SCIENCE IN TOYS.

VII.

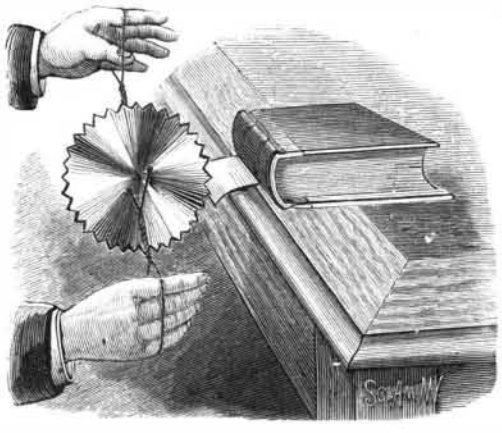
The student of acoustics need not go beyond the realm of toys for much of his experimental apparatus. The various toy musical instruments are capable of illustrating many of the phenomena of sound very satisfactorily, if not quite as well as some of the more pretentious apparatus.

Sound is a sensation of the ear, and is produced by sonorous vibrations of the air. It may be in the nature of a mere noise, due to irregular vibrations, like the noise of a wagon on the street, or it may be a sharp crack or explosion, like the cracking of a whip or like the sound produced by the collision of solid bodies. The clappers, or bones, with which all boys are familiar, are an example of a class of toys which create sound by concussion, and the succession of sounds produced by the clappers are irregular, and clearly distinct from musical sounds. A succession of such sounds, although occurring with considerably frequency and perfect regularity, will not become musical until made with sufficient rapidity to bring them within the perception of the ear as a practically continuous sound. The rattle, or cricket, produces such sounds.

CLAPPERS.

THE CRICKET, OR RATTLE.

The wooden springs of the cricket snap from one ratchet tooth to another, as the body of the cricket is rapidly swung around, making a series of regular taps, which, taken all together, make a terrific noise, having none of the characteristics of musical sounds. That a musical sound may be made by a series of taps is illustrated by the buzz, a toy consisting of a disk of tin having notched edges and provided with two holes on diametrically opposite sides of the center, and furnished with an endless cord passing through the holes. The disk is rotated by pulling in opposite directions on the twisted endless cord, allowing the disk to twist the cord in the reverse direction, then again pulling the cord, and so on.



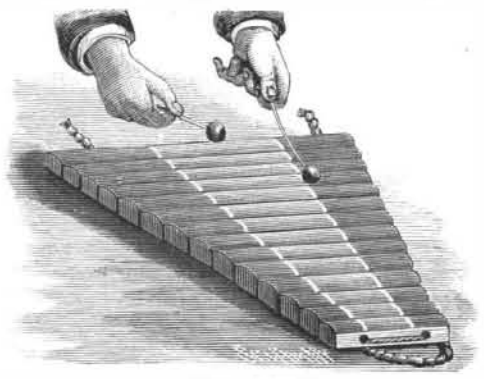
THE BUZZ

If, while the disk is revolving rapidly, its periphery is brought into light contact with the edge of a piece of paper, the successive taps of the teeth of the disk upon the paper produce a shrill musical sound, which varies in pitch according to the speed of the disk. Such a disk mounted on a shaft and revolved rapidly is known as Savart's wheel.

It is ascertained by these experiments that regular vibrations of sufficient frequency produce musical sounds, and that concussions, irregular vibrations, and regular vibrations having a slow rate, produce only noises.

Savart determined that the lowest note appreciable by the ear is produced by from seven to eight complete vibrations per second, and the highest by 24,000 complete vibrations per second.

The zylophone and metalophone are examples of musical instruments employing free vibrating rods supported at their nodes. The zylophone consists of a series of wooden rods of different lengths, bored transversely at their nodes, or points of least vibration, and strung together on cords. The instrument may either be suspended by the cords or laid upon loosely twisted cords situated at the nodes. By passing the small spherical wooden mallet accompanying the instrument over the wooden rods, very agreeable liquid musical tones are produced by the vibration of the rods, and when the rods are struck by the mallet they yield tones which are very pure, but not prolonged.

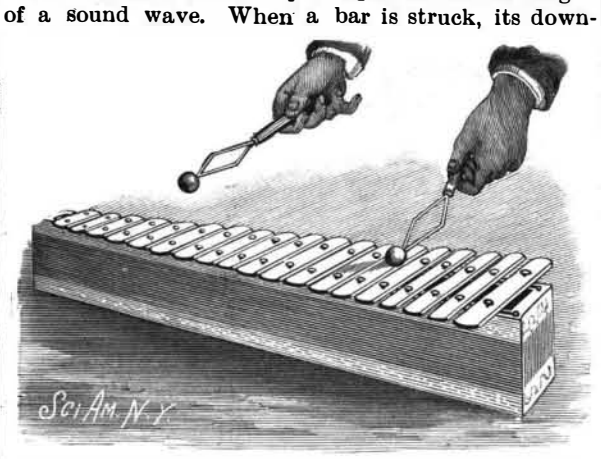


THE ZYLOPHONE.

The cheaper forms of zylophone are tuned by slitting the rods transversely at their centers on the under side, by means of a saw, to a depth required to give them the flexibility necessary to the production of the desired tones. The rods are divided by the nodes into three vibrating parts, the parts between the nodal points and the ends being about one-fourth of the distance between the two nodes.

The metalophone is similar in form to the zylophone, but, as its name suggests, the vibrating bars are made of metal—hardened steel. The bars rest at their nodes on soft woolen cords, secured to the upper edges of a resonator forming the support of the entire series of bars. The resonator is tapered both as to width and depth, and serves to greatly increase the volume of sound.

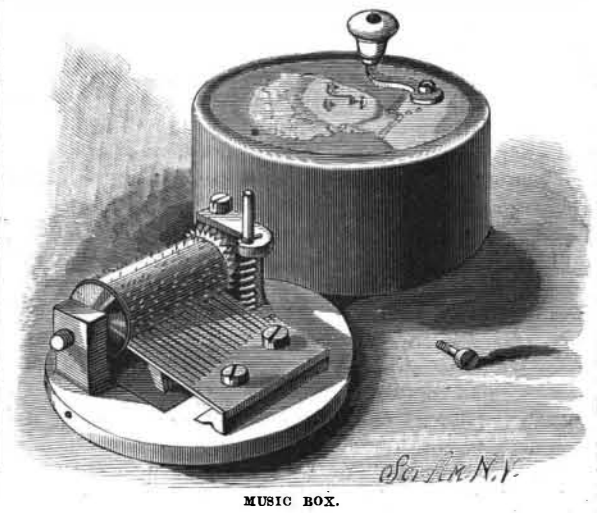
The resonator has a depth equal to half the length of a sound wave. When a bar is struck, its downward movement produces an air wave which moves downward, strikes the bottom of the resonator, and is reflected upward in time to re-enforce the outwardly moving air wave produced by the upward bending of the bar.



THE METALOPHONE.

The metalophone yields a sweet tone, which is quite different from that produced by the vibration of wooden bars.

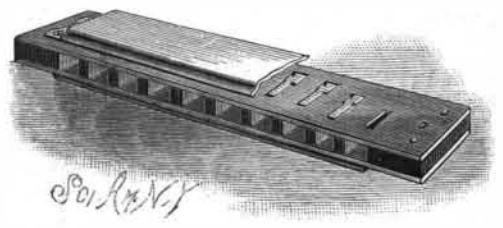
The music box furnishes an example of the class of instruments in which musical sounds are produced by the vibration of bars or tongues which are rigidly held at one end and free to vibrate at the other end. The tongues of the music box are made by slitting the edge of a steel plate, forming a comb, which is arranged with its teeth projecting into the paths of the pins of the cylinder, which are distributed around and along the cylinder in the order necessary to secure the required succession of tones. The engagement of one of the pins of the cylinder with one of the tongues raises the tongue, which, when liberated, yields the note due to its position in the comb.



MUSIC BOX.

The tongues are tuned by filing or scraping them at their free or fixed ends, or by loading them at their free ends. In this instrument the sonorous vibrations are produced by the tongue, which itself has the desired pitch.

In reed instruments the case is different. The sound is not emitted by the reed, but sonorous vibrations are produced by air pulsations, controlled by the reed, which acts as a rapidly operating valve. The mouth organ, or harmonica, is a familiar example of a simple reed instrument.



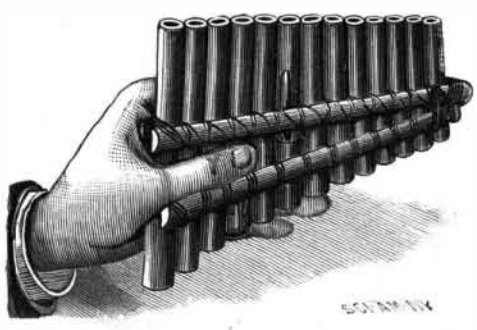
MOUTH ORGAN, OR HARMONICA.

When reeds are employed in connection with resonating pipes, as in the case of the reed pipes of an organ, the pipe synchronizes with the reed, and re-enforces the sound. When the reed is very stiff, it commands the vibrations of the air column, and when it is very flexible, it is controlled by the air column.

The horn is a reed instrument in which the lips act as reeds, and the tapering tube serves as a resonator.

THE BUGLE.

The ancient Pandean pipes present an example of an instrument formed of a series of stopped pipes of different lengths. These pipes are tuned by moving the corks by which their lower ends are stopped, and the air is agitated by blowing across the end of the tubes.



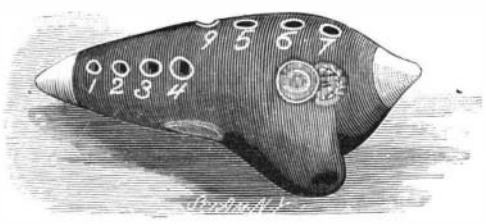
PANDEAN PIPES.

The flageolet is an open pipe in which the air is set in vibration by blowing a thin sheet of air through the air slit of the mouthpiece against the thin edge of the opposite side of the embouchure. The rate of the fluttering produced by the air striking upon the thin edge is determined by the length of the pipe of the instrument, the length being varied to produce the different notes, by opening or closing the finger holes. By comparing the flageolet with the Pandean pipes, it is found that for a given note the open flageolet pipe must be about twice as long as the Pan pipe. When all the finger holes of the flageolet are closed, it is then a simple open pipe, like an organ pipe, and, if compared with the Pan pipe yielding the same note, it is found to be just twice as long as the closed pipe. If,

FLAGEOLET.

while the holes are closed, the open end of the flageolet pipe be stopped, the instrument will yield a note an octave lower. These experiments show that the note produced by a stopped pipe is an octave below the note yielded by an open pipe of the same length, and the same as that obtained from an open pipe of double the length.

The ocorina is a curious modern instrument, of much the same nature as the flageolet. It is, however, a stopped pipe, and shows how tones are modified by form and material, the material being clay. It pro-

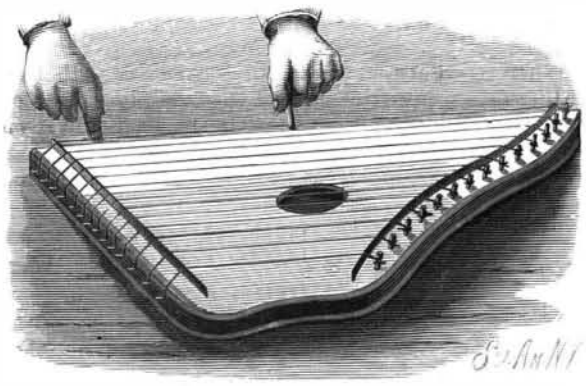


OCORINA.

duces a mellow tone, something like that of a flute.

The zither, now made in the form of an inexpensive and really serviceable toy, originated in Tyrol. It consists of a trapezoidal sounding board, provided with bridges, and having 24 wire strings.

Its tones are harp-like, and with it a proficient player can produce agreeable music. Much of the nature of the vibration of strings may be exhibited by means of



ZITHER.

this instrument. By damping one of the strings by placing the finger or a pencil lightly against its center, and vibrating the string, at the same time removing the pencil, the string will yield a note which is an octave higher than its fundamental note. By examining the string closely, it will be ascertained that at the center of the string there is apparently no vibration, while between the center and the ends it vibrates. The place of least vibration at the center of the string is the node, and between the node and the ends of the strings are the venters. It will thus be seen that the string is practically divided into two equal vibrating segments, each of which produces a note an octave higher. That the note is an octave higher than the fundamental note may be determined by comparing it with the note of the string which is an octave above in the scale of the zither.

By damping the string at the end of one-fourth of its length, the remaining portion of the string divides itself into three ventral segments, with two nodes between.

The division of the string into nodes and venters occurs whenever the string is vibrated, and all of the notes other than the fundamental are known as harmonics, and impart to the sound of the string its quality.

By tuning the first two strings in unison, the vibration of one string by sympathy with the other string may be shown.

The string telephone, although not a musical instrument, nor even a sound producer, exhibits an interesting feature in the conduction of sounds. It consists of two short tubes or mouthpieces, each covered at one end with a taut parchment diaphragm, the two diaphragms being connected with a stout thread. By stretching the thread so as to render it taut, a conversation may be carried on over quite a long distance, by talking in one instrument and listening at the other. The vibration of one diaphragm, due to the impact of sound waves, is transmitted to the other diaphragm by the thread.

TELEPHONE.

In the toys illustrated we have a representative of the Savart's wheel in the buzz; of the pipe organ in the Pan pipes, the flageolet, and the mouth organ; of band instruments in the bugle; and of the piano, harp, and other stringed instruments in the zither.

G. M. H.

DEVON CATTLE.

If it be true that "self-color," that is, a uniformity of color in all parts of the body, is proof of antiquity of breed, then the Devons have decidedly a valid claim to be considered a strictly aboriginal race. Red is the true Devon color, though the shade varies from a rich dark to a pale chestnut. Animals marked with any other color are not considered true Devons. Naturalists consider the Highland Kyloes, one or two of the Welsh breeds, and the Devons the descendants, more or less changed by crossing, soil, and climate, of the small Celtic breed, Bos longifrons, common on the island before and during the Roman occupation; but which was superseded by larger varieties of the Bos urus or Bos primigenius introduced by the Danish and Teutonic conquerers of Britain.

Certainly as far as history or tradition goes back, the northern part of Devon has possessed a breed of self-colored red cattle, whose compactness, general beauty, hardiness, activity as workers, and aptitude to fatten have endeared them to their owners and won them a wide celebrity. The southern part of the county has had cattle possessing the same general characteristics of form and color; but somewhat larger, coarser, and less active. In the northern part, the land is, in great part, poor, bleak, wet, and exposed; while in the southern part the land is rich, and the climate more congenial, hence the difference is due to variations in soil and climate, though some influence has probably been exercised by crosses of the old Somerset and Cornish cattle—both larger strains. Although for the past century great attention has been paid to improving the North Devons, no infusion whatever of the blood of any other variety of cattle has been made, and as Devons, no improvement could be made by such means.

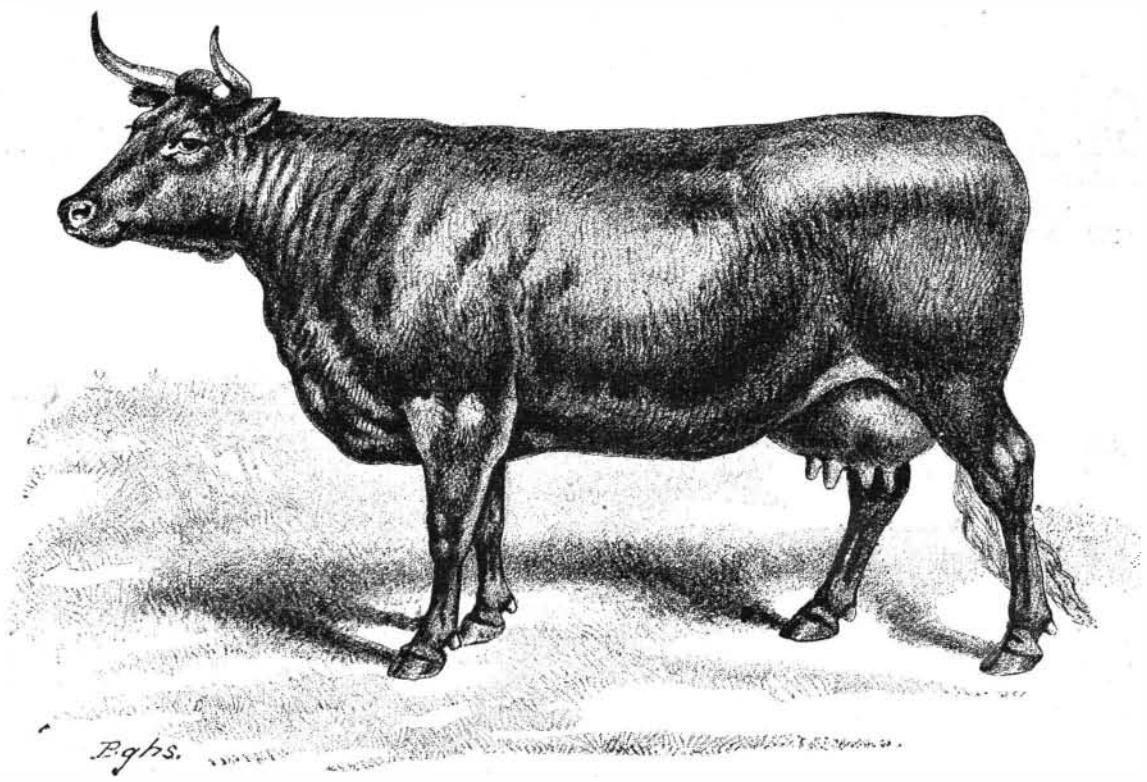
In size, the Devons are medium; but there is a great difference between the ox, bull, and cow. The first, full grown and in good working condition, will range from 1,400 to 1,600 pounds live weight; the second, from 1,000 to 1,200; and the third, from 800 to 1,000. Specimens sometimes exceed the greatest of these weights, but they are above the average. With luxuriant pastures and generous feed the size increases, and it is found that Devons on the rich fields of the West become larger than their congeners on the scanty pastures of New England.

Devons are the prevailing cattle in several districts in the southern counties of England, and there are there a considerable number of dairy herds of the breed. While there are several large milk and butter records of Devon cows, they have, as a breed, never been famous for giving large quantities of milk; but their milk is rich in quality, and Devonshire cream has a world-wide reputation. It is said that a gallon of Devon milk will yield more butter than a gallon of milk from any other breed, except the Jersey. It is only in comparatively recent times that much attention has been paid to the development of milking qualities in the Devon; for in times past, the Devon, like the Hereford, was raised chiefly with a view to the development of the male for working purposes. Hence the greatly smaller size of the cow, a point which should decidedly be considered in speaking of her yield of milk. In view of her hardiness, her ability to pick up a livelihood where a Short Horn, Holstein-Friesian, or any of the larger breeds would starve, her docility of temper under good treatment, and the comparatively small amount of food she requires, the Devon often gives a good profit in the dairy.

For work, Devon oxen are among cattle what thoroughbreds are among horses. In view of their size, they combine more fineness and strength of bone, more muscular power, more intelligence, spirit, and bottom than oxen of any other breed. Their slanting shoulders fit them better for the yoke than beasts of any other breed, except, perhaps, the Herefords. The nearer any other breed approaches Devons in shape and action, the more valuable are they, according to weight, for the plow, the cart, or the wagon. Their uniformity in style, shape, and color renders them easily matched, and their docility, intelligence, and activity make them excellent working animals, especially on light soils or a hilly or rough country.

At the great London Smithfield Fat Stock Show, the post of honor is always given to the Devons as beef animals, and in the English markets their meat, compact, sweet, marbled, and juicy, brings from one to two cents a pound more than that of any other breed, except the West Highland, and comparisons with other breeds go to show that on a given quantity and quality of food, they will make more beef than almost any other. Their bones, too, are very fine, and the amount of offal is small in proportion to the meat. When fattened for the butcher, the Devon matures early, and, for its weight, is probably the most profitable beef animal in existence.

It is likely that Devons were imported as long ago as the last century into this country, especially into New England, where working oxen of their type have long been more numerous than in any other section. But the earliest published records do not go back farther than the importation of Winthrop and Davenport, in 1800; while the first really important early importation was that of Caton & Patterson, of Baltimore, in 1817, from which most of the recognized pure bred American Devon herds have derived more or less of their blood. Lately, Devons have taken a more prominent place than ever before at our fairs, and are steadily advancing in popular favor, both for beef, dairy, and working purposes. The publication of the "Devon Herd Book" was begun in England in 1851, by Captain Davy, by whom it is still kept up. The "American Devon Herd Book" was established in 1880, and has since been published by James Buckingham, Zanesville, Ohio, under the direction of the American Devon Association.—*Rural New-Yorker.*



DEVON COW.

Nitrate of Mercury for Burglars.

Dr. Edwin F. Rush, whose house in Chicago has been despoiled by burglars eight times the past year, recently conceived a plan to play havoc with the marauders, claiming that the police have afforded him no protection. He has a fine home at Warren and California Aves. Three days ago the doctor placed tubes, containing fulminate of mercury, with nitrate of mercury, at all the windows. The poison, it was claimed, coming in contact with the skin of a human being, would cause blood poisoning. The raising of the windows was expected to explode the tubes and scatter the poison into the faces of the intruders. The facts came to the attention of the Fire Marshal, and he ordered the doctor to remove his deadly tubes. The marshal explained that he would not allow the lives of his men to be imperiled in order that a house might be protected from burglars and sneak thieves. He thought that section 1,281 of the Municipal Code, relating to the storing or keeping of any explosive in a building in the city, would cover the case.