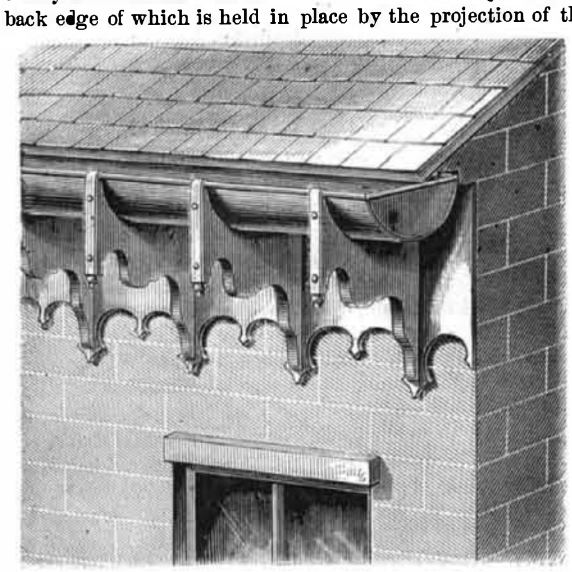
ROHRER'S IMPROVED GUTTER BRACKET AND SUPPORT.

The engraving represents a method of securing eaves gutters to buildings whereby beauty and usefulness are both secured. The brackets, now usually merely ornamental appendages, are, in this device, made of use in supporting the gutter, while that service does not detract from their office as ornaments. The tops of the brackets—which may be made of any form desired—are hollowed to receive the gutter, the back edge of which is held in place by the projection of the



eaves, and the front by strips of metal secured to the front edges of the brackets, and provided with a hooked end to embrace the edge of the gutter. The result is a neat and secure device for supporting eaves gutters. The attention of builders and others is directed to this economical and efficient device. Territorial and manufacturing rights are for sale by the patentee.

Patented through the Scientific American Patent Agency, Feb. 4, 1868, by Jeremiah E. Rohrer, Rohrersville, Md.

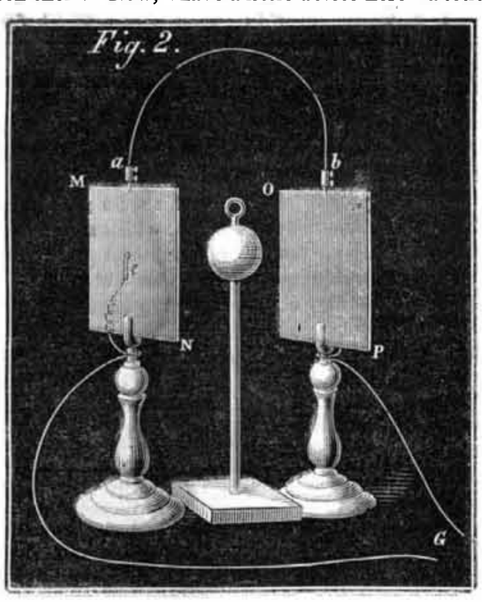
Science Familiarly Illustrated.

HEAT AND COLD.

BY JOHN TYNDALL, ESQ., LL. D, F.R.S.

Lecture V.--Continued.

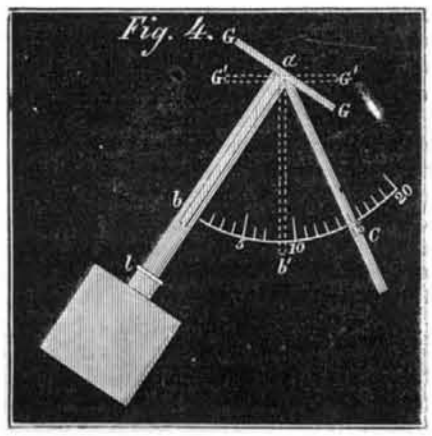
You see I have here two sheets of tin, M N and O P, one covered with lampblack, and the other uncovered. I place them facing each other, and I put this stand exactly midway between them. Now, I have a little device here—a telltale—



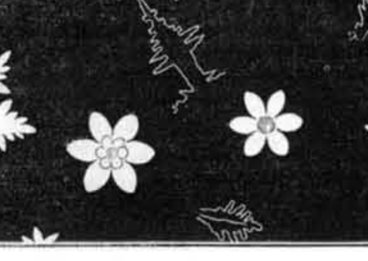
which will inform me which of these plates is heated. Suppose I heat this plate. Observe what occurs at the magnetic needle. I simply warm that plate by putting my finger upon it. The red end of the needle moves towards me. I cannot explain the wonderful power which moves the needle. It is what we call an electric current, and is produced by the union the two metals of the thermo-electric pile. When the plate is heated you see that a deflection of the needle is produced. The needle will return to zero when I withdraw my hand. I want you now to judge which of these two surfaces absorbs radiant heat most freely. The needle will not rest at zero unless these two plates are exactly at the same temperature. If one becomes warmer than the other the needle will deviate from zero. Thus we have it in our power to determine which plate absorbs heat most greedily. Now Mr. Cottrell will give me a ball of copper which is heated to redness. You observe it is radiating its heat as a luminous body radiates light [The red hot copper ball was placed equidistant between the two plates of tin, one of which was coated with lampblack. In a few seconds the needle of the pole began to travel from the zero.] Thus we prove that this surface coated with lamp black, which is the best radiator, is also the best absorber We might experiment with a variety of substances in this way, and prove that great differences exist as regards their absorptive powers.

It is very wonderful what a slight and trivial thing will be sufficient to prevent the absorption of radiant heat. I have here an exceedingly instructive substance. It is a piece of paint given me by Mr. Hills, of the firm of Bell and Co. A portion of this paint is coated with gold leaf, and though the gold leaf is infinitesimally thin, it has been competent to protect the surface of the paint from the action of radient heat to which the whole thing was exposed, while the other part of the surface, which was not covered with gold leaf, has become blistered. Where the gold leaf was present it prevented the rapid absorption of the heat.

I have here a sheet of paper covered on one side with iodide of mercury, a substance which has its color discharged by heat. On the other side of the paper there are certain figures represented by a thin coating of metal. I place the paper with the iodide of mercury side downwards; and over the other side I will hold a hot spatula which will radiate heat to the surface of the paper. Where the thin coating of metal is, the heat will be rejected, but where the paper is not coated the heat will be absorbed, and then it will reach the iodide of mercury on the other side and destroy its color. You will find that in this way we shall produce on the underside of the paper a perfect picture of the figures on the upper side, for you will find that the red color of the iodide of mercury will remain underneath the metal coating, for that coating has the power of rejecting the heat as the gold leaf rejected the heat in the other case, and so protected the paint and prevented its blistering. [The experiment was performed with a successful result.]



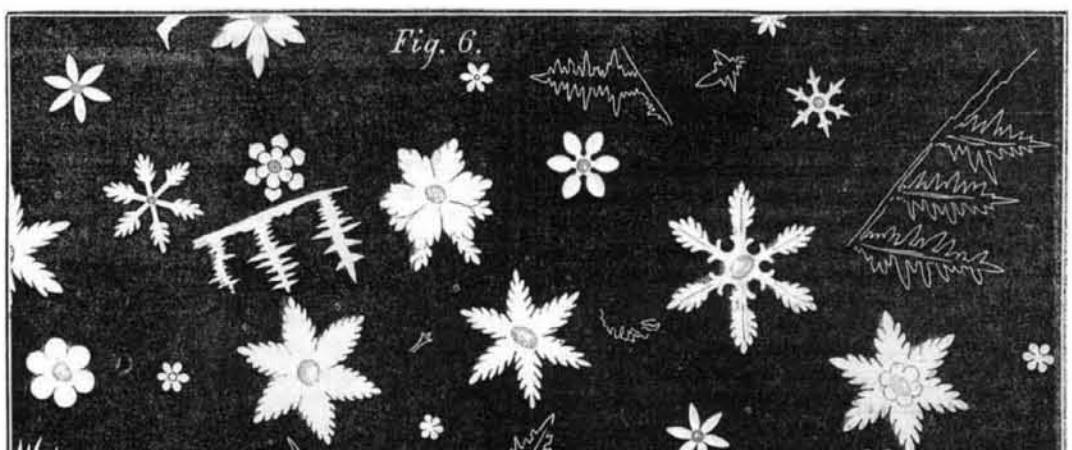
The radiation of heat obeys the same laws as the radiation of light, and it obeys the law of reflection due to light. This we can illustrate by means of our beautiful thermo-electric pile; but I will first of all make a single experiment that shall impress upon our minds the law according to which light is reflected. It is a very simple experiment, but I trust it will be very effective as far as regards the proof of the law. Mr. Cottrell, who knows my requirements very well, is now placing there in front a little looking-glass, G G. I intend to send a beam of light, *a b*, from the electric lamp, *l*, towards the mirror G G. The beam will strike upon the mirror, and be reflected. How? So that the reflected beam will lie as much on the left of this index, *a b*, which is perpendicular to the mirror, as the direct beam lies upon the right side of it. There are two terms employed in connection with this subject which the elder boys ought to remember. This angle, *g*, made between the perpendicular, *a b* (Fig. 5), and the line, *c a*, along which the direct ray goes to the mirror, is called the *angle of incidence*.—The angle, *h*, between the perpendicular *a b*, and the reflected ray, *a f*, is called the *angle of reflection*: and the



law was regards both light and heat is this—that " the angle of incidence is equal to the angle of reflection." If I am right in what I have stated you will find the reflected beam as far from the perpendicular on one side as the direct beam is from the perpendicular on the other side. I want now to prove the same with regard to radiant heat by a very rough experiment, and show you that it obeys the same law as light. I take this piece of tin, which will reflect heat, and hold it so that the radiant heat from this fire will fall upon it, and then be reflected, according to the law I have just mentioned, on to the face of the pile. I have no doubt that reflected heat will warm the face of the pile, and cause the needle to move towards me. We thus see that heat exhibits the same law in this respect as light.

I wanted to make one or two experiments more, and I wished to do so, as before, by means of our thermo-electric pile; but I find that the needle does not act freely although the pile does its duty. Hence I think I must tell you by my tongue what that needle, if it were in a proper condition, would have told you by its motion. I intended to make the needle my voice but it has become dumb. I wanted to show you that this thing we call radiant heat passes in very different degrees through different bodies. I wanted first to compare the passage of heat through glass with its passage through other bodies. I have here a piece of rough glass, and I have also a beautiful substance—a very common one, but to me more precious than the diamond, though the diamond is a beautiful thing. This substance is rock salt. This would allow heat to pass through it with perfect freedom, while the glass would cut it off. So with different liquids. I have here a liquid called bisulphide of carbon, and here I have some of the well known liquid called water. If I filled one cell with water and another with bisulphide of carbon, I should find that the bisulphide of carbon would transmit heat with great freedom, while the water would not transmit it at all. Water is, indeed, as regards heat, one of the most opaque bodies in nature to all but incandescent or luminous heat. It is a perfectly opaque body to all rays emitted, say from the surface of a boiling kettle, or from the heated cube, or from the cheek of the young philosopher who helped me in an experiment in the early part of this lecture. During the burning of Her Majesty's Theater the heat struck upon the windows of a club house opposite, and as the glass would not allow the heat to pass through, the windows became hot, and thus the glass was broken. Had those windows been composed of rock salt the heat would have passed through them, and they would have remained perfectly cool, although there might have been an efflux of the most powerful radiant heat. If time allows, I will show you in the next lecture that we can boil water by radiant heat passing through bisulphide of carbon, though the same heat does not boil the bisulphide of carbon through which it is transmitted, notwithstanding that bisulphide of carbon boils at a lower temperature than water.

I have told you that different bodies, both solid and liquid, possess the power of transmitting heat in different degrees. Now, the body which absorbs the radiant heat, instead of transmitting it, becomes warm by the absorption. Ice is a body which is exceedingly opaque to the rays of heat, but allows light to pass through with freedom. I intend to place a piece of ice in the path of a beam from the electric lamp, and which will be a mixed ray of heat and light. The ice will stop by far the greater portion of the radiant heat, and the heat will be lodged within the ice. But the temperature of ice cannot be raised beyond 32° Fahrenheit without the ice beginning to melt, so that the portion of the beam arrested by the ice will occupy itself in liquefying the interior of the



ice. It will liquefy the ice internally, and I want you to see the wonder and the beauty involved in this beautiful substance which you skate over every winter, but, perhaps, never think of. This beam of light and heat passing into the ice will dissect the ice and separate the crystals, and you will see the beautiful figures into which the ice resolves itself. The ice will break up internally into most beautiful flowers consisting of six petals. In order to enable you to see these figures I must magnify them very much, and for that purpose I shall cause an image of them to be thrown on this large white screen. The lamp is placed in the gallery to increase the distance from the screen, and so make the figures appear larger. Mr. Cottrell has a lens there, and he will now take a piece of ice, and make the surface smooth by putting it on a warm body, and then place it in the path of the beam. The ice has been cut parallel to the plane of freezing from a block of the so-called Wenham Lake ice. It has been cut, I say, parallel to the surface along which the ice grows. [After a short time the image of the ice-flowers began to appear on the screen.] I do not know any experiment that I have ever made which is more delicate and beautiful than this. The flowers are growing larger and larger. First of all you see these leaves, and within you see a crimping. Those spaces which you see are spaces entirely devoid of air, for you know that the water occupies less space than the ice. The ice is larger than the water which formed it, and as the inner portions of this piece of ice melt, the water occupies less space than the ice, and a small vacuum is produced at that spot. This screen presents a glorious surface of ice-flowers. Every particle of ice is built up in this beautiful way. The ice has now become disintegrated, but I do not think your patience has been ill rewarded.

TURNING A MOVABLE WHEEL AROUND A FIXED WHEEL.

"How many revolutions on its own axis will a movable wheel make in rolling once around a fixed wheel of the same diameter?"

In the earlier stage of this discussion, the two-revolution philosophers found no fault with the terms of the original question, as above presented, but without any qualification took the position that our answer, "one," was an error, and theirs, "two," the only true and correct reply. One of these champions, referring to the terms of the question, says, "It seems impossible to conceive how it could have been more clearly put, and we think its propounder deserves great credit for its extremely direct and explicit language."

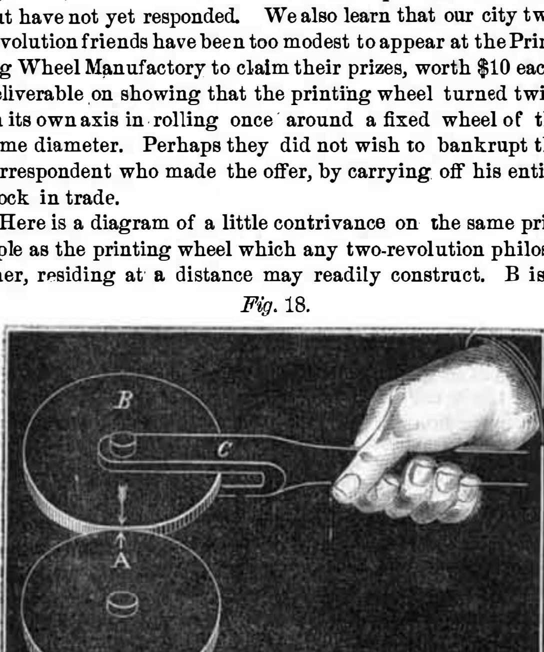
But as the discussion proceeds, the two-revolution philosophers appear to have become sensible of the necessity of attaching new conditions or explanations to the original question, in order to render their several positions tenable. One portion of them think that it ought to be expressly statedas part of the question, whether the axis is to be stationary, or is to revolve with the wheel; forif it revolves, the wheel will turn only once on its axis, but if stationary the wheel will turn twice on its axis.

To these we have replied that they might make the axis fixed or stationary, just as best suited them. In our view, the number of revolutions made by the wheel upon its own axis, will be precisely the same in either case, namely, one. Others of the dual philosophers deem it important that the word axis should be more explicitly defined. Some want the axle-tree, or journal on which a wheel ordinarily turns, to be defined as the axis. Others want the axis to be settled as being an imaginary point or line, drawn through the center of the moving wheel. To these we have answered that they might take their choice, as it did not affect the practical result, for the wheel will make the same turns on its own axis, whether the latter is defined as a point or a bearing.

With another portion of the two-revolution philosophers the daylight is beginning to dawn. They begin to see that unless the axial plane of both wheels is the same, all their mathematical calculations, postulates, theorems, astronomical references, and other supports, together with the dual conclusion based thereon, are likely to fall. They have been invited to answer explicitly whether the movable wheel in figure 11, made *one* or *two* revolutions upon its own axis; but have not yet responded. We also learn that our city two-revolution friends have been too modest to appear at the Printing Wheel Manufactory to claim their prizes, worth $10 each, deliverable on showing that the printing wheel turned twice on its own axis in rolling once around a fixed wheel of the same diameter. Perhaps they did not wish to bankrupt the correspondent who made the offer, by carrying off his entire stock in trade.

Here is a diagram of a little contrivance on the same principle as the printing wheel which any two-revolution philosopher, residing at a distance may readily construct. B is a

Fig. 18.



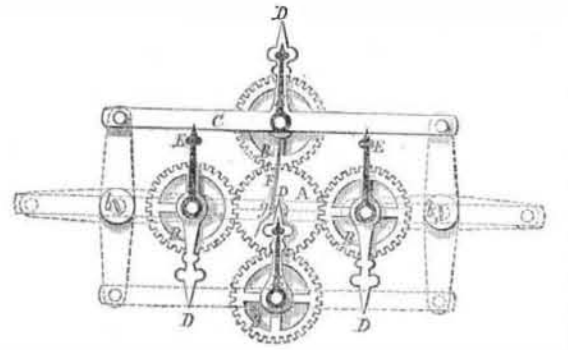
wheel set in a forked handle, C. Now roll B once around a fixed wheel, A, of same diameter, such as a table leg or a bottle and if you succeed in making B turn more than once upon its axis, then come to town with confidence and take home one of the $10 prizes offered last week.

We have lately made count of the wheel letters, and find we have some five hundred on hand; and still they come. We beg to remind correspondents that there are many other interesting topics that should engage their attention; and for fear that all their ideas will turn into wheels if the discussion is prolonged, we feel under the necessity of now moving the previous question. Those of our way of thinking will say "one." Contrary minds "one and a quarter," "two," "three," or "four," according to their several positions. Except for some novel or interesting comment we propose with the present number to dismiss the subject.

To the many esteemed correspondents who have taken part in the discussion we return our thanks for the candid and courteous manner in which they have presented their views.

MESSRS. EDITORS:—I think in counting the revolutions of a wheel on its axis from a pointer indicating its axial line, said pointer should not be allowed to revolve (as in W. E. H.'s model) but should always point in the same direction, say to one of the points of the compass. The mere changing of its position is no reason why it should change its direction. On referring to the accompanying diagram, it will be readily seen that the movable wheel, B, makes two revolutions on its axis while passing around the fixed wheel, A, once, its pointer, D, having been in conjunction with the pointer, E, indicating the axial line twice during its circuit.

Fig. 19.



I would add that the fact of the movable wheel winding the end of a string around itself only once while performing its circuit, the other end being held across the center of the fixed wheel, is not a proof of one revolution, as some of my "one revolution" friends will have it, but a distinct proof of two revolutions, which I think I can make clear by the following illustration.

It being conceded that the moon makes a revolution on its axis while passing around the earth, we will suppose one end of a line fastened to the moon and the other end held on the earth. How many times would the moon wind the line around itself while passing once around the earth? We must answer, *no times*. Now suppose that by some cause it made two revolutions instead of one on its axis, how many times would the line be wound around on completing a circuit. We now answer once, of course, consequently proving "two revolutions" instead of "one."

Two miter wheels, one fixed and the other held in position by means of an axle fastened at right angles to the axle of the fixed wheel and made to revolve around it in gear with the fixed wheel, seems to be regarded as an illustration of the "one revolution" theory. I think it should not be noticed in connection with this question, it being in fact but a wheel rolling on a plane, describing a circle of its own diameter, the plane of the wheel being at right angles (or nearly so) to the plane on which it rolls. A. W. BROWNE.

Brooklyn, N. Y.

A. W. B.'s letter was accompanied by a very neat model, of which the diagram, Fig. 19, is a view. A fixed wheel, B, movable wheel, and C, a bar-carrier, which conveys the wheel, B, around A. The ends of bar, C, are pivoted upon wrists, *b*; the dotted lines indicate different positions of C. D, index attached to B; E, index attached to bar, C; the center pin of E forms the journal or axle on which B turns.

This device differs not essentially from those presented by W. E. H., pages 150 and 166. In all of them that portion of the carrier which supports the movable wheel has the axis of motion at the center of the fixed wheel. In Fig. 19, the movable wheel makes one revolution on its own axis in rolling once around the fixed wheel, as may be readily proved by extending the cord, F, from *g*, to the movable wheel on which the cord will wind once. But A. W. B. appeals to the moon and earth to prove that, because a cord from a fixed wheel to a moving wheel winds once, therefore the latter turns twice on its axis. As neither of the bodies on which he depends are fixed, we submit that his appeal cannot rest.

Having called A. W. B.'s attention last week to Fig. 11, in which the one revolution of the moving wheel upon its own axis is isolated, and made distinctive, our correspondent, it will be observed, declines to attempt to apply his two-revolution doctrines thereto.

MESSRS. EDITORS:—While the learned are demonstrating that a wheel revolving around another of the same size, the latter being fixed, will turn on its own axis twice, will you permit an unlettered farmer to have his say? I have carefully studied the diagrams on page 106, present volume, and, notwithstanding the apparent clearness of the demonstrations, I can demonstrate their fallacy thus: Postulate, attach one end of a cord to the rim of a wheel, and the other end to a fixed axle projecting from the center of the wheel, and the cord will be wound once around the projection at each revolution of the wheel, on its own axis. Now, any one can see, by experiments, or by a careful study of the diagram of Mr. Hepburn, that such a cord would be wound but once around the supposed projection, while the wheel was passing once around its fellow. *Ergo*, the wheel made but one revolution on its own axis. WM. BASSETT.

Birmingham, Mich.

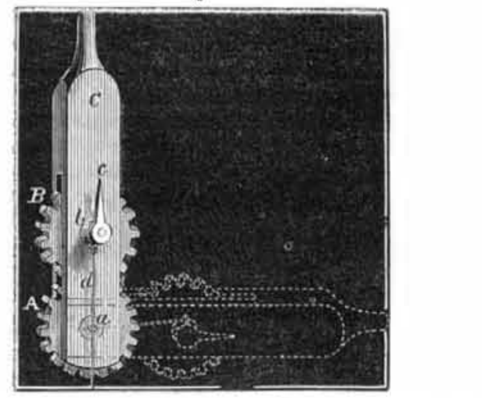
P. S.—Of course these gentlemen will find out, in due time, that one of the revolutions of the wheel is not on its own axis, but on the axis of the fixed wheel. N. B.

MESSRS. EDITORS:—The "wheel problem" has probably excited more thought and investigation, and will end in more benefit to a large class of your readers than any similar question started in your paper for years. With a simple model it is not difficult to convince nine out of ten that the wheel revolves twice on its axis in rolling once around the fixed wheel, and very difficult to convince them that the axis being carried around the circle with the revolving wheel neutralizes one half the apparent result, showing the revolution on its axis to be "once." The writer is not, therefore, "astonished at your patience" in keeping the question *open*, the result of which will be to *open* the eyes of many o your readers, and also to increase your subscription list. INVESTIGATOR.

West Pittsfield, Mass.

MESSRS. EDITORS:—I am searching for new and important principles in scientific knowledge, and at first I did not see the benefit that could possibly be derived from the discussion of the wheel question. But, now, I really think I see the point; and I conceive it to be in the center of the fixed wheel in the form of a pivot, *a*, upon which we will place a lever,

Fig. 20.



C, fixed to the lever we will put the axle, *b*, and a pointer, *c*. Now we will place upon the axle the movable wheel, B, and we are ready for the original question, to which we shall pay special attention.

How many revolutions will a movable wheel make rolling *around* a fixed wheel? Around is the word that governs the answer, and signifies moving in a circle. Every circle has a center—no matter if it is only imaginary—and for the benefit of my many friends, I have provided the lever with a convenient handle to the center of the fixed wheel, so they can all take hold and roll the movable wheel once around the fixed wheel, and then they will be able to decide by carefully watching the change of position of the pointer, how many times the movable wheel turns on its own axis. I am for "one." L. J. COHOON.

Whitesville, Ind.

MESSRS. EDITORS:—I would like to ask you just "one" question about the "two" wheel problem. If you should slide (not revolve) the movable wheel entirely around the fixed wheel, would the movable wheel make a revolution, or any part of a revolution, upon its axis?

What a tempest you have raised upon this subject. The old and the young are in a jangle over it. The unmarried of uncertain ages still adhere to "one." The pretty young ladies declare they *must* be "won." Under your lead the "ones" have it. Their hope is in *you*, and, like Sumner, their cry is, "Stick," that "one"-ders may not cease.

Woburn, Mass. R. W. P.

MESSRS. EDITORS:—We have tried the wheel experiment repeatedly, looked at it in every possible light, and have finally come to the conclusion that you are right. This is the universal verdict of many persons here. To the superficial observer it would appear to make two revolutions, but upon trial I can readily see that the movable wheel makes but one revolution on its own axis, and one revolution around the center of the fixed wheel. T. D.

Mt. Lebanon, N. Y.

Bringing the Wheel Question to a practical issue:

MESSRS. EDITORS:—I have always held that a movable wheel makes but one revolution *on its own axis* in rolling once around a fixed wheel of the same size. I have borne the assaults and researches of the "two revolution" party with commendable patience. I have been kept out of bed until two o'clock in the morning quietly answering objections. My plate has been revolved until my pork and beans were cold. My biscuits have come to table lined and figured, evidently with a piece of burnt wood. Bridget has complained of a mysterious disappearance of sauce-pan lids. My sulky wheels have several times been removed. Yesterday, however, my equable temper broke down, when one of the "two revolutionists" brought the *moon* into the discussion. Now I take notice that when one calls the moon to his assistance he is in a bad case. For example, when a man tries to convince me that the moon is made of green cheese, he is a fool, or takes me for one. The old woman, who tried to dissuade her son from Sabbath breaking by citing the shocking example and punishment of the "Man in the Moon," was at fault both in religion and science. Messrs. Editors, that old woman is not dead yet. In short, I am a plain, matter-of-fact man, and consider all those kinds of celestial appeals, come they from professor or pedler, as mere moonshine.

This question can be brought to a practical issue: If a *whole* wheel makes *two* revolutions in rolling once around a fixed wheel of the same size, a *half* wheel must make *one whole* revolution in rolling half way around a fixed wheel of equal diameter. A corduroy road and a wheel-barrow having but a half wheel, will furnish the apparatus to try this on. See sketch, which explains itself.

Anyone wishing to try the experiment may address JOB STUBBS.

Practical Lodge, Western Wilderness.

Fig. 21.

WHEELER—"*Two* Revolutions, or *One?*"
WHEELEE—"*Oh! ONE!*"