precipitates the carbonate of lime previously held in solution. The magnesia then dissolves, and unites with the bicarbonate of magnesia in the water. At first, water thus softened was suspected of attacking old boilers fed with it, and filling them with mud. It was afterward found, however, that it was the old hard scale that had been dissolved into mud; thus exposing any weak places and leaks that might have been corroded over before the purified water was introduced. The water thus treated has an alkaline reaction, and counteracts any possible acid corrosion. At first, stirring was considered an indispensable part of the process; but, eventually, it was found that straining the water, through an excess of the hydrated oxide of magnesia spread on a filtering medium, would produce the desired effect without further trouble. By mixing proportionate quantities of finely powdered oxide of magnesia and sawdust with water, and subsequent heating, hydrated oxide of magnesia will be formed throughout the whole mass. This preparation forms a most valuable filtering material. Metal cylinders are tightly filled with the mixture, and used as filters; and they are efficient, not only in cleaning dirty water, but also in softening it, for the carbonate of lime crystallizes directly upon the sawdust.

CENTRAL FRANCE UNDER THE CLOUDS.

It frequently happens that the plateaus of the center of France are covered with fogs, and even with a stratum of clouds that descend as far as the ground, while the mountains and elevated plains are enjoying a clear sky and atmosphere. Such a phenomenon has just again occurred between the 25th and 31st of December, 1883, and between the 18th and 24th of January of the present year. The annexed engraving gives an exact idea of the extraordinary spectacle as seen at the time from the top of the Puy de Dome.

The formation of this low stratum of clouds is due to atmospheric whirlwinds that have their origin near the Gulf of Genoa, and that remain afterward upon the Mediterranean. In order to prove this, let us go back a little. On the 28th and 29th of October, 1883, the winds from the southwest, under the influence of areas of low pressure that were passing over the Channel, blew tempestuously in mountain and plain, and carried along as they did so an excess of moisture that resolved itself into a drizzling rain. On the 30th, a zone of high pressure had established itself upon the east coast of Europe, and a gyratory motion made its appearance over the Gulf of Genoa. As always happens, the central plateau immediately came under the influence of the latter; the wind fell in the plain, and, preserving its force, turned to the northwest, at the altitude of the summit of the Puy de Dome. This state of things kept up until the 12th of November, and caused a few falls of snow. Low pressures succeeded over the Western Mediterranean, and the upper wind oscillated from northeast to southwest, and frequently blew strongly.

Eight times during this period it was possible from the summit of the Puy de Dome to enjoy the spectacle of a sea of clouds covering the plains, nothing being seen but the summits of the Puys, the culminating points of the Forez chain and of Mount Dore, like islands here and there.

On the 13th, the zone of strong pressures that had been prevailing over Western Europe since the 30th of October was driven toward the south. The gyratory motions upon the Mediterranean ceased, the phenomenon disappeared, and, up to the 21st, a series of tempests agitated the atmosphere of the country, under the influence of strong depressions that entered England or Brittany and afterward traversed the north of Europe. The stratum of clouds reappeared on the 21st and 22d, after a fall of snow, and this reappearance coincided again with the existence of a new barometric minimum in the latitude of the Gulf of Genoa. From the 25th to the 27th, Central France was again free from its stratum of clouds, because a zone of strong pressure had established itself over Italy and Southern France, while great cyclonic disturbances were passing over England. But, on the 28th, these movements became weaker, and went off through the north of Europe. Then a slight center of depression manifested itself anew over the Mediterranean, and the stratum of clouds again formed.

Since I have observed this phenomenon, it has always occurred under the same conditions; so its formation and disappearance may be foretold. Thus, on the 22d of January last I was able to announce that the clouds and fog that had lasted since the 18th would disappear the next day, on the 23d; and this really happened.

The stratum of clouds, which envelops us like a winding sheet and which involves a portion of France, and doubtless many other countries, in a misty and unwholesome atmosphere, is always thin, although its opacity is very great. Its lower surface, when it does not graze the ground, may rise to 1,500 or 2,200 feet, and is then perceptibly plane and horizontal and appears to be uniformly gray. Its upper surface, which is of a dazzling white, is sometimes mamillated, sometimes jagged, and sometimes plowed up into long parallel furrows that make it resemble the surface of a rolling sea. It oscillates between 2,200 feet and 3,800 feet.

The thickness of the stratum varies, then, between 625 and 2,200 feet. Sometimes it is only necessary to ascend the declivities in the vicinity of Clermont in order to emerge from the cold and damp clouds, and to get into the sunshine and breathe a pure and mild atmosphere.

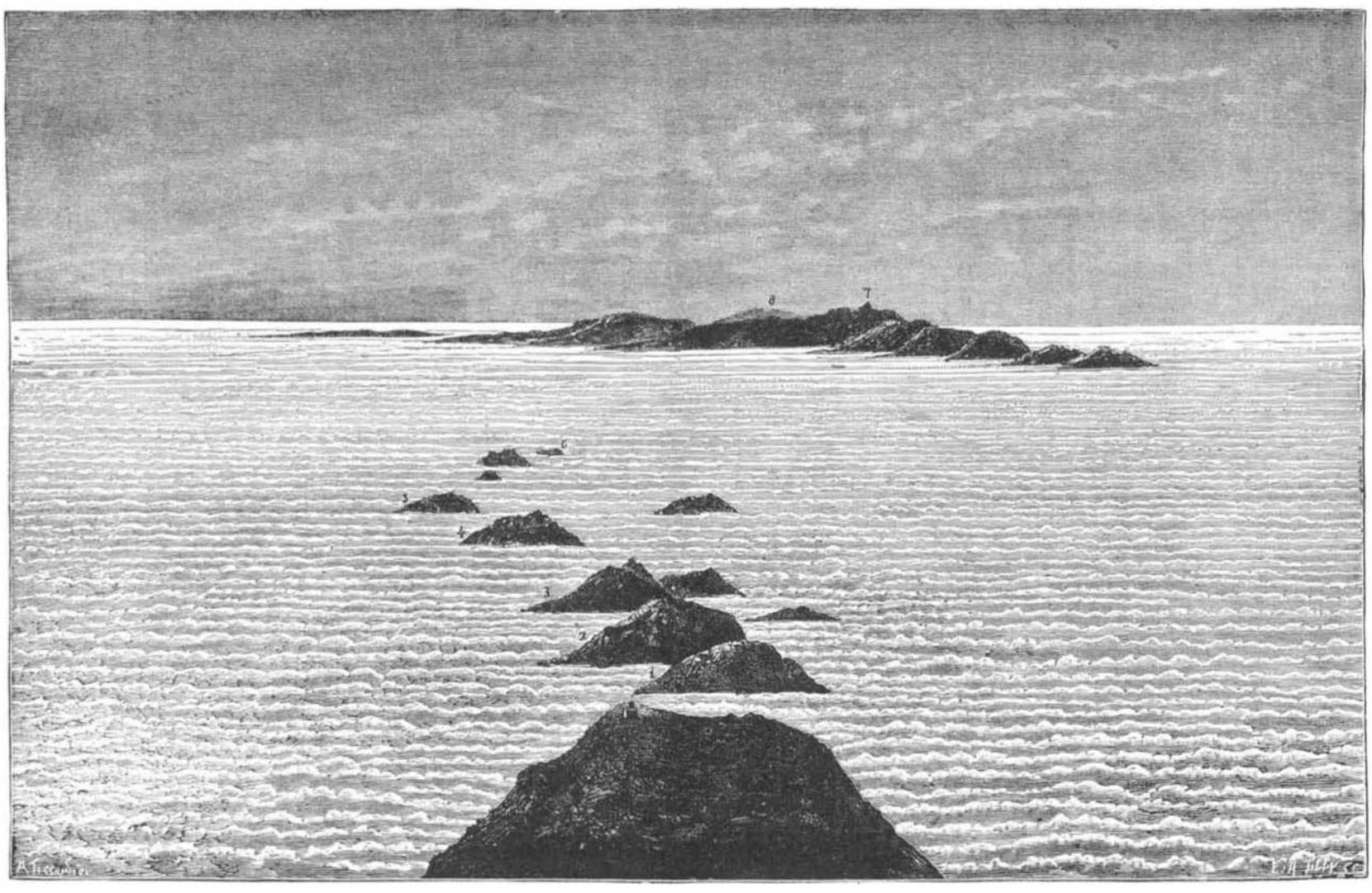
In the midst of these clouds abundant deposits of hoar frost are observed to be frequent, and below them there sometimes falls snow or a drizzling rain. It is especially during the existence of this stratum of clouds that a comparison of temperature observed in the two stations of the Observatory of the Puy de Dome presents great anomalies. They are then very pronounced, because the upper surface of the clouds is in contact with very dry air, and there occurs a very active evaporation; because the warm currents can prevail at the altitude of the summit of the Puy de Dome; and because near the ground the air, which is already chilled when the clouds form, is entirely shielded for several days from the calorific action of the sun.

On the 28th of last December, toward 7 o'clock in the morning, the thermometer marked 0° at Clermont, and +7·9° at the summit of the Puy de Dome. This fact is remarkable enough; but on the 26th of December, 1879, the temperature ascertained at the Puy de Dome was +4 7°, while at Clermont it was 15·6° above zero. Again, it should be remarked that the mean temperature at the Puy de Dome (4,600 feet) being about 4°, while at Clermont (1,200 feet) it is 10°, the inversion is still greater than it at first appears, reaching really 26°.—*M. Plumandon, in La Nature.*

The Theory of Magnetism.

At a recent meeting of the Royal Institution, Professor D. E. Hughes gave a lecture on "The Theory of Magnetism," illustrated by experiments. The mechanical theory of magnetism may be deemed to be the proper style and title of that brought forward by the lecturer. The phenomena of magnetism he explains by a simple rotation of the molecules of iron, as well as of all metals; nay, more, of all matter—solid, liquid, gaseous, or ether. All matter, according to his views, has inherent magnetic power, varying in degree in molecules of different nature, but not to any great extent.

The lecturer demonstrated each portion of his theory by experiment, so that the effects were visible to the audience. The striking effects of vibration, torsion, or mechanical strain upon the destruction or creation of manifest magnetism he showed in a variety of ways, the soft iron obeying the slightest mechanical tremor, while hard iron or steel resisted the most violent treatment. The molecules of the same bar behaved with extreme freedom, as in the instance of soft iron, but when a slight strain was put upon them, as when slightly bent, like an archer's bow, the bar became as rigid as steel, and mechanical action had no longer any effect.



SEA OF CLOUDS OBSERVED FROM THE SUMMIT OF THE PUY DE DOME FRANCE.

A detailed account was given of the lecturer's researches upon the atmosphere, in the course of which he has discovered that it has a saturating point, like iron, and that it is just like iron itself. This was illustrated by striking experiments upon the magnetism of the atmosphere as compared with that of iron, and with the effects of vibrations in allowing freedom of motion to magnetic conduction in iron, by means of which a magnetic pole was pushed forward to four times its previous distance. Heat and electricity produced like effects, whence Professor Hughes drew the conclusion that these three forces, each allowing molecular freedom when frictional resistance is lessened, must have a like origin, and that electrical currents can be fairly classed with heat as a mode of motion. When a bar of soft iron is strongly magnetized, as in the instance of an electromagnet, it returns, like a spring, to a neutral state upon the cessation of the inducing force.

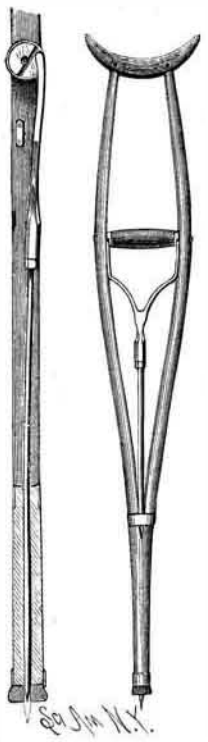
This well known fact has long remained a mystery. All theories of magnetism up to the present time supposed that the molecules became, on the removal of the induced current, mixed or heterogeneous. Professor Hughes believes he has made a great discovery in having solved this problem, leaving no mystery any longer, as the demonstration which he will bring forward this week before the Royal Society will reduce the matter within the domain of absolute fact. He proved his case before his audience at the Royal Institution in a less formal way, but quite as effectually, rendering a bar of iron sensibly neutral or polarized at will by simply turning it upside down. The mechanical inertia of the molecules was demonstrated by magnetizing a bar,

and then changing its polarity by the earth's influence alone. The inertia of magnetism and of electricity was illustrated by two bars of diverse hardness.

Having dealt with other points of great interest, the lecturer concluded by saying that scientific men are agreed that heat is a mode of motion, and that the molecules of the most solid bar of iron can move in a certain space with comparative freedom, the oscillations being greatly increased with every rise in temperature. If, as already well known, the molecules can move in all planes, then there could be no valid objection to the idea of their rotation, in fact, they were known to rotate in the act of crystallization. Thus, according to Professor Hughes, magnetism is an endowment of every atom of matter.

AN IMPROVED CRUTCH.

The accompanying illustration represents a crutch recently patented by Mr. W. H. D. Ludlow, of La Porte City, Iowa. Through a hole in the lower end of the crutch passes a steel rod which extends up between the branches, terminating in a screw socket that receives a screw stem attached to the lower end of a yoke, and provided with a jam nut. With this construction the prod may be turned, so as to project more or less from the end of the crutch, as required by circumstances. The two upper ends of the yoke are connected eccentrically to the ends of the handhold, which is swiveled, so that when turned by the hand of the user the prod will be projected from or withdrawn into the end of the crutch. Upon the inside edges of the branches of the crutch are fastened two lugs, so fixed in relation to the yoke that when the latter is turned past the dead center, in rotating the handhold to project the point, the sides of the yoke will strike against the lugs, keeping the yoke in place, so that pressure on the prod cannot drive it back until the handhold is reversed. In the crutch made in accordance with this plan either the rubber end or the prod may be used, as circumstances may require, the change from one to the other being instantly effected by turning the handhold. The cut shows a front view and an enlarged section.



Bleaching and Oxidizing Cotton Goods with Chloride of Lime.

BY H. SCHMID.

Vegetable fibers can be converted, by the action of chemical agents, into a condition resembling wool or other animal fiber, in which state they take the dye without previous mordanting. A new method of accomplishing this, discovered by G. Witz, of Rouen, is based upon the action of oxidizing agents, in acid or neutral solutions, upon textile fibers.

Witz's investigations have put an end to one of the most serious accidents in the bleaching process. The practical bleacher is familiar with the fact that in steaming bleached goods spots not infrequently make their appearance, which are either the same color as the unbleached goods were, or have a reddish yellow color. Witz has proved that they are caused by too strong a bleaching bath and by being left in it too long, since chloride of lime, not uniformly applied, and aided by the action of air and light, may prove very destructive. Hitherto it has been customary, if such spots appeared on steaming, to increase the strength of the chloride of lime bath, which likewise increased its destructive action. The rotting of the fiber caused by an inordinate use of bleaching material was attributed to its imperfect removal, and they sought to remedy the evil, and frequently in vain, by the use of antichlor. Witz substitutes a clear solution of chloride of lime not exceeding 0·5° B. in concentration, and gives more effect to the operation by boiling with water and washing.

Witz investigated the oxidation or animalization of the fiber with a 4 per cent solution of chloride of lime, using methylen blue as test reagent. Strips of cotton were suspended for a long time partially in and partially out of the chloride of lime solution. After washing and removing the chlorine with an alkaline bisulphite and acids, it was dyed with methylen blue. The portion that was in the bleaching solution took a faint blue color, while that which was just above took a dark blue color, showing that the carbonic acid in the atmosphere played an important part in setting free the hypochlorous acid which oxidized the cellular tissue. Light and warmth have a favorable effect on the oxidizing power of the chloride of lime.

The oxidized cotton not merely absorbs the aniline dyes, but it decomposes the neutral salts of iron and alumina, fixing the bases. Vanadium especially is precipitated on the oxidized fiber, as is readily recognized by the ease with which aniline black is formed, even when the vanadium solutions are extremely dilute. The action of air upon cotton for years will produce the same effect as the hypochlorite as proved by the test with methylen blue. Light assists the action of the air. Hydrogen peroxide and ozone play the same part, but ozone attacks the fiber least in proportion to the beauty of the blue produced. Even wool and silk, after being subjected to the action of ozone, take a deeper color in the dye bath than in their normal condition.

To utilize the new reaction for calico printing, Witz uses the chlorate instead of the hypochlorite. He prints upon the cloth with a saturated solution of potassium chlorate mixed with a little less hydrochloric acid than is required to liberate all the chlorine, thickened with gum tragacanth, and containing. 10 milligrams of vanadium in a liter. Chromates can also be substituted for hypochlorites.

Dyestuffs can be divided into two classes as regards their behavior toward the oxidized cotton—attracted and repelled. The latter dye cotton that has not been oxidized better than that which has; to this class belong the acid azo-dyes, like Ponceau and Bordeaux, and acid dyes of the nature of the phenols, phthaleine, and the amine colors that have acquired acid characters by the introduction of acid groups. The dyes that have basic characters, like rosaniline, constitute the attracted colors.

The dark side of the subject is that these dyes which have been fixed without mordants are unable to resist the action of even the feeblest alkalies, such as the soap bath.

Witz's process is not limited to cotton, wood fiber, silk, and wool, but even horn, hair, scales, skin, feathers, sponges, and bones can be so changed as to have the same qualities as the other fibers with respect to dyes.—*Dingl. Jour.*

A New Test for Lead.

BY A. WYNTER BLYTH, M.R.C.S.

A solution of cochineal is prepared by boiling the ordinary commercial cochineal in water, filtering, and then adding sufficient strong alcohol to insure its preservation from mould. A few drops of this solution added to a colorless neutral or alkaline solution containing dissolved lead, strikes a deep mauve blue to a red with a faint blue tinge, according to the amount of lead present. The test will distinctly indicate a tenth of a grain of lead per gallon in ordinary drinking water, and, by comparison with a solution free from lead, much smaller quantities are indicated.

In searching for traces of lead in water, it is convenient to take two porcelain dishes; into the one place 100 c. c. of the water to be examined, and into the other a solution of carbonate of lime in carbonic acid water, known to be lead free, and approximatively of the same hardness as the water to be examined; then add to each an equal bulk of the coloring matter in quantity sufficient to distinctly tinge the water; the colors may now be compared; the slightest blue tint will be either due to lead or copper; for copper in very dilute solutions gives a similar tint, but in solutions of 1 to 1,000 or stronger the hue is so different as to differentiate the two metals.

The method is within certain limits applicable for quantitative purposes on the usual colorimetric principles. As a qualitative test, it is superior to hydric sulphide and more convenient.—*Analyst.*

WINDOW BEAD FASTENER.

The engraving represents an invention recently patented by Mr. H. F. Neumeyer, of Macungie, Pa., by the use of which

NEUMEYER'S WINDOW BEAD FASTENER.

window beads can be fastened to the casing in such a way that they can be removed, and replaced and fastened readily. The bolt, *b*, is provided at one end with a milled head, *c*, and at the opposite end with a tubular head, *a*, having a transverse slit forming two prongs, each of which is recessed to form hook prongs as shown in the detached figures. At the inner end of a hole through the bead and into the casing, is held a screw, *f*, which is provided with a cross head that passes between the prongs, and into the notches of the hooks on the head, *a*. The withdrawal of the bolt is prevented by a brad driven through the bead.

After the bead has been placed against the casing, the bolt is pushed inward until the head on the screw passes between the hook shanks of the head, *a*. The bolt is then given a quarter turn, so as to cause the ends of the screw head to enter the notches of the hooks. The bead can thus be fastened on or released from the casing very easily and rapidly.

A Safety Rail Fastening.

The drawing of railroad spikes, from the springing of the rails under the wear of engines and trains, is the cause of many accidents. An invention which promises to obviate this difficulty has been made by Capt. Thomas J. Bush, of Lexington, Ky., interlocking bolts being used instead of spikes. Holes are bored in the tie on either side of the rail where the spikes would go, at such angles as to cross each other beneath the rail in the form of the letter X; the bolts have at their upper ends screw threads, which hold nuts squarely down on the flange of the rail, and one of the bolts has a slot, into which the beveled lower end of the other bolt causes a shoulder thereon to lock, and thus bind the rail firmly to the tie. A number of railroads are now experimenting with these bolts, among them the New York Elevated, the N. Y. Central, the Erie, the Pennsylvania, the West Shore, and the New York City and Northern.

RIPPING ATTACHMENT FOR SCISSORS.

Riveted to the inner edge of one of the handles of a pair of scissors and to the loop is a knife casing, in one end of which is pivoted the blade, which is held in the desired position by the usual form of spring at the back of the casing. When the blade is to be used for ripping seams, etc., the scissors are opened as shown in Fig. 2, so that the cutting edges of the blades will be as far apart as possible, and the knife is opened so as to project from the end of the handle. The attachment does not interfere in any way with the use of the scissors, as it is very compact when the knife is shut. This invention has been patented by Francis S. Loockerman, of Manokin, Md.

Forms of Planer Tools.

The form of the cutting portion of tools used on iron has much to do with their useful life and the result of their work. Some planer men in the machine shop will not use for roughing any but a diamond point tool; others do all their "first" work with a round-nose or U tool, and both finish with a square-nose tool. There is a planer tool that should be known and encouraged, that can be used either as a roughing or as a finishing tool. It may be described as a side tool for the lathe, curved around to make a "spoon" form, as understood by lathe and planer men. The tool takes the weight and pressure of the cut at its lowest and strongest point, and the forward uprising portion cleans the surface way, while the backward uprising portion finishes the deep cut. Properly made and properly used, such a cutter is as good as two—if not three—cutters in one. A practical, experienced planer man said recently, that he had used a tool of this shape on cast iron, with a one-eighth of an inch feed, for four hours without grinding, and got better work as to exactness than was possible with a diamond point or a round-nose tool.

The Attempt to Change the Patent Laws.

"Every important manufacturing concern from Maine to California is experiencing the withering effects of this uncalled for agitation. Fools may roll back and stay the tide of invention which is sweeping over the land, that may destroy our industrial progress, and bring ruin and havoc by their action, but they can give no recompense in return for their deeds of vandalism. Is it not time that manufacturers, inventors, indeed business men of intelligence everywhere, should let their voices be heard in this matter? Every senator should be fairly deluged with letters of remonstrance against the bills now before the Senate. And these letters should all be carefully written. Senators ought to know the feeling of the people in relation to these measures, and good sound reasons should be urged for their defeat.

This is a matter of vital importance, and no time should be lost in demonstrating to Congress that the American nation is not ready or willing to do injustice to our inventors even to accommodate the crowds of moonshiners or infringers, who, lacking brains to invent anything themselves, are only too willing to purloin the discoveries of those who can."—*Industrial World.*