box coils placed in the middle of the rooms, with a temperature of 65°, with a small ventilation, with the currents of air in the room up at the center and down at the windows (contrary to the general principle of warming for comfort) gave a result which was declared good.

In piano-case manufactories, and where specialties in glued and veneered furniture of the best quality are made, the workmen are generally supplied with a drying cabinet of a size suitable to the pieces to be done, in which the work is heated before the glue is applied, and into which it is again placed to properly dry.

These cabinets are usually rectangular boxes, with holes in the bottom and top, to allow the air from the room to circulate through them so as to carry off the moisture. Their steam coils are usually of the gridiron pattern, flat on the bottom of the box, with the valves on the outside. Sometimes they are heated indirectly with the warmed air conveyed in tin pipes from a large coil placed in some favorable position.

Some manufacturers claim the quicker the work can be dried after gluing the better it will be.

It is not profitable to dry by forcing air, as with a fan or blower, in connection with a steam coil.

High pressure steam should be used in connection with a blower.

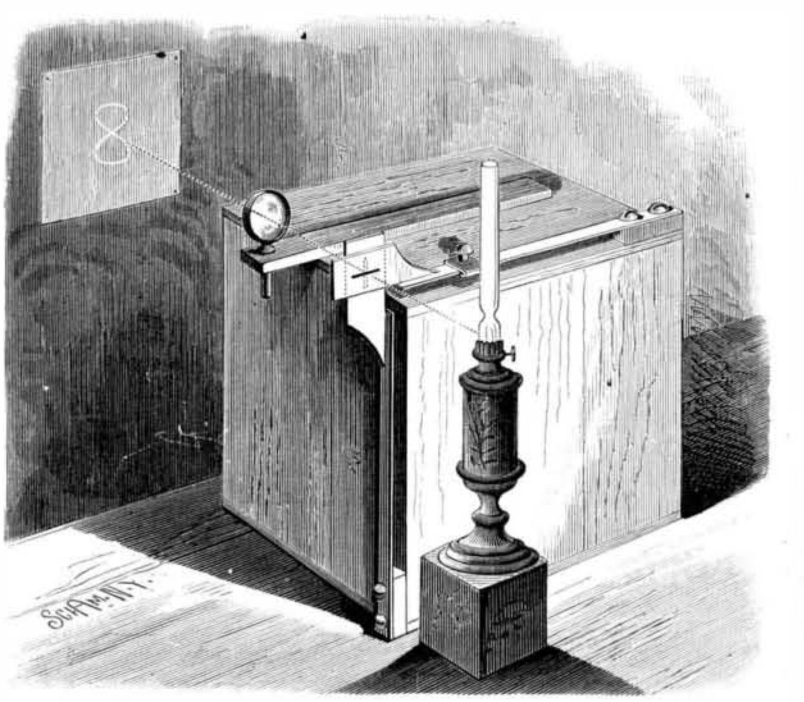
A temperature of 130° is considered good, and can be easily attained in a drying room.

The additional quantity of pipe necessary to raise the temperature of a drying room from 120° to 130°, if added again, will not raise it from 130° to 140°.

APPARATUS FOR COMBINING RECTANGULAR VIBRATIONS.

BY GEORGE M. HOPKINS.

There are several well known methods of combining rectangular vibrations to form the beautiful and instructive figures produced by M. Lissajous by means of two tuning forks carrying small mirrors and vibrating in planes at right angles to each other. The engraving shows still another method of accomplishing the same thing in a simple and inexpensive way; all the materials needed being a box about 24 inches square, two flat springs of wood, 1¼ inches wide, ⅛ inch thick, and 24 inches long; or two springs of metal $\frac{1}{16}$ inch thick, 1 inch wide, and the same length. These springs are secured to the sides of the box at diagonally opposite corners, by stout screws, a block 1 inch thick and 4 inches long being placed between the end of the spring and the box, to give space for the vibration of the spring.



APPARATUS FOR COMBINING RECTANGULAR VIBRATIONS.

Upon the free end of each spring, and in the plane of its vibration, is cemented a piece of thin cardboard, having a longitudinal slit ⅛ inch wide, parallel with the spring to which the card is attached. The slits in the two cards intersect each other at right angles, forming at their intersection a clear aperture ⅛ inch square. The two cards are placed as near each other as possible without touching. One of the springs carries an adjustable weight, the use of which is to change the period of the vibration of the spring by placing it in different positions. The weight is shown in the engraving on the horizontal spring, but it may be shifted to the vertical spring when a slow vibration is required.

If the two springs are set in motion by snapping them simultaneously with the thumb and finger, the square aperture formed by the intersection of the slits in the two cards will move so rapidly as to appear like a band of light, *i. e.*, supposing the operator to be looking through the aperture toward the light. If the two springs vibrate in unison the band will either be perfectly straight, bisecting the angle formed by the two springs, or it will be elliptical or circular. By changing the period of the vibration of one of the springs so that the periods of the two springs will be to each other as 1:2, the band of light will assume the form of the figure 8. Make the vibrations as 2:3, and the figure representing the fifth will be formed, and so on throughout the whole range of compound vibrations.

To project these figures on a screen all that is required is to place a lamp at one side of the slitted cards, and a magnifying glass of about six inches focus on the other side, as indicated in the engraving. An easy way to hold the magnifying glass in position is to place the handle in a hole in a board, the latter resting on the top of the box. This rude device admits of moving the lens forward or backward, and to the right or left, as may be required.

Arranged in this manner the figures may be made to occupy an area of 12 to 16 inches square on the screen. The same method applied to a lantern slide produces figures of any required size. Of course the construction of the apparatus is materially different in this case, and the workmanship necessarily finer.

If continuous action is desired electro magnets may be applied as in the electrical diapason described by me in this journal some months since.

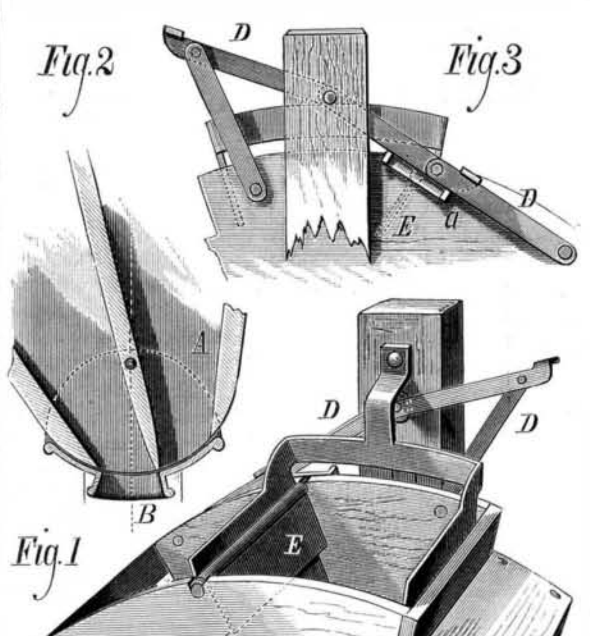
A Cæsarean Operation.

Twelve Philadelphia physicians lately assisted at the delivery of Mrs. William Burnell, by cæsarean operation. The mother is a dwarf, thirty-two years old, and forty-two inches high. Owing to a peculiar deformity it was seen that it would be impossible for her to give birth to the child in the usual manner. Porrow's method was adopted.

An incision was made on the median line of the abdomen, and the abdominal walls were cut through. The womb was removed, an incision made in it to correspond with those in the abdominal walls, and the infant released. After that the womb was restored to its bed and closed, and the other parts brought together. The clothing and all articles in the room were subjected to a solution of carbolic acid spray, according to Lyster's method, during the operation. The pulse of the woman remained excellent throughout the whole of this severe trial, and all her symptoms were favorable. At last reports both mother and child were doing well. Both would have died except for the heroic treatment adopted.

NEW GRAIN METER.

The grain meter shown in the engraving is designed to be used chiefly on thrashing machines, and can be readily attached to any separator, requiring no extra devices, except an elevator to carry the grain to it from the grain shute.



BARNARD'S GRAIN METER.

The weight of the grain does the work of measuring by simply oscillating the measuring box on its pivot. It will be seen that none of the power applied to the thrashing machine is consumed by the grain meter, which is entirely automatic and only requires to be supplied with empty sacks. The inventor informs us that actual use has proven that this meter is accurate and reliable and a great saver of labor.

In the engraving, Fig. 1 is a perspective view of the grain meter; Fig. 2 is a detail view of the locking mechanism; and Fig. 3 shows the valve at the bottom of the measuring box.

The box, A, is of quadrantal form, made convex at its lower end, and fitted to a concave valve, B, which is concentric with the pivot, C, upon which the box, A, oscillates. To the side of the box next its support are attached two jointed locking braces, D, which alternately lock the box in one or the other of its positions, and across the top of the box above the central partition which divides the box into two equal compartments, there is a wicket, E, whose pivot is extended beyond the side of the box and provided with two equal and opposite arms, *a a*, which are capable of touching the joints of the braces, D, and of unlocking them, so that the measuring box may swing and discharge one of the compartments, while the other is brought under the shute to be filled. The wicket, E, is operated by the pressure of grain when the compartment of the measuring box becomes filled. It will be noticed that the valve, B, having an opening of the same size as the opening of one of the compartments, only one side of the measuring box can be discharged at a time. Two strokers are attached to the standard supporting the measuring box, and brush the surplus grain from one compartment of the box, A, to the other. The speed with which the apparatus operates is controlled entirely by the quantity of grain flowing from the thrasher.

This useful invention was recently patented by Mr. George W. Barnard, of Economy, Wayne county, Ind.

The Color Blind Scare.

Connecticut is, we believe, the first State to pass a law prescribing certain regulations to be observed by railroad companies in regard to this subject. If all the other States should follow suit, and each of them enact a law as crude, vexatious, unjust, and annoying as this pioneer specimen, the skilled ophthalmic experts all over the land may safely count upon having a good time, however it may be with locomotive engineers and others who have rendered long and acceptable service upon our best managed roads. There is sure to be blundering, short-sighted work, when legislators who have no practical and scarcely any theoretical knowledge of railroad operation, undertake to remedy supposed defects in the system which in some unaccountable way have escaped the notice of the shrewdest and most capable managers; and the liability to blunder is none the less when the mercenary greed of a selected corps of professional experts is to be satiated at the rate of two dollars a head for the great army of railway employes whose duties require them to have anything to do with the form and code of signals. And so the companies must be taken in hand, and reliable and long-tried engineers, who have never had an accident on the road, driven from service because they can't read letters three-eighths of an inch long at a distance of 25 feet, or sort colored worsteds in a scientific manner, or see red and green precisely as some other people do, although they are able to discriminate just as sharply between the two, and be as little liable to confound or mistake one for the other. The logic of facts shows conclusively that the danger from color blindness, about which such a hue and cry has been raised, is greatly exaggerated, and that in no single one of the many careful and searching investigations that have been made in the past history of railroads, has the cause of an accident been traced to color blindness, nor has this particular cause even been suggested or suspected, so far as we have been able to ascertain from the record.—*National Car Builder.*

The Voice.

Dr. Ward, of New York, says on this subject, of the many agents which have more or less influence on the voice, the four principal are climate, dress, diet, and exercise. Change of climate may cause some slight deleterious effect on the larynx, but this influence is greatly overestimated. The present fashionable style of dress is decidedly unhealthy. The chest and abdomen are unnaturally confined, the lungs and other organs acting abnormally. All clothing should be loosely attached to the body, and the dress worn high. Avoid as much as possible appearing in full dress. The throat should not be wrapped in comforters, boas, etc. Chest protectors should not be worn, and the feet should be guarded against wet. The diet of the singer should be bland as well as nutritious. Of the different kinds of meat, venison, poultry, roast beef, and lamb are the easiest to digest, and due proportion of fat should be taken as a heat-supplying principle to the body. Cooked vegetables, unless too highly seasoned, are easily digested. Salads, cut cabbage, cucumbers, etc., should be avoided. Pastry should be invariably discarded. Dinner at noon, followed by a light tea at nightfall, is a rule which, if rigidly adhered to, will be a safeguard against all ordinary attacks of indigestion. In order that the act of singing be properly performed, it is absolutely necessary that the stomach be nearly empty. Alcoholic beverages should not on any consideration be indulged in by vocal artists.

For the full development and preservation of the vocal cords several rules must be observed. The exercises must be regularly and systematically practiced; they must always be within the register; they should never be pushed to the point of fatigue; they should never be made use of when the vocal organs are attacked with cold, no matter how slight. Always practice standing upright, so as to allow of full play of the lungs and accessory vocal organs. Bodily exercise is especially beneficial to the singer. In short, learning to sing is learning to be healthy.—*The Monthly Magazine.*

Ice at High Temperatures.

Prof. Thomas Carnelley writes as follows to the *Chemical News:*

Numerous experiments which I have made during the last few weeks on the boiling points of substances under low pressures, the details of which will shortly be published, have led to the following conclusions in reference to the conditions necessary for the existence of any substance in the liquid state. These are two in number, viz.:

1. In order to convey a gas into a liquid the *temperature* must be *below* a certain point (termed by Andrews the *critical temperature* of the substance), otherwise no amount of pressure is capable of liquefying the gas.

2. In order to convert a solid into a liquid the *pressure* must be *above* a certain point, which I propose to call the *critical pressure* of the substance, otherwise no amount of heat will melt the substance.

If the second of the above conditions be true, it follows that if the necessary temperature be attained, the liquefaction of the substance depends solely on the superincumbent pressure; so that if by any means we can keep the pressure on the substance below its critical pressure, no amount of heat will liquefy it, for in this case the solid substance passes directly into the state of gas, or, in other words, it sublimes without previous melting.

Having come to this conclusion, it was easily foreseen that if these ideas were correct it would be possible to have *solid ice at temperatures far above the ordinary melting point.* After several unsuccessful attempts I was so fortunate as to attain the most perfect success, and have obtained solid ice at temperatures so high that it was impossible to touch it without burning one's self. This result has been obtained many times and with the greatest ease, and not only so, but on once occasion a small quantity of water was frozen in a glass vessel which was so hot that it could not be touched by the hand without burning it. I have had ice for a considerable length of time at temperatures far above the ordinary boiling point, and even then it only sublimed away without any previous melting. These results were obtained by *maintaining* the superincumbent pressure below 4·6 mm. of mercury, *i. e.*, the tension of aqueous vapor at the freezing point of water. Other substances also exhibit these same phenomena, the most notable of which is mercuric chloride, for which latter the pressure need only be reduced to about 420 mm. On letting in the pressure the substance at once liquefies.

On the Absolute Invisibility of Atoms and Molecules.*

BY PROF. A. E. DOLBEAR.

Maxwell gives the diameter of an atom of hydrogen to be such that two millions of them in a row would measure a millimeter, but under ordinary physical conditions most atoms are combined with other atoms to form molecules, and such combinations are of all degrees of complexity; thus, a molecule of water contains three atoms, a molecule of alum about one hundred, while a molecule of albumen, according to Mulder, contains nine hundred atoms, and there is no reason to suppose albumen to be the most complex of all molecule compounds. When atoms are thus combined it is fair to assume that they are arranged in the three dimensions of space, and that the diameter of the molecule will be approximately as the cube root of the number of atoms it contains, so that a molecule of alum will be equal to

$$(\sqrt[3]{100} = 4{\cdot}64) \quad \frac{4{\cdot}64}{2000000} = \frac{1}{431000} \text{ mm.},$$

and a molecule containing a thousand atoms will have a diameter of $\frac{10}{2000000} = \frac{1}{200000}$ mm. Now, a good microscope will enable a skilled observer to identify an object so small as the $\frac{1}{4000}$ mm. Beale, in his works on the microscope, pictures some fungi as minute as that, and Nobert's test bands and the markings upon the *Amphiplura pellucida*, which are of about the same degree of fineness, are easily resolved by good lenses. If thus the efficiency of the microscope could be increased fifty times ($\frac{200000}{400} = 50$) it would be sufficient to enable one to see a molecule of albumen, or if its power could be increased one hundred and seven times it would enable one to see a molecule of alum.

Now, Helmholtz has pointed out the probability that interference will limit the visibility of small objects; but suppose that there should be no difficulty from that source, there are two other conditions which will absolutely prevent us from ever seeing the molecule.

1st. Their motions. A free gaseous molecule of hydrogen at the temperature of 0° C., and a pressure of 760 mm. mercury, has a free path about $\frac{1}{10000}$ mm. in length, its velocity in this free path being 1,860 m. per second, or more than a mile, while its direction of movement is changed millions of times per second. Inasmuch as only a glimpse of an object moving no faster than one millimeter per second can be had, for the movements are magnified as well as the object itself, it will be at once seen that a free gaseous molecule can never be seen, not even glimpsed. But suppose such a molecule could be caught and held in the field so it should have no free path. It still has a vibratory motion which constitutes its temperature. The vibratory movement is measured by the number of undulations it sets up in the ether per second, and will average five thousand millions of millions, a motion which would make the space occupied by the molecule visibly transparent, that is, it could not be seen. This is true for liquids and solids. Mr. D. N. Hodges finds the path of a molecule of water at its surface to be 0·0000024 mm., and though it is still much less in a solid it must still be much too great for observation.

2d. They are transparent. The rays of the sun stream through the atmosphere, and the latter is not perceptibly heated by them as it would be if absorption took place in it. The air is heated by conduction and contact with the earth, which has absorbed and transformed the energy of the rays. When selective absorption takes place the number of rays absorbed is small when compared with the whole number presented, so that practically the separate molecules would be too transparent to be seen, though their magnitude and motions were not absolute hinderances.

* Read before the American Association.

Lightning Strokes.

The fatalities from lightning are very much greater in number and extent than is generally supposed. In European Russia alone the deaths for five years—1870–74—were 1,452 men and 818 women. No fewer than 4,092 fires are here also officially reported from the same cause during this period. In Prussia, were the registration of the causes of death is exceptionally careful, 1,004 persons were reported as killed by lightning in the nine years from 1869 to 1877. If we may trust the report of our Registrar-General this country is more fortunate in this regard, for during the same period only 194 such deaths are registered for England and Wales; but our returns are admittedly incomplete.

In Austria—from 1870 to 1877 (eight years)—lightning occasioned upward of 40,000 fires, and destroyed more than 1,700 lives. In Switzerland the returns seem curiously variable. For example, in 1866 only three such deaths are reported; while in 1877 we find as many as thirty. Of the deaths by lightning in France, M. Boudin some years ago collected statistics, which showed that during the thirty years, beginning in 1834 and ending in 1863, as many as 2,038 people were struck dead by lightning in that country. During the last ten years of this period the deaths amounted to 880, and of these only 243 were women. Nothing, indeed, is more striking in these statistics than the uniform preponderance in the numbers of the male over those of the female sex. With the exception of Sweden—where, for some reason not explained, and not easily to be imagined, this preponderance is not so observable—there seem to be generally about two men killed to one woman. The traveler who accounted for the immunity of the Swedish women by their comparative "lack of personal attractions" was as ungallant, and we believe, moreover, as incorrect in his fact as he was certainly wanting in the decorum that forbids jesting on serious subjects. The country seems invariably to suffer more than the town; the village more than the great city.

Public buildings fare, it seems, little better than private houses, though a century and a quarter has elapsed since Franklin's famous experiment with the kite demonstrated the possibility of controlling the electric fluid, and nearly a century has passed since the learned, taking interest in lightning conductors, were divided into hostile factions on the famous question of "knobs or points." Mr. Anderson estimates that at least one-half, and perhaps two-thirds of the public buildings, including the churches and chapels, of Great Britain and Ireland, are without any protection against lightning; while it is believed that not five out of a thousand private houses are fitted with conductors. St. Paul's was among the first buildings in Europe to be protected, Benjamin Franklin's "lightning rods" having been first set up over Sir Christopher Wren's dome in 1768.—*London News.*

On Sound as a Nuisance.

For a long time it has been well known to the medical profession that in various critical states of the human system absolute silence, or the nearest possible approach to it, is not the least important condition to be secured. Accordingly muffled knockers, streets covered with straw or spent tan, and attendants moving about with noiseless step, are universally recognized as the signs and the requirements of severe disease. But the truth that noise is a contributor to the wear and tear of modern city life has scarcely yet been realized by the faculty, not to speak of the outside public. Consequently, while a zealous war is being urged against other anti-sanitary agencies, no general attempts for the abolition of superfluous noise have yet been made. We cannot, perhaps, give anything approaching to a scientific explanation why sound in excess should have an injurious effect upon our nervous system. Prof. Berthelot has recently shown, by a careful series of experiments, that sound waves do not, like thermic and luminous vibrations, set up chemical changes in bodies submitted to their influence; but our inability to give an account of the fact does not affect its existence. We feel that noise is distressing, exhaustive. The strongest man after days spent amidst noise and clatter, longs for relief, though he may not know from what. It may even be suggested that the comparative silence of the sea-side, the country, or the mountains, is the main charm of our summer and autumn holidays, and contributes much more than does ozone to restore a healthy tone to the brains of our wearied men of business. Indeed, if we consider, we shall find that this is the most unnatural feature of modern life. In our cities and commercial towns the ear is never at rest, and is continually conveying to the brain impressions rarely pleasant, still more rarely useful or instructive, but always perturbing, always savoring of unrest. In addition to the indistinct but never-ceasing sea of sound made up of the rolling of vehicles, the hum of voices, and the clatter of feet, there are the more positively annoying and distracting elements, such as German bands, organ grinders, church bells, railway whistles, and the like. In simpler and more primitive times, and to some extent even yet in the country, the normal condition of things is silence, and the auditory nerves are only occasionally excited. It is scarcely to be expected that such a change can be undergone without unpleasant consequences.

The question has been raised, why should some noises interfere with brain work by day and disturb our rest at night so much more than others? A strange explanation has been proposed. We are told that sounds made incidentally and unintentionally—such as the rolling of wheels, the clatter of machinery (except very close at hand), the sound of footsteps, and, in short, all noises not made for the sake of noise—distress us little. We may become as completely habituated to them as to the sound of the wind, the rustling of trees, or the murmur of a river. On the other hand, all sounds into which human or animal will enters as a necessary element are in the highest degree distressing. Thus it is, to any ordinary man, impossible to become habituated to the screaming of a child, the barking and yelping of dogs, the strains of a piano, a harmonium, or a fiddle on the other side of a thin party-wall, or the clangor of bells. These noises, the more frequently we hear them, seem to grow more irritating and thought-dispelling.

But while admitting a very wide distinction between these two classes of sounds, we must pause before ascribing these differences to the intervention or non-intervention of will. We shall find certain very obvious distinctions between the two kinds of sound. The promiscuous din of movement, voice, and traffic, even in the busiest city, has in it nothing sharp or accentuated; it forms a continuous whole, in which each individual variation is averaged and toned down. The distressing sounds, on the other hand, are often shrill, abrupt, distinctly accentuated and discrete rather than continuous. Take, for instance, the ringing of bells: it is monotonous in the extreme, but it recurs at regular intervals. Hence its action upon the brain is intensified, just as in the march of troops over a suspension bridge each step increases the vibration. The pain to the listener is the greater because he knows that the shock will come, and awaits it. Very similar is the case with another gratuitous noise, the barking of dogs. Each bark, be it acute or grave, is in the highest degree abrupt, sharply marked, or *staccato*, as we believe a musician would term it. Though the intervals are less regularly marked than in the case of church bells, we still have a prolonged series of distinct shocks communicated to the brain. Well might Goethe say,

"Vor allem
Ist das Hundegebell mir verhasst;
Klaffend zerreisst es das Ohr."

All the other more distressing kinds of noise possess the characters of shrillness, loudness, and of recurrent beats or blasts.

As an instance of an undesigned, unintentional noise being distressing to those within ear-shot, we may mention the dripping of water. A single drop, whether penetrating through a defective roof, falling from the arch of a cavern, or issuing from a leaky pipe, and repeated at regular intervals, is as annoying as the tolling of a bell, the barking of a dog, or the short, sharp screams of a fretful infant. The only difference is that the noise is not heard as far. We may hence dismiss the "will" theory, and refer the effects of noises of this class to regularity, accentuation, and sharpness.

It is particularly unfortunate that the multiplication of sound should accompany, almost hand in hand, that increase of nervous irritability and that tendency to cerebral disease which rank among the saddest features of modern life. A people worn out with overwork, worry, and competitive examinations might at least be spared all unnecessary noise. Many persons cannot or will not understand how necessary silence is to the thinker. A friend of the writer's, engaged in investigating certain very abstruse questions in physics, is often compelled to throw aside his work when an organ grinder enters the street, and suffers with acute pain in the head if he attempts to go on with his researches.

We should therefore propose, as measures of sanitary reform, the absolute prohibition of street music, which is more rampant in London than in any other capital in Europe. The present law, which throws upon the sufferer the burden of moving in the matter, is a mere mockery. Another necessary point is the abolition of church bells. In these days of innumerable clocks and watches every one can tell when it is the time for divine service without an entire neighborhood being disturbed for some twenty minutes at a time. Nonconformist places of worship collect their congregations without this nuisance. Further, all dogs convicted of persistent barking should be disestablished. And lastly, harmoniums, American organs, and wind instruments in general should be prohibited, except in detached houses.—*Journal of Science.*