Correspondence.

Liming Wood to Prevent Fire from Steam Pipes.

To the Editor of the Scientific American:

I have read much in your valuable paper about "Fires from Steam Pipes." We have many steam pipes in contact with wood, and have tried the use of lime on the wood coming in contact with the pipes. I coated the pipes where they touched any wood, and found that several coats of lime or whitewash was a good preventive against charring of the wood.

LOUIS J. SEHRING.

Joliet, Ill., Feb. 23, 1886.

Fire from Steam Pipes.

To the Editor of the Scientific American:

I am surprised to read a letter on the subject of fires caused by steam pipes, in the SCIENTIFIC AMERICAN, dated Jan. 30, 1886, signed by E. P. Clark, stating that it is impossible to set wood on fire with steam pipes working at any reasonable pressure.

A few years ago I was in the city of Toronto, and as business took me to one of the largest distilleries in that city, I happened to notice several men opening what appeared to be a covered drain. On looking into it, I saw a steam pipe about two and a half inches running through it from the boiler room to the cattle sheds, several hundred yards away. The steam pipe, when it was put there, was covered with wood, or I should say that the iron pipe was laid through a large wooden one several inches in thickness, for protection. When the earth and the covering were taken off the trench, all that remained of the wooden pipe that surrounded the iron one was a pile of charcoal, and as good a sample of charcoal as I ever saw; the wood was all gone. Some places the charcoal lay on the pipe as well as underneath it. The trench being covered with earth made it air tight; that I expect accounts for the wood burning to charcoal by the hot steam pipe. I hope this will satisfy persons interested in the matter that hot steam pipes will set wood on fire, especially when they are closely covered.

JOSEPH DIX, JR., *Master Mariner.*

Kingston, Canada, March 20, 1886.

Restoration of Magnetism by Heat.

To the Editor of the Scientific American:

To heat a magnet to a red heat has long been known to destroy its magnetism; but from a recent experiment of mine with two sound magnets that have from want of care lost nearly all their magnetism, I fully restored them by rubbing a red hot iron, ¼ inch, over them until it had become quite cool. The magnets are better now than when new. This experiment was prompted in my desire to prove magnetism bears to heat as close a relation as electricity. Thus we hope soon to be able to make a clearer demonstration.

CHAS. H. ROBERTS.

Troy, N. Y., March 30, 1886.

Dilatancy.

To Professor Osborne Reynolds is due the credit of making a discovery which promises to be of some importance. The discovery appears to have resulted from experiment, guided as much by inductive reasoning as pure curiosity. It is, says the *Engineer*, a remarkable discovery, in that it was quite unanticipated, and is, indeed, apparently opposed to past experience. Of course, it is not really opposed, for nature does not contradict herself; but the precise conditions necessary have never before been secured properly by a philosopher, though no doubt they have been present scores of times when the philosopher was absent. The discovery, referred to at the last meeting of the British Association, was more fully described at the weekly evening meeting of the Royal Institution on the 12th of February. A special word has had to be coined for dealing with the discovery, which word we have used at the head of this article. The title of Professor Reynolds' paper given at length is "Experiments showing Dilatancy, a Property of Granular Material, possibly connected with Gravitation."

If we ask any of our readers what will occur if an India rubber bag containing sand and water, and communicating with a bucket of water by means of a tube, be pressed between two flat boards, the answer will be that the water in the bag will be squeezed out into the bucket. Broadly stated, Professor Reynolds' discovery is that this is not what will happen, but that, on the contrary, water will at once rise up the pipe from the bucket, and enter the bag. Paradoxical as it may seem, the bag becomes larger, up to a certain limit, the more it is squeezed. Professor Reynolds began his discourse by telling his hearers something about the mysterious ether by which light is transmitted to us from the sun; by shearing which in two, according to Dr. Lodge, we get electricity; the possible cause of cohesion and gravitation; an elastic, homogeneous jelly pervading all space, more rigid, in one sense, a million times, than cast steel, and yet so tenuous that it does not sensibly retard the motion of planets moving through it. Whenever a phenomenon presents itself which cannot be otherwise explained, it is referred to the ether, and there are nearly as many ethers as there are philosophers. It has been said, indeed, that no less than six different ethers are needed to satisfy the predicates of the vibratory theory of light. Maxwell found no comfort in the ethers; on the contrary, he maintained that they were like the glasses of the dram drinker—one always led to another, necessary to explain the existence of the first. "As the result," says Professor Reynolds, "of a long-continued effort to conceive a mechanical system possessing the properties assigned by Maxwell, and, further, which would account for the cohesion of the molecules of matter, it became apparent that the simplest conceivable medium—a mass of rigid granules in contact with each other—would answer, not one, but all the known requirements, provided the shape and mutual fit of the grains were such that, while the grains rigidly preserved their shape, the medium should possess the apparently paradoxical or anti-sponge property of swelling in bulk as its shape was altered."

No one ever dreamed that the cubic content of sand in a sack was affected by the shape given to the sack. Yet, now that we are told all about it, we wonder that we did not see the truth before. If the grains interlock, their alteration of form must, under given conditions, augment the space occupied. For example, if we shake or disturb a brick wall, it is evident that we increase its dimensions, because the bricks are no longer so close to each other as they were. In an ordinary mass of brickwork or masonry well bonded without mortar, the blocks fit so as to have no interstices; but if the pile be in any way distorted, interstices appear, which shows that the space occupied by the entire mass has increased, as was shown by a model. At first it appeared that there must be something special and systematic, as in the brick wall, in the fit of the grains together, but subsequent consideration revealed the striking fact that "a medium composed of grains of any possible shape possessed this property of dilatancy so long as either of two important conditions was satisfied." The conditions are that the medium should be continuous, infinite in extent, or that the grains at the boundary should be so held as to prevent a rearrangement commencing. All that is wanted is a mass of hard, smooth grains, each grain being held by the adjacent grains, and the grains in the outside prevented from rearrangement.

Professor Reynolds obtained the necessary conditions by using a thin India rubber bag holding six pints. This bag being filled with clean dry sand, such as is used for hour glasses, served for many experiments. The bag was coupled to one leg of a mercury pressure gauge, and it was only necessary to flatten the bag to make the mercury rise 7 inches in the leg next the bag; in other words, a partial vacuum was established by squeezing the bag. The reader will naturally ask what would take place if no air found its way into the bag by the way of the mercury. In that case, the resistance to squeezing would be much increased, and when water is used, which is non-elastic, the shape of the bag cannot be altered at all.

"Taking," says Professor Reynolds, "the same bag, the sand being at its closest order, closing the neck so that it cannot draw more water, a severe pinch is put on the bag, but it does not change its shape at all; the shape cannot alter without enlarging the interstices, these cannot enlarge without drawing more water, and this is prevented. To show that there is an effort to enlarge going on, it is only necessary to open a communication with a pressure gauge, as in the experiment with air. The mercury rises on the side of the bag, showing when the pinch is hardest—about 200 pounds on the planes—that the pressure in the bag is less by 27 inches of mercury than the pressure of the atmosphere; a little more squeezing, and there is a vacuum in the bag. Without a knowledge of the property of dilatancy, such a method of producing a vacuum would sound somewhat paradoxical. Opening the neck to allow the entrance of water, the bag at once yields to a slight pressure, changing shape, but this change at once stops when the supply is cut off, preventing further dilation."

Professor Reynolds has as yet drawn few deductions. He prefers to continue his experimental researches, and some of the results are very curious. "Putting a bag filled with sand and water between two vertical plates, and slightly shaking while squeezing, so as to keep the sand at its densest, while it still has a free surface, it can be pressed out until it is a broad, flat plate. It is still soft as long as it is squeezed, but the moment the pressure is removed, the elasticity of the bag tends to draw it back to its rounded form, changing its shape, enlarging the interstices, and absorbing the excess of water; this is soon gone, and the bag remains a flat cake, with peculiar properties. To pressures on its sides it at once yields, such pressures having nothing to overcome but the elasticity of the bag, for change of shape in that direction causes the sand to contract. To radial pressures on its rim, however, it is perfectly rigid, as such pressures tend further to dilate the sand; when placed on its edge, it bears 1 cwt. without flinching. If, however, while supporting the weight it is pressed sufficiently on the sides, all strength vanishes, and it is again a rounded bag of loose sand and water." By shaking the bag into a mould, it can be made to take any shape; then, by drawing off the excess of water and closing the bag, the sand becomes perfectly rigid, and will not change its shape unless the envelope be torn; no amount of shaking will effect a change. In this way bricks can be made of sand or fine shot full of water, and the thinnest India rubber envelope, which will stand as much pressure as ordinary bricks without change of shape; also permanent casts of figures may be taken. When we walk along a wet beach, around each footprint the sand is seen to change color for some distance. This is because the pressure of the foot has changed the shape of the mass under it, and the water is sucked in, drying the sand all around. It seems a paradox that instead of squeezing the water *out* of that portion of beach rigid under foot, it is sucked in.

Although Professor Reynolds has not drawn deductions, we cannot resist calling attention to one or two which suggest themselves. May we not find here the cause of rigidity? The bag of sand is stable, because to change its form would augment its bulk. May not a bar of steel be stable for the same reason? Our readers will not be slow, we think, to see that Professor Reynolds has left a good deal to be explained. For example, to state that a cake of sand and water is stable because a change of form would augment its dimensions, is only to reason in a circle. We naturally ask, Well, why should it not increase its dimensions? and to this Professor Reynolds supplies no answer. It is true that an increase in volume would lead to the production of a partial vacuum inside, and that in so far the pressure of the air outside would tend to promote stability; but this stability ought to be elastic or dynamic stability, not static. Concerning this, no doubt Professor Reynolds will have more to say. The apparatus required is extremely inexpensive, and there is no reason why a whole army of workers should not attack this subject with excellent results. Meanwhile, we may say that it has long been known to engineers that sand, unlike water, exerts under suitable conditions no lateral pressure. For example, bags of dry sand have been employed instead of wedges to carry the centering of bridges. The loads may be very heavy, yet these canvas bags will not burst. If the sand behaved like a liquid, they would be rent in a moment by a hundredth part of the load. To strike the centers, it is only necessary to open a small hole in a bag, and let as much or as little sand run out as may be needed. A paper plug will suffice to stop the flow.

Germanium, a New Metal.

In the *Berichte der Deutschen Chemischen Gesellschaft* there is an account of a new metallic element discovered by Clemens Winkler. It occurs in argyrodite, a silver ore from the Himmelsfurst mine, near Freyberg. Germanium, symbol Ge, has a great resemblance to antimony, though it is distinguished by certain well-marked reactions. If the sulphide is heated in the absence of air, *e. g.*, in a current of hydrogen, it forms a blackish crystalline sublimate, which at a higher temperature melts to brownish red drops. This sulphide dissolves in ammonium hydrosulphide, and is reprecipitated with a white color by hydrochloric acid, and is again redissolved by ammonia. If arsenic or antimony is present, the color is yellow. If heated in air, or treated with hot nitric acid, the white germanium oxide is formed, which is not volatile at a red heat. The oxide dissolves in potassium hydroxide. If this solution is slightly acidified, it gives a white precipitate on treatment with hydrogen sulphide. The oxide is easily reduced by hydrogen; the sulphide less easily. The metal is gray, volatile at a full red heat, though less readily than antimony. The vapor deposits small crystals resembling those of iodine, which do not melt. In a current of chlorine the metal yields a white chloride, which is more volatile than antimony chloride. The acid solution gives a white precipitate with hydrogen sulphide. Herr Winkler is determining its atomic weight, with a view to determine its place in the periodic arrangement.

THE telephone is hardly a safe medium by which to convey news items to the printer. A Western newspaper related the incident of one of its townspeople—giving her name—having eloped with an eighteen year old man. In the next issue of his paper the editor apologized for his blunder by stating that the item was received by telephone, and should have stated that the woman was thrown from an eight year old mare.

A New Traveling Torpedo.

The details of moving torpedoes, as regards their steering power, propulsion, and explosive charge, have for some time past formed a special study with Mr. R. Paulson, who has effected what would appear to be some important improvements in these respects. Electro magnets are the chief agents used in the steering arrangements, although their exact construction and arrangement are points upon which the inventor prefers to preserve silence at present. So with regard to his improved means of propulsion and the explosive charge; the most that he is just now prepared to state publicly respecting these is that propulsion is effected by a system differing *in toto* from any of those at present employed.

Broadly stated, it consists in the use of chemically generated gas, which is utilized either for forcing a column of water direct astern or for causing it to actuate machinery for driving a propeller. The explosive charge consists of a species of gun-cotton possessing 50 per cent more power than ordinary gun-cotton, but having an equal degree of safety. The steering device is that upon which Mr. Paulson is most communicative, and this is stated to consist of two batteries, one pole of each of which is placed in connection with the coils of two sets of electro magnets, from which leads are conducted to two metal pins fixed on a disk of insulating material. Both the other poles of the batteries are placed in communication with a balanced magnetic needle of special construction. The metal pins are placed one on either side of the needle, and the course of the torpedo having been set, it is started. Any deviation of the torpedo from its assigned course causes a relative movement of the needle, which touches one or other of the pins, thus establishing the circuit through the coils of one or other of the two magnets. An armature connected with the rudder is attracted, and by this means the torpedo is again placed on its right course. The depth of immersion of the weapon is also regulated and maintained in a similar manner by a vertically balanced needle. Another feature is that the torpedo can be directed toward iron ships, irrespective of the predetermined course, by means of another balanced needle.

A demonstration of the steering powers of the apparatus was recently given by the inventor at 15 Cockspur Street, Charing Cross, a model torpedo, about 2 feet 6 inches long and 7 inches in diameter, being used. The model was not placed in water, but was swiveled on a stand, and it was clearly shown that when it deviated from the course upon which it had been laid, the electro magnetic arrangement—which was, of course, concealed within the torpedo—came into operation and restored it to its normal course. More could not be shown, but it was stated that a full sized torpedo, 16 feet in length and 14 inches in diameter, had been made and successfully tried on the coast in England. On the last occasion, however, the torpedo had managed to get away from its inventor, and had been no more seen. The material of which Mr. Paulson proposes to construct the shell of his torpedo differs from that hitherto used in that it is a species of papier mache, of a tough and fibrous nature.

The new weapon is to be discharged from the shore or from any ordinary boat, thus obviating the cost of a special torpedo boat. This feature points it out as valuable for coast and harbor defense, for which purposes it is the opinion of several naval authorities by whom it has been examined that it is especially adapted. In view of its apparent merits, it would appear desirable that the government authorities, who have had the matter under consideration for some little time past, should lose no time in constructing a torpedo of the proper working size and having it practically tested. This course is the less objectionable, seeing that the cost is stated to be only about £150. At any rate, the invention appears to justify prompt and thorough investigation, in order that its practical usefulness or otherwise may be ascertained.—*London Times.*

Freezing and Melting Points of Water.

Although water usually freezes at 32 degrees F., and ice melts when above that point, the result is not uniform in either case. If water, for instance, be kept in a clean, smooth-sided vessel, and perfectly still, it is possible to keep it from freezing until it reaches a temperature of 15 degrees. Under other conditions such a temperature would produce half an inch of ice in a single night, thus clearly indicating the influence of motion on crystallization. If this water at 15 degrees be disturbed in the least degree, the crystals will at once begin to form, and simultaneously therewith the entire mass of water will gradually rise to 32 degrees and freeze solid. In the same way the presence of salt and acid in water retards freezing. Again, it has been ascertained by experiments that if water be boiled in a glass flask, and the neck of the flask be plugged with cotton, the water may be cooled down to 9 degrees F. before it will freeze. With regard to the melting point of ice, the temperature is more uniform, as the solid ice is not subject to the law of motion as water is, but there are ways of precipitating the melting of ice, as has been frequently tested. Thus, for instance, if a block of ice be subjected to a heavy pressure, the melting point can be reduced to 18 degrees F., a point which would produce sharp freezing in a stream or lake, where the ordinary laws of nature were not interfered with.

ASTRONOMICAL PHOTOGRAPHY.

As a few experiments in celestial photography tried last year by means of quite rudimentary instruments gave good results, the Director of the Observatory has been pleased to authorize the construction of a special apparatus, which we illustrate herewith.

This new instrument consists of two juxtaposed telescopes inclosed in an oblong rectangular metallic case, and separated through their entire length by a thin partition. One of the objectives, of 9½ inches aperture and 12¾ feet focal length, is designed for visual observation, and serves as a finder. The other, of 11·4 inches aperture and 11¼ feet focus, is achromatized for chemical rays, and serves for photographing. As the optical axes of these two objectives are parallel, every star kept in the center of the ocular field of the first telescope produces an impression in the center of the sensitized plate of the photographic apparatus.

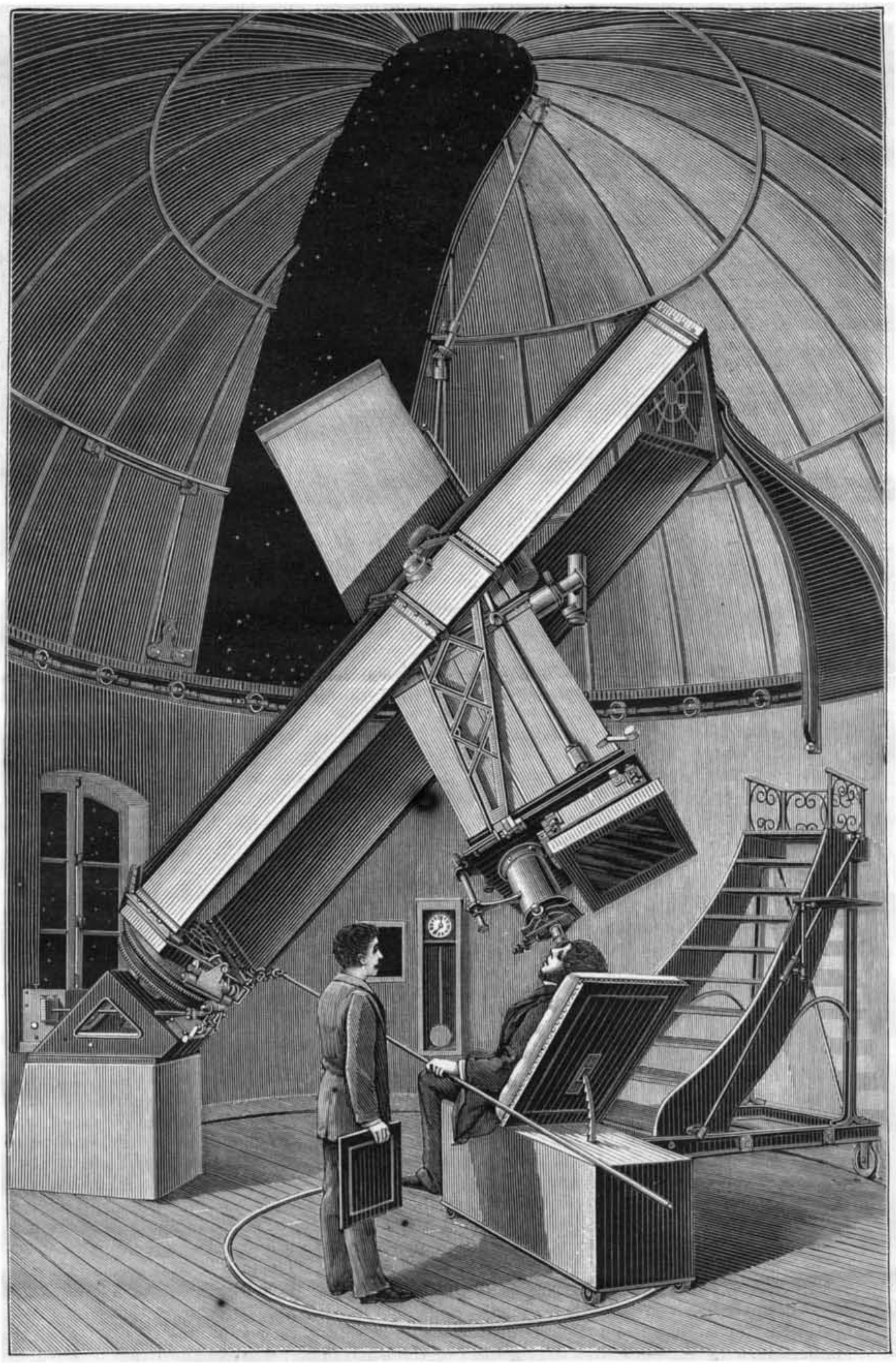

Fig. 3.—PARALLACTIC APPARATUS AT THE PARIS OBSERVATORY.

The equatorial is mounted after the English style, that is to say, the center of the tube always remains in the polar axis of the instrument. This arrangement permits of following up a star from its rising to its setting, without the necessity of turning back the instrument near the meridian, and, moreover, it has the advantage of giving the direct and inverse positions for every region of the heavens, thus allowing of the elimination of certain errors in centering.

Like a horary equatorial, it is provided with horary and declination circles, and a clockwork movement, which carries the apparatus along for three hours without rewinding. In addition, there are very slow, independent, back movements that permit of holding the axis of the telescope upon a given point of the heavens, in spite of any slight irregularity in the clockwork motion and in the setting of the telescope, or of variations in atmospheric refraction. The photographic objective, which is the largest that has hitherto been made, consists of a simple, achromatic system, and, although of extremely short focal proportions, is capable of covering a field three degrees in diameter without the use of a diaphragm.

Although it has been mounted but a short time, this apparatus has already permitted of considerable work being done. The very reduced chart shown in Fig. 2 is a specimen of what it is possible to obtain. In a surface representing an area of about five square degrees of the heavens, we can count more than three thousand stars of between the sixth and fourteenth magnitude, two only of which are visible to the naked eye. We can even distinguish in the negative traces of stars of the fifteenth magnitude, that are too faintly indicated to show up in the positive. Stars of the fourteenth magnitude exhibit themselves under a diameter of 0·00098 of an inch. It will be easily seen that points so small as these might be readily confounded with imperfections in the sensitized film, were not the precaution taken to make many exposures.

In the annexed chart, each star is formed of a group of three points forming an equilateral triangle, each side of which is no longer than 0·0033 of an inch. To the naked eye these three points appear to be confused into a single one; but, if we examine them by means of a strongish lens, the three exposures will become distinct, and it will then be easy to distinguish in the negative everything that does not belong to the heavens, and to eliminate it. By the ordinary processes, it would certainly have required a diligent labor of several months to obtain a chart such as we get here in three hours.

The time of exposure necessary for obtaining an image of the stars is as follows: