A SCIENTIFIC TOP.

BY GEO. M. HOPKINS.

Every street urchin can spin a top, and get an unending amount of amusement out of it; but it would seriously puzzle the majority of "boys of older growth" to satisfactorily explain all the phenomena of this simplest of toys.

Why does it continue to revolve after being set in motion? Why does its motion ever cease? Why does it so persistently maintain its plane of rotation? When its axis is inclined to the vertical, why does it revolve slowly around a new axis while turning rapidly upon its own axis? And when so inclined, why does it gradually right itself until it rotates in a horizontal plane? Why does it not revolve proportionately longer when its speed is increased? These and many other questions arise when we begin the examination of the action of the top. They have all been answered so far as it is possible to answer them, still it is difficult to reach far beyond the mere knowledge of the actions themselves.

the stud on which the friction driving wheel turns. The upper end of the rod is provided with a handle, and to the boss of the friction wheel is secured a crank.

A sleeve fixed to the spindle of the top is furnished with an elastic rubber covering which is engaged by the beveled surface of the driving wheel. After imparting the desired speed to the top, by turning the driving wheel, the wheel and the rod by which it is supported may be withdrawn from the top, without interfering in any way with its action.

A large number of interesting experiments may be performed by means of a top of this character. Most demonstrations possible with the whirling table may be adapted to this top, and, besides, many phenomena peculiar to the top itself may be exhibited. A few of the more striking experiments are illustrated.

By suddenly pressing upon one side of the top with a small rubber-covered wheel, as shown in Fig. 2, it will be found impossible to change its plane of rotation by the application of any ordinary amount of force. In fact, the side of the top to which the pressure is applied will rise rather than yield to the pressure.

By placing the step of the top on an elevated support, such as a tumbler (as shown in Fig. 3), and gently pressing against one side of the spindle, the axis of the top will be gradually inclined, and a gyroscopic action will be set up. The top will swing around with a very slow, majestic movement, traveling six or eight turns per minute around a vertical axis while revolving rapidly on its own axis, and it will slowly regain its original position.

As the peripheral speed of the top is almost a mile a minute, a little caution is necessary in handling it while in rapid motion, as any treatment that will cause it to leave its bearings will be sure to result in havoc among the surroundings, besides being liable to injure the operator.

Several methods of showing centrifugal action are illustrated, the simplest being that shown in Fig. 4. A small Japanese umbrella, about 20 inches in diameter, is arranged to be rotated by the top, by applying to its staff a tube which fits over the spindle of the top. In this, as well as the other experiments, the top is set in motion before the object to be revolved is applied. The tube attached to the umbrella having been placed on the revolving spindle, the arms are thrown up by centrifugal action, thus spreading the umbrella.

Fig. 5 shows a ring formed of two pieces of heavy rubber tubing secured to two metallic sleeves fitted to a rod adapted to the tapering hole of the top spindle. The lower sleeve is fixed, and the upper one is free to slide up or down on the rod. Normally, the rubber forms a ring, as shown in dotted lines, but, when rotated, the centrifugal force reduces it to a flat ellipse. A similar experiment, in which two elastic rings are secured on opposite sides of the rod, is shown in Fig. 6; the rings being circular when stationary, and elliptical when revolved.

In Fig. 7 is shown a device for illustrating the formation of an oblate spheroid. A tube, closed at the lower end and fitted to the hole in the top spindle, is provided near its lower end with a fixed collar and a screw collar, between which the lower wall of a hollow flexible rubber sphere is clamped. The upper wall of the sphere is clamped in a similar way between collars on a sleeve arranged to slide on the tube. The tube is perforated above the lower pair of collars to admit of filling the hollow ball with water. When the ball is filled or partly filled with water, and rotated, it becomes flattened at the poles and increases in diameter at the equator, perfectly illustrating the manner in which the earth received its present form.

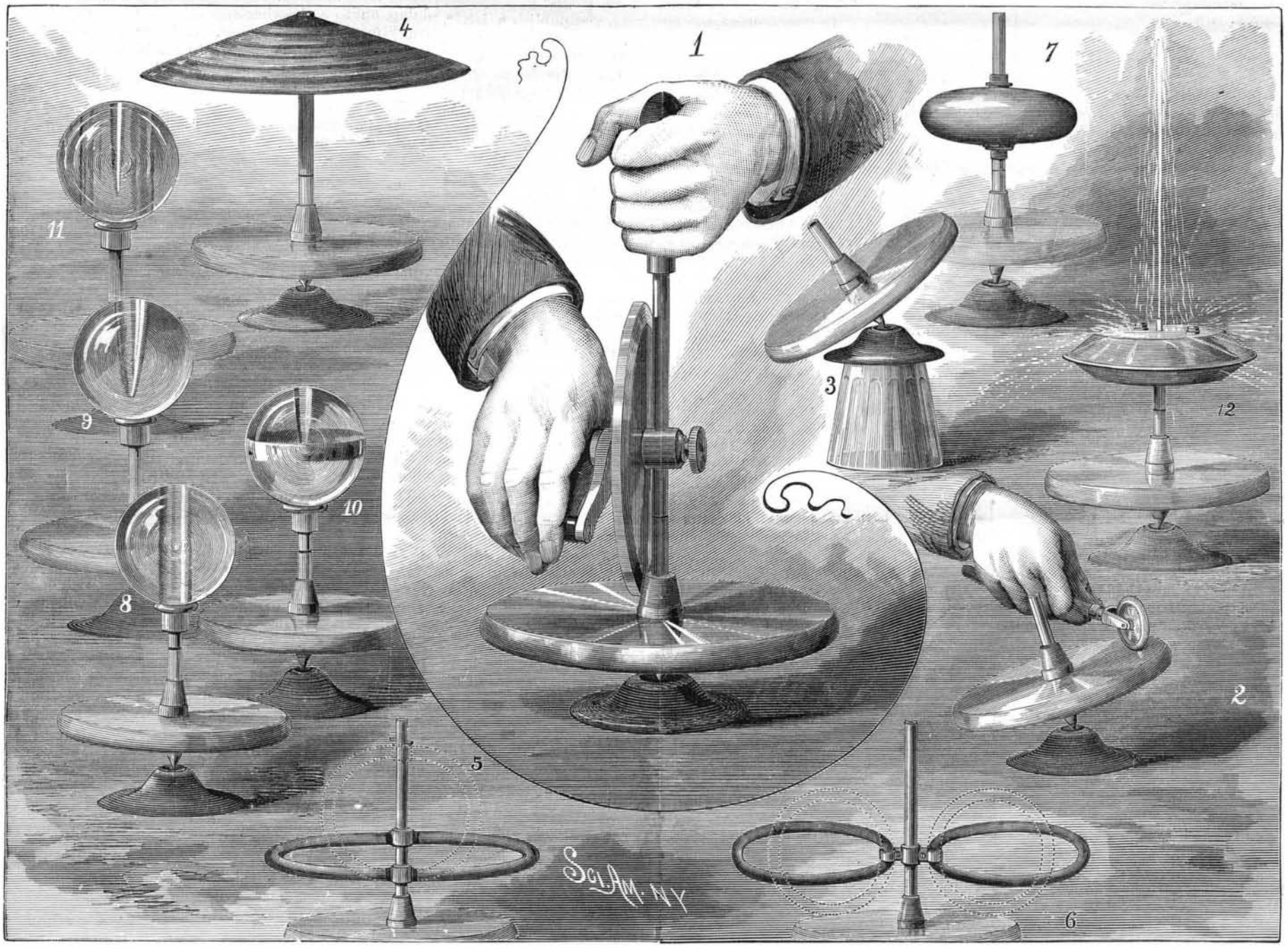
The glass water globe represented in motion in Fig. 8 exhibits a cylindrical air space extending through it parallel with the axis of rotation, the water having been carried as far as possible from the center of rotation by centrifugal action.

When the speed of the globe is reduced, gravity asserts itself, and the air space assumes a parabolic form, as shown in Fig. 9.

In the globe represented in Fig. 10, the filling consists of water and mercury. The rotation of the globe causes the mercury to arrange itself in the form of a narrow band at the equator of the globe.

Fig. 11 shows a globe filled with air, oil, and water, which, when the globe is revolved, arrange themselves in the order named, beginning at the center of the globe.

A Hero's fountain, operated by centrifugal force instead of gravitation, is shown in Fig. 12. The metallic vessel contains three concentric compartments. The jet tube extends downward into the central compart-



1. The Top. 2. Persistence in Maintaining Plane of Rotation. 3. Gyroscopic Action. 4, 5, 6. Examples of Centrifugal Action. 7. Formation of Oblate Spheroid. 8, 9, 10, 11. Examples of Centrifugal Action on Liquids. 12. Centrifugal Hero's Fountain.

A SCIENTIFIC TOP.

The top has already risen to some importance as a scientific toy, but it is worthy of being raised to the dignity of a truly scientific instrument. To give it that eminence, three things are necessary: first, a considerable weight, and in consequence of this, an easy and effective method of spinning, and finally, it requires a good bearing, having a minimum of friction.

The top illustrated has these three requisites. It weighs 3½ pounds, and its weight might be increased somewhat with advantage. It has a frictional spinning device by which a velocity of 3,000 revolutions per minute may readily be attained. It is provided with a hardened steel pivot which turns on an agate step.* It is almost perfectly balanced, and the friction of its bearing is very slight. When unencumbered, it will run for over 42 minutes in the open air with once spinning, and its motion may, at any time, be accelerated without stopping, by a new application of the friction wheel.

The brass body of the top is 6 inches in diameter, and ⅝ inch thick in the rim. Its steel spindle is ⅜ inch in diameter, and has a tapering longitudinal hole which is ¼ inch in diameter at its larger end. To this tapering hole is fitted the tapered end of a rod supporting

*An agate mortar of the smallest size, about 1¼ inches in diameter, mounted in a wooden base, forms the step.

ment and is bent laterally, so that it nearly touches the wall of the compartment. The intermediate compartment communicates with the outer compartment, and the outer and central compartments are connected by an air duct. The central and intermediate compartments are filled with water, and as the vessel is revolved the water in the intermediate compartment is carried by centrifugal action into the outer compartment, and, compressing the air contained in that compartment, drives it through the air duct, with a force due to the centrifugal action, into the central compartment, where it exerts a pressure on the water sufficient to cause it to be discharged through the jet.

[redacted] adaptations of the top will be described later.

[redacted]ARFUL RAILWAY COLLISION.

[redacted] of September an accident of the most [redacted]e took place at Silver Creek, N. Y., on th[redacted], Chicago & St. Louis Railway.

The [redacted]ra Falls excursion train, which left Ashtabula, O., at 8 A. M., stopped at all the stations to Silver Creek, and left there on time with the eleven passenger coaches well filled with Ohio, Erie, and Dunkirk people. There was a baggage car ahead and next to it was the smoker, half filled with men. Three-quarters of a mile east of Silver Creek, just as the train was leaving a big trestle to round a curve, engineer Lewis Brewer was horrified to see the engine of a freight train plunging toward him on the same track at a high rate of speed. Brewer whistled, put on the air brakes, and reversed his engine. Then he and his fireman jumped. The freight engineer whistled and jumped just as the engines came together with a terrible crash. The baggage car was instantly telescoped into the smoking car, but the other cars were not badly hurt. A moment after the crash the air was filled with the groans of the dying and the hiss of the escaping steam.

The engines were almost demolished, and the baggage car was found to have plowed to within five feet of the rear of the smoker. Great difficulty was experienced in working at the wreck, which was almost literally covered with blood. The scene was too sickening to be described, and many of the passengers who tried to help the railroaders were overcome with faintness. Body after body was taken out, until the bodies of fourteen dead persons were placed on the ground near the wreck. Some of the bodies were so horribly mangled that identification was uncertain.

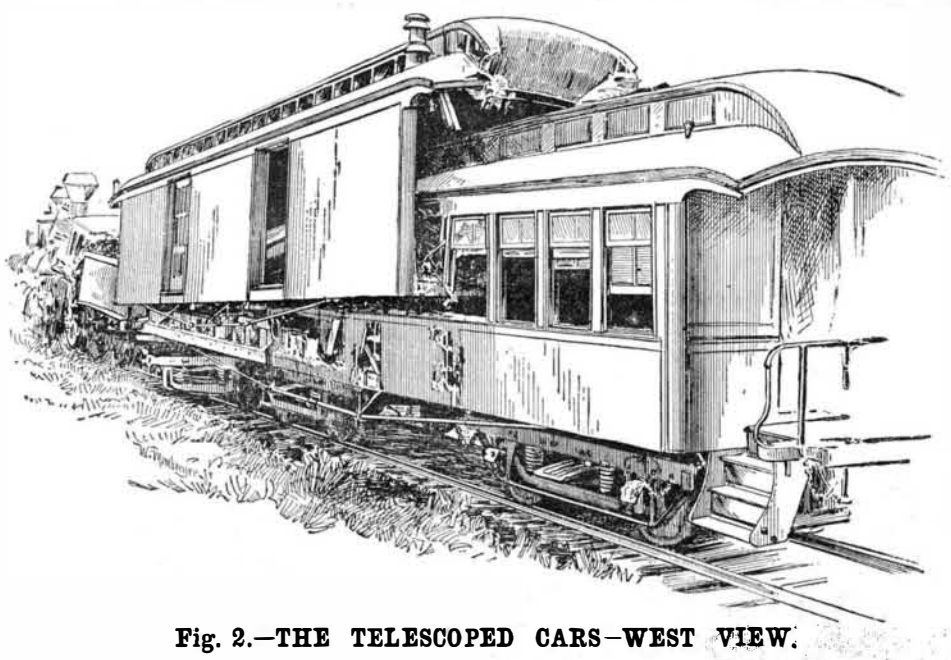


Fig. 2.—THE TELESCOPED CARS—WEST VIEW.

Many persons were badly injured; of these about eighteen have died, making the number of deaths about thirty-five.

The accident was due to disobedience of orders on the part of those in charge of the freight train. Instead of remaining at the siding directed, they attempted to proceed to the next siding ahead. Charles McSparren, of Erie, was one of the four passengers in the wrecked smoking car who escaped alive. His hands were lacerated with broken glass, his clothes were torn and spattered with blood. He said:

"You have no idea of the horrors of those few seconds. We had left Silver Creek, and were going along at a good rate of speed, when suddenly the train gave a lurch and the next instant there was a crash which sounded like an explosion. Then, for three or four seconds, the baggage car tore right through our coach as it telescoped us. The car was half full, and most of those ahead of me (I was on one of the rear seats) were crushed to death almost before they knew it. So sudden was it that there was not a chance to save themselves, or try to do it. The man in the seat ahead of me was killed, and the shock slung me around with his body. I was pitched out into the sand somehow, and when I came to I suppose the sight made me intensely sick."

The *Railroad Gazette*, from which we take the accompanying illustrations, says: The engravings will make very clear to railroad men its nature and probable cause. It will be remembered that in the telegraphic reports of the accident it was stated that "the drawbar of the baggage car was higher than that of the smoking car." Whether this was so ornot does not appear in the engravings, and we have no other evidence of it, but it will be seen that the "circumstantial evidence" that it was so is painfully strong. The collision, regarded simply as a collision, was a decidedly mild one. On the engines, one cylinder and a part of the steam chest of one engine was knocked off and the cylinder head of the other engine, but the coll sion was not violent enough to do any injury to the boilers, thus saving the horrible addition to the death roll from escaping steam which has so frequently resulted in such accidents. The manner in which the cab and tank are fractured likewise indicates no very extraordinary violence.

We may be quite certain that with a train of well built Pullmans, provided with approved coupler buffers, there would have been no telescoping from any such force as this.

Even with ordinary passenger and baggage cars, there would probably have been some broken sills and perhaps a general smash up in one end of some car, but hardly such a fearful case of telescoping as the two views of the cars show.

It seems evident that the baggage car mounted at once above the coupling and platform of the smoking car, gave a square blow against the end of the car, and in smashing it in was given a quick slant upward to the level of the windows.

There it encountered the line of least resistance, and went on in a nearly horizontal line, cutting through the windows on one side and the roof on the other until the force of the blow was spent.

When we consider that the smoking car was crowded full of passengers at the time, the awful scene of death within can be only too well pictured. According to the latest reports, out of 40 in the car, 14 were killed, 19 injured, and 7 escaped uninjured. One cannot help wondering that so clean a cut, with so little general fracture, should have been possible both on the sides and roof, but probably the strongest car would shear almost as easily, granting the provoking cause to start the telescoping. It is in that that the moral of the occurrence lies from a mechanical point of view.

Cement in Ireland.

Henri Sainte Claire Deville, the illustrious French chemist, in the course of certain recent researches, discovered that some compounds of hydrate of lime and hydrate of magnesia afford a cement of eminently hydraulic properties, and setting rapidly under water. He further found that the natural dolomites, which consist of carbonate of lime and carbonate of magnesia, in proportions either of one atom of each or of two or three atoms of the lime carbonate to one of magnesia, if calcined at a very low red heat and ground to powder, produce, without any other treatment, a fast-setting hydraulic cement, which becomes so hard that it may be employed also as an artificial stone, which, for architectural purposes, retains the fine warm tint of color of the dolomite in its natural state. Now, in many parts of Ireland dolomite is abundant as a quarry rock. It can be obtained of a fine creamy white color, and very free from iron and manganese, which would in the preparation darken its color as a cement. The amount of heat required for its calcination is very slight, and may with great advantage and cheapness be communicated in furnaces heated by gas evolved by the imperfect combustion of peat, employing a modification of Charles Siemens' regenerative furnace. The calcined stone can be ground by water power, and the casks for packing the cement may be a subsidiary manufacture, and even made from small native timber; but little skilled labor is required. The materials are all at hand, the product directly marketable. The process which has been given to the world by Deville is hampered with no patent. Here seem to be the conditions for at least one new industry in Ireland. Let us hope that the hint may not fall wholly unproductive.—*Robert Mallet, F.R.S.*

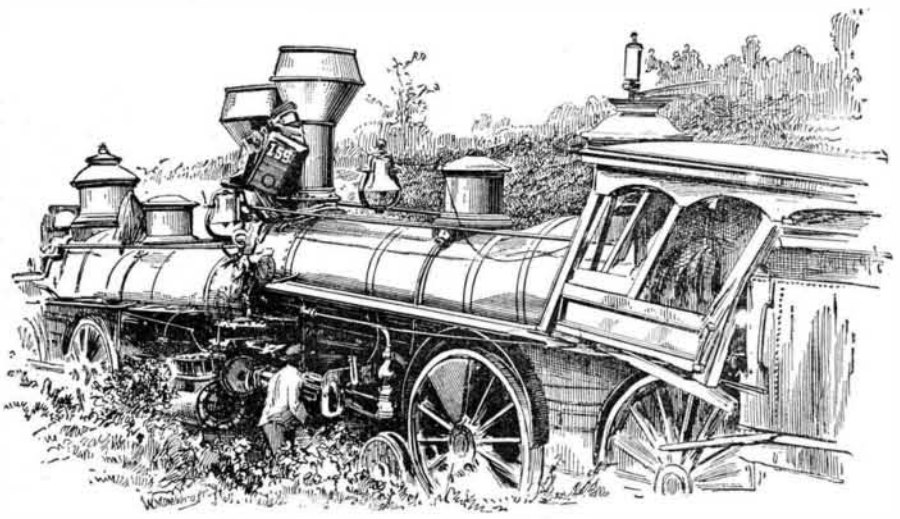


Fig. 1.—THE ENGINES.

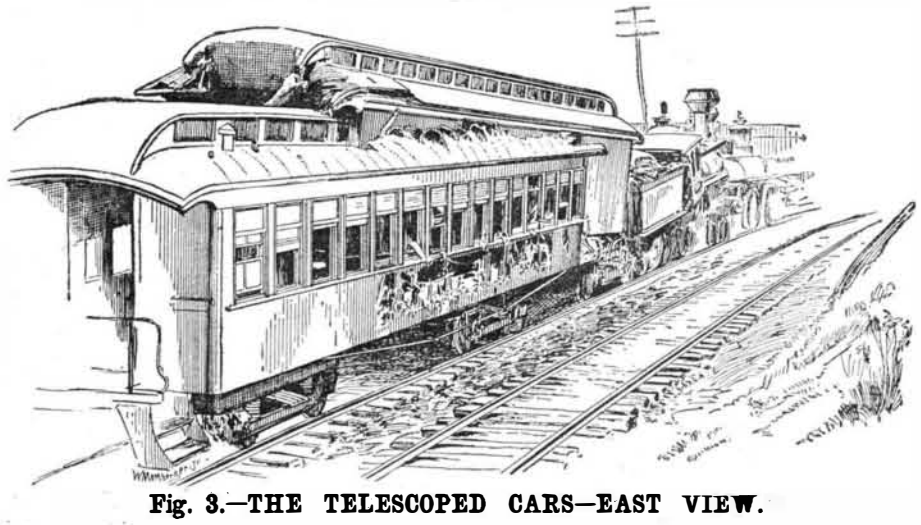


Fig. 3.—THE TELESCOPED CARS—EAST VIEW.

Increased Use of Asphaltum in Building.

Our experience in the use of asphaltum in the treatment of foundation and cellar walls fully confirms the following item from the *Western Manufacturer*, and we believe its use may be beneficially extended to many other purposes than those suggested.

The use of asphaltum in building is largely on the increase, principally employed as a prevention against damp cellar walls and mason work underground, also for watertight cellar floors, coating for rain water cisterns, covering for underground vaults, etc. The usual method of applying it is to reduce to a semi-liquid state, in a large iron pot, over a good fire, sufficient asphalt to about two-thirds fill it, care being taken that the flame does not rise over the top of the pot and ignite the asphalt. The wall is made as nearly dry as possible, and the joints somewhat rough, to admit of the asphalt penetrating the pores and securing a hold; the wall is then covered with asphalt, applied with a long-handled brush, while the material is hot and brushed in well—a coating one-half inch thick being as perfect a protective as a thicker one. A barrel of asphalt, as found in the market, heated and applied to vertical walls of brick, will ordinarily cover about two hundred and fifty square feet of surface, and produces most lasting results.

Basic Slag as Manure.

Dr. Munroe, F.C.S., Professor of Chemistry at the College of Agriculture, Downton, Salisbury, has issued a report on experiments made by him to test the germination and growth of farm seeds in various mixtures of garden soils and basic cinder made at the Northeastern Steel Works, Middlesbrough. The Professor points out the high manurial value of the phosphates contained in basic cinder, and gives the results of many experiments which have been most successful. Cargoes of basic slag have recently been shipped from Middlesbrough to different Continental ports, and one vessel has lately taken a cargo of 1,000 tons to Stettin.