WATER PRESSURE ENGINE.

The engine herewith illustrated is designed chiefly as a substitute for manual labor, especially in localities where the use of steam power is either inadvisable or impracticable. The cylinder is oscillating and supported on its trunnions by fixed bearings cast in one solid piece with the re spective crank shaft bearings. The two double bearings are bolted upon a foundation plate, supporting also an air vessel on its after part. The bearings are further connected by stays,as shown. The cylinder is made,on both right and left sides, with flat faces, turned and adjusted truly rectantangular to the axis of its trunnions. Into these faces open the ports of the two water passages contained in the lower part of the cylinder body, communicating at their other ends with the bore of the cylinder. Adjusted truly to them, and so held up as to be easy but tight against the cylinder faces, are two boxes, one at each side, which receive the water from the conduits and distribute it by an admission port alternately to the two cylinder ports, and consequently fore and aft the piston. A fly wheel is provided to over ome the dead points which occur at each end of the stroke. The water which has performed its work is expelled by the returning piston back through its passage and enters the above named boxes through two separate ports to the right and left hand of the admission port, whence it flows through suitable conduits to the drain pipe into a cistern or other receptacle, whence it may be used again for other purposes. Screws are used for the purpose of setting and fixing the valve boxes in their proper positions in reference to the cylinder ports. By means of set screws, they are screwed slightly up to the cylinder to make a tight joint between their faces and still allow of free motion of the cylinder between the boxes. This adjustment can be done, on account of the tendency of the water pressure inside to separate the boxes from the cylinder, to such a nicety that the friction between the said faces is practically nothing.

In Zürich, Switzerland, the water supply is elevated from the lake into reservoirs, partly by means of a water wheel placed within the principal pumping engine house, which is built upon piles in the middle of the river Limmat (the outlet of the lake of Zürich) but principally by means of large steam machinery in the same and other edifices.

At the present time 200 indicated horse power is employed, which raises 444,000 cubic feet of water per day, 55,000 cubic feet of which are consumed by water power engines. We are informed that, to such an extent have the advantages derived from the use of this water supply as a motive power been recognized, at the present time no fewer than 75 water power engines, of from ¼ to 2 horse power, are in daily operation, besides a great number of very small motors, used for driving sewing machines and similar light work.

Lithographers, printers, joiners, turners, piano manufacturers, machine makers, locksmiths, and kindred trades drive their lathes, saws, planing, drilling, boring, and molding machines, etc., with water engines. Butchers move their meat-cutting or pulping machines; weavers and lace makers operate their looms and winding machines, distillers their pumps, cutlers their grindstones and emery wheels, with them. These engines are also employed with hoists for stores, and for raising building material to buildings in construction. The inventors point out that their application, however, is not limited to town industries, but that it may be used advantageously in larger proportions for natural falls of water from 64 feet upwards, there being some engines at work with pressures up to 10 and 12 atmospheres. The only care required in using the machines is that the water should not carry pebbles or sand, which in most cases can be prevented by allowing such substances to collect in a reservoir at the head of the fall.

These engines may also be used for raising and forcing liquids, sewage, etc., for cleaning pits, as fire pumps, or for contractors' purposes, by simply applying motive power to the crank shaft and converting the in and out let pipes into suction and delivery hoses respectively.

The city engineer of Zürich, Mr. Bürkle, we learn, has subjected one of these engines to a trial under the brake, with water pressures varying between 35·2 and 140·8 feet head, and under speeds from 0·6 to 2·4 revolutions per second. The average result obtained was 90·2 per cent. The highest duty was given out at speeds of from 1 to 2 revolutions per second. The particular engine in question was of the following principal dimensions: Diameter of cylinder, 3·5 inches; stroke of piston, 6·8 inches; diameter of water inlet pipe, 2 inches: and area of base plate, 32 inches long by 14 inches wide.

The power given off by 120 revolutions per minute, and 140·8 feet head, was 2·133 horse power. From these data it is plainly seen that the space required for the engine is very small in proportion to the power developed. Patented in the United States to the inventors, Messrs. Wyss and Studer, Technisches Bureau, Zeughausstrasse No. 9, Zürich, Switzerland, who may be addressed for further information relative to sale of patent, etc.

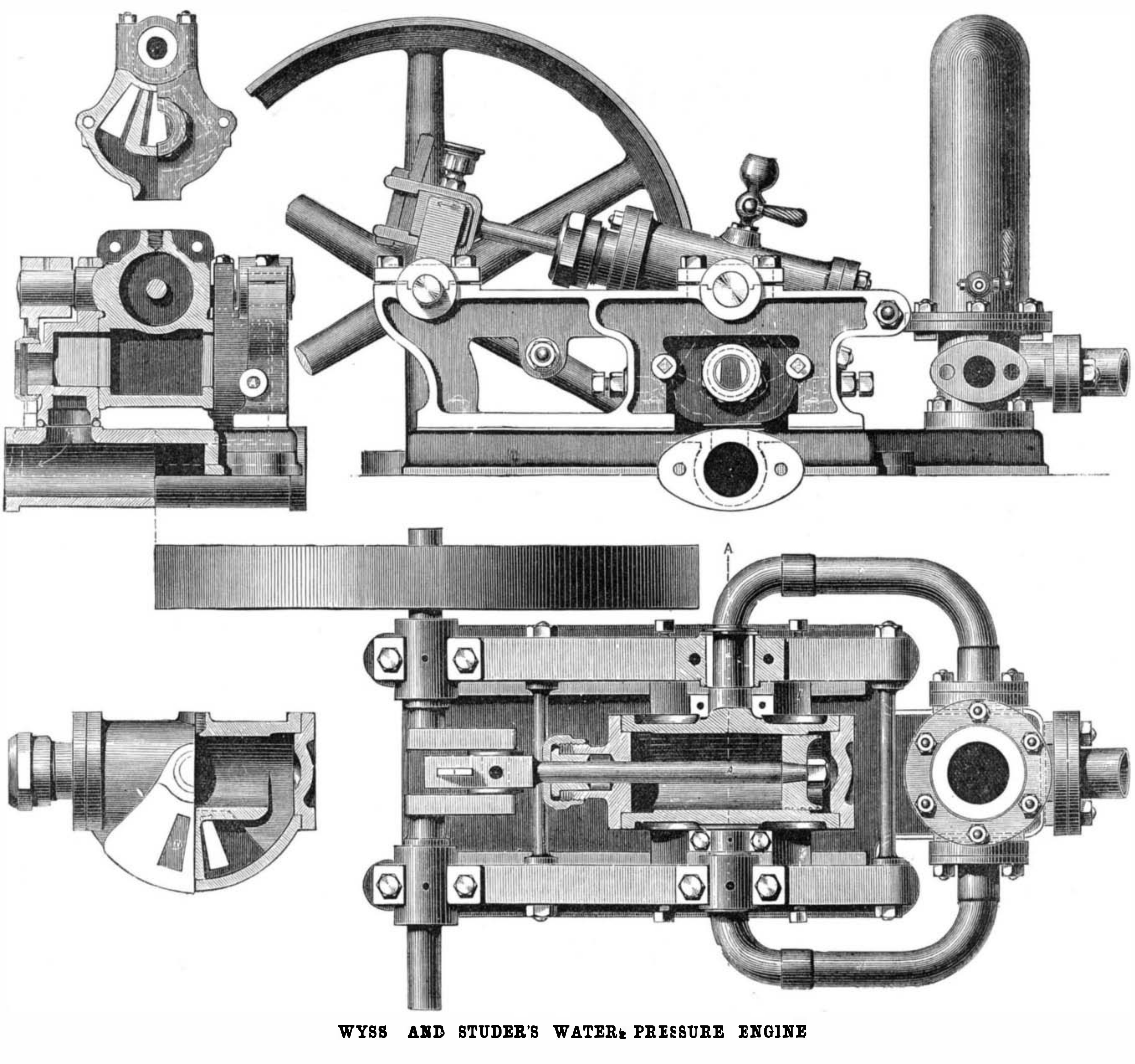
Interesting Torpedo Trials at Newport, R. I.

An extended series of torpedo experiments was recently made by the officers of the U. S. Naval Torpedo station at Newport, R. I., in the presence of the Secretary of the Navy and a large number of officials. The electrical instruments by which the torpedoes were fired were disposed on a lawn, or an elevated *plateau*, and were connected with batteries in the building. Among those instruments was an electric chronograph, invented and perfected by Farmer, worked by a pendulum driven by electricity, and designed so that it will fire from 1 to 120 torpedoes in as few seconds. By the side of this was an electric engine invented by Lieutenant Moore, which equals at best about twohorse power. The first item on the programme was a subaqueous salute to Secretary Robeson, of nineteen torpedoes, each charged with 10 lbs. of powder, arranged in line, south of the ferry landing. These were fired in the presence of the whole company by Lieutenant Manley, by the action of the pendulum of the chronograph above named, at intervals of six seconds, commencing southward. No better description can be given than by imagining a row of nineteen giant fountains, whose streams of water rise up in massives column to the average hight of 180 feet, each opening with a loud report and concussion.

The experiments were chiefly intended to show the utility of applying electricity under various conditions to the torpedo service, and thus, as a further illustration, Mr. Merrall next exploded a twenty-five pounder north of the ferry in deep water, to show the usefulness of Farmer's machine for boats.

Torpedo No. 3 consisted of 100 pounds of powder, placed east of the landing, and was fired by Farmer's machine for ships. This was in deep water. At the instant of the discharge it seemed as though 1,000 cannon had been fired under water. The spray flew up nearly 300 feet, deluging the persons in the nearest craft, and causing the water to seeth like a vast whirlpool.

Torpedo No. 4 was fired by the Lay torpedo boat against a



WYSS AND STUDER'S WATER PRESSURE ENGINE

raft at about 1,000 feet distance. The boat, having a five-pound torpedo fastened on the stern, was handled from the croquet lawn by Lieutenant Bradford. The boat is made almost in the shape of a cigar, with two pointed ends, and is almost totally submerged, the green outline appearing above the water being almost like a huge green fish. The boat is fitted inside with a small oscillating engine, driven and steered by carbonic acid gas, the steering being regulated through the electric machine, and by means of which it can be made to perform the most difficult evolutions so long as there is any gas left in the receiver. The object of this invention is to attack an enemy's vessel at a distance of two or two and a half miles, and, by means of immense torpedoes or charges of gunpowder or nitro-glycerin, destroy the enemy and the boat also. After a few fancy manœuvers, the deadly looking craft made right for the target, and in a few seconds the edge posts were shivered into atoms and thrown into the air a distance of twenty feet. Then the boat was sent on a cruise among the sailing boats and turned round and round with a rapidity that was astonishing, considering the distance.

Experiments were next made with the Ericsson torpedo boat. The engine was worked by compressed air, which was forced through an inch india rubber tube from the air box of a twenty-five horse power engine. The hose supplying the air is 800 feet long. The length used is also used to draw back the boat. The engine was started and the two propellers, which work in opposite directions, were set in motion. The air pressure was from seventy-five to a hundred pounds, and soon the tube, like an immense tail, began to run out after the boat.

In a few seconds the boat began to sink; and as the speed of the stationary engine, on the Nina. was increased, she sunk deeper and deeper, until the white disk on the ten-foot iron shaft on the upper portion of the boat was only three feet above the surface. Unlike the Lay boat, she made no ripple, and all that could be seen above water at 600 feet distance was the disk. The air is made to steer her through the tube that supplies her cylinder as effectually as the carbonic acid gas is made to govern the movements of the other boat. Great interest was manifested in this invention. As soon as the pressure is taken off, the boat rises to the surface; when speed is gained she sinks completely.

Next a group of torpedoes, six in number, were exploded north of the landing. They were in about six feet of water and charged with powder, from ten to forty pounds. These were fired by several ladies present. There was another row of startling water jets, which would have sent a small fleet to "Davy Jones' locker" in a few seconds.

A steam launch next appeared, with two seventy-five pounders rigged on spars at the bow. These were rapidly fired by Lieutenant Commander Wildes and several assistants. When the splash and splinters had cleared away, the Nina came past the stand with a 100-pound service torpedo rigged to a spar, which was exploded as she passed the stand. The torpedo used in this way is intended as a substitute for the ram which is attracting so much attention in modern naval warfare. In a few seconds, however, she returned to the charge, towing in her wake a "Harvey," which she quickly dragged against a floating raft and sent everything literally sky high. Now followed in rapid succession three fifteen pounders, which were fired by the contact of a small steam launch with buoys containing circuit losers of a peculiar construction.

In connection with these experiments the circuit indicator designed by Lieutenant Converse was used, which gives to the officer in charge absolute information as to the condition of his cables and torpedoes at all times. If a wire becomes defective or broken, it is signaled instantly by the ringing of a bell, which sound is kept up until the defect is repaired. It also enables him to fire the torpedo at will when the enemy's vessel does not come in contact with the circuit closer, and yet is near enough, in his judgment, to send her to the bottom. At the same time all the torpedoes can be rendered safe to a friendly vessel, their approach being merely signaled by the ringing of a bell, this being, in fact, the most complete apparatus yet designed. When one torpedo is fired, however, all others are thereby disconnected from the battery for half a minute, thus rendering it impossible for one torpedo to be fired by the action of another.

The next experiment was the simultaneous firing of seventy-nine dozen igniters. These were followed again by two extemporized torpedoes, the one in an old tin oil can, the other in a molasses jug, which rattled and thundered so that the whole of Newport must have been affected. These were constructed, at the request of the Secretary, by Messrs. Higginson and Davenport from the materials at hand. After the experiments on the east side of the island, Professor Hill created a commotion by exploding a hundred pounds of nitro-glycerin, placed to the west of the island, five feet from the surface of the water. The shock was quick and severe, and thousands of fish came instantly to the surface, apparently stunned, while many others were treated to a brief aerial voyage.

At the spot called Junction No. 12 by the experimenters, was effected the explosion of twenty-five pounds of dynamite under a raft which was floating on the surface of the water. This was the most splendid piece of work yet accomplished. The water was agitated a quarter of a mile distant from the raft, and the volume of water thrown in the air was laden with the splinters, which fell again into the water like match wood. The grandest spectacle of all was the last. The old coast survey schooner Bowditch lay quietly at anchor, 1,300 feet distant, under bare poles. Near her were a hundred little sailboats, which the steam launch was endeavoring to drive off; beneath her, however, was a terrific mine, consisting of three 100-pound gunpowder torpedoes and 250 pounds of dynamite in two others.

Mrs. Field, wife of Judge Field, of the Supreme Court, closed the circuit, and in an instant a vast column of water ascended about 300 hundred feet, followed by a roar and a concussion, and the timbers of the stately looking old craft were flying through the air. In the place where she had rested so placidly but a few seconds before a whirlpool was now seen spreading out its waves and receiving the falling *débris* as it descended, splash, splash, into the harbor; it was a complete annihilation. Not enough to make a doorpost, scarcely, was left whole. The hulk disappeared like a dream, for the instant the explosion took place she was crushed and carried up in the form of chips in the vast volume of water thrown by the force of the mine beneath.

Ballooning at Night.

M. Wilfrid de Fonvielle made a successful night ascent on August 1, for the purpose of observing meteorites. From 10 P. M. to 4 A. M., forty-two meteorites were observed between Rheims and Fontainebleau. Some of these emanated from *Cassiopeia*, others from *Perseus*, and as many as nine took a vertical direction, descending from the part of the heavens which was concealed by the balloon. None of these were very noteworthy, and it is probable that none would have been observed at the surface of the earth. Eight persons were in the car.

Correspondence.

What is the Electric Force?

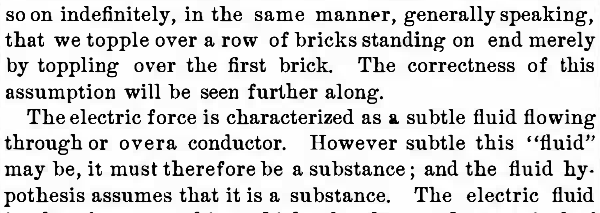
To the Editor of the Scientific American:

At the close of a life of patent research and experiment, it was the conclusion of Faraday that the electric force could not be defined; and it is almost universally conceded today that the nature and functional character of electricity must for ever remain one of the things unknowable. It is the purpose of the present article, in simple terms, to point out the partial fallacies of this proposition; and in order to arrive at a correct understanding of the subject, it is necessary that we frequently step aside from our subject to consider the bearings of other forces in respect of the electric force.

We may or may not accept at the outset a fact, susceptible of easy demonstration, that there is but one law regulating the transmission or continuation of force. It is of no sort of consequence what kind of force we may have in hand; there is one law inherent in all forces, and that law, in brief, is that no force can be transmitted except by molecular action. By molecular action I mean this: the first molecule or atomic particle of matter to which a force is imparted imparts that force to the next, and the next to the next, and so on indefinitely, in the same manner, generally speaking, that we topple over a row of bricks standing on end merely by toppling over the first brick. The correctness of this assumption will be seen further along.

The electric force is characterized as a subtle fluid flowing through or over a conductor. However subtle this "fluid" may be, it must therefore be a substance; and the fluid hypothesis assumes that it is a substance. The electric fluid is, therefore, something which, placed upon the terminal of a telegraph wire in New York, for instance, travels with inconceivable rapidity over or through that wire to the other terminal in Chicago. Let us note the facts which absolutely disprove this assumption.

We must first take into consideration the battery, or generator of electricity; and in so doing we are brought face to face with the question whether, when the electric circuit is established, any substance passes over or through the wire. In order that it may not be asserted that the fluid which leaves one pole of the battery returns to the other pole, thereby maintaining the equilibrium, we apply the battery to an induction coil, and for hours we discharge into the earth, from the secondary wire, a stream of brilliant sparks, the electricity generated by the battery. This will be understood as shown in Fig. 1, in which B is the battery, the electricity generated by which flows in the local primary coil, A; and C is the secondary coil, insulated from the coil, A, whose circuit is to the earth by way of the separated points, D.



We find an immense volume of electricity collecting at the points, D, and we know that the discharges cannot return to the battery. Therefore, if the electric force be a fluid or substance proceeding from the battery, the battery will in a certain period of time, have lost a certain quantity of its substance.

The battery is composed of certain metals, and chemicals in solution. By the action of the battery the nature of the metals and chemicals is changed, in precisely the same general manner that fire converts fuel into dust and gases, or water into steam. Now we have used our battery, we will say, for weeks, until the chemicals wholly, and the metals partially, have been converted; but although the electricity generated by the battery has been constantly given off, we find, if the battery be properly guarded from evaporation and its fumes collected, that not one atom of weight or substance has been lost. Therefore we can assert positively that the electricity generated by our battery, which has been constantly discharging in vivid sparks, not into the local circuit of the battery, but into the secondary earth circuit, is not a fluid or substance; that nothing leaves the battery and passes through the wire; that nothing passes through the wire, in the sense of substance; for this we do know, that, however subtle a "fluid" electricity may be argued to be, if it really be a fluid or substance flowing from the battery, there must inevitably be a loss in the weight of the substances comprising the battery, which we know there is not. There can be nothing more positive than these facts; and in view of them it cannot be argued that electricity is a substance, or a fluid, or a subtle fluid.*

Having gained this much, it will presently be seen that we have gained a great deal. What, then, is electricity?

First, it is clearly a force. Secondly, it is transmissible.

Being a force and being transmissible, it is like all other forces (all of which are transmissible) in its transmissibility. Like all other forces, electricity exists in a certain condition of the molecular or atomic structure of substances. It is no more a subtle fluid, nor is its transmission any more singular, than the force of traction is a subtle fluid or its transmission singular. And it is proposed to adduce the most striking facts to prove that the electric force differs from other forces only in the character of the molecular action in which the forces exist, without entering into a discussion of the ultimates of matter and force, for we can never have knowledge of these ultimates. We know there are matter and force; but when we arrive at a studious questioning, we find it impossible to distinguish between matter and force, to decide whether matter is an attribute of force, or force an attribute of matter; and finally we might carry the thing so far as to wonder whether force is not everything and everything is nothing.

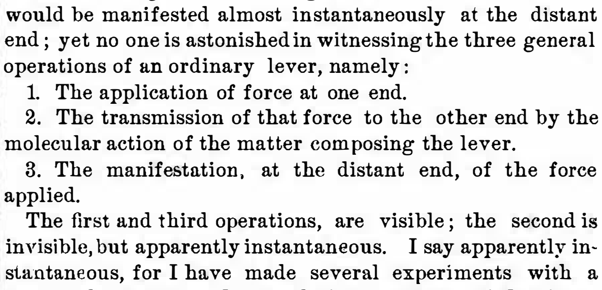
It may be confidently asserted that in the transmission of any force whatever, from the transmission of force through a simple lever to the transmission of electricity and light there is but one law, which is perhaps best exemplified in the toppling over of a row of bricks, as herein before mentioned. In this example, each brick crudely stands in the position of a molecule of matter, and acts upon the next brick in precisely the same manner (that is, as to imparting of force) that one molecule of matter acts upon another. If you blow a quantity of air into one end of a long tube, the same quantity of air will emerge from the other end; but you know that it is not the same air that is blown into the tube. The first impelled quantity of air yields its impulse to the next, and the next to the next, and so on indefinitely So if you take, with proper shape, a tube of water a mile long, for instance, and pour a certain quantity of water into one end, the same quantity will be displaced at the other end; but it would not be said that the water poured into the tube had traveled the length of the tube and emerged at the other end, although the effect is the same as though the quantity of water poured in had so traveled. It is the same with a belt or a lever; if you impart to one end a certain force, each atom or molecule of the belt or lever imparts that force to the next until finally the force is manifested at the distant end. And if the medium of transmission could be perfectly rigid or unyielding, the force applied at one end would be manifested almost instantaneously at the distant end; yet no one is astonished in witnessing the three general operations of an ordinary lever, namely:

1. The application of force at one end.

2. The transmission of that force to the other end by the molecular action of the matter composing the lever.

3. The manifestation, at the distant end, of the force applied.

The first and third operations, are visible; the second is invisible, but apparently instantaneous. I say apparently instantaneous, for I have made several experiments with a view to determining the speed of transmission of this force, and have ascertained that a reasonable period of time is required for the transmission of force through a rigid bar of iron as short as fifty feet in length. My first experiments led me to approximate the speed of this transmission to the speed of transmission of the electric force, but I have found that it varies with temperature and kind of metal. The bar of iron which I used, and which was fifty feet long, gave the best results. It was placed horizontally upon eight pulleys, with platinum contact points at each end, connected with an automatic telegraph recording instrument and batteries as follows:



Here are shown the bar A, fifty feet in length, running on pulleys, and the electrical connections, X being a projecting piece fixed to the bar, whose duty is to close the circuit of battery, B B, by forcing together the contact points, I I. The circuit of battery, B, is completed by the bar bringing together the contact points, *d d*, one of which is fixed to the bar. C C are the recording points, bearing upon the chemically prepared paper, E, which is carried over the metallic drum, D. It will be seen that a blow struck upon the end of

* It is a singular fact that, whenever something appears which is not capable of ready definition, instead of seeking for a solution, and suspending judgment until a solution is found, refuge is taken in hypothetical subtle fluids, or synonymous somethings