country, it often happens that the tuner is also obliged to be a repairer of the actions of pianos.

The business of piano-tuning is another of the employments to which women are beginning to aspire. There is in Boston a school where, for some time, tuning has been regularly taught to both men and women. The objection that women have not the requisite fineness of ear is met by the fact that of the applicants for admission to this school only a small proportion fail to enter by reason of any aural defect. The sense of tune or harmony appears to exist in greater or less degree in the majority of civilized people, and, if there is but a germ, it can be educated into something practically useful, be the pupil man or woman. The objection that women have not the strength required in the art is nonsense, for, with the proper tools, a child can break a piano-string with ease. The time required by a young woman to perfect herself in the art of tuning the piano, the pipe and reed organ, is about one year. The course of study begins with a systematic training of the ear in pure unison. For this purpose the pupil is provided with a piano from which the action has been removed. The three strings for each note are plucked with the fingers, and alternately tightened or loosened with the proper lever or key, till the pupil's ear clearly apprehends the difference between unison and discord. No attention is paid to pitch, as the sole aim is to train the ear to a true unison of tones. If the pupil fails in this stage of the work, it is hopeless to go on. She is simply "harmony-blind," precisely as one may be color-blind.

The next step is the training of the ear in pure harmony. For this work a piano is used having a worm and gear in place of the usual friction-pin for tightening the strings, so that the work of tuning is very light, the slightest movement of the hand controlling the instrument perfectly. The pupil now learns the relations of tones in a true major third. Then thirds are added together till the (tempered) octave is reached. Here the pupil discovers that the pure harmony does not bring the unison she had expected (from her previous studies) in the octave. In this manner the pupil discovers for herself the science of temperament. She soon hears the growl of the "wolf," and learns to catch the wailing "beats" of the interfering sounds. Then the science of tuning must be explained, and this leads to the study of acoustics in their relation to keyed instruments. Lectures and demonstrations in harmony and music are a part of the course. Having made some progress in tuning pianos, the pupil then takes up the tuning of the reed and pipe organ, with daily practice upon both instruments. During the entire course there is also drill in the gymnasium, with proper appliances for strengthening the hands and wrist. A good tuner also should know how to repair a piano. To equip the young woman for this work, there is regular practice upon models of all kinds of piano and organ actions. These are taken to pieces and put together with the usual tools till the mechanism is clearly understood. The action of a piano is easily taken out for repairs, and, as all the parts are interchangeable (for the same style and manufacture), it is not difficult to purchase the various parts and put them in their place when necessary. It is true the action is heavy, but there is always some one near who will lend a hand in lifting it out of the instrument. Piano-tuning is both a healthful and a profitable occupation, and a study of tuning trains the ear to good music.

Charles Barnard.

THE WORLD'S WORK.

Substitute for Hydrogen in the Lime-Light.

THE rapidly increasing use of the lantern in schools, public lectures, and exhibitions has led to a number of experiments to reduce the cost of the lime-light. In point of power and general usefulness nothing better, except electricity, has been found than the combination of hydrogen and oxygen in a single flame thrown against a piece of lime. In a few large cities the gases are easily obtained in commercial quantities, stored in iron tanks, ready for use, and at comparatively low prices. The tanks are troublesome to carry, and in smaller towns the gases must be made on the spot as required, and this involves expensive and troublesome apparatus. Every effort has been made to find a substitute for one of the gases. Street-gas, alcohol, and other things have been tried in place of the hydrogen, but with a decided loss of light. Common ether has been tried several times, but has been considered too dangerous. More recently an apparatus for saturating the oxygen with the vapor of ether has been devised, that appears to remove all danger of explosion and to give an excellent light. The apparatus consists of two strong brass cylinders, placed side by side upon a wooden support. These are open at one end, and have brass nipples at the opposite ends for receiving the gas-tubes. In each tube is placed a cylinder or roll of loose fabric, like flannel, having a small hole in the middle. These rolls fill the cylinders completely, fitting tight, and leaving only the small passage for the gas through the center of the material. Common photographic ether may then be poured into the cylinders till the wick-like filling is completely saturated, and then the excess of liquid is poured off and put back in its bottle. Two rubber caps, joined together by a short tube, are then fitted over the ends of the cylinders, and to one of the nipples is fitted the gas-tube from the oxygen-holder or tank, and to the other a tube leading to the burner. The oxygen for the burner is supplied by a third pipe. To use the light the oxygen is first turned through the cylinders, entering the rear of one and passing, by means of the short tube,

to the next, and so on to the light. On its passage enough vapor is absorbed from the wicking to give a good flame at the jet, and when the oxygen jet is added to it, a light is obtained that, as far as observation goes, is quite as good as the ordinary lime-light. The striking back of the flame, and consequent explosion of the ether gas, when the gas is suddenly shut off, is said to occur but rarely, and with proper care it need never happen. However, to prevent all serious results of such an explosion, the rubber caps and tube joining the two cylinders are put on very lightly, and if there is an explosion the caps will be blown off before any dangerous pressure is reached. The invention has the merit of saving all the trouble of making or carrying hydrogen, as the whole apparatus can be carried in the hand, while ether can be obtained anywhere. One filling of the cylinders will last about ninety minutes, and a quart of ether will give a light for five hours.

Fire-Proof Construction.

THE objection commonly raised against fire-proof materials and systems for dwellings is their cost. Wooden floor-beams and lath-and-plaster partitions are so much cheaper than any of the excellent fire-proof materials that have been described here within the last few years, that it is difficult to find any ordinary city dwelling that is in any sense fire-safe. To meet this objection a new system has been introduced, that aims to make ordinary floor-beams and walls fairly proof against fire. Nothing is absolutely fire-proof, and the aim of all methods now is to prevent the spread of fire by confining it to one place, and checking the actual speed of combustion. To accomplish this, it appears only necessary to exclude the air as nearly as may be from all wooden surfaces. In the new system the beams are laid in the ordinary manner, pains being taken to have the under side of the floor perfectly level. On each side of every beam next the lower edge is nailed a narrow strip or ledge. The fire-proof protection consists of slabs of plaster-of-Paris and broken coke or cinders, resembling the plaster slabs used for partitions, but somewhat lighter, thinner, and finer in texture. For protecting the sides of the beams the slabs, having a step or rabbet on one edge, are placed against the beams, supported by the ledge which fits the step on the slab, and are nailed securely to the beam. The slabs are of the same width as the beam, and when in place, and when the cracks between the slabs have been stopped with liquid plaster, the beam is cased in an air-tight covering on two sides. The top is protected by the floor, which rests on both beam and slabs: for it has been found that wood protected from the air at the sides burns very slowly downward from the top. Beneath, the beams are protected by nailing larger and thicker slabs directly to the under side of the beams. Each slab covers three beams in width, breaking joints in the middle of the beams, and when all the beams are covered and the cracks made air-tight, the unbroken sheet of plaster slabs may then be used as the ceiling of the room below, a finishing coat being all that is needed. As a further protection, and to deaden the floors, another slab is inserted between the beams a short distance above the lower slab, and resting on a ledge formed on the side slabs. This arrangement divides the floor into two parts or hollow air-spaces, and effectually prevents sounds from passing from one floor to another. It also serves as an additional protection. In case of a severe fire under the floor, the nails supporting the lower slabs might become heated, char the wood, and drop out, letting the slabs fall. The second slabs would prevent the flames from passing between the beams, and only the lower edges of the beams could burn. As the slabs can be easily cut and repaired, there is no difficulty in making repairs of the gas or water-pipes that may be laid in the floors, and in case of leaking gas, or even of fire from electric light wires laid in the floors, no harm can follow, as the pipes and wires are inclosed in the air-tight space between the slabs. At an experimental test of this system of fire protection a number of common floor-beams, protected by the slabs and a floor above, were exposed to a fierce fire below for over an hour without injury to the floor. A portion of the lower slabs then fell off, exposing the lower edges of two beams to the fire. They were burned somewhat, but the progress of the fire was so slow that the strength of the beam was not appreciably impaired, though the fire below was kept up twenty-five minutes longer. A fire was then built on top, and allowed to burn till the floor was destroyed. On putting out the fire the beams were found to be only slightly charred on the upper edge, and to be practically as strong as ever. As far as our inspection of the beams that were exposed to the fire on both edges could decide, they seemed to be sufficiently strong after the fire to carry any ordinary load that could be put upon them. Given sufficient time and heat, of course such a system would fail. This is not the aim. If the fire is checked, and the strength of the floor maintained till help arrives and the fire can be put out, the construction meets all practical requirements. This appears to be accomplished. To make a slow-burning partition, the usual scantling is replaced by rough boards, tongued and grooved and fitted together, and making a solid but thin wall of wood. At intervals on each side of the partition is nailed lathing, placed vertically and in the middle of a board. Upon these are nailed horizontally the ordinary lathing. This gives a lath-and-plaster wall, but with no large, hollow places in which fire may spread unseen. The rough coat is put on as soft as possible, and the mortar is forced between the laths, filling all the narrow space behind them. This gives a wall of solid plaster, with a solid wooden core, the laths and boarding being covered air-tight on both sides. An inspection of some partitions built in this way seemed to indicate that the system is as valuable as that just described. The wall was firm, solid, and stiff, and showed a decided gain in thickness over the ordinary style of partition. The plaster was carried close to the floor and ceiling to prevent the intrusion of fire and rats behind the mop-board and cornice, and the door-jambs were made solid to exclude the air from the ends of the wall. Both of these methods of construction are cheap, the cost of a fire-proof wall being only a trifle more than an ordinary lath-and-plaster partition.

The Electric Light in Photography.

THE arc light has already been made the subject of experiment in photographic portraiture, and is now regularly used to illuminate a number of studios in Europe. By a new arrangement of the lights and the studio, the source of light is placed completely within the control of the operator, and effects are obtained that cannot be secured in any other way. The studio examined is at the end of a low, dark store on the ground floor, and there is no dependence whatever upon daylight. Upon the sides of the room near the ceiling are two tracks carrying a wooden car that reaches from side to side of the room. On this car are laid tracks for a smaller car, that travels on across the room in the opposite direction. The arrangement, it will be seen, is the same as that used in stone-yards and machine-shops, and known as an overhead crane. On this crane is suspended a powerful arc light, and, by pulling cords at the side of the room, the light can be moved to any part of the ceiling, or raised and lowered, as may be desired. In front of this crane is another having only one motion, across the room, the car on top carrying five arc lights suspended beneath it. This crane is also controlled by cords in easy reach of the operator. The subject sits in front of these six lights, and by moving the lamps perfect control of the illumination is secured. The light may be concentrated at one side, or spread out in front, or distributed in any manner that the artistic treatmen requires. To secure still more complete control of the light, a platform is placed in the middle of the room before the lights. This platform is large enough to contain a seat for the subject and the camera. It is also pivoted at the center, so that it can be turned completely round in a horizontal plane. In taking a portrait, the subject sits upon the platform facing the camera, and the lights are raised, lowered, or moved about till just the effects of lighting that are desired are obtained. The operator stands on the floor behind the camera, with one hand resting on a handle fastened to the platform. The instant the exposure begins, the operator slowly turns the platform round, keeping it in motion while the exposure lasts. It is plain that the camera keeps the same relative position to the subject during the time of exposure and while the platform is moving, while the relation of the subject to the light is continually changing. This arrangement gives a continually shifting play of light on the subject, and secures a portrait having a fine gradation of tone and excellent modeling of the features. Only dry plates are used with the apparatus, and the exposure is a trifle longer than with daylight. To secure a like degree of definition the plate must be exposed five seconds, where a dry plate in sunlight would require three seconds. The portraits made by this arrangement of electric lights were marked by an excellent degree of finish, so that retouching did not appear to be necessary. The complete control of the light makes it possible to carry on work at all hours of the day or night, and in any weather. For copying, the electric light appears to be excellent, a single arc lamp with a reflector of white paper being all that is required.

Rain-band Spectroscopes.

WHILE the spectroscope has proved to be one of the most remarkable inventions of modern times, and while it is an invaluable aid to nearly all scientific research, it has not proved of general use in the daily work of the world. It is too costly, and can only be employed in the study of light, and, withal, the spectroscopic department of this branch of physics is a limited one. In the use of the spectroscope in studying the light of the sun there has been noticed a peculiar darkening of the solar spectrum, that appeared to be due to causes in the air, and not in the sun. In the colored band of the solar spectrum there appear, between the orange and yellow, a group of dark lines, the largest of which is known as the sodium line, and is marked "D" on the spectrum maps. This line is due to the presence of sodium in the sun, and is one of the most familiar of the absorption bands. Near this line is the group of lines known as the rain-band, a series of absorption lines due to the presence of invisible watery vapor in the atmosphere. In large spectroscopes this rain-band, when at its best, appears as a group of lines and hazy bars, and, by studying the changes in the number and intensity of these lines, something can be learned directly of the amount of watery vapor in the air, and indirectly concerning the weather for the next following day. If all the lines are visible, there is much vapor in the air, and, though the sky may be cloudless, rain may be expected very soon. If all, or nearly all, disappear, the following day will be pleasant. From this study of the rain-band in the spectroscope, it appears possible to predict the weather one or two days in advance with tolerable certainty. A spectroscope showing all the details of the rain-band group of lines would cost too much for ordinary purposes, and smaller and cheaper instruments have been recently introduced. These are not intended to show a very fine spectrum, but only enough of the red and green where the rain-band may be found. These spectroscopes are inserted in a small brass tube, about three inches long, that can be easily carried in the vest pocket. In the one examined, provision is made for adjusting the focus of the eye-piece by drawing out a telescopic slide. To adjust the slit of the prism, a small screw is placed at the side of the tube. It was dull and cloudy at the time, but on pointing it to the sky and looking through it, the rain-band could be seen as a thin line between the orange and yellow. Heavy rain followed the next day. It was not convenient to make further study of the subject with the instrument, but it appeared to be well made and properly adjusted to its work. In using this form of spectroscope, it should be pointed to the sky at a few degrees above the horizon, a north or west aspect being the best. No rules appear to be laid down as to the study of the band seen in these small spectroscopes, for the group of lines is here condensed into a single band; yet there seems to be no difficulty, after a little practice, in learning to judge of the amount of vapor in the air, and from this to infer the probable behavior of the weather.

BRIC-À-BRAC.

Swedenborg on Civil Service Reform.

"THERE appeared to me some spirits * * * who said that, when in the world, they had been in stations of great dignity, and that they deserved to be preferred to others, and to command them. They were examined by the angels, to ascertain what their character intrinsically was; and it was found that, in discharging the duties of the offices which they had filled in the world, they had not had regard to uses, but to themselves, and thus that they had preferred themselves to uses. But as they intensely desired, and were urgently solicitous, to be set over others, it was granted to them to take a place among some whose office it was to consult about matters of superior importance; when it was perceived that they were unable to attend at all to the business that was being considered, or to see things interiorly in themselves, and that, in their speeches, they did not regard the use of the matter in question, but some use connected with themselves; and further, that they wished to act from their arbitrary pleasure, according to personal favor. They were therefore dismissed from that function, and left to seek employment for themselves elsewhere. They went on, therefore, * * * and were occasionally received upon trial; but they were everywhere told that they thought of nothing but themselves, and of no matter of business except with a view to themselves; consequently, that they were stupid, and were only like corporeal, sensual spirits. On which account, wherever they went, they were soon sent away again. After some time, I saw them reduced to the greatest destitution, so as to ask for alms."—[Swedenborg's "Treatise on Hell," paragraph 563.]

"Nigger Mighty Happy."

PLANTATION SONG.

HOG start a-runnin' when de overseer callin';
Whipperwill holler when de jew-draps fallin';
Duck keep a-quackin' when de hard rain po'in';
Crows flock togedder when de young corn growin';
Pig gwine to squeal when de milk-maid churnin';
Nigger mighty happy when de blackberries turnin'!

Squ'el go to jumpin' when de scaly-barks comin';
Bee-martin sail when de honey-bee hummin';
Lean horse nicker when de punkin-vine spreadin';
Rabbit back his ear when de cabbage-stalk headin';
Rooster start a-crowin' when de broad day breakin';
Nigger mighty happy when de hoe-cake bakin'!

Big fish flutter when he done cotch de cricket;
Bullfrog libely when he singin' in de thicket;
Mule git slicker when de plantin'-time over;
Colt mighty ga'ly when you turn him in de clover;
An' it come mighty handy to de nigger man nater
When he soppin' in de gravy wid a big yam 'tater!

Black-snake waitin' while de old hen hatchin';
Sparrer-hawk lookin' while de little chicken scratchin';
Big owl jolly when de little bird singin';
'Possum gwine to clam whar de ripe 'simmons swingin';
Nigger mighty happy—ef he aint wuf a dollar,—
When he startin' out co'tin' wid a tall stan'in' collar!

J. A. Macon.

Free.

A DOVE lay caught in a fowler's snare;
By cruel cords her wings were pressed,
Ruffled was all her plumage fair,
And her heart beat fast in her panting breast.

But the fowler loosened each cord and twist,
He smoothed her ruffled plumes, and then
Her snowy bosom he gently kissed
And bade her seek the skies again.

And the fowler sighed; for, safe and fair
In summer skies, he knew that she
Would think of the cord and the cruel snare,
But not of the hand that set her free.

Walter Learned.

Ballade of Rhyme.

WHEN blossoms born of balmy spring
Breathe fragrance in the pleasant shade
Of branches where the blue-birds sing,
Their hearts with music overweighed;
When brooks go babbling through the glade,
And over rocks the grasses climb
To greet the sunshine, half-afraid,—
How easy 'tis to write a rhyme!

When invitations are a-wing
For gay Terpsichore's parade;
When dreamy waltzes stir the string
And jewels flash on rich brocade,
Where Paris dresses are displayed,
And slippered feet keep careful time;—
In winter, when the roses fade,
How easy 'tis to write a rhyme!

When by your side, with graceful swing,
Some fair-faced, gentle girl has strayed,
Willing and glad to have you bring
Your claims for love and get them paid
In kisses, smiles, and words that aid
The bells of bliss to better chime;—
When Cupid's rules are first obeyed,
How easy 'tis to write a rhyme!

ENVOY.

Reader, forgive me, man or maid,
Against Calliope this crime;
And let this brief ballade persuade
How easy 'tis to write a rhyme!

Frank Dempster Sherman.