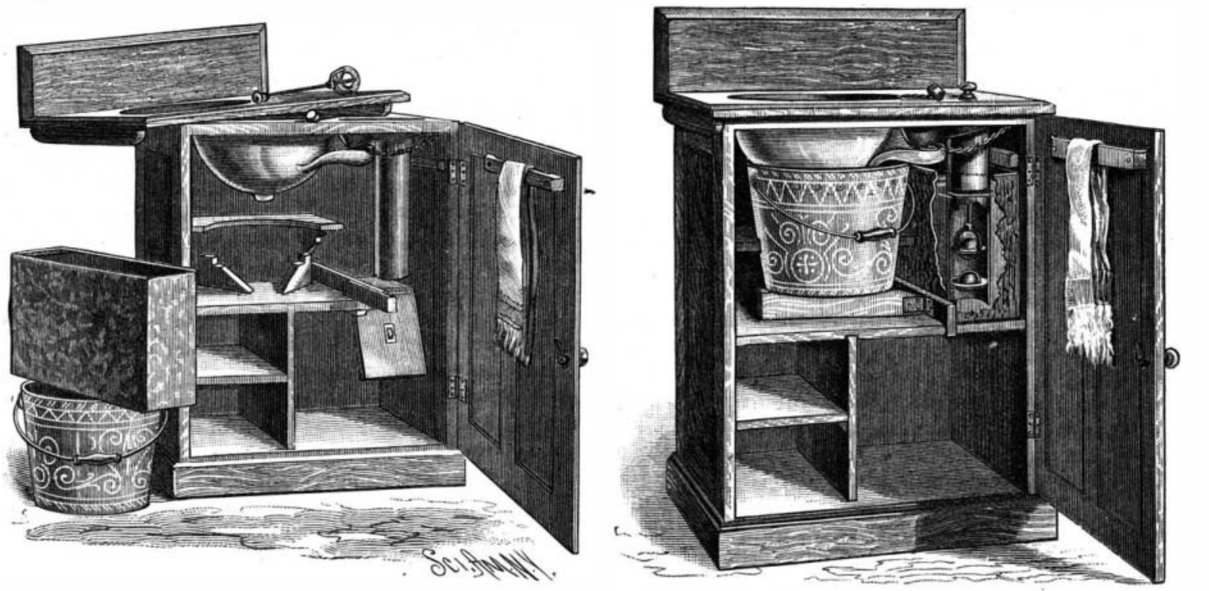
AN IMPROVED TOILET STAND.

In the patented toilet stand shown in the accompanying illustration, the fresh water is held in a reservoir beneath, and is pumped up and into the bowl over a projecting lip to the bowl beneath the slab. The pump is large, has no packing or closely fitting joints and the water is simply lifted in an easy, strong flow. The valves are rubber balls filled with shot and calculated to last many years, while they can readily and cheaply be replaced at any time. The fresh water reservoir is easily filled from time to time by simply pulling it forward, as a drawer, and replenishing from an ordinary nozzle spouted bucket. It can also be taken out entirely at any time to clean and air. The waste receptacle is an ordinary pail which sets up around and slightly above the lower portion of the bowl. Thus when full, or nearly full, it backs water up into the bowl and notifies the user. All danger of overflow, to which other such hidden sub-receptacles are incident, is thus avoided. The waste receptacle is securely held in place when in use, and is easily removed for emptying and cleansing by swinging open the little gate on which it rests in front and drawing it down and out. Every part of the stand is readily accessible and removable. The whole forms an extremely simple and economical arrangement, occupying but little space. The labor and breakage involved in lifting pitchers and bowls and spilling or splashing water into an exposed slop jar is avoided, and all the convenience and appearance of a stationary bowl is secured without the expense and the danger incident to the use of water and sewer pipe connections. This stand may be finished in any style and is susceptible of varied construction. For further information in regard thereto address Mr. H. C. Lowrie, Denver, Col.



A TOILET STAND FITTED WITH STATIONARY BOWL.

SPONTANEOUS MOTIONS OF BODIES ON THE SURFACE OF LIQUIDS.

Camphor, various odorous solids, and porous bodies saturated with volatile liquids, exhibit on the surface of water singular rotary and backward and forward motions, that attracted much attention from scientists during the first half of the present century. They have been attributed now to electricity, and now to simple mechanical phenomena of recoil, produced by the disengagement of vapors or fluid parts emanating from the substance and striking the air or water, but no definite solution, no clear and satisfactory explanation, of the phenomena has been given.

Dutrochet, the illustrious discoverer of endosmosis, after studies that were unfortunately vitiated by grave errors in the beginning (1841), but which were finally (1843) supported by experiments of a high value, found nothing to explain the movements under consideration but the hypothetical existence of an unknown force appearing at the surface of separation of any two liquids, and that he named epipolic force (from 'επιπολῆ, a surface). This notion of a new force introduced into science was not accepted, yet, on the other hand, nothing was proposed as a substitute. To account for the movements of camphor, an effect of recoil, analogous to that of a sky-rocket, was supposed, and yet this would not answer, for any one can see a very great disproportion between such cause of the motion and the motion itself.

Dutrochet guessed correctly when he conjectured that a special force must reside on the surface of liquids. To-day, in fact, it is everywhere recognized that such surface is the seat of a force which has been named superficial tension. As we shall need to know what this is, in order to understand what is to follow, we shall try to give a clear and simple idea of it.

Let us consider a soap bubble left to itself at the end of the tube that has served to inflate it. We see its volume rapidly diminish until it wholly disappears. At the opening, the air is expelled as if by an internal pressure, and produces an appreciable breath of wind. It is demonstrated in physics that the force that produces this pressure upon the air resides solely upon the free surfaces of the bubble, whether they be external or internal. These surfaces each act like a taut elastic membrane maintaining air under pressure. But it is not necessary to have a thin sheet of liquid with two free surfaces; a drop of water is, in fact, very much like a soap bubble, except that there is but one free surface, corresponding to the external surface of the bubble.

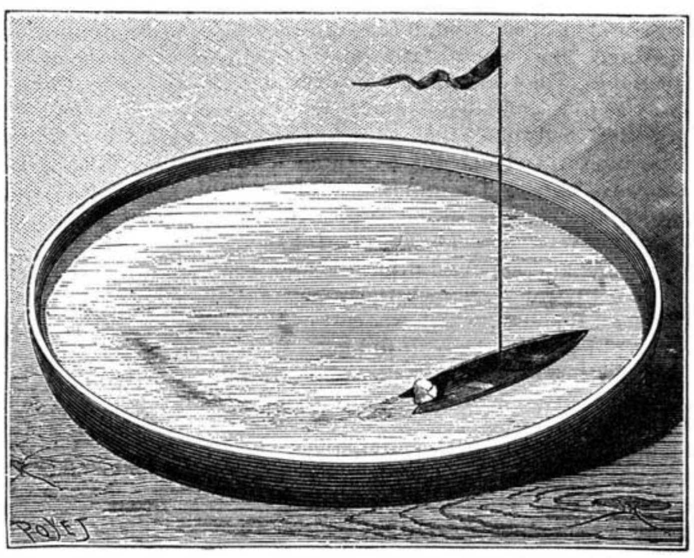


Fig. 1.—BOAT MOVED BY A FRAGMENT OF CAMPHOR.

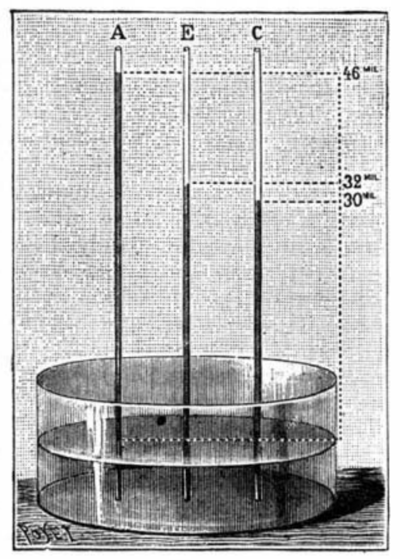


Fig. 2.
Levels to which water rises in a tube filled with air, A, vapors of ether, E, or vapors of camphor, C.

Finally, we might demonstrate that the free and plane surface of any liquid whatever is also the seat of a force that acts exactly as if the mass of liquid terminated in a very thin elastic and taut membrane. It has been found that it is to this force that are due the phenomena of capillarity, and perhaps many other less known ones. Let us say, even, to terminate these succinct notions, that this superficial tension of liquids is very probably only a peculiar case of attraction which is exerted between all bodies.

We know, then, that there constantly exists, at the surface of all liquids, a force that is at times powerful in its effects. But it is very remarkable that the intensity of this force changes with the nature of the liquid considered. We ascertain this by immersing the same capillary tube in various liquids, and observing the latter rise to different levels. It suffices, even, to pour a small quantity of any liquid upon water, to change the latter's superficial tension. This change is nearly always a diminution, on account of the very great tension of water at its surface, and which is greater than that of most liquids.

It was guided by these theoretical ideas that we were tempted to construct the little scientific toy shown in Fig. 1. It is a boat cut with scissors out of a thin sheet of tin, and hollowed out behind. When placed upon water, it readily floats. With a pipette, we place a drop of alcohol at the stern so as to touch the water, and we at once see the boat suddenly start off. At first sight, it really seems that a sudden and powerful repulsion occurs at the moment that the alcohol comes into contact with the water. But let us consider the facts from the standpoint of the tensions and tractions that the boat undergoes, when surrounded on every side by a liquid surface. In front, and at the sides, this surface is one of pure water, and, consequently, the seat of a strong tension. Behind, it is covered with alcohol, and this stratum, as thin as it is, renders the tension here notably less. Therefore, influenced by two contrary and unequal effects, the boat cedes to the more powerful, and is continuously carried along toward the free surface of the water.

There is, therefore, no need of invoking the existence of a repulsive force of unknown nature, for we know that there is an attractive force whose existence is certain, and which cannot remain without effect: the difference between a strong attraction, that of water, and a feeble one, that of alcohol. This fact is absolutely general. In fact, ether, chloroform, and oils produce a more or less rapid motion of the boat. Theoretically, most liquids might serve, on account of the strong tension residing on the surface of the water.

It might, doubtless, be thought that these effects occur only with quite a thick stratum of liquid on the water; but it is easy to demonstrate the contrary. An extremely tenuous stratum suffices to produce marked effects. Even vapors show these, and it is only necessary to suck air charged with them from bottles by means of a capillary tube and then insert the tube in water to see the level of the latter therein completely changed—lowered to a considerable degree (Fig. 2). Let us note

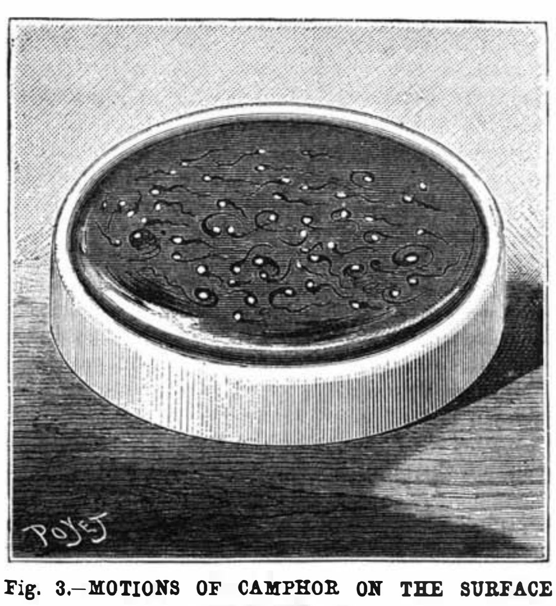


Fig. 3.—MOTIONS OF CAMPHOR ON THE SURFACE OF MERCURY.

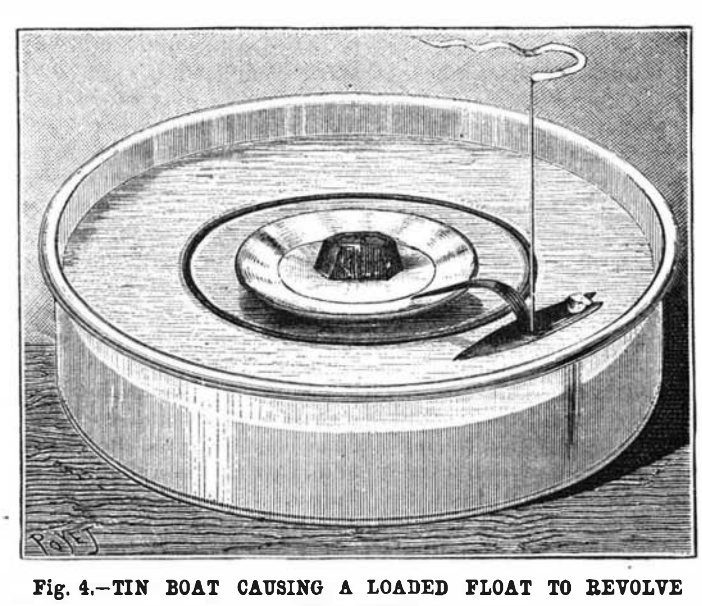


Fig. 4.—TIN BOAT CAUSING A LOADED FLOAT TO REVOLVE ON WATER.

here that the effect is produced perfectly with the vapors of camphor, so that we should suppose that this body ought to set the boat in motion just as the preceding liquids did. This, at least, is what *we* thought, and the experiment really exceeded our anticipations, for the boat was not only set in motion, but kept up a regular and rapid movement for a long time—for entire hours. We recommend it to experimenters. It is very easily tried. It is rendered very visible to spectators by fixing a mast (glass or straw) to the center of the boat by means of sealing wax and fastening a flag to the summit.

By these experiments the cause of the motion of camphor and other bodies on the surface of water is explained without difficulty. It is always a difference of unequal superficial tensions that produces the motions. The thing is equally true with mercury, upon which, as we know, camphor moves as it does upon water. *Apropos* of this subject of experiment, we think we ought to say here that it is not necessary, as recommended by Messrs. Joly and Boisgiraud, to redistill and purify the mercury that is to be used. We have had constant success with the experiment by simply sucking up the mercury in a pipette (so as to avoid the impurities of the surface), and dropping it into a cup placed upon a plate. If need be, we pass a very clean strip of glass over the edge of the cup, so as to scrape off the surface of the metal. Upon afterward sprinkling a few granules of camphor over the mercury and forming a mist with the breath, we observe a multitude of what look like long-tailed tadpoles of extreme agility moving over the surface. This experiment is most curious, and very easy to perform (Fig. 3).

For mercury, as for water, it might be demonstrated that the motion is indeed due to a difference of superficial tensions. We have, moreover, a demonstrative experiment to this effect. It suffices to blow gently and continuously, from the side, over the surface of the mercury, to see the "tadpoles" move in a crowd against the wind and assemble on the convex edge of the metal nearest the observer. These motions are at the same time more lively, especially when the precaution is taken to heat the mercury slightly. The same thing is observed with naphthaline.

We have succeeded with the same experiment on water, although success is not so certain, on account of secondary influences that we cannot detail. This time it is by means of burning flowers of sulphur floating upon the liquid. The motions are capricious and analogous to those of camphor. When we blow in a contrary direction the flame is urged, and we have often seen a fragment move against a strong current of air and apply itself to the edge of the plate. The observation is here particularly startling, for the wind produced carries along swiftly all the other floating particles.

In these two experiments it is scarcely possible to invoke a reaction produced upon the air, unless we gratuitously assimilate each fragment to one of those flying skyrockets that always rise against the wind. On the contrary, with the idea of superficial tensions, we see that the breath has exactly the effect of directing the emitted vapors in such a way as to force the fragment to move against the current of air. It renders the surface in front free, and encumbers it in the rear.

We now know the cause of the motions of the camphor, but we as yet know nothing as to the mechanism of their stoppage. It results, however, from Messrs. Joly and Boisgiraud's experiments, that this occurs every time that a greasy pellicle, even a very thin one, exists upon the surface of the water. It seems very natural, then, to attribute the stoppage to a diminution of the superficial tension. An experiment analogous to another already made with a thin soapy film is demonstrative as regards this. Lay a ring formed of flexible waxed wire upon the surface of very pure water. It is irregular in its contour, but it is only necessary to place a drop of oil within it to see it immediately bend into a nearly perfect circle that confines the oil within its circumference. When placed outside, the oil produces the opposite effect, contracting the ring into folds as close as the flexibility of the wire permits. These effects are explainable on the assumption that the wire is in both cases attracted toward the surface which is free and which has retained all its force. This consequently demonstrates to us that the oil lowers the tension at the surface of the water. But there is another factor to be considered, and that is viscosity. This is so great here that we see the oily stratum move in a body along with the ring. In order to separate the viscosity and the diminution of superficial tension, it occurred to us to connect two boats, one of them placed upon an oily surface and the other upon a pure one, by means of a rigid bridge. A floating ring of waxed brass wire is first laid upon the pure water and the bridge is placed astride it. A fragment of camphor, being placed behind the external boat, puts the whole in motion. We then put a drop of oil within the inner circle, and observe that the continuous motion scarcely slackens. Yet we observe that, starting from this moment, the ring is manifestly carried along. So the viscosity of the oil does not suffice to explain the stoppage of the camphor's motion. It is, therefore, the change of superficial tension that is the sole important factor. We already see that the theory of a reaction (produced this time upon the liquid or the air) is very poor in argument; but that is not all. We place upon the water, be it oiled or not, a large float in the form of a watch crystal, and put the neighboring boat at the side of it, and the motion continues, although it necessarily slackens. Upon the float, we place a bottle or any object whatever weighing anywhere from two ounces to two pounds, and the motion ever continues. It is in vain to arrest it; it quickly begins again (Fig. 4).

When we reflect upon the friction overcome and the mass carried along, we have to recognize the fact that the current produced by the emission of less than twelve one-hundred-thousandths of a cubic inch of air in one minute is incapable of such effects, for it would be necessary to attribute to these particles a sudden velocity of about forty miles per second.

From these experiments, as a whole, and from several others that we have had to pass over in silence, for want of space, we think that we can assert that the cause of the mysterious motions of camphor upon water and mercury is definitely ascertained, and is due to the effects of a known and measurable force.

In a communication which produced a profound sensation last year at the Academy of Sciences and in the scientific and commercial world, Admiral Cloue raised a question very similar to the one under consideration—that of the action of oil upon the waves of the ocean. The study that we have just made will perhaps allow us to approach one side of the problem that has hitherto been neglected. And certainly we believe that if a few laboratory experiments could throw light upon the solution of a question upon which depends so many human lives, those who are continuously asking science for practical applications would have reason to declare themselves satisfied.—*H. Devaux, in La Nature.*

New Guns for the U. S. Navy.

The new 53 ton gun which has recently been completed at the South Boston Iron Works has been loaded on the deck of a schooner, and is to be transported directly to Sandy Hook, where it is to be tested under government supervision. This gun is of the French type, and is a 12 inch breech-loading cast iron rifle, hooped and tubed with steel. The casting, when taken out of the pit, weighed 90 tons, which has been reduced to its present gross weight of 53 through the shrinkage in turning and boring. The outside of the gun is made of 27 wrought steel rings, which are shrunk on, overlapping in such a way as to re-enforce one another. The bore is provided with a steel tube 5 inches thick, which is inserted at the breech and extends as far as the trunnions, a distance of 14 feet. The gun is 30 feet long. The trial to which the gun is to be subjected at Sandy Hook is a very severe one. The standard of the trial is 500 rounds, using an 800 pound projectile and a charge of 265 pounds of powder. This is the same test to which the American Rodman, which was cast at the same foundry, was subjected, and which did not come up to the standard, as the erosion became so great that further testing was discontinued after the 137th round. It is hoped that the steel tube in the bore of the new gun will enable it to resist the wear, and that it may be able to stand the severe requirements of the Ordnance Bureau.

The Rodman gun is being held at Sandy Hook awaiting the result of the experiment of the new gun, and in case the trial is satisfactory it may be possible, with the knowledge now to be had concerning the practicability of inserting a steel tube in a cast iron gun, that the Rodman gun may be rebored and provided with a steel core, as in the case of the French gun.

The South Boston Iron Works have also in course of completion a new gun of the Italian type, which is to be subjected to the same government test. This is the gun which met with an accident while being cast in 1884. While the metal was being run into the mould the flask broke and the liquid metal vomited out through the top of the mould, causing considerable loss and delay. This event was commented upon and illustrated in the SCIENTIFIC AMERICAN of July 26, 1884. When completed, the gun will weigh 54 tons.

The last casting, which has been most satisfactory, has been successfully bored, and is now ready to receive the steel tube which is to be inserted at its breech. This tube is 14 ft. long and 5 in. thick. The gun has not yet been rifled.

Perhaps the most important ordnance work, however, that is being conducted is the construction of two "built-up" steel rifles. These are all steel and have an eight inch bore. These guns are of a different type from any that have been constructed here, and their success or failure will have much to do in determining the future of gun making in this country. Two eight inch pneumatic gun carriages for naval use are also being constructed at these extensive works, as also four 10 in. carriages of a similar type for use on the monitor Terror.

One of the new ten-inch steel breech-loading rifles has recently been tested at Annapolis. This gun was designed for the ironclad Miantonomoh, and was tested after being mounted on its hydraulic turret carriage. The gun was handled with great apparent ease and performed quite as good service after as before the trial.

This gun is the first of the ten-inch rifles for the ironclad monitors. It is 27 ft. 6 in. long and weighs 58,000 pounds, exclusive of its carriage. It fires a charge of 250 pounds of cocoa powder and a steel armor-piercing shell weighing 500 pounds. It gives a muzzle energy of from twenty-four to twenty-five thousand government tons.

Opium Cultivation in Persia.

Opium occupies the first place in the foreign trade of Persia. It insures the largest and most direct cash return to the producer, and, as a natural consequence, the area under cultivation is increasing greatly. The two principal markets are Hong Kong and London. In 1886, 4,993 chests, worth 374,475*l.*, were exported from the ports in the Persian Gulf, exclusive of what was sent away by land routes or was consumed in the country itself. The quantity of morphia contained in Persian opium is 11½ to 12 per cent, while in other opium producing countries it rarely exceeds 9½ per cent. *Papaver somniferum*, or white poppy, of which opium is the inspissated juice, is grown principally in and about Ispahan, Yezd, and Shiraz, that of Ispahan being superior both in quality and quantity. The preparation of the land begins about September 5, and consists in plowing, harrowing, fertilizing abundantly with ashes and detritus, and laying off into squares to facilitate irrigation. After sowing, the fields are irrigated three times, at intervals of fifteen days. After that there is only one more irrigation—about the middle of the winter. In the spring, irrigation takes place on March 20, after which the land is repeatedly harrowed and hoed in order to extirpate all parasitic weeds. The plants are thinned, and then watered every ten days until flowering begins, when all work must cease. When the heads have formed and have fully ripened, a last flooding is given. Then six slight incisions are made at about the junction of the stem with the head. This should be done at noon. The juice that exudes is collected the next morning and the morning following at daybreak. When these first incisions have ceased discharging, others are made lower down, and the operation may be thus thrice repeated, the opium obtained after each successive incision being proportionately inferior quality. Next, the plants themselves are cut down and the heads sold, the natives using the seed on bread as a substitute for butter. The end of May is the season for harvesting. —*Chemist and Druggist.*

Electricity in Place of Horses.

The Fourth Avenue street railway cars are soon to be propelled by electric motors propelled by storage batteries carried on the cars. About one-fourth of the building of the 85th Street stables has been appropriated to the operations of the Julien company, and there are masons and machinists at work on the ground floor putting up steam boilers and machinery. There are also draughtsmen and designers in the second story, all earnestly engaged upon the plans that are intended soon to banish horses and confine steam to the work of turning a dynamo. The dynamo itself is already at work, and two long tables on the ground floor are covered with accumulators undergoing the charging process. The exhibition car which has been seen upon the road during many months past has been taking a rest recently while workmen were engaged in making alterations to lighten it and improve its running qualities. It has been much improved. The first ten cars have been ordered and are expected to be ready soon. The capacity of the charging room, now in preparation at 84th Street, will be equal to the supply of accumulators for twenty cars. If the performance of this number of cars is found satisfactory after they have been equipped, the main stables on Fourth Avenue will be taken for the location of the dynamos as the more central and convenient point.—*New York Sun.*

Curious Case of Deafness.

Some time ago, says the Columbus *Journal*, an engine driver on the Little Miami Railroad was suspended because, after having been examined by Dr. Clark, he was found to be quite deaf. The engineer claimed at the time that he could hear everything while running his engine; but the doctor found that in a still room he could not hear ordinary conversation a foot away. The engineer lives at Cincinnati, and received treatment in that city for his disease, but without any special benefit. After being suspended eight months the engineer again came to Dr. Clark and insisted that he could hear perfectly while on a moving engine. The doctor thought he would test the case, and, accompanying the man to Cincinnati, made a number of experiments with him on engines. The result was that the doctor found the engineer was not only telling the truth in regard to the matter, but also that the deaf man could hear low remarks and whispers on a moving engine that even Dr. Clark's keen ear failed to catch. The engineer was reinstated in his former place.