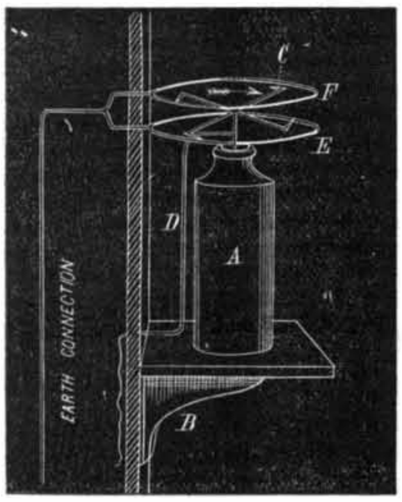
*l*, therefore, any new method of construction fails to be approved by a majority, it is abandoned. We will not undertake here to determine whether the suppression of individuality is a gain or a loss. It is quite certain that originality is very expensive when it exercises itself in the construction of locomotives or other railroad machinery, and that the Chinese virtue of uniformity has much merit, and is often profitable when great ingenuity and skill would not be.—*Railroad Gazette*.

## Correspondence.

### An Electric Toy.

*To the Editor of the Scientific American:*

I send you herewith a sketch of a scientific toy, which I have recently constructed and placed on a bracket in front of the desk in my engine room. The main belt of the engine is 30 inches in width, and about 120 feet in length, and runs from south to north, at an angle of about 45°, and with a velocity of 2,500 feet per minute; it is highly electrical.




The idea occurred to me that the electricity so developed might be made use of for mechanical or other purposes; and having seen an engraving of what is called an electrical wheel, I constructed one as shown herewith, but without the coils. A is a vial, about 6 inches in length by 1½ inches in diameter, the bottom of which is inserted in a cavity in the bracket, B. In the center of the cork is inserted the eye end of a darning needle, the point projecting upward about 2 inches, on which rests the wheel, C, which consists of two pieces of copper wire, 1-32 inch in diameter and 7 inches in length, placed at right angles to each other; their centers are flattened and soldered together, and half an inch of the end of each arm is bent at a right angle, all in the same direction, and filed to a point. D is a copper wire, one eighth inch in diameter, one end of which rests against the needle, the other running in front of and about 6 inches distance from the belt, and terminating in 5 or 6 points, 2 inches long, projecting toward it.

On connecting the conducting wire with the needle, my wheel immediately started off at a speed of 100 turns in 50 seconds. I soon ascertained that, by placing a good metallic conductor beneath the wheel and making an earth connection, I could add materially to its speed. Accordingly I placed a copper coil, E, 5½ inches in diameter, one inch below the wheel, connecting it with the gas pipe, which accelerated its speed to 148 turns in 50 seconds. Soon my wheel began to gyrate even to an angle of 20°. This annoyed and puzzled me. I eventually found that, by adding another coil, F, one inch above the wheel, and connecting it with the earth, I not only restored its equilibrium, but also increased its velocity to 173 turns in 50 seconds.

When the air is dry and frosty, I have had it running as fast as 280 turns per minute, and the ozone given off by the wheel is apparent to the senses at a distance of several feet. It also acts as a barometer, indicating (by increasing or diminishing its speed) atmospheric changes several hours in advance. It is especially lively on the approach and during the prevalence of a northeast snow storm; but with the wind anywhere from east to south, it will scarcely move at all.

The apparatus can be easily constructed by any person of ordinary intelligence, and it makes a very interesting scientific apparatus. It can as well be located in the counting room or ffice as in the engine room.

328 Delancy street, New York city. EDWIN LEACH.

### Elasticity and Slipping of Belts.

*To the Editor of the Scientific American:*

It is pretty generally admitted, though sometimes contested, that any belt running upon two pulleys, one the driver and the other the driven, must slip on both when any appreciable amount of power is being transmitted by it. It seems to be very evident that, if a belt is passing from a state of greater to one of lesser tension, or *vice versa*, in its passage around a pulley: in the former case it must undergo contraction, and in the latter case extension, in direction of its length; and we know that a belt always exists in a different state of tension in the parts entering upon and leaving the given pulley. If, then, in passing around the driving pulley, a belt undergoes contraction, and on the driven pulley, extension, there can be no point of the belt but must have a sliding movement on both pulleys, and thus result in the driven pulley having a lower velocity than would be mathematically due to the diameter of the pulleys. Thus, of two pulleys of exactly equal diameter, one driving and the other driven the latter must have the lower velocity. In cases where high speeds are to be obtained by means of belts and the prime belt, that from the first driver, has a low velocity, this may become an important consideration.

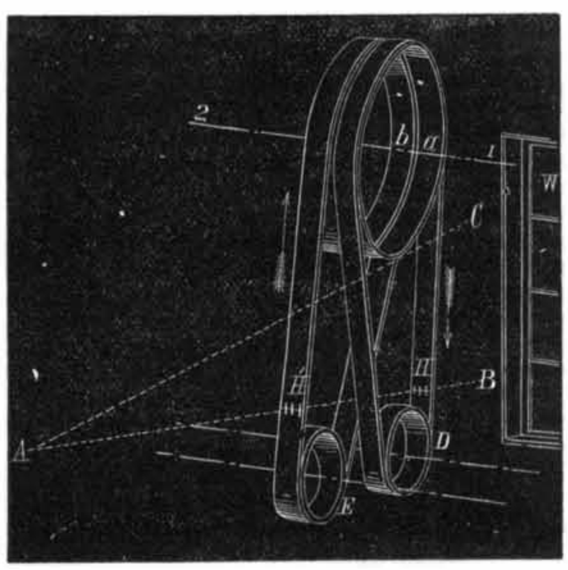
I recently, quite accidentally, observed a peculiarly delicate and interesting illustration of this property of belts, especially illustrative of the invariable slipping upon the driving pulley; and I think it will be of interest to your readers, as it establishes that fact in a very beautiful manner.

I have, in my factory, a number of pairs of spindles running at about 5,000 revolutions per minute. Each of the pairs is driven from one countershaft by two separate driving pulleys, situated nearly close together, as in the illustration, and the spindle pulleys are so situated, one in advance of the other, as to take the belts from them. The countershaft being directly over the median line between the two spindles, the two belts were practically of equal length. The spindles are alike in all material respects, and carried 4 inch pulleys, the drivers on the countershaft being 24 inches in diameter. The work done by the spindles alternated regularly about 60 times per minute, the belt of one spindle having—while the other was at work—nothing more to do than to turn the spindle in its bearings; and while the feed mechanism of the machine containing the spindles was not in operation, neither belt had any more to do than simply turning the spindles, which was practically equal.

In this case: owing to the great disparity in the diameters of the driving and driven pulleys, and consequently in the area of surface wrapped by the belt (the distance from countershaft to spindle being less than four feet), and the fact that the drivers were directly overhead, bringing the weight of belts to their aid: it is certain that, but for the elasticity of and the consequent difference in the tension of the two halves of the length of the belts, whatever slipping occurred from the resistance of the work would take place upon the smaller pulley. But this experiment shows indubitably that these belts always slip on the 24 inch or driving pulleys as well, and, of course, most when the work is greatest.

It so happens that, of one pair of the 24 inch drivers, one is slightly larger in diameter than its companion, but so small an amount that it can only, with great care, be detected with the callipers; and—although not essential to this illustration, as the same effect would be produced by a difference in the length of belt—but for this latter fact the following interesting observation would probably never have taken place.

In the engraving, 1, 2, is the countershaft with its pulleys, *a* and *b*; D and E are the pulleys of the spindles. The observer is situated at A, and at W is a window. The holes in the belts made for the fastenings,—which, from use, had become sufficiently enlarged to permit the passage of the light —when situated as at H H′, would allow the passage of a ray of light through the downward side of one belt and the upward side of the other, as at A B; and as the speeds of the belts were such as to cause these holes to cross the line of vision in periods of time less than the duration of the impression upon the retina, there appeared to be a permanent




opening through them. If the pulleys, *a* and *b*, were exactly of the same diameter, and the feed works of the machine not in operation, the points, H and H′, would, after completing a circuit, reappear in the same position; but owing to the slightly larger diameter of the pulley, *b*, the ray of light, when both spindles were idle, had a very regular upward movement until cut off by the pulley, *a*, as shown at C A, and, after a short time had elapsed—a little less than a minute, by repeated timings—would reappear at B A; and as the belts were running at about 5,000 feet per minute, it will readily be seen how small was the difference in the diameters of the pulleys, *a* and *b*. Now, when the spindle, D, was at work, E being idle, the downward motion of the point, H, became at once retarded, and the upward motion of the ray would become suddenly accelerated; but when the spindle, E, was at work, and D idle, the point, H′, became in turn retarded, and the ray would either come to a stand still or slightly descend, according as the material being operated upon by the machine offered more or less resistance to the cutting tools. The descent, however, was never so great as the ascent; and whether the ray passed upward regularly, as when the spindles were both idle, or intermittently, as when they alternated in their work, its recurrence at B A always took place in the same period of time. The intermittent motion of the ray of light could only be produced by the slipping of the belts on the upper pulleys, except that a small fraction of it might result from the stretching of the belts between pulleys, that is, between the leaving one pulley and entering upon the other; but that this must be very small will be evident from the fact that, during one second (the period of one alternation of work from one spindle to the other and return), the belt would make about 21 complete circuits, or pass from pulley to pulley 42 times in that period; therefore the change in tension in the two halves of the belt's length must take place principally upon the surface of the pulleys.

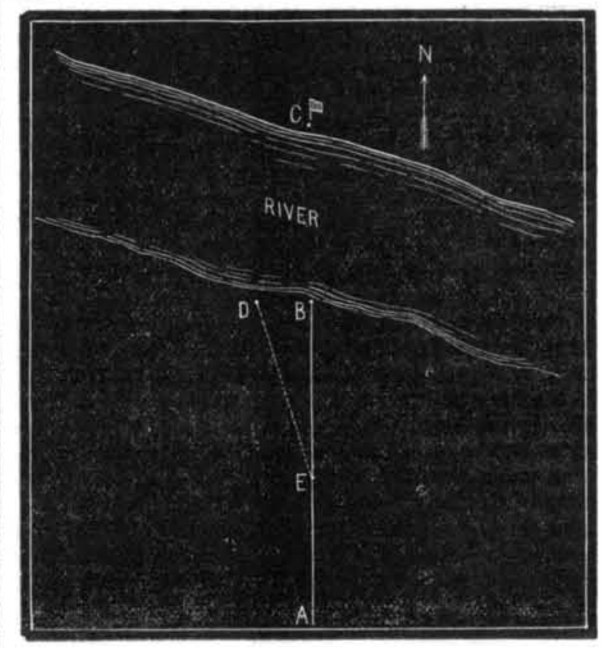
I think this example shows conclusively that, in any belt whatever, the side in contact with a pulley has a greater velocity than the surface of the pulley itself.

New York city. JOHN L. HAWKINS.

### Measuring the Width of a Stream.

*To the Editor of the Scientific American:*

In surveying, it is often necessary to ascertain the width of river, pond, or other body of water, with the least possible delay.




Let A B represent the line of survey (the course being due north), striking the river bank at B. Have a flag set on this line at C. Take your station at D, at a right angle with your line, B A, at any convenient distance, with or without measurement. Set your compass at D, and bring it to bear on your flag at C. By observation you find the course N. 13° E. Reverse your compass, taking your course S. 13° E. Send a flagman back on the survey line, keeping in range with B C, until he comes in range of your compass sight at E. Measure from B to E, and you have the distance from B to C.

Farmington, Iowa. JOHN CROSS.

### The Relative Attraction of the Sun and the Earth.

*To the Editor of the Scientific American:*

Permit me to correct a serious mistake contained in Dr. Vander Weyde's communication, published in your issue of April 18th. Your correspondent incorrectly asserts that I have constructed an apparatus for measuring the changes of terrestrial attraction, consisting of a heavy iron globe floating in mercury; regarding which he remarks "that a floating object is identical with a lever scale, as the liquid balances the floating body, and any change in the gravitation will equally affect both; so that such an apparatus would show no change whatever, even when transported to the moon or to Jupiter." Dr. Vander Weyde appends to his irrelevant remark the following unwarrantable conclusion: "It is, therefore, not in the least surprising that Captain Ericsson, according to his own showing, had no results." The reader will be surprised to learn that my apparatus, the principle of which Dr. Vander Weyde evidently does not understand, has been constructed for the sole purpose of proving practically that, at the rising and setting of the sun, solar attraction exerted on a body resting on the surface of the earth is exactly balanced by the centrifugal force acting in an opposite direction, called forth by the earth's orbital motion round the sun. The reader will find, on referring to my communication inserted in the SCIENTIFIC AMERICAN, March 14, 1874, that the result of the experiment with the floating iron ball was mentioned in my demonstration relating to solar attraction simply for the purpose of convincing Mr. W. B. Slaughter, by actual experimental test, that solar attraction is neutralized by orbital centrifugal force. The reader will also find, by referring to the said demonstration, that, while the sun's attraction on the iron globe exerts a pull of fully 748 grains, and that while a tractive force of a few grains suffices to move it across the vessel of mercury in which it floats, yet the globe remains perfectly stationary on the surface of the liquid metal when subjected to the stated pull of 748 grains exerted by the attraction of the rising sun. Consequently the instituted experiments with my apparatus, which in the opinion of Dr. Vander Weyde have produced "no results," prove incontestably that the centrifugal force, called forth by the orbital motion of the iron globe, exactly balances the attractive energy exerted on its mass by the sun at the moment of rising and setting. I will not detain the reader by commenting on Dr. Vander Weyde's criticism of my solar attraction apparatus, since it is based on the irrelevant fact that "a floating object is identical with a lever scale, as the liquid balances the floating body." Moreover, the reader cannot fail to perceive, without further discussion, that, according to his own showing, Dr. Vander Weyde does not comprehend the principle of the apparatus nor its object.

J. ERICSSON.