PRACTICAL EXPERIMENTS IN MAGNETISM, WITH SPECIAL REFERENCE TO THE DEMAGNETIZATION OF WATCHES.—No. 1.

BY ALFRED M. MAYER.

The extensive uses now made of electro-magnets in telegraphy, in dynamo-electric machines, and in the many practical applications of electro-magnetism, have greatly increased the risks of damage to watches by their magnetization. I have no doubt that in any one of our larger cities there are scores of watches safely packed away in drawers regarded as past recovery from overdoses of magnetism. They are looked upon by their owners as bullion kept in reserve for "a rainy day."

To be aware of the danger is not a sufficient guard against *accidents.* My own experience is a case in point: I had already silenced one watch, saturating it with magnetism by approaching an electro-magnet in my laboratory which had been allowed to remain in action by the person who had that day used it in his experiments. After purchasing another watch, I always took the precaution to place it on my office table before I approached the large electro-magnet of the Stevens Institute of Technology. I always did this, no matter whether the magnet was or was not in action. But one day I was suddenly called out of the room and detained by a visitor for a half hour or more. I took my watch from the table as I passed out of the room. I returned to my laboratory with my mind entirely engrossed with the experiments I had in hand, walked up to the magnet, rearranged the apparatus, and charged the magnet. My watch at the time was not 3 inches from the pole of this huge magnet! I was only aware of my "accident"—call it, if you will, thoughtlessness about the watch or thoughtfulness about the experiments—when that afternoon I leisurely walked to the station to take a train, and was informed that "it had gone over half an hour." My watch had lost half an hour in about three hours! Persons more cautious than I have had the same experience, for it is impossible, without idiocy supervening, to be constantly thinking of a watch. I have also remarked that out of the two or three dozen owners who have had watches apparently ruined by this same large magnet, each one considered "the other feller" a careless and *thoughtless* person until his turn came to do the same thing, when he was in a really *thoughtful* mood—about something, *which was not his watch.*

My last magnetic accident turned my thoughts to ways of taking the magnetism out of watches. I have succeeded perfectly, and the process which I have finally adopted as the best is so simple that any one can practice it, and that, if you wish, without even detaching your watch from its chain.

Though the process is simple, yet, of course a knowledge of the elementary facts and laws of magnetism is required to understand *how* it is done; and I know that every intelligent American mechanic really wishes to understand the reasons for performing the operations that he may be called on in practicing any new process.

To render clear to all the operations used in *demagnetizing* (that is, in taking the magnetism out of) a watch, I will assume that I am addressing those who have little or no practical experience as experimenters in magnetism, and also those who wish to be at the least expense in practicing watch demagnetization. I will, therefore, explain the facts and principles of magnetism on which the operations depend, by describing actual experiments made with apparatus which is so cheap and homely that it can be made by any one with a very little trouble and at a trifling expense.

I will at once proceed to show how to make the simple instruments required in our preliminary experiments and in the demagnetization of a watch.

The Magnet may be made out of a piece of a large rat-tail file. The one I have used is 7 inches long and averages ⅜ of an inch in diameter. There is something either in the quality of the steel or the temper of these files which makes them capable of receiving powerful charges of magnetism. The most powerful magnet I have ever examined is the rat-tail file just spoken of. It lifts several times its own weight. If a large rat-tail file cannot be had, then a piece of Stubs steel, 10 inches long and ½ inch in diameter, must be obtained. This steel rod must be first heated to cherry red, and then lowered gradually, while in an upright position, into a bucket of water. This will render it hard and capable of receiving and retaining a magnetic charge. The file or steel rod is magnetized either by drawing it over the pole of a powerful electro magnet, or by wrapping around it insulated copper wire, and passing through the wire a current of electricity from a galvanic battery.

The Magnetometer.—We call thus the small magnetic needle suspended in a glass shade by a fiber of silk, Fig. 1. It is made thus: Take a No. 4 or 5 needle, and draw it several times, from point to eye, over the N. end of your magnet. This operation will magnetize the needle, and when suspended from its middle, its pointed end will point toward the north. Now, on to a piece of wood, B, which is 3 inches square, glue and screw the slips, A and A, across its grain, so that it cannot warp. Then on its upper side paste a piece of damp white drawing paper. When this has dried it will be tightly stretched on the piece of wood. Draw on the paper a circle slightly larger in diameter than the length of the No. 4 needle. Divide one half of this circle off into 180 parts of one degree each; or, if that be too tedious, divide the semicircumference into ninety equal parts of two degrees each. To suspend the needle, you get a skein of floss silk, such as is used in embroidery. This silk is untwisted, and from it you can readily draw a thread formed of a few fibers, which is very delicate and without the slightest twist or torsion in it. To suspend the needle, stick to its middle a small dot of wax. Then press the end of the silk thread into the wax and work the wax over it with the fingers. The other end of the thread is passed through the eye of a large No. 1 or 2 needle. This needle is then passed through a hole in a piece of cardboard, C, placed on top of the lamp chimney, L. The silk thread must be of such a length that when the needle is pushed downward through the hole in C, the magnetic needle, N, may be brought to rest on the paper covering the block, B. Now, on slightly drawing up the needle, S, the magnetic needle, N, will hang just above the board, B, and will swing round with its pointed, or N., end toward the north of the horizon. After many oscillations the needle will come to rest and will point in a direction which is called the *magnetic meridian.* This direction is different for different places. Here, in New York, it makes an angle of 7° with the true north and south line, and the N. end of the needle points 7° to the west of the true north. This pointing of a suspended needle away from the true N. is called its *magnetic declination,* or magnetic variation. In New York and its vicinity the magnetic declination is 7° west.

Fig. 1.

In addition to the magnet and magnetometer the experimenter will need the following materials:

Three pieces of soft iron. One piece 12 inches long and ⅜ inch in diameter; another piece, 3 inches long and ¼ inch in diameter; a third piece, 1¼ inch long and ⅜ inch in diameter. These pieces of iron should be made very soft by heating them to bright redness and then allowing them slowly to cool in hot ashes.

A piece of steel wire, 6 inches long and $\frac{1}{16}$ inch in diameter.

Iron filings, made from soft iron and passed through a fine sieve.

Pieces of window glass. Two 12 inches by 6, and two pieces 6 inches square.

A small bottle of spirit varnish, such as photographers put over their negatives.

Needles, nails, and tacks of various sizes.

With the above simple and cheap things a great many interesting and beautiful experiments can be made; and we will now show how to obtain from these homely instruments much information that is really sound and useful.

Experiments showing in what a Magnetic Substance differs from a Magnet.—Place the magnetometer on the table and allow the magnetic needle to come to rest. Now take the piece of soft iron 3 inches long and bring it slowly up to the magnetic needle, always keeping the piece of iron pointing toward the point of the needle, as shown in Fig. 2. You will observe that the point of the needle moves toward the iron, turning around its center, C, in the direction shown by the arrow.

Fig. 2.

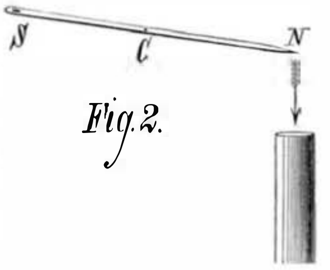
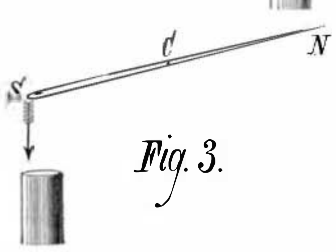


Fig. 3.



Slowly and steadily draw away the piece of iron. As you do so the needle slowly turns on its center, C, and comes again into the magnetic meridian. Now bring the piece of iron up to the eye end of the needle, and you will see that this end turns toward the iron in the same manner as did the point of the needle in the previous experiment. Thus we find that a piece of soft iron attracts either end of the magnetic needle. Each end moves toward the iron. If this be so, it necessarily follows that if you point the piece of iron directly toward the center of the needle and bring it up to the needle in this position, keeping care always to have the length of the piece of iron at right angles to the length of the needle, the needle will not move, but remains steadily pointing in the magnetic meridian. Each end of the needle is equally attracted toward the iron, and as each end tends to turn in the direction shown by the arrows in Fig. 4, it remains at rest under the action of two equal forces tending to rotate the needle in opposite directions.

Now we will make some experiments similar to those just described, but differing in this: we use a magnetized No. 1 sewing needle instead of the piece of soft iron. Take a No. 1 sewing needle and draw it from point to eye over the N. end or pole of your rat-tail file magnet. You will, by this operation, have converted the needle into a magnet, and if you suspend it, as I wish you now to do, like the needle of your magnetometer, you will find that *it points in the magnetic meridian with its point toward the north.* The ends of magnets, or, more accurately speaking, certain points in the center of magnets and *near* their ends, are called *the poles of the magnet.* To distinguish these two poles, they are respectively called north pole or south pole, corresponding to the end of the needle which points toward the north or south geographic pole. The points of our magnetized needles are, therefore, north poles, while their eye ends are south poles.

Fig. 4.

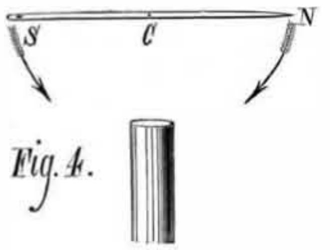
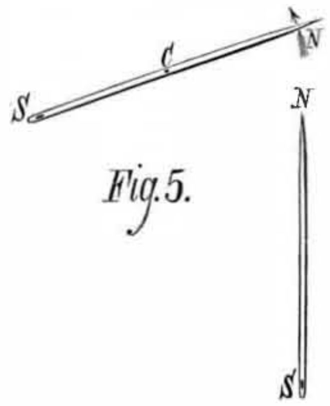


Fig. 5.



Bring the No. 1 needle up to the needle of the magnetometer, with its point toward the point of the magnetometer needle and with its length always at right angles to the magnetic meridian, as shown in Fig. 5. The N. pole of the needle moves away from the north pole of the No. 1 needle, and we here have *repulsion* instead of attraction, as we had when the piece of iron was placed in the same position. Now point the north pole or point of the No. 1 needle toward the eye end, or south pole, of the magnetometer needle, as shown in Fig. 6. In this position of No. 1 needle, the S. pole of the suspended needle moves toward the N. pole of the No. 1 needle. So in this experiment we have attraction of the S. pole toward the N. pole. Thus we have found out that the north poles of magnets repel each other, while the north pole of one magnet attracts the south pole of another magnet. This being the case, it follows that the No. 1 needle, attracting the S. pole of the suspended magnet and repelling its N. pole, must, when pointed at right angles to the suspended needle and directed toward its center, C, cause the suspended needle to rotate, its S. pole moving toward the point of the No. 1 needle, as shown in Fig. 7.

Fig. 6.

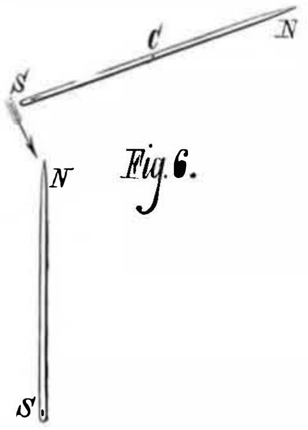
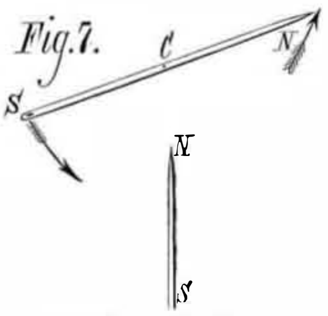


Fig. 7.



The experimenter must now compare this experiment with the similar one with the piece of iron. The iron when pointed toward the center of the magnetic needle did not rotate it, but when the magnetized needle is placed in the same position the suspended needle rotates and its N. pole moves away from the N. pole of the No. 1 needle.

Let us vary these experiments by pointing the eye end, or south pole, of the needle first toward the N. end and then toward the south end of the magnetometer needle, and then toward the center of this needle. Figs. 8, 9, and 10 show the results of these experiments. They differ from those of Figs. 6, 7, and 8 in this: the south pole of the magnetized No. 1 needle acts on the suspended needle in place of the north pole. The results are as follows: The S. pole of the No. 1 needle repels the S. pole of the suspended needle and

Fig. 8.

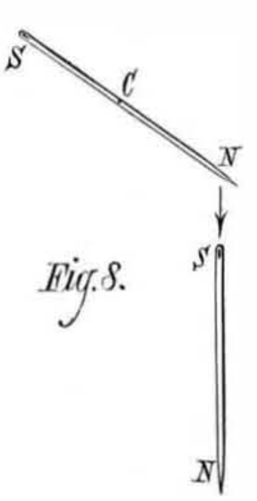
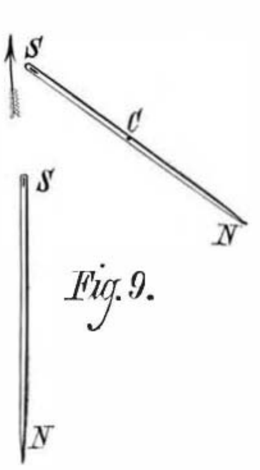


Fig. 9.



© 1879 SCIENTIFIC AMERICAN, INC

attracts its N. pole; and consequently when its eye end is pointed toward the center, C, of the suspended needle the latter has its N. end pulled toward the No. 1 needle and its S. end repelled. It necessarily turns around its center, C., its N. pole moving toward the eye end or S pole of the No. 1 needle.

These are very simple experiments, yet they have already given us the knowledge of an important law, which may be summed up thus:

Like poles repel each other, while unlike poles mutually attract each other.

These experiments also give us a practical and easy method of determining whether a body is merely *a magnetic substance* like our piece of soft iron, or a piece of nickel or cobalt; or is a magnet like our No. 1 magnetized needle.

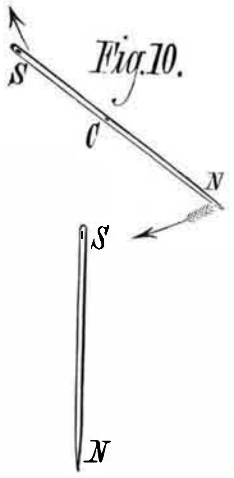


Fig. 10.

Each end of a bar of a magnetic substance attracts either the N. or S. pole of a suspended magnet; but *a magnet has poles*, and one of its ends acts to attract one end of a suspended magnet, while the other end of the magnetic bar will repel the same end of the suspended magnet. Hence to tell whether a certain bar is a magnetic substance or a magnet, we place it with its length at right angles to a suspended magnet and pointing toward its center. If in these circumstances the suspended magnet remains at rest then the bar is formed of a magnetic substance, or one which has no action whatever on a magnet. To determine whether the latter is the nature of the bar, we bring one of its ends near an end of the suspended magnet; if the latter remains at rest, then the bar is formed of a substance which has no sensible magnetic action on the suspended needle. If, however, the suspended magnet turns when the bar is placed at right angles to its length, then the bar is a magnet, and the end of it which is toward the needle is the pole which is of the same name as the pole of the suspended magnet which moves away from the bar.

With the magnetometer we may, therefore, determine the name of the pole of a magnet by the direction in which the magnetometer needle moves, and we can compare its intensity with another magnet by observing the number of degrees of the circle over which the needle rotates.

These experiments on the mutual attractions and repulsions of magnets may be modified in a very pleasing manner by allowing a No. 1 magnetized needle to adhere from the end of a piece of soft iron, and approaching to the free end of the needle first one pole and then the other of the magnet. Figs. 11*a*, 12, 13, and 14 may serve to clearly show the different phases of these experiments without further explanation.

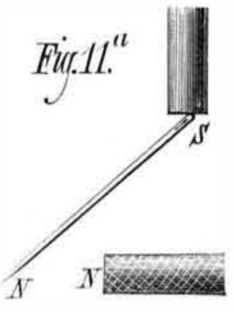


Fig. 11*a*.

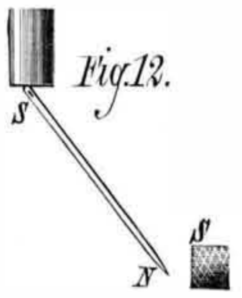


Fig. 12.

Experiments in Magnetic Induction.—Pour some iron filings on a sheet of paper and roll your rat-tail file in them. Lift the magnet from the paper and you will see that the filings stick in the form of bristles or brushes to the two ends, and at some distance from the two ends of the magnet, but to the middle portion of the magnet no filings adhere, as is shown in Fig. 11.

Stick the end of the piece of soft iron in the filings; you will see that they do not adhere. Now stand the piece of iron upright in the filings and bring the rat-tail file down on the upper end of the iron. Lift the magnet, and the iron, you will find, adheres to the magnet; also, you will observe that the iron itself is now magnetic, for the filings adhere to it, as shown in Fig. 15.

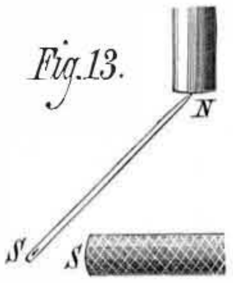


Fig. 13.

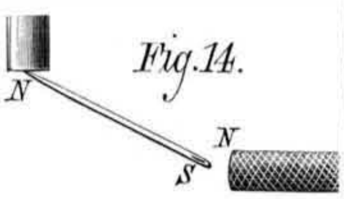


Fig. 14.

If you take hold of the piece of iron with one hand and then detach the magnet, lifting it above the iron, you will see that the iron loses its magnetism, for the filings fall when the magnet is removed to a distance from the iron. Yet it is not necessary that the magnet should actually touch the iron to render it magnetic, for you will find that the iron will attract the filings and cause them to adhere to it even when the magnet is held at a short distance above the end of the iron, as shown in Fig. 16, though the quantity of iron filings which it is capable of holding, and consequently the strength of its magnetism, is less than when the iron adhered directly to the magnet.

The above experiment is modified in an interesting manner by using different sized nails, brads, and tacks in place of the filings.

In this experiment, represented in Fig. 17, the magnet has directly adhering to it a large nail. This nail is thus made a magnet, and it in turn holds up a smaller nail, and this a yet smaller one, which in turn supports a brad, and this brad a smaller one, and to this sticks a tack, and to the tack adheres some iron filings. Each nail in turn acts on the nail or tack which adheres to it, just as the magnet acts on the large nail directly adhering to it.

Thus it is seen that the magnet *induces* the iron to become a magnet like itself when it touches the iron or is held near it; hence this action of a magnet on soft iron is called *induction.*

We will now repeat these experiments in induction, but we will use a piece of steel in place of the soft iron. Select a short thick sewing needle that contains no magnetism. Of this you may be sure if, when the needle is pointed toward the center of the magnetometer needle, and at right angles to its length, it does not cause the latter to rotate. If the needle, when dipped in iron filings, does not cause them to adhere to its ends it will be free enough of magnetism for our experiments.

Having tested the needle and found it free of magnetism, you now hang it to the end of the rat-tail file magnet and bring its free end into the filings. They now adhere to the needle, as shown in Fig. 18.

Hold the needle between the fingers of one hand and remove the magnet to a distance with the other hand. You now see that the needle behaves differently from the piece of soft iron, for when the magnet was removed from the latter the iron filings dropped from its end, but in the case of the needle the filings remain suspended. In other words, the iron is only temporarily magnetized by induction; that is to say, it remains magnetized only while in contact with the magnet. On the other hand, the needle is permanently magnetized by induction; that is, it remains magnetized after the magnet has been removed from it. This difference in the after effects of induction on soft iron and steel is best observed in the following experiment.


Fig. 15.


Fig. 16.

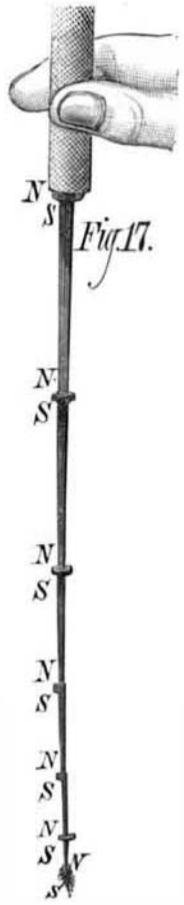


Fig. 17.

Take a piece of the softest iron, and having ascertained that it is entirely free of magnetism, draw it repeatedly over the end of the magnet; if the iron is really soft you will find that even repeated stroking on the magnet cannot give it the power of attracting the filings. However, generally the iron will retain a slight, though often very slight, amount of magnetism, and will cause a few particles of filings to adhere to it. Now perform the same experiment with a large sewing needle, and observe how powerful a magnetic charge has been given to it. When rolled in the filings large tufts adhere to its ends, surprising those who have never seen before how strong a magnet may be thus made of a large sewing needle.

This retention of a magnetic charge by steel enables us to readily fashion magnets of any form and size. If steel or some other easily worked body had not this property we would be obliged to construct our mariner's compass needles out of the hard and brittle calamite or loadstone. Indeed, it would be difficult to select from the whole range of the special properties of matter one more valuable to man, or more necessary to his present high and widely spread civilization, than this one of the capability of steel to receive and retain the properties of the loadstone.

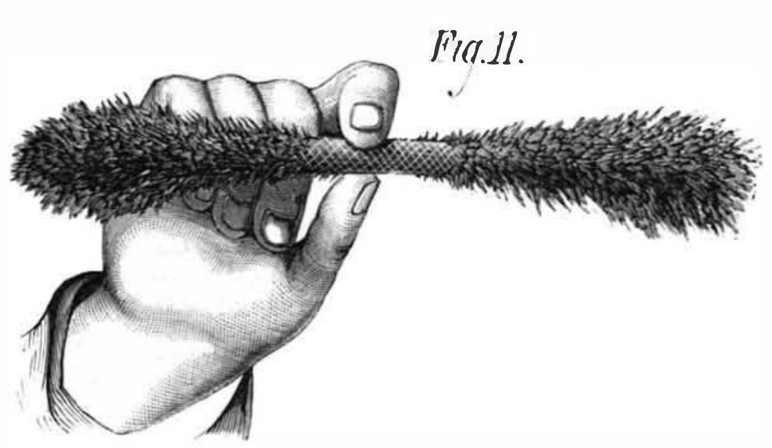


Fig. 11.

Further Experiments in Magnetic Induction.—Let us, by means of other simple experiments, examine more minutely into the nature of this magnetic induction.

Take two pieces of very soft iron wire and suspend them by silk fibers, as shown in Fig. 19. Hold the ends of the fibers separated, between the thumb and forefinger, so that the wires may hang a quarter of an inch or so apart. Now bring them slowly down toward the N. end of the magnet, as shown in Fig. 19. They now no longer hang parallel to each other, but are inclined, the upper ends of the wires repelling each other, so that the two suspending threads are forced outward and no longer hang vertically. This repulsion between the upper ends of the soft iron wires is caused by their having the same magnetic polarity. We have already seen that like poles mutually repel. (See experiments described in Figs. 5 to 14.) If the N. pole of the magnet is pointing upward, as shown in Fig. 19, then the lower ends of the suspended iron wires are of S. polarity and their upper ends are of north polarity.


Fig. 18.

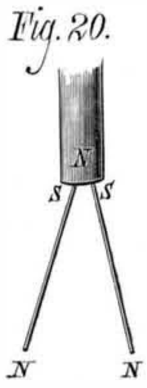


Fig. 20.

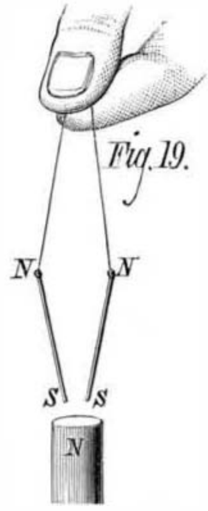


Fig. 19.

The experiment just described may be modified by simply holding the two wires parallel to each other between the thumb and forefinger and bringing their ends to touch the end of the magnet. They will adhere to the magnet, and on relieving the wires between the thumb and finger they will at once fly apart, from their mutual repulsion, as shown in Fig. 20.

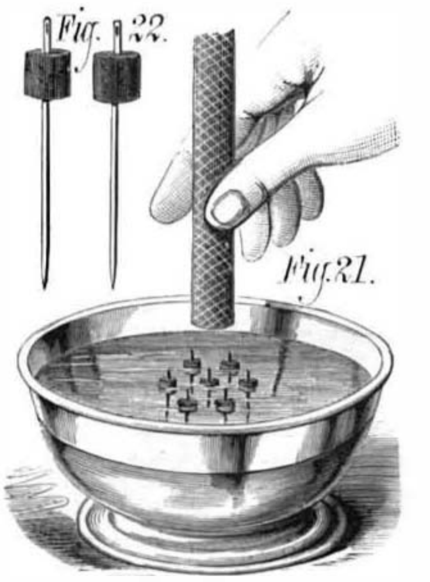


Fig. 22.

Fig. 21.

Take seven pieces of iron wire, each about 1 inch long, and run them through small corks, about ¼ of an inch long and $\frac{3}{16}$ inch in diameter. Throw these pieces of wire into a

© 1879 SCIENTIFIC AMERICAN, INC

bowl of water and they will float vertically. They will come to rest at various hap-hazard positions on the water. Evidently there is no order in their arrangement. Now take your rat-tail file magnet and, holding it in a vertical position, bring it over the water in the bowl. At once the pieces of wire sail toward the magnet, and after many motions among themselves they at last take up the definite figure of a hexagon with a floating wire in its center, as shown in Fig. 21.

This is a beautiful illustration of magnetic induction, and this experiment tells the whole story when viewed in the light which another gives, and which will be at once described before speaking further of the one just made.

Take seven sewing needles; "Milward's No. 6 betweens" are good for this experiment. At the N.Y. Cork Cutting Co., 45 Fulton street, New York, you may buy a gross of corks, of ½ inch in length and $\frac{3}{16}$ inch in diameter, for 10 cents. Magnetize each needle by drawing it from point to eye end over the N. end of your rat-tail file magnet. Then run each needle through the center of a cork made by halving one of the corks just described. In other words, the corks which will float these needles are ¼ inch long and $\frac{3}{16}$ inch in diameter. Now throw these needles in the bowl of water. They repel one another, and if time enough be given them they will at last reach the edge of the bowl and will arrange themselves at equal distances apart around the border of the water. They do so because when floating upright their like poles are opposed to each other, as shown in Fig. 22, and these like poles mutually repel.

While the needles remain on the border of the water in the bowl, bring down vertically the rat-tail file over the center of the water, with its N. pole pointing downward. The magnetic needles at once rush toward the middle of the bowl, and after moving about each other for a while they end by forming the same regular geometric figure of the hexagon, with a needle in its center, as happened in the experiment with the floating iron wires, shown in Fig. 21. In the experiment with the magnetic needles we know the exact magnetic conditions of the experiment. We know that the needles are magnets, and that their south poles are pointing upward and their north poles are down in the water. The like poles of these needles being opposed, they mutually repel, and keep apart till the N. end of the magnet has been brought over them; then this strong north pole attracts the upper or south poles of the needles, and they draw toward the N. pole of the magnet. In other words, the attraction existing between the N. pole of the magnet and the south poles of the needles is stronger than the repulsive force existing between the needles. The needles therefore move toward the magnet and approach one another till their mutual repulsive actions keeping them apart just balance the attraction of the magnet which tends to bring them together.

If the magnet be held at rest, the figure of the hexagon remains at rest; but if the magnet be slowly raised, the hexagon enlarges as the magnet goes further off from the hexagon, for in this case the attractive action of the magnet diminishes. If, however, the magnet approaches the hexagon, the latter shrinks in size, for the attractive force of the magnet on the hexagon increases, and the needles approach till their increased mutual repulsion exactly equals the increased attraction exerted by the magnet on them when the magnet is nearer the hexagon.

If the reader's interest should be excited by the description of these new experiments in magnetism, he will find in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 129, an extended description of them and of the phenomena which they may serve to explain and illustrate, with a full set of the various figures found by different numbers of floating magnets.

Now let us return to our experiments with the floating iron wires. These wires were not magnetized, therefore they did not repel one another when thrown into the bowl of water. They differed from the magnetic needles in this, and hence did not drive one another toward the border of the bowl. But when the magnet was brought over them they acted precisely like the magnetic needles, and formed the same regular hexagon with a floating wire in its center. The force acting on the wires and the needles was the same. It was the N. pole of the magnet. We know that the needles will only move toward the N. pole of the magnet when their south poles are upward and their north poles are down in the water. The wires did the same, and we therefore have a right to assume that when they moved toward the N. pole of the magnet their upper ends were made south poles by the inductive action of the magnet, and their lower ends, under the water, were made north poles by the same action.

We can now understand the condition of the polarity in the magnetic chain formed by the suspended nails, brads, etc., in the experiment shown in Fig. 17. To the N. pole of the magnet is attached a nail. The end of the nail touching the magnet is made its south pole by induction, while its other end is made its north pole. This nail now acts just like the magnet which magnetized it, and the nail in turn magnetizes by induction nail No. 2, and this nail No. 3, and so on to the end of the magnetic chain, which is terminated by the magnetized iron filings.

(*To be continued.*)

A New Blue Dye.

Reichenbach's wood-tar color, pittacal, has been resuscitated by A. Grätzel, and it is now an article of commerce at the price of £4 per kilo, under the formidable name of "German-Imperial-Flower-Blue," with reference probably to the blue corn flower, which is said to be the favorite cognizance of the German Emperor. The pure base is insoluble in water, but dissolves in every acid, and the solutions can be diluted to any extent. The acetate is generally used for dyeing, dissolved in a little acetic acid diluted with water, and almost neutralized with ammonia. In this bath, silk and wool take a fine reddish blue without the aid of any mordant. Cotton and other vegetable fibers are prepared with a solution of tannin, followed by a solution of tartar emetic. The colors produced are perfectly fast.—*Reimann's Färber Zeitung.*

Gelatine Photo Plates.

Many amateurs—and, for that matter, professionals also—who would otherwise practice the gelatino-bromide process, are deterred from so doing by a consideration of the difficulties which attend the preparation of the emulsion in hot weather, its limited keeping qualities, and the consequent necessity for making repeated small batches instead of "going in" for a large quantity at once, and thus securing, at least, a fair chance of uniformity throughout a large number of plates.

The plan I am about to describe is one which removes these difficulties; and I can recommend it on the score of efficiency, having for some time worked it myself. But to the users of small quantities of emulsion it offers especial advantages, as it enables them to emulsify a considerable quantity of silver bromide at one operation, and keep it in a convenient form for adding to the requisite quantity of gelatine just when the emulsion may be required for use.

The operator is thus relieved of the trouble of having continually to attend to the "cooking" arrangements of his emulsion, and, what is of equal importance at this season, the gelatine itself is for so short a time in contact with moisture that the chances of decomposition are reduced to a minimum, and the tendency to frilling and other evils diminished.

To make the emulsion proceed as follows: Dissolve 300 grains of gum arabic in ten ounces of distilled water; put the water in a wide-mouthed bottle, and the gum—together with a piece of chalk the size of a hazel nut—in a piece of muslin suspended therein. The chalk is to prevent any tendency on the part of the gum solution to turn acid. Take of the above four ounces, and dissolve in it eighty grains of ammonium bromide. To sensitize, dissolve 125 grains of silver nitrate in two ounces of water, and add a little at a time to the bromized gum solution, shaking well between each addition. When all the silver has been added put aside to digest.

A gelatine emulsion may be made at any time by adding to each ounce of the above thirty grains of gelatine; when soaked dissolve in a water bath, allow it to set, wash, redissolve, and coat. Or the gum emulsion may be dialyzed to remove decomposition salts, in which case it may be kept for a very considerable time without any change in its sensitiveness or general character. It would, however, be then advisable to reduce the proportion of gum, as it must be borne in mind that there is no washing to remove the gum, which, therefore, remains in the gelatine film.

To sum up, the advantages are:

1. Emulsification may be prolonged to any extent.
2. The bromide of silver will remain perfectly in suspension in the temporary menstruum.
3. A large quantity may be made, and portions taken at intervals as required.
4. The gum being very soluble, and permeating the jelly, the salts are more easily got rid of in washing.
5. Heat is not required, except to dissolve the gelatine.

Those whose patience is being tried by the vagaries of gelatine during this weather should try the foregoing, which will, I think, in the majority of cases, prove an effective cure.—*Peter Mawdsley, in British Journal of Photography.*

Combination of Cyanogen with Hydrogen and with Metals.

The author having measured the heat of the formation of hydrocyanic acid and of cyanogen from their elements (— 14·1 and — 38·3), concludes that the synthesis of hydrocyanic acid from cyanogen and hydrogen ought to evolve a considerable quantity of heat. He finds that gaseous hydrocyanic acid may be heated to 550° for three or four hours in a sealed tube without betraying any marks of decomposition or dissociation. The author effected the direct combination of cyanogen and hydrogen by heating the pure dry gases in equal volumes in a sealed tube of hard glass to 500° to 550° for several hours. On opening the tube a loss of about one seventh of the volume was apparent, due to the formation of a certain quantity of para-cyanogen. Potassa absorbed five sevenths of the gas, and the residual one seventh was found on analysis to consist of water almost pure. The volume of this residual hydrogen being sensibly equal to the original condensation (representing the change of a certain quantity of cyanogen into para-cyanogen) it follows that the gas absorbable by potassa is hydrocyanic acid exempt from free cyanogen. At a lower temperature the synthesis is less complete, and at greater heats a portion of nitrogen is set free. At 300° cyanogen combines with zinc, cadmium, iron if brought in contact in a sealed tube.—*M. Berthelot.*

Laws of Atmospheric Electricity.

Atmospheric electricity presents daily in Piedmont two maxima following the rising and setting of the sun, at an interval of some hours. These two maxima are separated by a minimum which follows the passage of the sun over the meridian of the place. As regards the annual fluctuation the maximum value of the atmospheric tension falls in February, and the minimum in September. Before and after storms the electrometer almost always marks zero, but during their passage or proximity the tension is very great. Rain and snow increase tension more slightly, and are often preceded and followed by electric diminution. The action of fogs, hoar frosts, and of the formation of clouds increases atmospheric electricity, though to a less extent than that of rain and snow. In calm and hot weather the lowest values are observed. South and especially southeasterly winds increase the electricity of the air; north winds have an opposite effect. Rain and snow are accompanied by negative electricity, at least as often as by positive. The same proportion holds good for storms and to a less extent for rain and snow. Negative electricity is generally due to storms or rain at a distance, to the formation of clouds, or to a polar aurora. In the normal conditions of the atmosphere electric tension decreases with altitude.—*P. F. Denza.*

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although only approximate, they will enable the ordinary observer to find the planets.

M. M.

POSITION OF PLANETS FOR OCTOBER, 1879.

Mercury.

On October 1 Mercury rises at 5h. 41m. A.M., and sets at 5h. 38m. P.M.

On October 31 Mercury rises at 8h. A.M., and sets at 5h. 27m. P.M.

Venus.

On October 1 Venus rises at 5h. 14m. A.M., and sets at 4h. 34m. P.M.

On October 31 Venus rises at 3h. 11m. A.M., and sets at 3h. 9m. P.M.

The motions of Venus can be watched by referring the planet's places to the stars in Leo, and it will be seen that Venus moves toward the west until the 14th, and toward the east after that date. Venus is near the waning moon on the 12th, and at its greatest brilliancy on the 30th.

Mars.

Mars is coming into better position for evening observers.

Mars rises on October 1 at 7h. 57m. P.M., and sets at 10h. 12m. of the next day.

On October 31 Mars rises at 5h. 39m. P.M., and sets at 7h. 56m. A.M. of the next day.

After October 6 the motion of Mars among the stars will be toward the west; it can be compared with the stars of the Pleiades. Mars is in conjunction with the moon on the 30th.

Jupiter.

Jupiter, Saturn, and Mars are brilliant in the evenings of October.

Jupiter rises first: on October 1 at 4h. 25m. P.M., on October 31 at 2h. 24m. P.M.

An ordinary ship's glass, or a good opera glass, will show the varied positions of Jupiter and its four moons. If we take the hours between 8 and 10 in the evening for our observations we shall see Jupiter rise, unaccompanied by its first satellite, on the 5th, in consequence of the satellite coming in front of the planet and passing across the disk. The same will occur on the 21st and 28th.

The first satellite will be invisible at some time during these hours on the 6th and 29th, because it is in the shadow of the planet. On the 20th it will not be seen, because behind the planet.

The smallest satellite of Jupiter, the second in order of distance from the planet, will not be seen until near 10 P.M. on the 7th, when it passes from the face of the planet. It will disappear about 9 P.M. on the 14th, because it passes between the planet and the earth and is thus projected upon the face of Jupiter.

The third satellite of Jupiter, which is the largest, will disappear by going behind the planet, October 9. The approach of the satellite and planet can be watched, and its motion around Jupiter can be followed; it will reappear after midnight. This satellite will pass across the disk of Jupiter between 6 and 10 P.M. of the 27th; it will be seen to pass from the face of Jupiter between 9 and 10 P.M.

The fourth satellite of Jupiter will reappear from the shadow of Jupiter on the 25th, between 8 and 9 P.M.

Saturn.

Saturn comes to its best position early in October. A small telescope will show the ring projecting on each side the planet.

Saturn rises on October 1 at 6h. P.M., and on October 31 at 3h. 56m. P.M.

Saturn is in conjunction with the moon on the 27th at midnight, Saturn being about 8° south of the moon.

Uranus.

On October 1 Uranus rises at 3h. 20m. A.M. On October 31 Uranus rises at 1h. 29m. A.M.

Uranus is very near the star Rho Leonis.

Neptune.

Neptune rises on October 1 at 7h. 7m. P.M., and on October 31 at 5h. 7m. P.M.

Between 4 and 8 P.M. of October 1, Jupiter, Saturn, Neptune, and Mars come above the horizon; and on the 31st the same planets rise between 2 and 6 P.M.

◆

AN immense steel bridge is now in progress over the Frith of Forth, in Scotland.

© 1879 SCIENTIFIC AMERICAN, INC