ertion. As regards immunity from cold, we think the well-rubbed-in porpoise oil was not without good effect, as the sailors who helped him into the carriage on Calais Sands described him as feeling like a lump of cold tallow, and they themselves got lubricated with the remains of the oil. Whether his heart and physique are in any way specially adapted to stand such long immersions can only be ascertained by medical examination.

Matthew Webb was born at Irongate, Shropshire, England, on January 19, 1848, and was therefore just over twenty-seven years and seven months of age when he started. He is 5 feet 8 inches high, measures 43 inches round the chest, and weighs about 203 lbs. He learnt to swim at seven years of age. In 1870 he dived under a ship—whereon he was rated —in the Suez Canal, and cleared a foul hawser. On April 23, 1873, when serving on board the Cunard steamer Russia, he leapt overboard to save the life of a hand who had fallen from aloft while the watch was taking in second reef int opsails, the ship being then running free under all press of steam and canvas. Of course it was a long time before she could be brought head to wind and a boat lowered. However, Webb was saved with difficulty, after having been upwards of half an hour in the water, although he failed to rescue his shipmate, who was probably stunned, and sank at once. A subscription of $500 was collected for him on board, and he received three medals. When he first went to Dover to train for the present event, he successfully swam out to the N. E. Varne Buoy—more than half way across—by way of a feeler. The only things he suffered from, after his recent great feat, were an excoriated neck from constantly turning his head to protect a weak eye from the waves, and inflamed eyes from the salt.

In his training Captain Webb wisely took long and steady exercise in preference to sharp work. Being naturally a quiet and moderate liver, this came more easily to him, and very long walks, alternated with a three or four hours' swim, were the chief order of the day. In fact, when he dived, he was anything but a highly trained athlete in the usual acceptation of the term.

Correspondence.

What is the Electric Force?

To the Editor of the Scientific American:

In continuing the explanation of my views on this subject, commenced by me on page 196 of your current volume, allow me to say:

In the point of sound force, we have accurately determined the number of vibrations of matter per second necessary to the production of a certain sound; in that of light force, we have approximately estimated the number of vibrations, waves, or molecular motions per second necessary to the production of the various colors. In the point of heat force, we have determined that it exists in a certain violent molecular motion; and in the point of electric force, we have determined that it also exists in a certain molecular motion. And I may here mention, as being one of the strongest proofs, the fact that a current transmitted through a bar of iron will not disturb it, the fact that a current transmitted around it will not disturb it, and the fact that a current transmitted simultaneously through it and around it will cause it to twist in a very appreciable degree, which would not be the case unless the electric force consisted of molecular motion. If we were in possession of no other proof that the idea of a fluid flowing through an electric wire is a myth, we might easily be assured of it by the fact that molecular motion alone is the necessary condition of all other forces. This motion, beyond doubt, varies in intensity and form in different forces, but that it is the one condition of force there can be no doubt: and that the only difference between the forces is the difference between molecular actions may be accepted as a truism. To my mind the force of attraction of gravitation, and perhaps the more remarkable orbital motions of the planets, are forces to which the electric force bears no comparison. The electric force, in fact, is no more mysterious than is any other force. When one pulls a bell cord, and instantaneously a bell is rung in a distant room by the molecular transmission over or through the bell wire of the force applied at the cord, does not one realize that he is as veritably, as wonderfully, and by a similar molecular motion, transmitting that signal as though he were transmitting it by applying a battery to a telegraph wire and thus setting the atomic particles in motion? Cannot one realize that, if there are bells at different places upon a long wire, the nearest bell will ring first and the most distant last? But no one would speak of a subtle fluid as the cause of the ringing, although there is just as much subtle fluid passing over the bell wire as there is when a telegraph operator in New York makes a signal in Chicago by applying the battery to the line of wire connecting the two distant places.

As in this force, so in electricity, nothing flows through the wire. There is, in fact, the most striking analogy between the molecular transmission of electricity and the molecular transmission of all other forces. The stronger and more rigid the lever, the larger and firmer the belt, the larger the tube for water or air, the better the transmission of the forces applied. The larger the conducting wire, the more perfect the transmission of the electric force: because the larger conductor we have, the more perfect must be the molecular motion.

We are now brought to consideration of one of the most important facts bearing upon the question of molecular motion and the theory of a subtle fluid. The force of the electric current is as the square of the distance or length of the conductor. A battery is a constant generator of electric force. These are our premises, and it is not difficult to understand that if, as according to the subtle fluid theory, a wire have a certain capacity to hold that fluid, just as a tube has a certain capacity to hold a liquid, it cannot matter what the length of the wire may be. It is well known, also, that the resistance of a wire varies as the square of the diametric amount of metal. Therefore, in considering the electric force as a fluid, we are bound to consider the wire as a reservoir for that fluid. Now an immense quantity of electricity passes over a very small wire in a certain period of time; and a wire $\frac{1}{4}$ of an inch in diameter, the battery being of proper dimensions, will charge a condenser up to a certain point in one half the time that a wire of less diameter, composed of $\frac{1}{2}$ the diametric amount of metal will charge it, and in one fourth the time that a wire composed of one fourth the diametric amount of metal will charge it; but the smallest wire will charge it to its full capacity as well as the longest wire. merely requiring more time in proportion. Therefore, if a battery be attached to a wire 100 miles in length, the subtle fluid theory would, as soon as the battery should have sufficiently charged the wire, make it necessary that the strength of the electric force in the 100 miles of wire should be as great as though the wire were but a mile, or a few feet, even, in length. This statement cannot be controverted.

Very far from this, however, is the case. We may have our battery upon the wire for any length of time, and we shall find that the force of the electric current still varies as the square of the length of the wire. This, alone, utterly disproves the theory that, in transmitting a signal by telegraph, the wire is charged by a subtle fluid, and proves beyond doubt that the action of the battery is to impart a certain force to the atomic particles of the conductor, which act, each in turn, upon the next and the next, losing force in each successive action, just as we behold every day in the operation of all the forces surrounding us, as, for instance, the ripples occasioned by the dropping of a pebble into a still pond, widening and widening and decreasing in force and intensity as the square of the distance. In the molecular action, there must be a loss of force every time one atomic particle imparts the electric force to another. This we know is the case. According to the subtle fluid theory, this could not be the case.

Again, if we can prove, as in the case of light, that one transparent substance will transmit certain rays of light and not others, we prove that the transmission of the light force is due to molecular action, that the light force itself, in fact, is a certain molecular action. This will be conceded; and I suppose I need not at this point endeavor to prove that such is the case, as the facts have been set forth by students in this line of science, among them Professor Tyndall, in far weightier terms than I am able to command. The one and only deduction to be made from the results attained is that certain atomic conditions are necessary to the transmission of certain forces, and that certain substances are incapable of assuming the atomic conditions necessary to the transmission of certain forces. The same general law holds good in respect of the electric force.

Without entering into all details of the subject, it may be asserted that the very fact that one metal is a better conductor of electricity than another proves conclusively that the propagation of the electric force is dependent upon the atomic structure of the metals; that as its propagation is dependent upon this atomic structure, the propagation of the electric force is by the atomic or molecular action of the metals; and that as this is true, so the electric force is a certain molecular action. The conductivity of the metals is expressed by their resistance, the metal offering the least resistance to the propagation of the electric force being the best conductor. Thus with the resistance of silver expressed as 107, the resistance of quicksilver is 5,550, the latter metal, which is almost without tenuity of the atomic particles, being the poorer conductor, as would inevitably be the case under the molecular theory, and so would not be the case upon any other hypothesis. There are other causes, however, for the difference in the conductivity of different metals. Heat, we know, is a violent molecular motion. The electric force, being or consisting of a certain molecular action, should therefore be disturbed by the molecular action which constitutes heat; and we find that the resistance of a metal to the propagation of the electric force is increased by increase of temperature in the metal. The violence of the molecular action which is the electric force must be apparent to any one who witnesses the wonderful deflagrating effects of that force. Intense, we know, is the molecular action which constitutes heat; and it is a remarkable fact, as pointed out by Forbes, that the order of the metals as regards their conductivity for heat is the same as their order in conductivity of the electric force.

I will conclude the present article with one more argument in proof of the assertion that electricity is nothing more nor less than a certain condition of the atomic particles of matter.

The majority of the readers of the Scientific American have doubtless witnessed the discharge of electricity from a condenser, such as a Leyden jar, or from a battery or induction coil. They have beheld the brilliant sparks, and very many are cognizant of the fact that every spark is e particle of the metal of the discharging point heated to tha state necessary to the production of the light witnessed. The electric light is not something which has passed over or through the wire, or something partaking of the nature of many metals which may compose the wire, but it is confined in kind to the properties of the metal composing the discharging point. Thus of platinum, silver, iron, copper, o which the discharging points may be composed, each gives its own peculiar light, no matter of what metal the greater length of the conducting wire may be composed: as, for instance, we may transmit the electric force through a hundred miles of copper or iron wire, and finally, when we get the discharge, it passes through a film of platinum $\frac{1}{10000}$ of an inch in thickness: but we get the same result in the kind of light produced as though the whole of the wire were platinum. Yet the electric force is the same no matter of what the conductor may be composed; and no reasoning can account for the projection of a flaming atom of matter from the discharging points, oftentimes with force sufficient to penetrate a piece of glass several inches in thickness, beyond the theory of intense molecular action.

The simple fact that the electric light which we witness is composed of the atomic particles of the conductor, heated to the state in which we observe them, and projected or following from the mass of the conductor, from one electrode to another (atomic particles which we know never have passed through the conducting wire, but have existed at and are wearing off from the terminal alone), proves beyond doubt that nothing that we witness in electrical phenomena has passed over the conducting wire in the sense of a current; that as this force is manifested at the distant end of the conductor in the shape of projected atomic particles of matter, it is clear that the electric force is a certain intensely active condition of the molecules of matter, which activity is set up by the violent action of acids upon metals or chemicals, by heat, or by friction, and transferred from one atom to another with inconceivable rapidity; and that as no heat can exist except by combustion or by friction (unless imparted heat, which is itself sustained by combustion or friction), the voltaic arc, the most intense heat, which is not sustained by combustion but exists in all its intensity in a vacuum, can only be the result of friction; and inasmuch as the mass of the metal is not subjected to friction, the friction can only exist in a violent action of the atomic particles of the metal.

Knowledge is of two kinds, positive and negative, namely, that which we know is, and that which we know must be, because it can be nothing else. It is more by the negative than by the positive reasoning that we can determine the nature of electricity. Deschanel, recognizing the crudities of the electric fluid theories, said of the positive and negative currents: "It is conceivable that the two electricities, instead of being two kinds of matter, may be two kinds of motion, or in some other way may be opposite states of one and the same substance." The reasoning by which we establish the verity of this conception is both positive and negative, and the reasoning of analogy.

Washington, D. C. W. E. Sawyer.

Remarkable Explosion.

To the Editor of the Scientific American:

On August 28, a terrific explosion took place at the works of the Milburn Wagon Company at this place, under the following circumstances: The shop is cleared of shavings by a system of pipes and pneumatic fans. The magazine was located in the boiler room, and was about 25x10 feet, and 28 feet high. Near the top of the magazine was a 20 inch sheet iron pipe leading into the main chimney stack, and immediately under it was a second one, similar in all respects. These were used to take the fine dust out of the magazine. Six feet below them were four 12 inch pipes leading in to the furnaces, and entering under the grate bars, These had valves to them, and were mostly kept closed. The works were running at the time of the occurrence; and a fire had just been put in, and the door closed, when it "kicked," as the term is, and an explosion took place in the magazine, which completely wrecked the boiler room and magazine, tearing the roof off and blowing the wall down. Fortunately no one was injured.

This should be a warning to wood workers not to have direct communication between shaving magazines and furnaces, if fans are used, as few understand the explosive nature of the fine dust from woodworking machines.

Toledo, Ohio. Toledo.

[We are exceedingly obliged for this note. We have often seen miniature explosions of the kind described by our correspondent, but have very seldom seen an account of one so violent. Our correspondent is deserving of great credit for the clear explanation which he has given.—Eds.]

The Solar Chronometer.

To the Editor of the Scientific American:

It may be interesting to your American readers to know that the solar chronometer illustrated in your issue of September 11 was invented by one of their number.

In 1868 I invented the same instrument, though in a slightly different form, and applied for a patent. The claim was rejected on the ground that the invention was not new. The "equation curve," which I constructed, was identical with the one illustrated, and was constructed as follows: A meridian is assumed as the axis of abscissas, and the equator as the axis of ordinates, their intersection being the origin of the curve. The sine of the sun's longitude is the abscissa and the equation of time is the ordinate for the corresponding point of the curve. The *plus* and *minus* signs to the equation of time project the curve on opposites of the axif of abscissas; but as the ordinates for two opposite points, in two opposite quadrants of longitude, are not equal, the curve is not symmetrical, though it is nearly so. Instead of reading the time on the meridian line, as in the ordinary dial, the time is read on the curve, at a point indicated by the declination of the sun shining through the lens. The reading, being commenced at any point, is followed in retrograde order, from the right and over to the left, the curve being completed in one year. The time thus read is equated time. But all the elements that go to make up the equation of time are not considered in the construction of the curve, so the time is not strictly equated, though it is nearly so.

Moreover, the curve is not constant in its form; so that a dial, being made for one date, is not correct for a subsequent date, the error accumulating with time. This results from the fact that the equation of time depends on two elements, that have a relative motion with each other. That depending on the eccentricity of the earth's orbit runs forward in regard to longitude, while that depending on the obliquity of the earth's orbit with the earth's axis follows the line of equinox backwards in regard to longitude, these elements forming a complete revolution with regard to each other in about twenty thousand years or more. But as one of these elements has two zero points, or places where the equation of time is 0, and the other has four such points, and as in the course of one revolution each zero point of each element comes to or coincides with each zero point of the other element, we have eight oscillations of the equation of time in one of the revolutions, that is to say, in about 250 years the dial above referred to will have accumulated error to the amount of about thirty-four minutes of time.

Ferrysburg, Mich. H. C. PEARSONS.

Ancient Human Remains in Texas.

To the Editor of the Scientific American:

Some eight miles distant from this place, while digging a well at a depth of thirty-six feet, a quantity of human bones were found. They were imbedded in a yellowish dry dust, which presented the appearance of decomposed bones and flesh. On digging further down, the bed was found to be twenty feet thick, bones occurring at intervals through the whole depth. Just below this stratum, and fifty-six feet from the surface, water was found in soft quicksand. The parties, not desiring to drink water from such a well, sunk another, about eighty yards distant from the first, with precisely similar discoveries. At thirty-six feet deep were found the bones they continued for twenty feet, and then water was found in the quicksand.

A thigh bone, a breast bone (half petrified), a jaw bone (with one tooth still in it) and a foot with all the bones complete, lying in position to show that they had not been disturbed since the flesh was decomposed, were found and taken out, also fragments of broken earthenware, without inscription or pictures.

The thirty-six feet of earth first gone through were clay and sand; and the position is on a hill, estimated to be 400 or 500 feet above the sea.

Whence came this tremendous deposit, and to what age did the bones belong? By what means were they so engulfed?

Huntsville, Walker county, Texas. W. T. ROBINSON.

The Supply of Gutta Percha.

To the Editor of the Scientific American:

I wish to call your attention to an item in your issue of July 3, which states that "gutta percha and india rubber are brought hither chiefly from Brazil and Columbia." For the past eighteen years, nearly all the gutta percha coming to this country has passed through our house; and instead of its being "brought here chiefly from Brazil and Columbia," not a particle has ever come from those sources. In fact the only region of production thus far discovered is the East India Islands, in the immediate vicinity of Singapore.

Gutta percha is wholly unlike rubber, the former being non-elastic as compared with rubber; although it is very plastic, and is readily worked into a variety of forms by means of hot water or steam. The principal uses to which gutta percha has been put, of late years, is for insulating telegraph cables, and for cementing. The total consumption of the United States is now comparatively insignificant, England quite monopolizing the cable business.

India rubber, on the contrary is collected in localities all around the globe between the tropics, the best quality being found along the Amazon river and its tributaries. Brazil annually produces about 14,000,000 lbs. and the Central American States, Africa, and the East Indies together about 15,000,000 lbs. The consumption is about equally divided between the United States and Europe.

Boston, Mass. GEORGE A. ALDEN.

Repairing the Independence Bell.

To the Editor of the Scientific American:

I think that I can suggest an improvement upon the method of Mr. Charles Smith, described in the SCIENTIFIC AMERICAN of September 11. I would follow his suggestions in cutting out the piece represented by the dotted lines. Then I would mold the bell with the side to be repaired upwards, placing under the cavity a piece of material that would not fuse at any heat that the job might require.

I would arrange a large receptacle or cavity in the sand at the mouth of the bell, for a large amount of surplus molten metal to fill. I would melt an abundant quantity of bell metal, as nearly similar in composition to that which the bell is composed of (the proportions can be ascertained by analysis). I would build on to the bell (around the cavity to be filled) with some infusible material, like plumbago, so that the metal could be cast above the surface, say half an inch or more. I would arrange material at the mouth of the bell, so as to close the channel and stop the flow of molten metal a little below the lower edge of the bell. I would fuse the metal, and heat it to a very high degree, then pour the cavity full of molten metal, keeping a steady flow out until the sides of the recess were seen to be in a molten state; then I would instantly close the channel and stop the flow, when a perfect union would be made.

The recess could be superheated with a gas blowpipe flame, and the molten metal poured into it. Then the surplus metal could be removed, and the bell peal forth as clearly as in 1776.

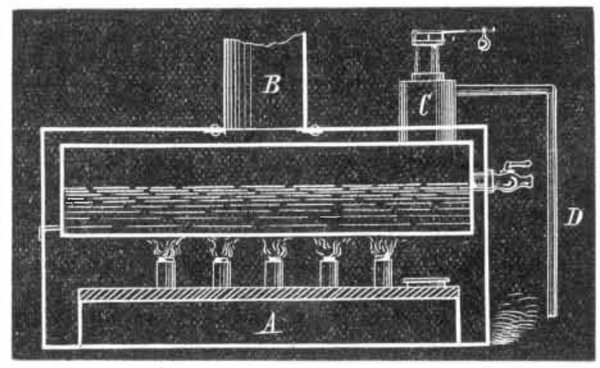
I had a piece united to a broken press in the same manner, and it is a perfect union, with all the strength of solid cast iron, as it was before the break

Beaver Falls, Pa. J. E. EMERSON.

A New Small Steam Boiler.

To the Editor of the Scientific American:

For the benefit of amateur steamboat builders, I send a drawing of a boiler that has given the utmost satisfaction, being cheap and strong:



A is a lamp, with burners enough to heat the whole length of the boiler, which is of copper. The outer cover is of tin, and half an inch space should be left all round, between the boiler and the cover, to make a draft, which will find its exit through smoke pipe, B. C is a steam drum surmounted by a safety valve, and D the steam pipe. The oil or spirits in the lamp can be protected from heat by coating the upper surface of the lamp with plaster of Paris.

For an engine 1 inch by 1 inch, the boiler should be 9 inches long, and 4 inches wide. A. M. BLUNT.

Scarborough, N. Y.

Repairing the Independence Bell.

To the Editor of the Scientific American:

There is another way to mend the independence bell, of which Mr. Charles Smith speaks in your issue of September 11

I saw in a foundery a cast iron wheel, laying on its side, the rim of which was broken in cooling; the ends were apart about ¼ inch. It was mended by placing a fire tile on the inside and on the outside of the rim, over the fracture. Sand was banked around the tiles, and a space made for pouring in hot metal; at the bottom was a small hole to allow the metal to run out. When all was ready, the pouring of hot metal through the fracture began, and continued a short time until the broken ends began to melt; the small hole at the bottom was then closed, and the fracture was filled. On examination, the joint proved good. Perhaps the bell can be repaired in the same way

Dayton, Ohio. J. H. B.

Effect of Magnetism on Watches.

To the Editor of the Scientific American:

A few weeks ago my watch, for the first time in ten years, refused to go. Up to then, it had kept correct time, and was then in good repair, having been recently cleaned. When it first began to stop I would start it by the key, and it would sometimes run a day; but finally it stopped entirely. I had it carefully examined by an expert, who, although he could find no cause, failed to make it run even for an hour.

I am running at my works a powerful magneto-electric machine for depositing copper; and having noticed that I could magnetize a piece of soft iron at a distance of at least six feet from the machine, so that it would lift and support the weight of a large nail, I became impressed with the idea that some of the steel parts of my watch had become permanently magnetized; so I made a watch repairer take it apart. Having some fine soft iron filings, I dipped the balance wheel, escapement wheel, lever, and hair spring into the filings; and each piece raised up at least one half its own weight of the filings, showing all the polar characteristics of the particles.

I have read of watches being spoiled by magnets, but had no idea that it was unsafe to go into a room containing a magnet.

The watchmaker thought he might "brush it off" for about a dollar: I let him brush on it three days as a lesson in magnetism, and then told him that nothing short of heating it red hot would demagnetize it. He put in new parts, including a new mainspring, which was also infected, and the watch now runs as well as ever.

496 Cherry street, New York city. I. B. FULLER.

Terrestrial Magnetism.

To the Editor of the Scientific American:

In an article entitled "Terrestrial Magnetism" on page 164 of our current volume, I notice a statement which may mislead, and beg leave to correct it. "That the earth is not a great magnet, but that the phenomena of the magnetic needle are due to the electric earth currents which flow at right angles to the earth's axes." These two statements are contradictory. "The earth is a great magnet, and the phenomena of the magnetic needle," etc., is the way it ought to have been put. For all our most recent knowledge tends to confirm Ampère's theory that a magnet is merely a closed circuit of electric currents acting parallel and in same direction, and not necessarily a mass of iron, nickel, or cobalt. So that the earth, being surrounded by such currents, is as much a magnet as the magnetic needle. I. B. M

Hoboken, N. J.

[For the Scientific American.]

Cotton Mathematics.

NUMBER II.

Deduction of a formula for the production, in hanks and lbs., of any weighted roller, the diameter of roller and it revolutions per minute being known.

Let D = diameter of roller in inches.

Let R = number of revolutions per minute.

Let S = decimal hank of sliver per lb.

Then: 3·1416 D = production in inches per revolution.

3·1416 D R = " " " " minute.

60 × 3·1416 D R = 188·496 D R = production in inches per hour.

The hank measures 30,240 inches:

Hence $\frac{188{\cdot}496\ D\ R}{30{,}240} = 0{\cdot}006233\ D\ R$ = hanks and decimals of hank per hour; and for different times,

0·03739 D R = hanks per 6 hours' work.
0·04363 D R = " " 7 " "
0·04986 D R = " " 8 " "
0·05600 D R = " " 9 " "
0·06233 D R = " " 10 " "

Application of the formula:

Suppose a drawing frame, whose front roll is $1\frac{3}{8}$ inches in diameter, makes 275 revolutions per minute: required the number of hanks produced in 8 hours of efficient work?

The 8 hour formula is 0·04986 D R.

Substituting their values for D and R, 0·04986 × 1·375 × 275 = 18·85 hanks of sliver produced in 8 hours of efficient work, and to find the number of pounds that should be produced, of ⅛ hank sliver, under conditions specified:

$$\frac{0{\cdot}04986 \times 1{\cdot}375 \times 275}{0{\cdot}125} = \frac{18{\cdot}85}{0{\cdot}125} = 150{\cdot}8 \text{ lbs.}$$

of ⅛ hank sliver produced in 8 hours' work under conditions specified.

The formula may be used to indicate the number of revolutions required to produce any required length or weight of any desired sliver. Take for example the 8 hour formula, and suppose that:

D = $1\frac{3}{8}$ inches (= 1·375).
S = ⅛ hank per lb. (= 0·125).
Time = 8 hours.
R to be ascertained by formula.

Length 18·85 hanks; then, by substitution, we have 0·04986 × 1·375 × R = 18·85, and 0·06855 R = 18·85, and

$$R = \frac{18{\cdot}85}{0{\cdot}06855} = 275$$ revolutions of front roll required to produce 18·85 hanks in 8 hours.

Again: Suppose the same conditions, but that 150·8 lbs. of ⅛ hank sliver are required, instead of 18·85 hanks as above; then $\frac{0{\cdot}04986 \times 1{\cdot}375 \times R}{0{\cdot}125} = 150{\cdot}8$ lbs., and 0·06855 R = 150·8 × 0·125 = 18·85, whence $R = \frac{18{\cdot}85}{0{\cdot}06855} = 275$ revolutions required.

Again: To show a convenient application of the formula, suppose that the calendar rolls of a finishing lap machine are 8 inches in diameter, and that 1,500 lbs. of lap, weighing ¾ lb. per yard, are wanted in 8 hours' work. To find the number of revolutions of calendar roll required:

The decimal hank of the lap will be (for ¾ lb. per yard) 0·001587, so that

S = 0·001587,
D = 8,
R = to be ascertained by formula.

By applying these values to the 8 hour formula, we have $\frac{0{\cdot}04986 \times 8 \times R}{0{\cdot}001587} = 1{,}500$, and 0·39888 R = 1,500 × 0·001587 = 2·3805; whence $R = \frac{2{\cdot}3805}{0{\cdot}001587} = 5{\cdot}967+$ revolutions of calendar roll required, say, 6 revolutions per minute.

Proof by another method:

1, 2—12 inches per foot	Revolutions per minute, 6—1.
1—3 feet per yard	Inches diameter of roll, 8—4.
1, 2, 14—840 yards per hank	Ratio, { 3·1416—0·4488 / 0·2244 . 0·0748
0·001587 hank per lb.	Minutes per hour, 60—1
	Hours' work, 8.

$\frac{4 \times 0{\cdot}0748 \times 8}{0{\cdot}001587} = 1{,}508$ lbs. lap, ¾ lb. per yard made in 8 hours, the roll being 8 inches in diameter, and making 6 revolutions per minute. FORWARDS.

THE largest reflecting telescope at the Paris Observatory is completed, although it will not be brought into use for two or three months. The equilibrium of the tube is perfect, and it can be directed with the utmost facility on any part of the heavens, although it weighs about six tuns.

A COMPARATIVE trial of the relative advantages of dynamite, gun cotton, and gunpowder was recently made at the railway tunnel works under Clifton Down, England, with the result of showing that dynamite is much superior to either gun cotton or gunpowder.