HOW SOUNDS ARE MADE VISIBLE.

BY J. F. ROWBOTHAM, AUTHOR OF "A HISTORY OF MUSIC."

A MINIATURE LANDSCAPE.

AMONGST the most interesting results of its investigations that modern science has revealed to us, is the discovery that musical sounds can, so to speak, imprint themselves upon matter, and produce definite forms as surely and unerringly as the electric needle can record the motions of the fluid which is discharged from a distant battery. Sound is a thing so ethereal to fancy, that its very nature long baffled the penetration of men, and we cannot wonder that the recondite aspect of its power to which we specially allude should have remained entirely unknown until a comparatively recent period. Yet if we reflect upon the constitution of sound, we shall see nothing very surprising in the fact that it can be productive of form.

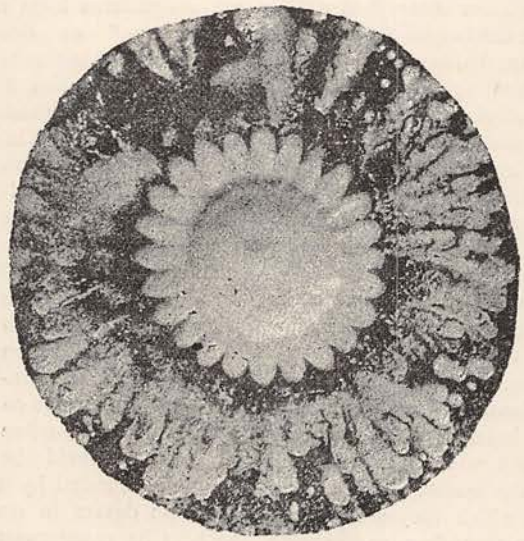
When an elastic body vibrates, it imparts its vibrations to the surrounding atmosphere. The air vibrating in response to the movements of the body is itself the sound, though not recognised by us as such until these vibrations have been conveyed to our ear. But as a breeze will cause a twig to stir, and as the slightest whisper of a wind will create motions among the leaves, and lift them to a new position from that which they occupied in the dead and tranquil calm preceding, so similarly the harmonious vibrations of the air will evidently have their effect in altering the conditions of the body they impinge on, no less than the breezes which strike the leaves. This fact, I imagine, was theoretically conceded by men of science long before the possibility of demonstrating it was believed in; but no test being practicable, it would be classed with the numerous dreams which have bewildered the path of philosophy without leading to any valuable result. Towards the close of last century, however, the theory —the dream—attracted the notice of the ingenious experimentalist Chladni, who was at that time conducting researches into the nature of the vibrations of sonorous bodies. In testing the vibrations of a plate of glass or metal, he noticed that it gave different sounds according as it was struck at various places. To obtain the most accurate results, he thought best to suspend the glass plate in air by means of a hole drilled through the middle, in which a rod was wedged, running up to the ceiling. Drawing a violin bow across the edge of the glass plate, he was enabled to listen to the purity of the tone, and observe the vibrations of the body. But immediately this second idea struck him, that if he at the same time scattered a little sand over the surface of the plate, he might observe what effect the vibrations would have upon the sand. The sand was scattered: the bow was drawn with a long musical note against the edge of the glass, and immediately the sand leapt from a heap of chaos to a pattern of perfect beauty and symmetry. As the fragments of glass in a kaleidoscope become, on our turning the tube, charming and symmetrical patterns to the eye, so did the sand sort itself to symmetry on the application of Chladni's bow, and in patterns very similar to those of the kaleidoscope. Again and again he drew his bow, at different parts of the plate, producing different sounds; and to ever new and various patterns leapt the sand. In using the word "symmetry" as descriptive of these patterns, we are using it in its strictest and most technical sense. The sand on the square plate was always equibalanced. It most usually fell into two distinct parts, separated by a line of sand drawn diagonally, and each the exact reproduction of the other. An arabesque of little rings on the left side of the line of section would be faithfully reflected by its counterpart on the right; a fantastic device in one corner would never occur without its counterpart in the other corner; rings, curves, lines, stars, circles invariably ran into symmetrical pairs, and if broken at the line of partition the sand on the other side of the line would contain the corresponding half only.*

TREES.

TREE AND FERNS.

* Engravings of the patterns which Chladni thus produced on the sand may be seen in "Rowbotham's History of Music," vol. ii., p. 440.

Such interesting experiments as these incontestably demonstrated the truth that sound could be productive of form, and that by its variation in intensity and pitch the form would change accordingly. The only drawback to convincing the most sceptical was the interference of the plate in the experiment; for vulgar reasoning was apt to retort on the experimentalist that in the patterns of the sand we merely see the vibrations of the plate, and not the operations of the waves of sound. This objection, however, if it can be seriously called one, has since been overcome; and experiment has amply proved that the human voice alone is capable of printing form upon matter as successfully and as distinctly as a violin bow drawn across the edges of a plate. The discoverer of this great fact is a lady, Mrs. Watts Hughes, who originally intended to devote herself to the art professionally, but through failure of health was led to renounce the intention of a public career, and undertake delicate investigations into the nature of sound instead. Her efforts in this direction are likely to prove much more interesting to her contemporaries than if she had become a second Patti or Albani. The experiments are conducted as follows:—A hollow receiver is procured, over the mouth of which is stretched an elastic membrane. The surface of the membrane is covered with a semi-fluid paste, of such consistency that very light impressions can be easily received. The singer then approaching the apparatus sings on to the surface of the membrane, exercising the greatest care that his notes are singularly steady and perfectly accurate in the intonation of the given sound. At once the musical note mirrors itself on the paste, and in the most unexpected forms. The statement will doubtless not readily be believed when we say that the forms of flowers, as perfect as if they were drawn, occur among the rest, and, indeed, contribute the majority of the figures. Daisies, with every petal exactly shaped, are common; lilies, as symmetrically made, are not rare. A change of note, or of *timbre*, will produce a miniature tree on the paste. By some slight variation, impossible to estimate, the figure of a star-fish will appear on the surface of the membrane; another imperceptible difference of sound will lay, side by side with the star-fish, an anemone. Occasionally the vibrations—presumably owing to an unconscious augmentation of force on the part of the singer—will imprint themselves in the form of shells, beautifully voluted, the wrinkles in the scroll being so incisively indented that when photographed they appear as if creases in the picture. Suddenly deserting these marine forms as capriciously as it took them up, the sound will create ferns, suspend bunches of fruit, and otherwise adorn with similar emblems the surface. There is, of course, much room for conjecture in the explanation of these various forms. Some facts, however, we know for certain. When the sound is producing flowers on the paste, the singer can at pleasure increase the number of petals by gradually making the tone ascend. At each fraction of a tone on which his voice rises, a new petal is added to the flower. He can thus by a careful management of his breath increase a pigmy daisy that lies first imprinted on the paste to a gigantic sunflower, occupying nearly the whole surface. In the other forms—*e.g.*, the shells—this addition of piece by piece does not appear, and the scroll once fashioned remains.



A DAISY.

The forms thus produced on the paste are photographed whilst the membrane is in sonorous vibration; or water-colour impressions are taken, which are transferred on to glass immediately after being produced. The advantage of the latter method is that the minute beauty and delicacy of the forms can be shown to perfection by the use of various colours for different parts of the same object. Some people, however, when examining these reproductions have fallen into the error that the sound had likewise created the variety of colours, which is not the case. We particularly allude to some specimens of both styles which elicited considerable attention at the recent Arts and Crafts Exhibition, where, while examining one of the plates, we overheard one or two erroneous remarks to that effect.

Such results of modern science as the preceding bring us to the threshold of an interesting inquiry into the reality of one of the most extraordinary ideas of antiquity. The Greeks, who were certainly innocent of any such research into the mysteries of sound as we have just described, held in the person of Pythagoras, his school, and numerous natural philosophers who followed him, the doctrine that music is the principle of form in nature, and that every shape and natural figure in the animate and inanimate world was determined and created by the divine infusion of music into the formless matter of chaos. "By whatever means it were introduced," says one of the greatest of these ancient thinkers, "for on that point we are left entirely without a basis for speculation, music, and nothing else but music, *must* have been infused into matter so as to bring the formless universe

to harmonious order, and to produce the forms we see around us of landscapes, rivers, trees, flowers, instead of the everlasting chaos which preceded." It is not a little singular in illustration of this ancient idea to find the vibrations of musical sound at the present day being proved to produce the forms of flowers, trees, shells, and other natural objects, spontaneously and without any previous suggestion of the form by pencil or the hand of man: to see the same power, when exercised upon a chaos of grains of sand, at once throw the sand into patterns of symmetry, whose lines and curves might very easily, if we were disposed to carry out the analogy, be construed into miniature models of winding rivers, sweeping mountain chains, and other objects, which give order and outline to the vague monotony of a landscape. Pythagoras, who went further than others of the same school, proceeded to great detail in exemplifying the power of music in giving form to matter. He made the bold assertion—for which he has been called a madman—that the octave gave our globe its present form. We should not like to enumerate the treatises that have been written, or to allude to the endless derision which has been showered on this philosopher for his apparently wild and meaningless assertion. But we will remark—in strange agreement with such a hypothesis—the experiments of Chladni have revealed that whenever an octave is sounded on the glass plate the sand, whatever its previous position may have been, invariably ranges itself in the form of a circle.

Into this phase of the subject, however, we do not intend to go, beyond remarking that a vast literature of dreams and speculations existed in antiquity—to which, *en passant*, belongs the doctrine of the harmony of the spheres—connected with the subject of which we have been treating. In modern times, the little that has been done in the way of scientific investigation has been recorded above. But the field is an ample one, open for any experimentalist; and if the moderns would only investigate it as much as the ancients dreamed about it, discoveries not only interesting but surprising might be expected.

THE AMERICAN PARLIAMENT.

BY AN ANGLO-AMERICAN.

BEFORE attempting to describe for uninitiated readers the appearance of Congress in session, it may be well to state a few facts regarding this important legislative body, ruling the destinies of over sixty millions of people, of which, no doubt, even many Americans are ignorant.

Congress consists of two Houses, the Senate and the House of Representatives. Senators are elected by the Legislatures of the States they represent, two for each State—making just now eighty-four in all—for a term of six years. The terms of senators from the same State are not coterminous, however, each one being elected at a different session of the Legislature. A senator must be thirty years of age, and must have been an American citizen at least nine years. He must also be a resident of the State which elects him.

The House of Representatives consists of 329 members, representing constituencies based on population—a readjustment taking place after each decennial census. In the first Congress, each member of the House represented a constituency of 30,000, while in the present Congress—the fiftieth—each member of the House represents a population of 151,912 souls. In spite of this increase in the population of the Congressional districts, as they are called, the number of Congressmen increases so fast in this rapidly growing country that people are now discussing the question very seriously as to how to prevent the House getting unwieldy without making the constituencies too big. Members of the House must be twenty-five years of age, and must have been American citizens seven years. They must also be residents of the State in which they are elected. Although not exacted by law, the practice of requiring a man to be a resident of the Congressional district which he represents seems to be universal, and to have all the force of law. The disabilities attaching by the third section of Amendment XIV. of the Constitution to those who, having sworn to defend the Constitution of the United States, "shall have been engaged in insurrection or rebellion against the same, or given aid or comfort to the enemies thereof," may be removed by a two-thirds vote in Congress; and as a matter of fact, the only person disqualified under this Amendment during recent years was the late President of the Southern Confederacy, Mr. Jefferson Davis. It will be remembered, however, that the ex-Vice-President of the Confederacy, Mr. Alex. Stephens, of Georgia, was for several years before his death a member of Congress.

In the matter of emoluments, these will no doubt appear extremely liberal to unpaid English M.P.'s. Both senators and representatives receive an annual salary of $5,000, or about £1,000 English money; they are allowed besides mileage at the rate of 20 c. a mile from their residence to Washington for each session of Congress, and they receive an allowance of $125 a year for newspapers and stationery.

Besides the 329 members elected by regularly constituted Congressional districts, there are five delegates from the territories which are not yet erected