks upon this head bear wholly upon those who, being put in charge of an engine which is performing properly, do not hesitate to change it, as they fancy, for the better, simply by guessing. There is only one way to remedy defects in engines, and that is, so far as the distribution of steam is concerned, to indicate it. No guessing is needed then, for the remedy is in plain sight. In cases of extreme derangement, however, the man with the screw wrench cannot do a great deal of harm if he is fit to be about an engine at all. Of course he can screw up and key up until he has everything blue hot, but he is not apt to do it regularly. Engines by standard makers leave the shops in good order, fit for work, but they lose their efficiency oftener through the mistaken zeal of those in charge rather than through hard work. The tinker can do more mischief in an hour with a screw wrench, as regards loss of efficiency, than the engine itself would lose in a year's time.—*Milling Engineer.*

Floating Iron Moles.

Sakhansky, a Russian engineer, who designed, a short time ago, a floating port for the 9 ft. shallows at the mouth of the Volga, has been delivering a lecture at St. Petersburg on his system in general. Objecting to stone moles on the ground of their cost and the constant dredging they require, owing to the silting of the harbors inside them, he advocates the adoption of submarine iron pontoons, chained to the ground in such a manner as to allow a circulation of water above and below them. The pontoons proposed are 10 yards long, and would be first sunk over the spot selected for the mole, and then allowed to rise to the required height by pumping a certain quantity of water out of them. The force of the waves breaking over the top would repress the tendency of the pontoons to rise, and keep them in proper position, while the circulation of the water below would prevent silting.

Trades and Professions in France.

The following interesting figures are taken from the *Revue Industrielle:* Half the population of France lives upon agriculture, one-quarter lives by various manufacturing industries, one-tenth by commerce, four-hundredths by the liberal professions, and finally six-hundredths are "rentiers" of various kinds. Among the agriculturists, there are 9,176,000 who are proprietors farming their own land. The others are tenant farmers under various system of holding, laborers, or very small holders who also work for others. The large industries, such as mines, quarries, and the more important manufactories and workshops, occupy 1,130,000 persons, while the lesser industries occupy 6,093,000. Under commerce are comprised 789,000 bankers, brokers, and wholesale merchants, 1,895,000 retail dealers or shopkeepers, and 1,164,000 hotel keepers and what we should class as licensed victualers. The railways and various carrying trades on land and the merchant marine occupy 800,000 persons. Various government and communal employes number 806,000.

Diffusion of Gases.

In illustration of the diffusion of gases, Mr. W. Anderson recently gave some good examples through porous media of inconceivable fineness. When two gases, such as hydrogen and air, are separated by a porous medium, they immediately begin to pass into each other, and the lighter gas passes through more quickly than the heavier. He showed a glass tube, the upper end of which was closed by a thin slice of cork, the lower end dipped into a basin of water. The tube was filled with hydrogen, which is about 14½ times lighter than air; consequently, it left the tube through the cork more quickly than the air could enter in by the same means, and the result was a partial vacuum in the tube, and a column of water drawn up, proving that the cells of cork are eminently pervious to gases. The pores in the cell walls appear, however, to be too minute to permit the passage of liquids.

The Meteorite of May 10.

Mr. H. V. Noszky, of Rosetta, Florida, informs us that at 7:40 P.M., May 10, he observed a fine large meteorite falling toward the southern horizon. This was the same hour at which observers in Havana and other parts of Cuba were startled by the appearance of an immense meteorite passing across the zenith from the northwest to the southeast. From the path of the wanderer, and the close agreement in the time of its passage, there can be but little doubt that it was visible in both countries. Mr. Von Noszky, however, appears to be the only observer who has recorded its appearance in the United States.

* The SCIENTIFIC AMERICAN SUPPLEMENT Nos. 402 and 410 contains illustrated articles on the science of baseball playing. These articles were highly commended by expert players at the time they were published, but the skill of the game has considerably advanced since then. All interested in baseball, however, will be interested in those papers.