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ACOUSTIC RAINBOW

A sounding-plate made of brass, nine inches long and half a line in thickness, covered with a layer of water, may be employed to produce a rainbow in a chamber which admits the sun. On drawing a violin bow strongly across the plate, so as to produce the greatest possible intensity of tone, numerous drops of water fly perpendicularly and laterally upwards. The size of the drops is smaller as the tone is higher. The inner and outer rainbows are very beautifully seen in these ascending and descending drops, when the artificial shower is held opposite to the sun. When the eyes are close to the falling drops, each eye sees its appropriate rainbow; and four rainbows are perceived at the same time, particularly if the floor of the room is of a dark colour. The experiment succeeds best if, when a finger is placed under the middle of the plate, and both of the angular points at one side are supported, the tone is produced at a point of the opposite side, a fourth of its length from one of its angles. An abundant shower of drops is thus obtained.

TRANSMISSION OF SOUND

Suspend any sonorous body, as a bell, a glass, a silver spoon, or a tuning-fork, from a double thread, and put with the finger the extremities of the thread, one in each ear; if the body be then struck, the apparent loudness and depth of the sound will be surprising.

Again, if you shut your ears altogether, you will yet feel very sensible of the impression of any sound conveyed through the mouth, the teeth, or the head : if you put one end of a small stick or rod in the mouth, and touch with the other extremity a watch lying on the table, the beatings will become quite audible, though the ears be actually shut. So, also, if a log of wood be scratched at one end with a pin, a person who applies his ear to the other end will hear the sound distinctly.

Fogs and falling rain, but especially snow, powerfully obstruct the free propagation of sound; and the same effect is produced by a coating of fresh-fallen snow on the ground, though when glazed and hardened at the surface by freezing it has no such influence.

Over water, or a surface of ice, sound is propagated with remarkable clearness and strength. Dr. Hutton relates, that on a quiet part of the Thames, near Chelsea, he could hear a person distinctly at 140 feet distance, while on the land the same could only be heard at 76 feet. Lieutenant Forster, in the third Polar expedition of Captain Perry, held a conversation with a man across the harbour of Port Bowen, a distance of 6696 feet, or about a mile and a quarter. This, however remarkable, falls short of what is related by Dr. Young, on the authority of the Eev. W. Derham, viz. that at Gibraltar the voice has been heard ten miles, perhaps, across the strait.

The cannonade of a sea-fight between the English and Dutch, in 1672, was heard across England as far as Shrewsbury, and even in Wales, a distance of upwards of 200 miles from the scene of action.

At Carisbrook Castle, in the Isle of Wight, is a well 210 feet in depth, and twelve feet in diameter, into which if a pin be dropped, it will be distinctly heard to strike the water. The interior is lined with very smooth masonry.

PROGRESS OF SOUND

A stretched string, as that of a pianoforte, may be made to vibrate not only from end to end, but in aliquot

parts, the portions being separated by points of rest which interrupt the progress of the sound. This kind of effect may be shown by shaking a long piece of cane in the air, when there will be one, two, or three points of rest, according to the mode of vibrating it.

An elastic surface has, likewise, some parts in motion and others at rest; and these parts may be made visibly distinct, by strewing pieces of bristle over them upon the sounding- board of an instrument.

When a bow is drawn across the strings of a violin, the impulses produced may be rendered evident by fixing a small steel bead upon the bow; when looked at by light or in sunshine, the bead will seem to form a series, of dots during the passage of the bow.

SOUND TURNING CORNERS

Take a common tuning-fork, strike it, and hold it (when set in vibration) about three or four inches from the ear, with the flat side towards it, when the sound will be distinctly heard; let a strip of card, somewhat longer than the flat of the tuning-fork, be interposed at about half an inch from the fork, and the sound will be almost entirely intercepted by it; and if the card be alternately removed and replaced in pretty quick succession, alternations of sound and silence will be produced: proving that sound is by no means propagated with so much intensity round the edge of the card, as straight forward. Indeed, to be convinced of this fact, you have only to listen to the sound of a carriage turning a corner from the street, in which you happen to be, into an adjoining one. Even where there is no obstacle in the way, sounds are by no means equally audible in all directions from the sounding body; as you may ascertain by holding a vibrating tuning-fork or pitch-pipe near your ear, and turning it quickly on its axis.

TO TELL THE DISTANCE OF THUNDER

Count, by means of a watch, the number of seconds that elapse between seeing the flash of lightning and hearing the report of the thunder : allow somewhat more than five seconds for a mile, and the distance may be ascertained. Thus, say the number of seconds is,—or the distance may be estimated by remarking the number of beats of the pulse in the above interval; provided, of course, that we know the rate at which the pulse beats in a certain time. In a French work it is stated, that if the pulse beat six times, the distance of the thunder will be about 30,000 feet, or five miles and a half; thus reckoning 5000 feet for each pulsation.

In a violent thunder-storm, when the sound instantly succeeds the flash, the persons who witness the circumstance are in some danger; when the interval is a quarter of a minute, they are secure.

HEARING BY THE TOUCH

If a deaf person merely place the tips of his finger-nails on the window-shutters or door of a room in which instruments are playing, he may enjoy their concert of harmony.

CONVERSATION FOR THE DEAF

If two persons stop their ears closely, they may converse with each other by holding a long stick or sticks between their teeth, or by resting their teeth against them. The person who speaks may rest the stick against his throat or his breast; or he may rest the stick, which he holds in his teeth, against a glass tumbler or china basin into which the other speaks. The sound may also be heard when a thread is held between the teeth by both persons, so as to be somewhat stretched.

GLASS BROKEN BY THE VOICE

On vibrating bodies which present a large surface, the effects of sounds are very surprising. Persons with a clear and powerful voice have been known to break a drinking- glass, by singing the proper fundamental note of their voice close to it. Looking-glasses are also said to have been broken by music, the vibrations of the atoms of the glass being so great as to strain them beyond the limits of their cohesion.

FIGURES PRODUCED BY SOUND

Stretch a sheet of wet paper over the mouth of a glass tumbler which has a footstalk, and glue or paste the paper at the edges. When the paper is dry, strew dry sand thinly upon its surface. Place the tumbler on a table, and hold immediately above it, and parallel to the paper, a plate of glass, which you also strew with sand, having previously rubbed the edges smooth with emery powder. Draw a violin bow along any part of the edges, and as the sand upon the glass is made to vibrate, it will form various figures, which will be accurately imitated by the sand upon the paper ; or, if a violin or flute be played within a few inches of the paper, they will cause the sand upon its surface to form regular lines and figures.

TRANSMITTED VIBRATION

Provide a long, flat glass ruler or rod, as in the engraving, and cement it with mastic to the edge of a drinking-glass fixed into a wooden stand ; support the other end of the rod

—p very lightly on a piece of cork, and strew its upper surface with sand ; set the glass in vibration by a bow, at a point opposite where the rod meets it, and the motions will be communicated to the rod without any change in their direction. If the apparatus be inverted, and sand be strewed on the under side of the rod, the figures will be seen to correspond with those produced on the upper surface.

DOUBLE VIBRATION

Provide two disks of metal or glass, precisely of the same dimensions, and a glass or metal rod ; cement the two disks at their centres to the two ends of the rod, as in the engraving, and strew their upper surfaces with sand. Cause one of the disks, viz. the upper one, to vibrate by a bow, and its vibration will be exactly imitated by the lower disk, and the sand strewed over both will arrange itself in precisely the same forms on both disks. But if, separately, they do not agree in their tones, the figures on them will not correspond.

CHAMPAGNE AND SOUND

Pour sparkling champagne into a glass until it is half full, when the glass will lose its power of ringing by a stroke upon its edges, and will emit only a disagreeable and puffy sound. Nor will the glass ring while the wine is brisk, and filled with air-bubbles ; but, as the effervescence subsides, the sound will become clearer and clearer, and when the air-bubbles have entirely disappeared, the glass will ring as usual. If a crumb of bread be thrown into the champagne, and effervescence be reproduced, the glass will again cease to ring. The same experiment will also succeed with soda-water, ginger-wine, or any other effervescing liquid.

MUSIC FROM PALISADES

If a line of broad palisades, set edgewise in a line directed from the ear, and at even distances from each other, be struck at the end nearest the auditor, they will reflect the sound of the blow, and produce a succession of echoes : these, from the equal distance of the palisades, will reach the ear at equal intervals of time, and will, therefore, produce the effect of a number of impulses originating in one point. Thus, a musical

note will be heard.

THEORY OF THE JEW'S HARP

If you cause the tongue of this little instrument to vibrate, it will produce a very low sound; but if you place it before a cavity (as the mouth), containing a column of air, which vibrates much faster, but in the proportion of any simple multiple, it will then produce other higher sounds, dependent upon the reciprocation of that portion of the air. Now, the bulk of air in the mouth can be altered in its form, size, and other circumstances, so as to produce, by reciprocation, many different sounds; and these are the sounds belonging to the Jew's harp.

A proof of this fact has been given by Mr. Eulenstein, who fitted into a long metallic tube a piston, which, being moved, could be made to lengthen or shorten the efficient column of air within at pleasure. A Jew's harp was then so fixed that it could be made to vibrate before the mouth of the tube, and it was found that the column of air produced a series of sounds, according as it was lengthened or shortened; a sound being produced whenever the length of the column was such that its vibrations were a multiple of those of the Jew's harp.

MUSIC OF THE SNAIL

Place a garden-snail upon a pane of glass, and, in drawing itself along, it will frequently produce sounds similar to those of musical glasses.

TO TUNE A GUITAR WITHOUT THE ASSISTANCE OF THE EAR

Make one string to sound, and its vibrations will, with much force, be transferred to the next string : this transference may be seen by placing a saddle of paper (like an inverted A) upon the string, at first in a state of rest. When this string hears the other, the saddle will be shaken, or fall off; when both strings are in harmony, the paper will be very little, or not at all, shaken.

MUSIC FROM GLASS OR METAL RODS

Provide a straight rod of glass or metal; strike it at the end in the direction of its length, or nib it lengthwise with a moistened finger, and it will yield a musical sound, which, unless its length be very great, will be of an extremely acute pitch; much more so than in the case of a column of air of the same length, as in a flute. The reason of this is the greater velocity with which sound is propagated in solids than in the air. If the rod be metal, the friction will be found to succeed best when made with a bit of cloth, sprinkled with powdered resin ; or if of glass, the cloth or the finger may be moistened and touched with some very fine sand or pumice powder.

Generally speaking, a fiddle-bow, well resined, is the readiest and most convenient means of setting solid bodies in vibration. To bring out their gravest or fundamental tones, the bow must be pressed hard and drawn slowly; but, for the higher harmonies, a short, swift stroke, with light pressure, is most proper.

THE TUNING-FORK FLUTE PLAYER

Take a common tuning-fork, and on one of its branches fasten with sealing-wax a circular piece of card, of the size of a small wafer, or sufficient nearly to cover the aperture of a pipe, as the sliding of the upper end of a flute with the mouth stopped : it may be tuned in unison with the loaded tuning-fork (a C fork), by means of the moveable stopper or card, or the fork may be loaded till the unison is perfect.

Then set the fork in vibration by a blow on the unloaded branch, and hold the card closely over the mouth of the pipe, as in the engraving, when a note of surprising clearness and strength will be heard. Indeed, a flute may be made to " speak" perfectly well, by holding close to the opening a vibrating tuning-fork, while the fingering proper to the note of the fork is at the same time performed.

MUSICAL BOTTLES

Provide two glass bottles, and tune them by pouring water into them, so that each corresponds to the sound of a different tuning-fork. Then apply both tuning-forks to the mouth of each bottle alternately, when that sound only will be heard, in each case, which is reciprocated by the unisonant bottle ; or, in other words, by that bottle which contains a column of air, susceptible of vibrating in unison with the fork.

THEORY OF WHISPERING

Apartments of a circular or elliptical form are best calculated for the exhibition of this phenomenon. If a person stand near the wall, with his face turned to it, and whisper a few words, they may be more distinctly heard at nearly the opposite side of the apartment, than if the listener was situated nearer to the speaker.

THEORY OF THE VOICE

Provide a species of whistle, common as a child's toy or a sportsman's call, in the form of a hollow cylinder, about three- fourths of an inch in diameter, closed at both ends by flat circular plates, with holes in their centres. Hold this toy between the teeth and lips; blow through it, and you may produce sounds varying in pitch with the force with which you blow. If the air be cautiously graduated, all the sounds within the compass of a double octave may be produced from it; and, if great precaution be taken in the management of the wind, tones even yet graver may be brought out. This simple instrument, or toy, has indeed the greatest resemblance to the larynx, which is the organ of voice.

A speaking-machine has been invented in Germany, with which have been distinctly pronounced the words, mamma, papa, mother, father, summer. This instrument consists of a pair of bellows, to which is adapted a tube terminating in a bell, the aperture of which is regulated by the hand, so as to produce the articulate sounds.

SOUND ALONG A WALL

Whisper along the bare wall of an apartment, and you will be heard much further than hi the middle of the room ; for the trough or angle between the wall and the floor forms two sides of a square pipe, which conveys the sound.

SOUNDS MADE AUDIBLE BY NIGHT THAN BY DAY

The experiment with a glass of champagne (page 69) has been employed" by Humboldt in explanation of the greater audibility of distant sounds by night than by day. This he attributes to the uniformity of temperature in the atmosphere by night, when currents of air no longer rise and disturb its equilibrium; as the air-bubbles in the champagne interfere with the vibration within the glass. Again, the universal and dead silence generally prevalent at night renders our auditory nerves sensible to sounds which would otherwise escape them, and which are inaudible among the continual hum of noises which is always going on in the day-time.

MUSICAL ECHO

If a noise be made in a narrow passage, or apartment of regular form, the echoes will be repeated at very

small equal intervals, and will always impress the ear with a musical note. This is, doubtless, one of the means which blind persons have of judging of the size and shape of any room they happen to be in.