were easily broken off with a common wrench, indicating its brittle character.

The pieces shown full size, Fig. 9, and also on a smaller scale in Fig. 7, were obtained by cutting off the rivet heads that held them to the flange of the stand pipe, as shown.

They are pieces of the patch, and have, at *c*, a sample of the old cracks that existed before the explosion. These cracks were filled in places with lime scale deposited from the water.

The conclusion is almost inevitable, after careful study—

That these two boilers exploded in succession so rapid as to be practically simultaneous, beginning at the weak line A B of No. 6 boiler.

That they contained the usual supply of water.

That the pressure was too great for boilers of their size and thickness of iron.

That the use of cold feed water has hastened the deterioration of the poor iron, causing cracks and leaks, from which external corrosion arose, and that the force stored in the water of these two boilers by its sudden liberation through sufficient openings caused the destruction observed.

It is, therefore, strongly recommended that heavier and stronger material be used for boilers of this size and pressure; that regular and continuous feeding of hot water be practiced; and that more care be exercised by inspectors and those in charge of steam boilers in searching for and immediately repairing dangerous defects.

The fact that the proprietors of the Keystone Rolling Mills have ordered first-class steel boilers to fill the places of the exploded ones indicates that they appreciated the recommendations of the SCIENTIFIC AMERICAN representative, who explained to their superintendent the causes of the failure of these old boilers.

Chinese Method of Manufacturing Vermilion.

BY HUGH MACCALLUM.

There are three vermilion works in Hong Kong, the method of manufacture being exactly the same in each. The largest works consume about six thousand bottles of mercury annually, and it was in this one that the following operations were witnessed:

First Step.—A large, very thin iron pan, containing a weighed quantity, about fourteen pounds, of sulphur, is placed over a slow fire, and two-thirds of a bottle of mercury added; as soon as the sulphur begins to melt the mixture is vigorously stirred with an iron stirrer until it assumes a black pulverulent appearance with some melted sulphur floating on the surface; it is then removed from the fire and the remainder of the bottle of mercury added, the whole well stirred. A little water is now poured over the mass, which rapidly cools it; the pan is immediately emptied, when it is again ready for the next batch. The whole operation does not last more than ten minutes. The resulting black powder is not a definite sulphide, as uncombined mercury can be seen throughout the whole mass; besides, the quantity of sulphur used is much in excess of the amount required to form mercuric sulphide.

Second Step.—The black powder obtained in the first step is placed in a semi-hemispherical iron pan, built in with brick, and having a fireplace beneath, covered over with broken pieces of porcelain. These are built up in a loose porous manner, so as to fill another semi-hemispherical iron pan, which is then placed over the fixed one and securely luted with clay, a large stone being placed on the top of it to assist in keeping it in its place. The fire is then lighted and kept up for sixteen hours. The whole is then allowed to cool. When the top pan is removed the vermilion, together with the greater part of the broken porcelain, is attached to it in a coherent mass, which is easily separated into its component parts. The surfaces of the vermilion which were attached to the porcelain have a brownish red and polished appearance, the broken surfaces being somewhat brighter and crystalline.

Third Step.—The sublimed mass obtained in the second step is pounded in a mortar to a coarse powder, and then ground with water between two stones, somewhat after the manner of grinding corn. The resulting semi-fluid mass is transferred to large vats of water, and allowed to settle, the supernatant water removed, and the sediment dried at a gentle heat; when dry it is again powdered, passed through a sieve, and is then fit for the market.—*Pro. Pharm. Soc.*

BOTANICAL NOTES.

The Color of Spring Flowers.—In a contribution to the *Science Review*, on the color of spring flowers, Mr. A. W. Bennett states that out of a list of sixty-four species, 40·5 per cent are white, 20·3 per cent yellow, 17·4 per cent blue or violet, and 7·8 per cent pink. Thus the white and yellow flowers would appear to preponderate. He accounts for this by the fact that white flowers owe their color to the presence of air in the cells of the petals, and that the yellow flowers of spring, such as *Tussilago farfara, Eranthis hyemalis, Primulus, Cheiranthus*, etc., owe their color to xanthine, a solid pigment, probably a modification of chlorophyl, only slowly soluble in alcohol and potash. The predominance of flowers of brighter hues during summer and autumn he considers to be due to the presence of coloring matters which require a strong light and a high temperature for their production, particularly the red coloring matter, as shown by Batalin. The effect of light is shown by a reference to the flora of Switzerland, in which the larger portion of red, pink, and blue flowers in spring is remarkable. H. Müller attributes this to the greater transparency of the mountain air, and consequently more intense light. On this account, and because of the spring being a month later than at lower elevations, the alpine flowers are more brightly colored. This explanation is confirmed by Siemens' recent experiments with the electric light.

White-fruited Blackberries.—Mr. G. M. Wilber, in a note in the *Torrey Botanical Bulletin*, reports that in two localities in Dutchess County, in this State, he has detected plants of the common blackberry (*Rubus villosus*) bearing berries that were perfectly white when ripe, and that were as sweet and pleasant to the taste as the usual black fruit of the same species. Some of the bushes having been transplanted were found to produce the albine berries in succeeding years.

Superabundance of Pollen in Indian Corn.—Prof. C. E. Bessey says, in the *American Naturalist:* "Nature evidently intends to secure the fertilization of the young ovules in the Indian corn (*zea mais*) beyond all chance of failure. In the autumn of 1875 I made a large number of careful counts and estimates, which resulted in fixing upon twenty-five hundred as the average number of pollen grains in each anther. Each panicle of male flowers (the "tassel") was found by careful estimates to contain about 7,200 stamens, so that the number of pollen grains produced by each plant is about eighteen millions. Allowing two ears, of one thousand kernels each, to each plant (a very high estimate), there are still nine thousand pollen grains for every ovule to be fertilized!

What is an Apple?—Is an apple a fruit? It is generally regarded so; but, botanically speaking, a *fruit* is that part of a plant which contains the seeds, and it is nothing else. The *core* of an apple, then, according to this, is the true fruit, for that is the part that contains the pips, and the pips are the seeds. It is a cartilaginous five-lobed capsule splitting along the edges. "What oddities," says Dr. M. T. Masters, "these botanists are; they leave on their plates the fruit, and they eat something which they say is not the fruit! What is that something which is not the fruit? To answer this question to his own personal satisfaction . . . the reader should see before him a flower of an apple or pear in the earliest stage of its growth, and he should trace in other stages, from this earliest condition to the ripe state, the growth of the apple or the pear." A careful examination of this kind, says our author, will "enable him to discover that the flesh of the apple or pear is nothing whatever but the end of the flower stalk, which gradually swells out into a succulent mass, and which holds embedded within it the true fruit—the core. What in ordinary language is called the fruit is, then, only the swollen flower stalk. Alechemillas and spiræas, peaches and cherries, are not to be h d in flower just now, else a cut down through the center of the flower of either of these would reveal the cup-like stalk encircling the young fruit in the center, just as a pill is inclosed within a pill box. Now, suppose the cup to be fleshy, and so thick as to come in contact with the fruit, and we have exactly the condition of an apple. So, then, to say that the core of an apple is the true fruit, and the flesh thereof the dilated flower stalk, is no dogma to be accepted as an article of faith, but it is a statement which any one with a pair of eyes, ordinarily nimble fingers, and a little patience, can, at the proper season verify for himself. . . . To be able to recognize the core of an apple as the fruit proper, and to see in the flesh of the apple a swollen flower stalk, is not to indulge in a mere botanical technicality, as some might at first be inclined to suppose; but it affords a means of ascertaining a truth, and, as such, of opening up possibilities of future utility and development; for truth is never barren of result—the sterility lies with the man who does not avail himself of the truth so far as he can. Deep thoughts to be evolved from the castaway core of an apple!"

Dried Foods.

At present we export to Europe about 6,000,000 pounds of evaporated apples. The process is extremely simple. The fruit is "cored" and sliced into pieces one-sixteenth of an inch in thickness; it is then exposed to sulphur fumes, which arrest all fermentation, and then to a dry and hot blast of air, which reduces it to about half its original weight. The sulphur fumigation prevents the fruit from becoming dark, and after drying it is almost as white as when first cut. Simple as is this process, it costs about twice as much as drying the fruit in the sun, but such is the saving in weight and flavor that it is preferred, and evaporated apples sell to-day in the European markets for fifteen cents a pound.

An old produce dealer interested in the European export trade told an *Evening Post* reporter that, in view of the astounding magnitude of the export trade in food products, it would not be surprising to hear of attempts at compressing or drying every product of the country. The same process as that applied to apples has been used with some success with peaches, and some berries that can be grown cheaply, and as the export of dried food products increases the import is constantly decreasing. The raisins from California promise to drive all foreign raisins out of our markets. There are vineyards of hundreds of acres in Placer, El Dorado, Los Angeles, San Diego, and other counties, given up to growing and drying grapes, partly by evaporation and partly by sun heat.

Another recent use of the evaporation process applied to food products concerns the preparation of codfish for Europe, and especially for tropical climates. The business has been established in this city about six months. The persons who use the process assert that ninety per cent of the weight of a fresh codfish consists of water. By evaporating the matter until the fish product becomes a sort of fine dry meal, a substance is obtained which can be packed in boxes and exported, one pound of the evaporated cod being equal to ten pounds of fresh cod, so far as nutritive properties go. The company which is engaged in the business has factories on the coast of Maine and at Gloucester, Mass.

Wet and Dry Thunderstorms.

A correspondent of the London *Times*, writing from the Transvaal, South Africa, says: "Every afternoon tremendous storms of thunder and lightning burst upon us. These were of two kinds, the wet and the dry. The first is harmless, though noisy; the second exceedingly dangerous. During the dry thunderstorms, which were prevalent toward the end of October, the lightning seemed quite stupefying. It was unaccompanied by either wind or rain. The angry flashes were followed almost simultaneously by awful crashes of thunder, which seemed to shake the earth. One or two tents were struck, and the grass was set fire to in several places within sight of our camps, but no life was lost, only some arms damaged. The dry thunderstorms were soon followed by wet ones. The rain, mixed up with enormous hailstones, soused the thirsty earth, and every little crack on the veldt bore its burden of water to the Vaal, which rose and became impassable."

Oxygen as a Source of Energy.

As is well known, however, the highest temperatures are obtained by combustion—that is, by the combination of other bodies with oxygen. Since oxygen is continually inhaled and consumed by animals during life, we are obliged to consider this as the source of heat and force. We have here a problem which is open to discussion, namely, whether the energy liberated by the combustion was originally contained in the oxygen or in the other substances. It appears as if the latter assumption was generally accepted; at least, statements are often met with, such as, for instance, that coal contains the heat of the sun which has been stored up during thousands of years. Although we cannot at present, with the means at our disposal, definitely solve this problem, it can at least be shown that the statement has little in its favor. The decomposition of carbonic acid by the influence of the light and heat of the sun is effected in such a manner that the carbon is employed in the formation of the compounds of which the plant is built up, while the oxygen escapes into the atmosphere. Now, we know that solids contain the least energy, because it must be supplied to them in the form of heat in order to convert them into the liquid or gaseous state, while, on the contrary, heat must be withdrawn from gases to condense them to liquids or solids. Oxygen is one of the most permanent gases, and must therefore possess an enormous amount of energy, while carbon, on the other hand, being one of the most difficultly diffusible and volatile bodies, can only contain a little energy. This makes it extremely probable that the force of the sun, taken up by the plants, is not stored in their bodies, but in the free oxygen of the atmosphere. Hence the latter is to be considered as the inexhaustible source of power on which man and animals draw, and in the carbon we possess a valuable aid for making this energy, contained in the oxygen, available.—*Edmund Drechsel, in Popular Science Monthly.*

RECENT INVENTIONS.

An improved whip has been patented by Messrs. Henry Mullen and James Noble, Jr., of Westfield, Mass. The core of this whip is formed of a leather or rawhide piece at the butt and a whalebone piece at the lash end, so that the advantage of a whalebone whip is retained, while the cost is greatly reduced.

An improvement in fishing reels has been patented by Mr. John Palmer, of New York city. The invention consists of a fishing reel provided with an extensible crank for increasing the length of leverage when necessary when reeling in the line, the extension arm being adapted to be withdrawn to shorten the lever to ordinary length while casting out the line.

Mr. John Owen Smith, of Savannah, Ga., has patented a means for protecting windows or doors against burglars. It consists in a strong protective frame of metal or wood, provided with lugs at the top, adapted to enter seats formed in plates in the sides of the window frame, and provided with tongues of metal at the bottom, projecting at right angles to the frame inwardly, and adapted to enter horizontal holes in the window sill and be locked by set screws or pins inside.

An improved combined button lap and stay for garments has been patented by Mr. David W. Thompson, of Englewood, Ill. The invention consists in the combination, with the garment or body piece having simply a straight slit cut in it where the opening is to be, of a single piece of material, which, when folded and stitched to the sides of said slit, constitutes both an upper and under button lap or fly, a facing, and a stay for re-enforcing the bottom of the opening, making a finished piece of work without raw edges.

An improved process of making skinless furs and articles thereof has been patented by Messrs. Charles Koch, Jr., and Charles E. Burgmüller, of Newark, N. J. By this process the inventors are enabled to produce real fur without the pelt or skin of the animal. The process is such that articles of apparel, such as caps, collars, muffs, and the like, of any shape or style, may be made in the manufacture of the fur, and the articles may be made seamless, and fur may be left upon both the inside and outside of the articles, if desired.

Removing Prints from their Mounts.

It is by no means an unusual circumstance that, for some reason or other, it becomes necessary to remove a photograph from its mount. Possibly it is mounted on the page of an album, and it may be desired to frame it or transfer it to another; or, on the contrary, it may be framed, and it is desirable to place it in an album; or, again, the style of frame and mount is not in accord with others with which it is to hang, or, what is by no means improbable, the print has faded, and it becomes necessary to replace it with a fresh one, retaining the original mount, which may bear an autograph that it is important to preserve.

Now, the removal of a print from its mount—as, no doubt, many from experience are aware—frequently proves to be by no means such a simple operation as at first sight it may appear, and the attempt often leads to the destruction of a valuable picture, or—what in some cases is an equal misfortune—the original mount is injured to such an extent that it becomes worthless.

If we could always ascertain the mountant employed much trouble would be saved, as we should then at once know how to proceed. In the present instance we shall assume that we are entirely ignorant of it. The first thing to do, supposing the print to be framed, is to take it out, and, if it be in a cut-out mount, to remove that. If the print were framed by a photographer, in all probability it would be simply secured to the mount by strips of gum paper; but if by a picture-frame maker or a professional mounter, it will, no doubt, be glued to the mount, in which case, unless care be taken in separating it, the picture may be torn at the edges. The best plan is to gently force it away from the mount by passing the blade of a palette knife round the opening from the inside. After removal the picture is closely examined to see if any clew can be obtained as to the kind of cement with which it is attached. If it be "rough mounted," probably some of it may have exuded from the edges, and then its color may serve as a guide; for if it be dark in color it is no doubt either glue or dextrine, and if the former it may be detected by wetting it with saliva, when its well known odor will be developed.

India rubber has been so little employed as a mountant that the probability of that having been used is somewhat remote; yet it may have been. In that case, if the picture have been but recently mounted, it may sometimes be removed by raising one corner with the point of a penknife, and then gently peeling it off; or, if the mounting be of an old date, possible the India-rubber may have perished, and then its removal is easy enough. Failing this the picture must be saturated with benzole, and this will soften the rubber and permit of an easy removal. If the mount be of plate paper the benzole is better applied from the back.

We will now suppose that India-rubber was not the mountant employed; therefore the print should be immersed in clean cold water, where it may be allowed to soak for an hour or two, trying it from time to time to see if the mountant has softened at all. If so, a longer immersion will, no doubt, allow of its removal. If, on the contrary, after several hours' soaking the cement show no signs of yielding, the print should be put into warm water for a quarter of an hour or so, when, if the mountant be glue or gelatine, the print and mount will be easily separated.

With this treatment most of those materials that are employed for mounting photographs will have yielded, but there are some kinds of starch which will obstinately resist it—even after many hours' soaking in both hot and cold water. When we get an obstinate case such as this, it is better to abandon the idea of removing the print from the mount, but to reverse the order of procedure and remove the mount from the print. Doubtless, from the prolonged soaking, the mount itself will have shown signs of succumbing, and we, therefore, proceed to separate the sheets of paper of which it is composed (one by one) until we get to the last—that to which the print is attached. It is now removed from the water, placed face downward on a plate of glass, and flooded with warm water. The paper is now abraded and carefully rubbed off, bit by bit, with the finger, and with care and patience it may be entirely removed without injury to the picture.

Supposing the print has been mounted in an album, the treatment above described cannot be applied. We must, therefore, proceed as follows: First get two plates of tin, or pieces of waterproof paper (such as are employed in copying books), somewhat larger than the pages, and several sheets of damp, white blotting-paper a little smaller. Now place several sheets of the latter at the back and front of the leaf carrying the print, inclose the whole between the tin plates, and put them under pressure. The tin plates will effectually protect the other leaves of the album from the moisture. After resting for an hour or two (during which time the blotting-paper must be kept damp), if the print cannot be removed the blotting-paper should be ironed with a hot laundry iron. After this treatment the print can no doubt be easily removed, and any adherent cement cleaned off with a soft sponge and warm water. The leaf is then pressed between several thicknesses of dry blotting-paper; after which sponged both back and front with strong alcohol, and again blotted off. If this treatment be repeated several times the alcohol will remove the greater of the water, and the leaf when dry will not be nearly so much cockled as if it were allowed to dry spontaneously.

It sometimes happens that it is necessary to remove a print which has faded from its mount, and the latter may contain a title or an autograph, which it is impossible to replace. Under these circumstances we proceed in much the same manner as with the album, taking care, however, that the blotting-paper as well as the water with which it is moistened is scrupulously clean, as plate paper is most easily soiled. In an obstinate case, the print being of no valve, it may be rubbed off piecemeal, as was recommended for removing the last sheet of paper, when the mount had to be destroyed. After the print has been "coaxed off" the margin of the mount should be thoroughly wetted, and then dried between sheets of blotting-paper, which will keep it flat. In putting prints on mounts that have borne other pictures care should be taken that they are trimmed a trifle larger than the old ones, so that they overlap the space previously occupied.—*Brit. Journal of Photography.*

How to Avoid Dangers in Electric Lighting.

The Boston Manufacturers' Mutual Fire Insurance Company is engaged in making a thorough investigation as to the alleged dangers which may occur from the electric light and other matters connected therewith. The company makes the following observations in a recent preliminary report:

The danger of the arc lamp itself, unless protected above and below, has already been stated, and is easily provided against. The dangers of contact with telegraph, telephone, or electric watch clock wires, are too obvious and well known to call for further warning, and are all readily guarded against in a well organized mill yard.

There is another danger, which may also be easily avoided but of which notice should be taken at once by every member using an electric arc light, or contemplating such use; namely, it appears that, if the wire conveying the current is suddenly fractured while the dynamo machine is in operation, the voltaic arc is extended while the ends of the wire are separating, through several feet of distance, varying according to the power of the machine; that is to say, if the wire is broken at such a place that one end can fall or separate from the other, the voltaic arc, or what would be called in common speech the electric spark, will follow from one broken end to the other, from one to six feet, according to the power of the current generated.

If in that distance the current should pass through or come in contact with wood or any combustible material, especially loose stock of fibrous material, fire would instantly occur. Such an arc might also and probably would be dangerous to life, if a person were exposed to it.

A fracture of the wire may be occasioned by the breaking of a belt, by the rupture of machinery, by a careless mechanic working in the neighborhood of the wire, and by many other causes which will be obvious to every member.

The greatest care should, therefore, be taken in choosing the position of the wires; and they should never be carried along the underside of the beams and transverse thereto, or in any proximity to belts, shafting or pipes.

The danger of suspended wires, exposed to the action of machinery, will be apparent. We are not yet fully prepared to suggest the true method of placing wires and protecting them, but, having indicated the danger, would ask suggestions from those who have used the electric light, in order to enable us to work out the proper instructions.

It may be suggested that the wires should be carried upon the walls out of reach of contact, and across the mill upon or protected by the beams but insulated therefrom.

In dye houses, bleacheries, print works, paper mills, and other works where wet processes are in use, the greatest care must be taken that the two wires do not come in contact, with the same surface of damp or wet wood, as in such case a cross arc may be formed upon the wood; and it appears that, if common salt is in the water, and perhaps other salts, the danger of a cross arc upon the wood is very much increased. Salt being used in whitewash, a damp surface of wood whitened may be most dangerous. By "cross arc" is meant the diversion of the electric current from one wire to another across the damp or wet woodwork.

It is suggested that this danger may be avoided wholly by carrying the wire from the machine to the lamp over a separate beam or surface of wood from that on which the other wire is carried away from the lamp.

It may be added that we have not yet found any cause of danger of fire, from the use of the electric method of lighting, which may not be avoided, if the right method and proper care be used in putting up and operating the apparatus; but electricity is a force which cannot be too carefully controlled, directed, and watched, if generated in currents of considerable intensity.

It will take yet a considerable time to obtain all the necessary information for making a full report upon this important subject, and our final report may not be submitted for some weeks.

We add also one word of caution. Our members should be careful with whom they deal, and be perfectly sure not only of good and safe work, but also of the responsibility of the contracting parties, both with respect to the character of the work and of immunity from loss, in view of the fact that the whole subject may be said to be shingled over with patents.

Medical Fees in London.

I believe that it is now the habit of the principal London physicians to charge three guineas ($15) for a visit at the house of the patient, two guineas ($10) for the first visit of a patient to the physician's office, and one guinea ($5) for a subsequent visit there. After all, a man who is believed to have special talents for healing is right to charge highly for it. The abuse seems to me to be this: whereas any physician may charge more than a guinea, no physician is allowed by the etiquette of the profession to charge less, and yet probably there are many clever young physicians who now have very little practice, and would themselves gain and benefit others, were they allowed to charge half a guinea.—*London Truth.*

Fire-Resisting Construction.

It is a common error to suppose that stone and brick and iron are the only materials capable of resisting fire. The brick arch and cast iron girder system has been found hopelessly defective—in fact positively mischievous, and the only way of rendering iron safe was not discovered till large factories and buildings had been wrecked. Then it was found that the weakness of the system resided in the exposed lower flanges of such girders, and it was not long after the incasing of the ironwork with some refractory material, such as concrete or fireclay, suggested itself. Concurrently with the notion that nothing is safer than iron, is the belief often held that wood is the most destructible of all materials. In reply to those who distrust wooden construction, we may refer to some plans which have been proposed to render wooden flooring resistive of the action of fire, but which appear to have escaped attention.

One of these is to construct solid timber floors, composed of ordinary joists placed close to each other, and spiked or screwed at intervals with bolts. The bolts are fixed alternately. To form a key for the plastering angular grooves are cut under each joist, these grooves forming a series of dovetails. In a similar manner stairs can be formed by a series of joists screwed or spiked together, which are cut to the form of the soffit, the latter being prepared for plastering by grooves. This system of construction was introduced by Messrs. Evans & Swain. With regard to partitions, the French plan of constructing them with quarterings, filled in with rough stone rubble, then lathed on each side with strong laths, and a coat of plaster applied and pressed through the vacuities from each side, ought to be more generally employed. In the construction of roofs the solid system of concrete or of layers of fibrous material covered with earth and sand, as used by some Eastern nations, have undoubted merits over the timber and hollow roof systems used by modern builders, which readily invite fire. Solid concrete flats laid on iron joists, or iron joists fixed to the inclination of the roof, and then filled in with concrete on the French system, covered with Claridge's asphalt, would render our large buildings comparatively safe from the destructive ravages of flames which now find their way through the roof.

Wood and concrete are not so much used together as they might be. In floors, as well as in roofs, the timbers might be filled in with concrete. Mr. Marrable adopted a very simple method of constructing floors. Instead of the wooden joists being cut to the usual rectangular section they were cut diagonally of a wedge-shaped form and placed at about eighteen inches apart, the wide end being placed downward. Upon these concrete was filled in upon a wooden centering, and the joists performed the office of skewbacks for the concrete. Another form of floor, suitable for warehouses, offices, and small dwellings, is composed of wood joists with a lower flange, these flanges being made also of wood rabbeted close together, forming a boarded ceiling in appearance below. This ceiling could be painted. Such a timber floor resists an outbreak of fire for some time, and is very strong. We do not now consider the many excellent, though more costly, systems of flooring of iron and concrete, or iron incased with fireclay or embedded in concrete, such as the Dennett, the Hyatt, and Moreland systems, our object being to show that timber can be used with good effect to resist as well as to court the flames. A solid impermeable surface or floor covered with asphalt has been known to resist the flames for hours, and by imprisoning it the danger of a conflagration is lessened. It is this principle which has given to the concrete floors their invulnerable character. The value of doors of concrete, such as those erected by Mr. Lascelles, and wrought iron sliding doors, are great, and for security against the extension of fire surpass the sheet iron doors provided by the Building Act.—*Building News.*

Tractive Force upon Macadamized Roads.

Some interesting experiments have been made at Salem, Mass., to ascertain the tractive force requisite to move street cars and vehicles on a macadamized road. The apparatus used consisted of an inclined plane, at the upper end of which was an iron wheel, over which passed a rope. A loaded box car, weighing, with its contents, 12,820 lb., was drawn up the grade by a weight of 970 lb. suspended at the other end of the rope. The empty car, weighing 4,820 lb., was drawn up the same grade by a weight of 283 lb. A smaller box car weighing when empty 2,730 lb., was occupied by fourteen persons, and drawn up by 339 lb., and when unoccupied by 176 lb. An ordinary load of sand on a macadamized road was started by 514 lb., and an empty hack, weighing 1,550 lb. by 196 lb. The same hack, with four passengers inside, required 230 lb. to move it. On a level road the load of sand was started by 240 lb., while the large box car yielded to 56 lb. These experiments were made by a horse railroad company to prove that their work was not unusually severe for the horses, and the result was declared to have been altogether satisfactory.

The Art of Seeing Stereoscopic Pictures Without a Stereoscope.

In order to describe in what manner any individual possessing eyes in fair condition may be able to bring both pictures of a stereoscopic card into one, it is not at all necessary to go into the somewhat abstruse question of the convergence of the optic axes, which, although necessary if we were discussing binocular vision in the abstract, is not so when giving, as we propose to do, simple directions by which the stereoscopic effect may be seen *without the stereoscope.*

The eyes must, first of all, be tutored, by giving them a somewhat simple lesson to perform. The way by which we have invariably succeeded best in this tuition of the eyes is to make two bold ink marks, such as a cross, at a distance of an inch apart, upon a sheet of white paper, and within a half inch of the upper edge of the sheet. Now, upon a second sheet of paper make another single mark, similar to the two others. We prefer a cross for this purpose, although any other form will answer. Hold this latter sheet about twenty inches from the eyes, which must then be directed to the cross. While this is being done, hold the other paper, with its two marks, about half way between the eyes and the single cross sheet. Upon looking intently at the single or more distant mark the mind will soon become conscious of there now appearing to be *three* crosses upon the nearer sheet. Should they not coalesce immediately, move the paper a little way near to or further from the eyes till they do so.

It is now requisite that the eyes be diverted from the distant mark to the central one of the three that are apparent on the nearer paper, and after a minute's practice this can readily be done. The next step in advance is to practice upon a card having two similar crosses at a much greater distance apart than the former pair; and when these can be with facility brought into one, in doing which it may be necessary to hold them at a greater distance away than in the former case, then may a stereoscopic slide be substituted.

At first it is best to employ a stereoscopic picture specially selected for the purpose—one having a well-defined bold object in the center, such as a tree. Not only so, but it will be advantageous to cut this picture into two halves and remove a piece from the center, so as to bring the objects much closer together than is usually the case; for the nearer the two pictures are together the more easy will it be for the eyes to unite them by the process described. There will be three pictures visible, but the center one, being composed of the other two, will stand out in full stereoscopic relief.

While examining this divided photographic picture upon a table, as soon as the eyes have acquired facility in individualizing every detail in them, the halves may be slowly separated; and if, during this operation, the eyes are fixed upon one point of the scene depicted, a separation to the extent of the distance between the two eyes may be made.

Should there be more difficulty in getting the photographs to combine than was experienced in the case of the two ink crosses let them be treated as in the original experiment; that is to say, hold up the single cross sheet at a distance of thirty or forty inches, and hold up the pictures at eighteen or twenty inches away. Now look at the cross until you realize that the slide which intervenes contains three pictures, and let the eyes be then gently transferred from the contemplation of the cross to the center figure on the stereoscopic slide, which will be in the same line of vision. The stereoscopic effect will now be seen in all its boldness.

After this art has been acquired it will not again be forgotten, and it will afford a high degree of pleasure to its possessor, who, when turning over a quantity of stereoscopic pictures on the table of a friend, or when examining them in the window of a store, can realize their full beauty without requiring to use an instrument.—*Photo. Times.*

The Great Desert of Sahara.

In a paper which Dr. Oscar Lenz contributes to the *Zeitschrift* of the Berlin Geographical Society, he gives an authentic account of the results of his journey across the Sahara, from Tanger to Timbuctoo, and thence to Senegambia. The real journey was begun at Marrakesh, at the northern foot of the Atlas Mountains, where Dr. Lenz laid in his stores of provisions and changed his name and dress, traveling further under the disguise of a Turkish military surgeon. He crossed the Atlas and the Anti-Atlas in a southwestern direction. The Atlas consists, first, of a series of hills belonging to the Tertiary and Cretaceous formations, then of a wide plateau of red sandstone, probably Triassic, and of the chief range which consists of clay-slates with extensive iron ores. The pass of Bibauan is 1,250 meters above the sea level, and it is surrounded with peaks about 4,000 meters high, while the Wad Sus Valley at its foot is but 150 meters above the sea. The Anti-Atlas consists of Palæozoic strata.

On May 5, 1880, Dr. Lenz reached Tenduf, a small town founded some thirty years ago, and promising to acquire great importance as a station for caravans. The northern part of the Sahara is a plateau, 400 meters high, consisting of horizontal Devonian strata, which contain numerous fossils.

On May 15 Dr. Lenz crossed the moving sand dunes of Igidi, a wide tract, where he observed the interesting phenomenon of musical sand, a sound like that of a trumpet being produced by the friction of the small grains of quartz. But amidst these moving dunes it is not uncommon to find some grazing places for camels, as well as flocks of gazelles and antelopes. At El Eglab Dr. Lenz found granite and porphyry, and was fortunate enough to have rain. Thence the character of the desert becomes more varied, the route crossing sometimes sandy and sometimes stony tracts of sand dunes, with several dry river beds running east and west between them.

On May 29 he reached the salt works of Taudeni, and visited the ruins of a very ancient town, where numerous stone implements have been found. Here he crossed a depression of the desert only 145 to 170 meters high, while the remainder of the desert usually reaches as much as 250 to 300 meters above the sea level, and he remarks that throughout his journey he did not meet with depressions below the sea level. The schemes for flooding the Sahara are therefore hopeless and misleading. The landscape remained the same until the wide Alfa fields, which extend north of Arauan. This little town is situated amidst sand dunes devoid of vegetation, owing to the hot southern winds. Four days later Dr. Lenz was in Timbuctoo, whence he proceeded west to St. Louis.

During his forty-three days' travel through the Sahara Dr. Lenz observed that the temperature was not excessive; it usually was from 34° to 36° Celsius, and only in the Igidi region it reached 45°. The wind blew mostly from the northwest, and it was only south of Taudeni that the traveler experienced the hot south winds (*edrash*) of the desert. As to the theory of northeastern trade-winds being the cause of the formation of the desert, Dr. Lenz remarks that he never observed such a wind, nor did his men; it must be stopped by the hilly tracts of the north. Another important remark of Dr. Lenz is what he makes with respect to the frequent description of the Sahara as a sea bed. Of course it was under the sea, but during the Devonian, Cretaceous, and Tertiary periods; as to the sand which covers it now, it has nothing to do with the sea; it is the product of destruction of sandstones by atmospheric agencies. Northern Africa was not always a desert, and the causes of its being so now must be sought for, not in geological, but in meteorological influences.—*Nature.*

A Perfect Apple Tree

BY H. C. HOVEY.

The apple tree has long been a favorite. That ancient botanist, Solomon, mentions it as conspicuous for beauty "among the trees of the wood," and other oriental writers have named it along with the graceful palm and noble citron. Apples have been cultivated on the soil of Great Britain ever since the time of the Roman invasion; and it is said that there are now known to be as many as 2,000 varieties, some of which are successfully grown as far South as New Zealand, while others thrive as far north as the 65th degree of latitude. The fruit is universally appreciated, and each variety has its admirers, from the globular, aromatic pippin, down to the painted Siberian crab. And yet, among all the thousands of trees now growing, how rarely do you see one that is shapely and symmetrical!

The perfect apple tree of which an account is here given is a specimen of the hearty, juicy, old-fashioned Vandeveer pippin. It was selected with care by my father, in 1838, and transplanted to a sunny, sheltered spot, near his home in Crawfordsville, Ind. The virgin forest had just been removed from the fertile soil amid which its roots were placed; and throughout its career it has been plentifully watered by the overflow from two ample roofs.

The law of spiral growth, so often distorted, has been beautifully wrought out in this individual tree. The reader is probably aware that the leaves on every tree follow a definite arrangement on the stem. The plan is highly complex in pines and cedars, but simple in the apple tree. Fasten a thread to a leaf and pass it from one to another, in the same direction, and it will go twice around the stem before reaching a leaf situated exactly above the first. The divergence of the second leaf from the first is 144°, or two-fifths of a circle; there is the same distance between the second and the third, and so on to the sixth, which is directly above the first. This is what is known as the *generating spiral.*

The leaf is the builder of the tree. It hangs out its inch or two of oval green in the air for breath and sunshine, and drinks in the dew and the rain, conveying the result of its vegetable chemistry to a permanent place in the substance of the tree. From the heart of each leaf a cord goes into the fiber of the wood, which is only a binding and knitting together of many leaf cords, and when the leaves shrivel and fall, these cords remain as their monuments. As Ruskin has said, "Behold how fair, how far prolonged in arch and aisle, the avenues of the valleys, the fringes of the hills, the joy of man, the comfort of all living creatures, the glory of the earth, they are but the monuments of those poor leaves that flit faintly past us to die."

It is evident that, unless the orderly procedure of nature be in some way disturbed, each twig, branch, and bough, and the very structure of the trunk itself, should conform to this law of spiral development, the entire fabric being reared after the plan marked out by the first five leaves.

And thus it is, in the fine old tree here held up as an example of what a tree is capable of becoming. All its conditions have favored a symmetrical and uninterrupted development. Hence one can trace the spirals from the ground to the outmost bough, except where they lose themselves by being knotted together.

Five buttressed roots, each one foot in diameter, mark the emergence of the tree from the ground. The circumference of the trunk immediately above them is nine feet; and it is made of five distinct strands, like those of a rope, twisted around each other, until at the height of six feet from the ground, and exactly over each corresponding root, each strand puts forth a branch. The girth of the tree, midway, is eight feet; but just below the whorl of branches it increases to nine again. The branches, five in number and arranged in a spiral, measure at the point of divergence respectively, three feet, three feet and six inches, three feet and eight inches, four feet, and four feet six inches. The height of the entire tree is about forty feet. The diameter of its canopy from north to south is forty-three feet; and from east to west it is forty-five feet.

It should be added that this patriarchal apple tree enjoys a green and fruitful old age; being still a prolific bearer, although it has stood where it now is for forty-four years, and is probably as much as forty-six years old.

Fertilizer Experiments.

In the discussion on fertilizers, at the recent meeting at Newtown, Conn., Mr. Sedgewick, of Cornwall, said he thought that Dr. Atwater's experiments had saved the farmers a great amount of money by teaching fertilizer manufacturers that less nitrogen is required for many crops than had formerly been supposed. Nitrogen is the most costly ingredient used in commercial fertilizers, and the most difficult at the present time to obtain. It would be wasteful, therefore, to use a greater quantity than is really needed, and such waste is exceedingly costly to the farmer. As it is found that less nitrogen is required, the price of fertilizers has been gradually dropping in market, and this gain is greatly to the benefit of the farmer. It enables him to buy more, and to use more with a fair prospect of obtaining a profit. One objection to the use of guano, he believed, was that it contains a larger percentage of nitrogen than is needed, and consequently a larger proportion than farmers can afford to pay for. A saving of one per cent in the amount of nitrogen in a ton of fertilizer will cheapen the cost about four dollars. He thought the most profitable way to use fertilizers is in connection with stable manure, the fertilizers being compounded in such a way as to make the manure and fertilizer together just meet the wants of the crops to be grown. Exactly how the nitrogen is taken by plants, he did not attempt to explain, but it is evident that soil which is well filled with the tops and roots of clover and other plants contains a large amount of nitrogen that the growing crop will in some way appropriate.—*New England Farmer.*

How to Make Peppermint Drops.

Take a convenient quantity of dry granulated sugar; place it in a pan having a lip from which the contents may be poured or dropped; add a very little water, just enough to make the sugar a stiff paste, two ounces of water to a pound of sugar being about the right proportion; set it over the fire and allow it to nearly boil, keeping it continually stirred; it must not actually come to a full boil, but must be removed from the fire just as the bubbles denoting the boiling point is reached begin to rise. Allow the sirup to cool a little, stirring all the time; add strong essence of peppermint to suit the taste, and drop on tins, or sheets of smooth white paper. The dropping is performed by tilting the vessel slightly, so that the contents will slowly run out, and with a small piece of stiff wire the drops may be stroked off on to the tins or paper. They should then be kept in a warm place for a few hours to dry. If desired, a little red coloring may be added just previous to dropping, or a portion may be dropped in a plain white form, and the remainder colored.

There is no reason why peppermint should alone be used with this form of candy, but confectioners usually confine themselves to this flavor. Any flavor may be added, and a great variety of palatable sweets made in the same manner. If desired, these drops may be acidulated by the use of a little tartaric acid and flavored with lemon, pineapple, or banana. In the season of fruits, delicious drops may be made by substituting the juice of fresh fruits, as strawberry, raspberry, etc., for the water, and otherwise proceeding as directed.—*Confectioner and Baker.*

Effect of Electric Lighting on the Demand for Gas.

The *Journal of Gas Lighting,* in a review of the past year, says: "Perhaps the most positive and abiding result of the rage for electric lighting in public streets is the increase of gas consumption which inevitably follows the removal of the electric lamps, or is insisted upon in districts adjacent to those occupied by the electricians. The old style of street lighting, with five foot burners, or even worse, will no longer satisfy the public in busy thoroughfares. More light is demanded even from gas, and there is consequently a large and growing use for high-power gas burners. It is fortunate for the interests of gas lighting that the opportunity has not been allowed to pass fruitlessly by the manufacturers of gas lamps. Numerous inventors, such as Herr Frederick Siemens, Messrs. Sugg, Bray, Wigham, and, latest of all, Mr. Douglass, have demonstrated that the modern demand for better means of lighting is capable of being amply satisfied by ordinary coal gas alone. Whether electric lighting eventually succeeds in establishing itself or not, it is certain that it has given a great impetus to the business of gas lighting in the past year.