MAGNETISM.

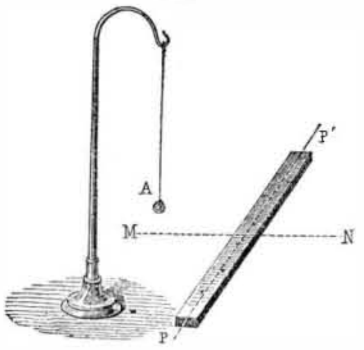
In ordinary observation, magnetism is scarcely known except as existing in iron, and especially in steel, and as related in some obscure manner to the earth. But there is reason to believe that it is one of the most extensively diffused agents in Nature. It can be traced not only in iron, but also in every substance into which iron enters into composition. It is found in nickel, cobalt, chromium, and other substances, and even in some gases. Wherever a galvanic current exists in Nature, whether produced by chemical action, or appearing in the thermo-electric form as originating from the effects of heat at the place of union of different substances, magnetic effects can be elicited. On the larger scale, it is certain that the whole earth acts as a combination of magnets, and there is reason to think that the sun and the moon also act as magnets.

The laws of magnetic force, however, have been experimentally examined with philosophical accuracy, only in their connection with iron and steel, and, by inferences bearing considerable probability, in the influences exerted by the earth as a whole. The ferruginous minerals of the formula $Fe_3 O_4$ possess the property of attracting iron and its filings, and are called natural magnets or lodestones.

Experience has demonstrated that the attractive action of magnets takes place in a vacuum and through all bodies, whether gaseous, liquid, or solid, when they are not themselves magnetic. All the properties of natural magnets may be permanently communicated to needles or to bars of steel properly tempered, which are then said to be magnetized, and take the name of artificial magnets.

If a small iron ball, A (Fig. 1), be suspended by a flexible thread, and successively presented to various points of the surface of a magnetized bar, although it may be kept at the same distance from the bar in every case, the deviation of the ball, A, will undergo considerable variation as it is changed from point to point.

Fig. 1.



In the section, M N, perpendicular to the middle of the axis of the figure, P P', the attractive action is zero; in either direction from this position the pendulum is more deviated from the vertical as it is placed nearer to the ends of the bar.

The same fact may be demonstrated by rolling a magnetized bar in iron filings (Fig. 2); or better still, (Fig. 3), by covering a magnet with a thin cardboard which is lightly tapped with the fingers, while iron filings are scattered over its surface from a sieve. The directions which the lines of filings take prove that the middle section, M N, produces no action whatever, and that, towards the ends of the bar, in the axis of the figure there are two points, P P', which are centers of the strongest attraction.

Fig. 2

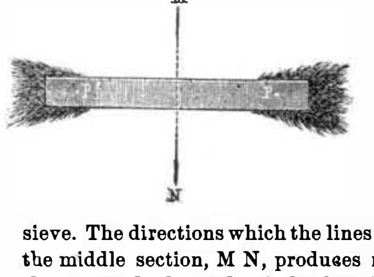
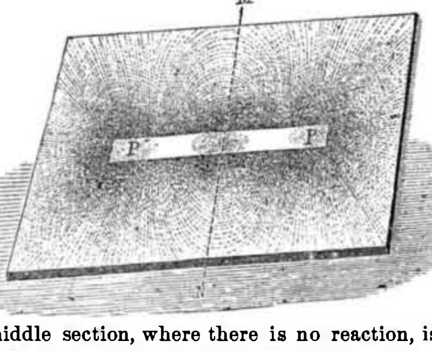


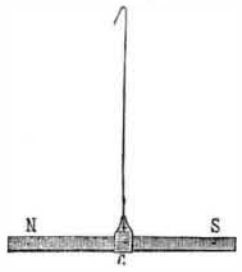
Fig. 3.



The middle section, where there is no reaction, is designated as the neutral line, and the centers of attraction, P P', are called the poles of the bar. Every magnet, whether natural or artificial, possesses at least two poles. When the magnetization is regular, the magnet has but two poles, which are situated in the axis of the figure and near its ends. When the minerals containing iron, or the steel bars, have more than two poles, they are said to be irregularly magnetized, or that they have consequent points. In every case, however, two consecutive poles are separated by a neutral line or a line in which there is no action.

If a magnetized bar is suspended horizontally by means of the stirrup, C (Fig. 4), made of paper or copper, and supported by a thread without torsion, the whole system partakes of a movement set up by the magnetic influence of the earth. After a certain number of oscillations, the bar becomes quiet in such a position that its axis is directed from north to south.

Fig. 4.



If the same bar is used several times in succession, it always comes to rest in the same position, and the same end always turns toward the north. Several bars suspended in the same manner, and at a certain distance from one another, always place themselves in parallel directions. The vertical plane which passes through the axis of a bar freely suspended, when in its position of equilibrium, is called the magnetic meridian. The magnetic meridian does not coincide with the terrestrial meridian; the angle comprised between these two planes in a given place is called the declination. The declination is said to be east or west, as the half of the bar turned toward the north places itself east or west of the terrestrial meridian. The declination also changes in value and even in sign, according to the place of observation; and it undergoes, besides, continual variations at the same place.

The end of the magnet which turns toward the north is called its north pole, the opposite end its south pole.

If the poles of a freely suspended bar magnet are successively brought near the poles of another bar, the suspended magnet will be turned out of the magnetic meridian. The direction in which it is displaced in each case shows that poles of like names repel each other, while, on the contrary, poles of unlike names are mutually attractive.

If we place a string bar, M (Fig. 5), in any position whatever below a bar, M', whose suspension is without torsion,

Fig. 5.

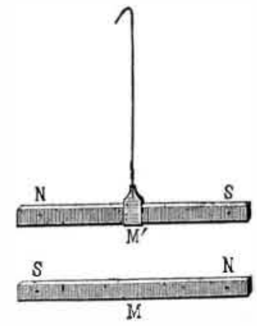
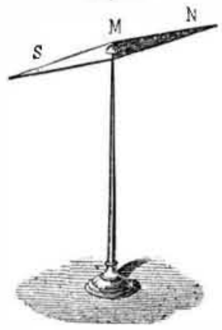


Fig. 6.



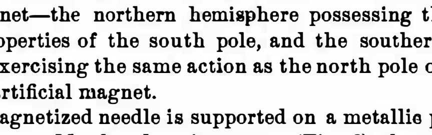
the latter bar immediately turns in a horizontal plane, and, after a few oscillations, comes to rest. In this position the axes of the two bars are parallel, and the poles of unlike names are placed one above the other, on the same side of the suspension thread.

The terrestrial globe may therefore be considered as a great magnet, with one of its magnetic poles placed in its northern, the other in its southern hemisphere. The two hemispheres of the earth are thus like the two halves of a bar magnet—the northern hemisphere possessing the magnetic properties of the south pole, and the southern hemisphere exercising the same action as the north pole of a natural or artificial magnet.

If a magnetized needle is supported on a metallic point by an agate cup, M, placed on its center (Fig. 6), the needle is then free to turn in a horizontal plane. When left to itself, it oscillates under the influence of terrestrial force, and finally comes to rest in such a position that the line joining its poles, which corresponds with its center of figure, is in the magnetic meridian of the place.

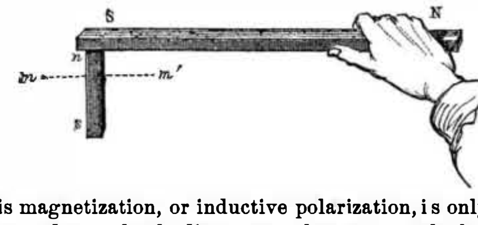
By placing (Fig. 7) a bar of soft iron which presents no

Fig. 7.



trace of magnetism in the neighborhood of the poles of a bar magnet, the former, under the influence of the magnet, acquires the property of attracting iron filings, and becomes itself a real magnet, with its two poles and its neutral line. In soft iron, magnetized by induction, the poles stand in a direction opposite to those of the bar; and its neutral line, instead of occupying the middle position, is placed in the neighborhood of the end which is opposite the bar.

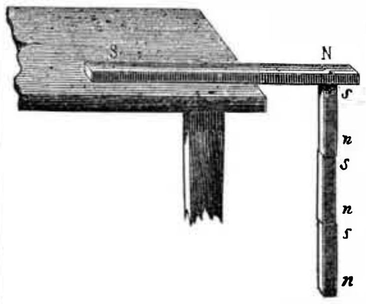
Fig. 8.



This magnetization, or inductive polarization, is only temporary, and completely disappears the moment the bar and the soft iron prism are separated some distance from each other. The phenomena are the same when a soft iron prism (Fig. 8) remains suspended by the attraction of one of the poles of a bar magnet.

This temporary induced magnetism of soft iron prisms may be shown in another manner. If a soft iron prism is suspended from the north pole of a strong magnet (Fig. 9) it becomes capable of supporting a second prism; the second prism is in turn inductively magnetized, and will support a third, and so on. In this magnetic chain, the indirectly magnetized prisms always touch each other with poles of contrary names, and the action becomes weaker as the distance from the bar increases.

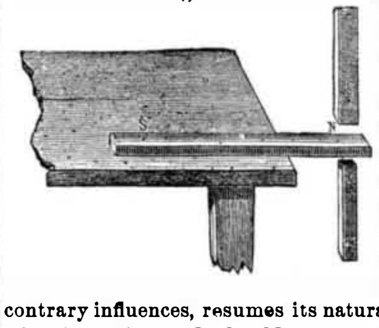
Fig. 9.



But now, if the bar is detached from the first soft iron prism, all traces of polarization disappear in the several prisms, and they immediately separate from each other.

We have seen that a prism of soft iron, presented to the north pole of a magnet, becomes itself a real magnet by induction, the contrary poles attracting each other, and the soft iron remaining suspended against the force of gravitation. If, when a prism is suspended in this manner, the south pole of a second bar (Fig. 10) is brought near it, all magnetic adherence ceases; the soft iron prism detaches itself, and falls.

Fig. 10.



In this experiment, the second bar tends to develope in the prism a magnetization whose polarity is opposite to that developed by the first bar. The soft iron being thus submitted to the two contrary influences, resumes its natural state, loses all trace of polarization, and should necessarily obey the action of gravitation. Experience has demonstrated that when a bar magnet is broken, each of its parts, whatever may be their number, forms a complete magnet, with its two poles and neutral line. The magnetization induced in a piece of soft iron is less as the distance through which the bar acts is greater. From the preceding facts it appears that the action of a magnetic pole, on a series of soft iron cylinders submitted to its influence, very much resembles the induction exercised by an electrified sphere on a series of insulated conductors. Under the influence of the magnetic pole, the soft iron cylinders are polarized, and the polarization endures while the influence lasts. In the same way, the ends of the insulated conductors, placed in the vicinity of an electrified sphere, are charged with electricity of contrary names; this polarization lasts as long as the inductive action of the sphere is maintained, and completely disappears when the sphere is removed or discharged.

There is, however, a great difference between a magnetized bar and an electrified sphere. The contact of the soft iron by no means enfeebles the magnetic properties of the bar; but the magnetism, whatever its nature may be, does not, by apparent contact, pass from the bar to the piece of soft iron. On the contrary, when an electrified sphere is touched with an insulated conductor, a part of the electricity of the sphere is spread over the conductor, and the electric properties of the sphere are enfeebled.

Plants and Animals found in the Human Mouth.

According to Dr. C. N. Peirce, in an essay in *Dental Cosmos*, the following variety of organisms is found in the oral cavity, as shown by the microscope: 1. Oidium albicans. 2. Cryptococcus cerevisiæ. 3. Leptothrix buccalis. 4. Leptomitus. 5. Bacteria, vibrios, and monads. 6. Paramecia 7. Heterogeneous mass.

OIDIUM ALBICANS, OR WHITE PLANT.

As revealed to the observer, it seems to consist of thickened epithelial cells, mingled with numerous minute sporules or seeds, from the midst of which long, thread-like, jointed and branching plants arise, mycelium, intertwining with each other. The question as to whether this vegetable growth is the origin or sequence of disease has not yet been settled. So far as I can learn of its prevalence or predisposition, it occurs most frequently in the mouths of persons living in situations where the air is impure and diet unwholesome, or where previous gastric or intestinal disorder has interfered with the health and vigor of the infant. It is found alone or simultaneously on the inner edge of the lips, where the mucous membrane begins, on the inner side of the cheek, on the gums and palate, on the upper and lower surface of the tongue, in the throat, and in the œsophagus, down as far as the cardia, or upper opening of the stomach.

CRYPTOCOCCUS CEREVISIÆ—*Cell or Capsule.*

This plant is composed of round or oval cells, which present in their interior one or two little corpuscles resembling somewhat an oil globule. They are propagated with great rapidity when in contact with decomposing substances at a favorable temperature. This cryptococcus is so similar to that found in yeast, beer, ale, and sour milk that it may be considered practically identical, the principal difference noticed being a variation in the size; while in shape, manner of propagation, and apparent globule within, the modifications are but slight. It is developed in the morbid secretions of the mouth, the œsophagus, and stomach; it is also introduced into these situations by the drinking of beer.

In the black fur of the tongue of persons laboring under typhus, or in the oral secretions where persons have been long sufferers from organic disease, it is also found. Vogel thinks it of great importance to regard this plant only as an accompaniment and not as the cause of disease.

LEPTOTHRIX BUCCALIS—*Slender hairs in the mouth.*

This consists of slender structureless fibers, of various lengths, and straight or curved as the fiber is long or short. One end is free, the other is planted in or projecting from a fine granular mass, though a limited number are always noticed floating in the secretions, detached from any substance. They are found singly or in bundles, and multiply with great rapidity. Scarcely any portion of the mouth is free from them. They appear on the surface of the tongue, in depressions of the teeth, and cavities of decay, on the neck

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and surfaces of the teeth; indeed, everywhere within the oral cavity that lodgment can be found for a particle of food.

They are found also growing from the surface of accumulations of tartar, whether such accretions be upon the necks of the teeth, in the cavities of decay, or on artificial dentures. There is probably no situation where they grow with greater rapidity than on the surfaces of the plate, either upper or under. The soft cheese-like substance that so quickly accumulates there is most prolific in their production, though from this situation they are neither so long nor attenuated as those taken from an inflamed mucous membrane. While great care in cleanliness limits their number, it is impossible to entirely eradicate them or prevent their development.

LEPTOMITUS—*Slender Threads.*

This growth, as the name indicates, is neither so long nor so slender as the leptothrix. It also has occasional branches, and marked transverse striæ, which complete its morphological difference from the plant just described. It is found upon the tongue and in the pharynx of persons suffering from pneumonia, pleuresia, phthisis, apoplexia, and chronic gastritis.

BACTERIA AND VIBRIOS.

These organisms form some of the most minute objects which the microscopist has the opportunity of examining, and it is with the greatest difficulty their structure can be accurately determined. They are both found in the fluids of the mouth, but the profusion in which they exist is modified by the care exercised in keeping the fluids of the oral cavity free from decomposing substances. In the fangs of teeth where the pulps are devitalized, they are found to rapidly develop. Nor is their presence in this locality confined to such teeth as have defective crowns giving communication with the fluids of the mouth; but in a number that were examined where there was devitalization of the pulp without any loss of the hard tissues from caries or otherwise, their presence was readily detected. Upon opening into such cavities, they were, as usual, very offensive from the degenerated pulp, and on examining this putrid material these living organisms were observed in abundance.

MONADS.

With these two low forms of life we must associate what are known as monads, or, as Bastian calls them, plastide particles. These are invariably found in the same solutions with the former, and are supposed by some observers to result either by direct growth and development, or by aggregation and coalescence into bacteria and vibrios.

"Naturalists have been in doubt as to whether they should be regarded as independent living things of the lowest grade, having an individuality of their own, or whether, rather, they should be looked upon as developmental forms of some higher organisms, either animal or vegetable."

The discovery of these low forms of life in the mouth is not of modern origin, as we shall see from the following by Leuwenhoek. In 1682, at the age of fifty years, he wrote respecting his teeth: "It is my custom every morning to rub my teeth with salt, and afterwards to wash my mouth, and, after eating, I always clean my large teeth with a toothpick, and sometimes rub them very hard with a cloth. By these means my teeth are so clean and white that few persons of my age can show so good a set; nor do my gums ever bleed although I rub them very hard with salt; and yet I cannot keep my teeth so clean but that, upon examining them with a magnifying glass, I have observed a kind of white substance collected between them, in consistence like a mixture of flour and water. In reflecting on this substance, I thought it probable (though I could not observe any motion in it) that it might contain some living creatures. Having therefore mixed it with rain water, which I knew was perfectly pure, I found, to my great surprise, that it contained many very small animalcules, the motions of which were very pleasing to behold. The largest sort of them had the greatest and quickest motion, leaping about in the fluid like the fish called a jack: the number of these was very small. The second sort had a kind of whirling motion, and sometimes moved in the direction of a spiral, and undulated; these were more in number. Of the third sort I could not well ascertain the figure, for sometimes they seemed roundish but oblong, and sometimes perfectly round. These were so small that they did not appear larger than a speck. The motion of these little creatures, one among another, may be imagined like that of a great number of gnats or flies sporting in the air. From the appearance of these to me, I judged that I saw some thousands of them in a portion of liquid no larger than a grain of sand, and this liquid consisted of eight parts water and one part only of the before-mentioned substance taken from the teeth.

"With the point of a needle I took some of the same kind of substance from the teeth of two ladies who I knew were very punctual in cleaning them every day, and therein I observed as many of these animalcules as I have just mentioned. I also saw the same in a white substance taken from the teeth of a boy about eight years old; and upon examining in like manner the same substance taken from the teeth of an old gentleman, who was very careless about keeping them clean, I found an incredible number of living animalcules, swimming about more rapidly than any I had before seen, and in such numbers that the water which contained them (though but a small portion of the material taken from the teeth was mixed in it) seemed to be alive."

PARAMECIA.

Having now considered all the growths deemed vegetable found in the mouth, I have still one other organism to describe, as to the true place of which in Nature there is no division of sentiment, it belonging undoubtedly to the animal kingdom. I allude to the paramecia, a genus of infusoria. They are only found in the oral cavity in cases of extreme uncleanliness; and though increasing rapidly in infusions adapted to their growth, they are somewhat limited in this situation, owing to the constant changing of the secretions. About fifteen varieties have been described. They have a soft flexible body, variable in form, though usually oblong or oval, and more or less depressed. In most of them, numerous rows of vibratile cilia are noticeable, projecting from their integument.

Useful Recipes for the Shop, the Household, and the Farm.

Vienna bread and Vienna beer are said to be the best in the world. Both owe their superiority to the yeast used, which is prepared in the following manner: Indian corn, barley, and rye (all sprouting) are powdered and mixed, and then macerated in water at a temperature of from 149° to 167° Fah. Saccharification takes place in a few hours, when the liquor is racked off and allowed to clear, and fermentation is set up by the help of a minute quantity of any ordinary yeast. Carbonic acid is disengaged during the process with so much rapidity that the globules of yeast are thrown up by the gas, and remain floating on the surface, where they form a thick scum. The latter is carefully removed, and constitutes the best and purest yeast, which, when drained and compressed in a hydraulic press, can be kept from eight to fifteen days, according to the season.

By drawing up the earth over the potato in sloping ridges, the plant is deprived of its due supply of moisture by rains, for when they fall the water is cast into the ditches. Further, in regard to the idea that, by thus earthing up, the number of tubers is increased, the effect is quite the reverse; for experience proves that a potato, placed an inch only under the surface of the earth, will produce more tubers than one planted at the depth of a foot.

Brown bronze dip, for coating hat hooks and similar small hardware articles, is made of iron scales, 1 lb.; arsenic, 1 oz.; muriatic acid, 1 lb.; zinc, solid, 10 ozs. The zinc should be kept in only when the bath is used. The castings must be perfectly free from sand and grease.

A good test for gold or silver is a piece of lunar caustic, fixed with a pointed stick of wood. Slightly wet the metal to be tested, and rub it gently with the caustic. If gold or silver, the mark will be faint; but if an inferior metal, it will be quite black.

Cider may be purified by isinglass, about 1 oz. of the latter to the gallon. Dissolve in warm water, stir gently into the cider, let it settle, and draw off the liquor.

The solvent power of glycerin upon several substances commonly used in medicine and the arts is as follows: 1 part of sulphur requires 2,000 parts of glycerin; iodine, 100 parts; red iodide of mercury, 340 parts; corrosive sublimate, 14 parts; sulphate of quinine, 48 parts; tannin, 6 parts; veratria, 96 parts; atropia, 50 parts; hydrochlorate of morphia, 19 parts; tartar emetic, 50 parts; iodide of sulphur, 60 parts; iodide of potassium, 3 parts; sulphide of potassium, 10 parts.

Some weeds can be killed and prevented from growing in garden paths by watering the ground with a weak solution of carbolic acid, 1 part pure crystallized acid to 2,000 parts water. Sprinkle from a watering pot.

A screen or blower of wire gauze, from 36 to 40 wires to the inch, placed in front of range or stove fires, will prevent, it is said, smoke coming into the room when the chimney fails to draw well.

To prevent condensation in a steam pipe laid under ground, place it inside another larger pipe, filling the intervening spaces with pulverized charcoal. The outside pipe should b watertight.

Tar water may be employed for dyeing silk or wool ashen gray. The stuff is first mordanted with weak perchloride of iron, by soaking in the solution some hours. It is then drained and passed through the bath of tar water. The oxyphenate of iron, which is thus precipitated on the fabric, gives a very solid color.

A cement, impermeable by air and steam, and especially well adapted to use for steam or gas pipes, is made of powdered graphite 6 parts, slaked lime 3 parts, sulphate of lime 8 parts, and boiled oil 7 parts, well kneaded.

Cider may be preserved sweet for years, by putting it up in airtight cans, after the manner of preserving fruit. The liquor should be first settled and racked off from the dregs, but fermentation should not be allowed to commence before canning.

The mordants used for dyeing with sumac are either tin, acetate of iron, or sulphate of zinc. The first gives yellow, the second gray or black, according to strength, and the third greenish yellow.

When boilers are ordinarily fed with hard water, it is worth while to save the drippings of the exhaust pipe, the condensation of the safety valve blow-off, and that from the cylinder, and use the water thus obtained to fill the boiler after blowing off. The result will be surprising in effect in loosening scale.

The evaporative efficiency of American anthracite and American bituminous coals is in the proportion of 8·9 to 9·9.

Glossed shirt bosoms: Take two ounces of fine white gum arabic powder, put it in a pitcher and pour on a pint or more of water, and then, having covered it, let it stand all night. In the morning, pour it carefully from the dregs into a clean bottle, cork, and keep it for use. A teaspoonful of gum water stirred in a pint of starch, made in the usual way, will give to lawns, white or printed, a look of newness, when nothing else can restore them, after they have been washed.

A cheap fertilizer consists of sulphate of ammonia, 60 lbs.; nitrate of soda, 40 lbs.; ground bone, 250 lbs.; plaster, 250 lbs.; salt, ½ bushel; wood ashes, 3 bushels; stable manure, 20 bushels. Apply the above amount to six acres. Labor in preparing included, it costs about $15. It is said to give as good results as most of the commercial fertilizers costing $50 per ton.

To make a handy paint, break an egg into a dish and beat slightly. Use the white only, if for white paint; then stir in coloring matter to suit. Red lead makes a good red paint. To thin it, use a little skimmed milk. Eggs that are a little too old to eat will do for this very well.

Magnetism of Iron Filings.

"De Haldat published, during 1836, in *Memoires de l'Academie* of Stanislas, that he had put iron filings into a brass tube (closed by two screw plates), which he magnetized by the ordinary process, and that he succeeded in obtaining two contrary poles. The polarity slowly decreased when varying quantities of river sand were mixed with the filings, while in every case it was very weak, and disappeared when the metal grains were displaced in position by shaking the tube I repeated this experiment by firmly ramming down the iron filings into the tube, by means of a small hydraulic press I found that when the filings begin to aggregate the polarity considerably augments, and continues to increase with pressure. I now lay before your Academy some tubes, 3 2 to 4 inches long and 1 2 inches in diameter, which attract at least as powerfully as those made from broken pieces of good steel of the same dimensions. As the iron filings which I used were of unknown origin, I had some prepared under my own eyes, from good soft iron, perfectly reduced, and without appreciable coercive force: the results were not lessened. Thus, then, a metal which has no coercive force when it is entire acquires it in as considerable a degree as that of steel when it has been reduced and compressed by pressure. Is it not to this fragmentary character that we must attribute the observed polarity? and is it not, also, this same cause which explains the coercive force of steel? One cannot explain the distribution in a magnet without considering it as composed of rows of very small magnetic elements of opposite poles, reacting between themselves at a distance; and it is proved that the quantities of separate magnetism in each of them increase, by this reaction, from the extremity to the middle line. Until now it seemed admissible that these elements are the molecules themselves; but the preceding experiment appears to show they are formed of either compacted iron fragments or small agglomerated crystals, as in steel. When, before pressing the filings, materials which render the mass more homogeneous are put with them, the same polarity can no longer be given to them as before the mixture. For example, if we make a paste of chloride of iron and filings, and press it, we obtain, after several days, a subchloride of iron of continued appearance, which may be filed and polished like pure iron, but which can scarcely be magnetized. Iron reduced by hydrogen and oxygen from scales behaves like iron filings; but magnetic or diamagnetic bodies mixed with the filings notably change its faculty of becoming magnetized. It is probable that, in very powerfully ramming home the powders, the coercive force would be found to increase to a maximum, and that it will afterwards decrease when the compactness of the fragments will have given a sufficient continuity to the mass."—*J. Jamin, in Comptes Rendus.*

Concrete for Walks, etc.

John Turner, in the London *Agricultural Gazette*, gives his experience in making and using asphalt as follows: "I have done a great deal successfully in walks and some kinds of floors such as the floor of a pig house, but have never attempted it for heavy traffic. It is neither difficult nor expensive. Of course a great deal depends upon the cost of material; the labor is trifling. I have used screenings of gravel (I don't like it clean, but mixed with sand); I have used sand alone (when I could not get anything better), blacksmiths' ashes, and ashes from my engine. The last I did was for our churchyard walks; for those I got the screenings of Leicestershire granite, which made a splendid path, but of course more expensive—the granite cost $2.50 per tun. It is quite an unnecessary expense and trouble to boil the tar. Get your material dry, mix it with tar, turn it over twice, and let it lie a couple of days, then turn it again, and mix a little lime with it, about a tenth, let it lie another day, and then on a fine sunny day lay it on, rake it even, and roll well as soon as it will roll, in an hour or two's time; if the roll does not work well (it ought to if the stuff is not mixed with two much tar), scatter a little dry sand over it. Every summer I brush my walks over with cold tar, and give a good sprinkling of sand, and they are as good now as when first put down, fifteen years since. Any laborer can do it, only take care, before laying it down, it is of proper consistence. When ready it ought not to show the least tar, but should be a dull dead black, and, when moved with a shovel, ought to be lively, exactly like a mass of mites in a cheese. The stuff will keep a long time in a heap if covered up or other wise kept dry."

Boiler Explosion.

Mr. R. Nickerson, of Harlem, Ga., informs us that a boiler at Sawdust, Ga., exploded on August 7. It was in a sawmill, and the building was torn to pieces. Parts of the boiler were thrown to a distance of several hundred yards. One man was blown to pieces, and two seriously injured. Mr. Nickerson states that the pressure gage showed 45 lbs.; but the gage was defective, as the practice (indulged in by the person in charge) of hanging car couplings on to the safety valve did not appear to form any increased pressure in the boiler.

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