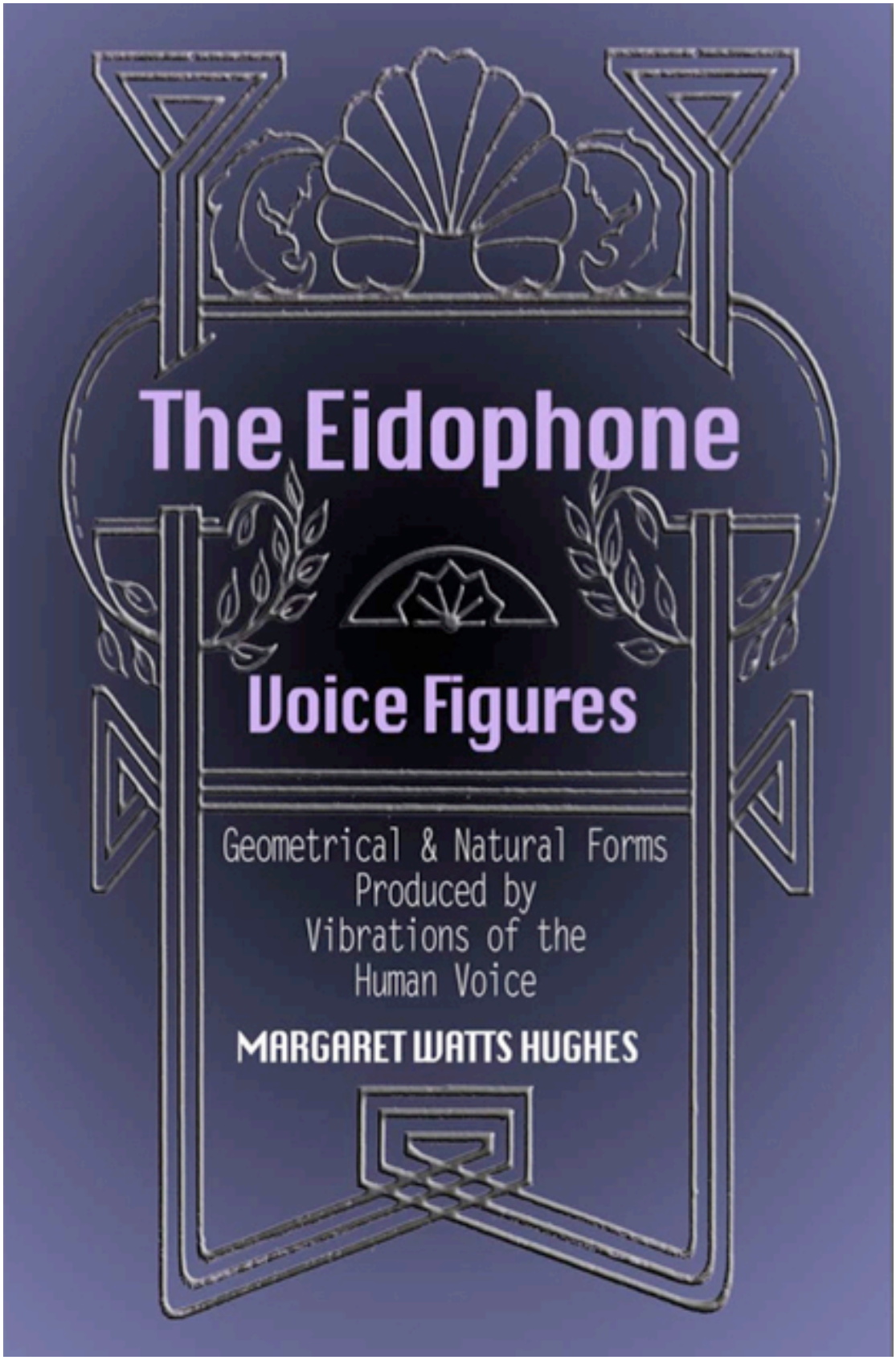
The Eidophone
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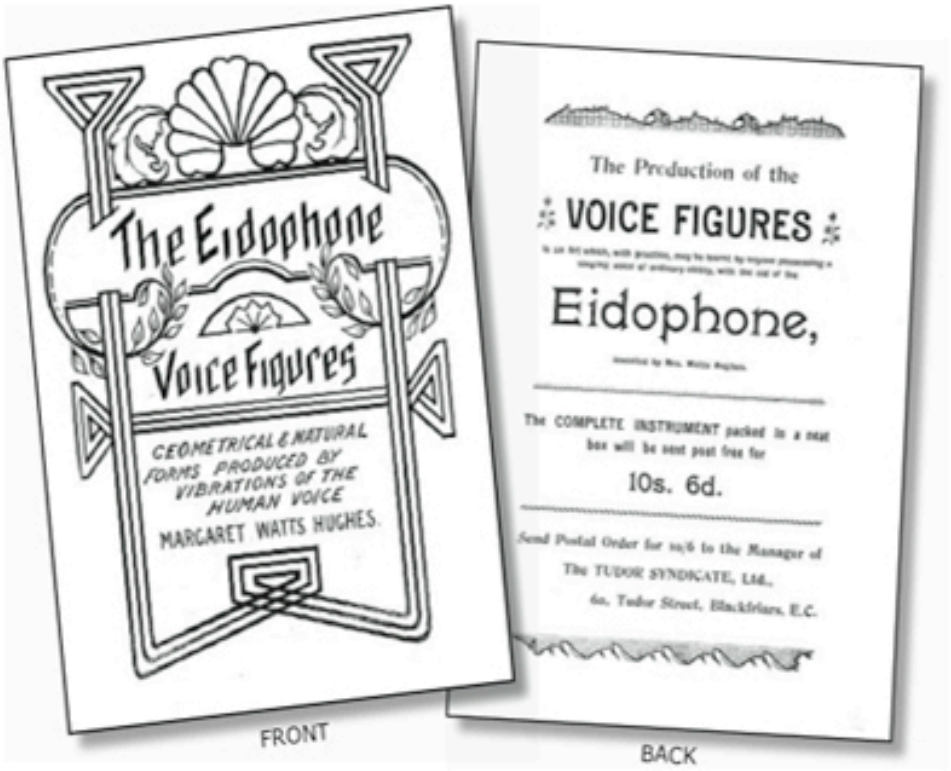
Produced by
Vibrations of the
Human Voice
MARGARET WATTS HUGHES



Original Booklet by Margaret Watts Hughes

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THE

EIDOPHONE VOICE FIGURES.

GEOMETRICAL AND NATURAL FORMS PRODUCED BY VIBRATIONS OF THE HUMAN VOICE.

BY

MARGARET WATTS-HUGHES.

TWO SHILLINGS.

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PREFACE.

THE delay in the publication of the Second Edition of "Voice Figures" has been unavoidable; but while it has been a cause of regret to many who were unable to procure a copy of the first edition, the time that has elapsed has given opportunity for further experiment, which has resulted in the additional notes and illustrations now inserted in this New Edition.

In this work no attempt is made to give an explanation of the phenomena referred to in the description of the various forms.

The subject being a very wide one, reaching out in many directions into the realm of physical research, the first duty that devolved upon me seemed to lie in the introduction of the forms themselves; the second, in making known, as far as this was possible without practical demonstration, the various methods employed in their production.

An acquaintance with the methods of operation, and the classification of the figures, will prepare the reader for a more technical treatment of the subject.

This New Science, which is given to us by one note of the human voice, aided by simple methods of operation, yields such varied and complex results that appear not only marvellous but almost miraculous. It is a science which, for explanation of its phenomena, points to the musical world as well as to the scientific world; to the vocal artist, as also to the searcher after scientific truth, and to the interpreters of those mysterious laws which underlie the visible forces of Creation.

Readers of the Holy Scriptures who make a careful study of the Voice Figures, cannot do so without being struck with the analogies and

suggestions they contain. Some of these may prove to be helpful in throwing light upon sentences and passages to be found in the Sacred Volume.

With the aid of the Eidophone disc, both singer and scientist are able to witness the effect not only of one but of many kinds of vibration upon different substances.

The extraordinary power given to these vibrations to control and arrange various particles of matter calls undoubtedly for explanations; and enquiries will occur, such as: What may be the law which impels one kind of vibration to scatter dry powder abroad, while another vibration of the same note gathers it together, and, if needs be, to cohere so closely and so compactly as to appear like a solid whole? Or, further: What may be the secret of the arrangement of lycopodium dust into hundreds of tiny but symmetrically-shaped mounds, while another class of vibration of the same note gives a complex form of exquisite beauty?

The laws which govern the dispersion, attraction, and cohesion of dry particles, and which seem so remarkably to suggest the principle of universal integration and disintegration of matter—while these same laws are to be recognised in the semi-liquid department, they seem to operate towards a totally different end. The moistened particles, under the influence of the different vibrations, disperse, cohere, and arrange themselves, but now to assume a form resembling a natural form. Here we have given to us, also, not only the *form* of the Daisy and Trefoil flowers, but, in addition to that *form*, in many instances a floral form with streaks and delicate markings on the surface of the petals, resembling some of our well-known garden and field flowers.

In the impression figures, in response to certain kinds of vibration the result will be the instantaneous formation of a tree or fern, or some intricate pattern of cross waves.

Not the least among the many subjects for enquiry is that which points to the *force* and *energy* of the vibrations themselves, when produced under favourable circumstances. An explanation of these phenomena, and of what, also, may be the chemical or electrical action which, under the influence of *voice* vibrations, can thus control matter, suggests a very wide area of investigation.

VOICE FIGURES.

INTRODUCTION.

It is little more than a century since any connection of sound with forms was discovered. In the year 1785 Chladni ascertained that the vibrations of plates in the act of giving out musical notes (when set vibrating by drawing a violin bow across their edges) caused powder strewn upon them to form regular patterns, and these have been since known as Chladni's figures. It is only within the last few years that Professor Sedley Taylor has exhibited by his Phoneidoscope the crispations of a soap film set in vibration by a vocal sound; and still more recently that, by employing elastic membranes, I have been enabled to produce Voice Figures, in which the delicate vibrations of the voice record and register themselves in several different ways, and with remarkably interesting results. For we have only to examine these figures, simple as is the principle that underlies them, to find ourselves face to face with Nature in her almost limitless variety; while every variation that we notice records some difference in the production of the figure that displays it, either in the character or the quantity of the substance used, in the form, the quality, or the tension of the elastic membrane, the vibrations of which evoked it, or in the pitch, intensity, or quality of the vocal note that created those vibrations.

The apparatus used for producing Voice Figures I call the *Eidophone*.

Its construction may be said to have originated from the following circumstances:—In the year 1885 I had been devoting attention to the study of the six properties of sound in relation to the voice, and, being impressed with the important part played by intensity in the formation of vocal sounds, especially in relation to quality and the creation of over-tones, I became desirous to find some means by which I could test the different intensities of the tones of the human voice. My first task was to search for an instrument, and I made diligent enquiry as to what had

already been accomplished in this direction. So far as I was able to ascertain, no such instrument had been produced, and I felt very much disappointed. Not willing to give up my project, I endeavoured to construct an apparatus of my own, which I hoped eventually might answer my purpose. This apparatus consisted of a tube, a receiver, and a membrane which was stretched over the top of the receiver. The membranes were made of various kinds of materials—paper, parchment, fine silk, goldbeaters' skin, tin, and indiarubber. My aim at this time was to test the force of the different notes sung into the tubes by the weight of the various substances placed on the membranes.

I had been working on this path until May, 1885, when on one occasion as I sang I noticed that the seeds which I had placed on the indiarubber membrane, on becoming quiescent, instead of scattering promiscuously in all directions and falling over the edges of the receiver on to the table, as was customary when a rather loud note was sung, resolved themselves into a perfect geometrical figure. Surprised at the unexpected appearance, and wondering if it were the result of mere accident, I cleared the diaphragm of its contents and scattered fresh seeds on its surface. Upon singing the same note as before, the seeds gave the same figure.

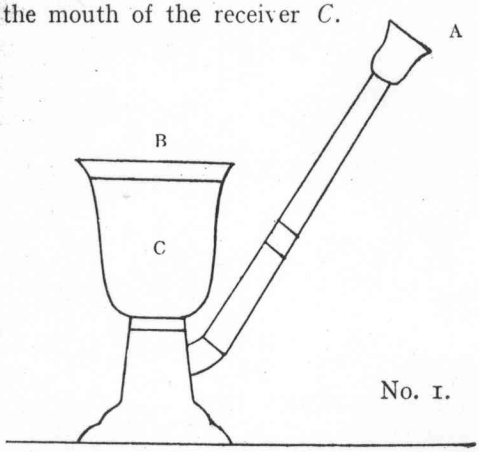
This figure, therefore, which I never searched for, became the progenitor of all that followed in the department of the dry powders, and the apparatus which was intended to demonstrate the capacities of only *one* of the properties of sound, has proved since to be the instrument that was needed to enable the singer to make visible the effects of the vibrations, and to show the endless possibilities of the human voice in this new path in the world of sound.

By varying the sizes of the discs it is possible to find one to suit the lung capacity of every voice. I have made use of a great number, ranging from one inch to thirty-seven inches in circumference.

This apparatus, simple though it be, may be said to have opened not only a new department in the domain of science, but also a new art, demanding the highest skill of the vocalist to interpret, and which appeals to human beings not by the usual way, orally, but by a new way—the visual sense.

The illustration herewith (No. 1.) shows one of the most convenient forms. A sustained vocal note is directed into the tube *A*; its

vibrations strike the elastic indiarubber disc *B*, stretched across the mouth of the receiver *C*.



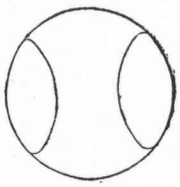
No. 1.

If the disc be thoroughly flexible, evenly stretched, and perfectly level, the sound-waves will cause it to vibrate regularly. Its vibrations will vary in rapidity with the pitch of the note producing them; and they will divide the disc and subdivide it, creating centres of motion, and boundaries or lines of rest, which in their turn govern the distribution and arrangement of the substance placed upon the surface of the disc, and thus form the Voice Figures.

The Eidophone disc can be set in motion so as to form *some* figures in sand and other substances by means of the flute, cornet, organ, or any musical instrument giving sounds sufficiently powerful to cause the disc to vibrate regularly. But complete success can be ensured only when the movements of the disc are directed by the *voice* of a skilful vocalist.

Any flexible disc, whatever its shape or size, under the influence of regular vibrations may be made to divide and subdivide so as to give a *series* of different figures.

In order to obtain such a series, the notes of the singer must correspond with those proper to the divisions of the disc itself. The singer, therefore, when experimenting, is not free to choose a keynote of any pitch, if he desires to obtain a series of figures corresponding to the diatonic scale, for he must first ascertain the capacities of the disc. The easiest way of doing this is, after strewing a little sand on the surface of the disc, to sing a few low notes, and continue to do so until a figure appears showing three centres of motion; this figure indicates one of the simplest divisions of the disc. (No. 2.) If the figure be regular, and the note easily sustained the singer can then ascend the scale, in steps of tones, semitones, or



No. 2.

quarter-tones, as high, or descend as low, as his compass will permit. In doing so, each note of different pitch should be carefully sustained, and the surface of the disc should be strewn over afresh with sand for each change of pitch.

Further, in order to obtain a series of figures in regular succession, and in correct relation to each other as to pitch, each disc should be suited to the capacities of the particular voice acting upon it, since discs of the same size differ in their rates of movement, if of different weights. Indeed, every figure formed on the disc may be said to register the movement of a definite weight, under the action of a vocal note of a necessarily corresponding definite intensity.

On ascending the scale, it will be found that it is only certain notes that will produce definite figures. To some notes the powder on the disc will respond at once by an instantaneous arrangement; to others, not so promptly, not so definitely, or not at all. In these latter cases, too, the singer experiences a constant sense of resistance, which creates a curious difficulty in sustaining the notes.

The human voice, as a power for directing the movements of the disc, is above comparison with any other musical instrument. Rightly viewed, the voice is not a single instrument at all, in the same sense as is a flute, cornet, or harp. It is more like the organ, containing a number of stops, all different in the character of the sounds they send forth; except that in the voice we can usually hear but one at a time.

Compared with most musical instruments, the range of the human voice as regards pitch is but limited, and its maximum strength is still more so. But in every other direction its comparative powers are so great as to render it unique.

The voice is the result of the combined action of four distinct sets of organs, which form a mechanism of such delicacy as to enable a skilful singer to produce sounds possessing in some degree the characteristics not only of all musical instruments, but of all sounds of whatever description.

The secret of this capacity lies in the great number of modifications of which every vocal note is capable, not only as regards pitch and intensity, but also quality. The singer can not only create notes of different pitch and strength, but can also shape, colour, and modify these, and cause them to convey a definite meaning.

Again, some vocal notes are *simple,* and others *compound,* in their character. When we hear a simple note, we distinguish a single pitch and a single quality. When, on the other hand, we listen to compound notes, we distinguish either sounds of different pitch though one in quality, or sounds of one pitch and of two different qualities. The first kind of compound note is similar in effect to two notes of different pitch sounded with the same stop of an organ; the other kind resembles in effect a single note sounded with two stops.

As it is, of course, in the power of the singer to determine the character of the notes used, it is well, when singing into the Eidophone, to bear in mind what has just been said. Notes suitable in pitch and intensity as well as in vowel should be chosen, and the vocal organs should be so adjusted that all notes sung can be sustained unwaveringly.

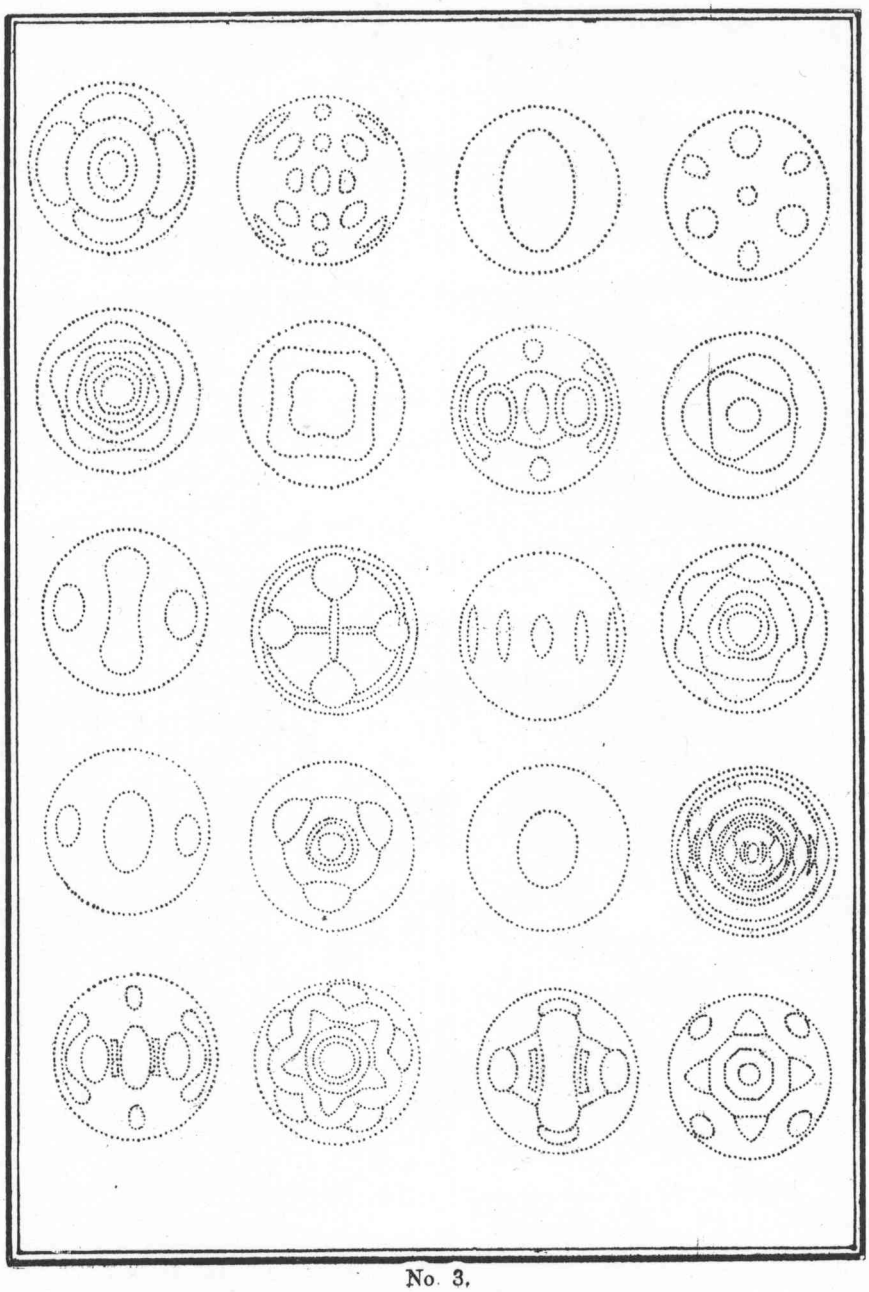
To include within the limits of these pages a detailed account of *all* forms of voice figures would be quite impracticable.

A general idea of the character of the figures may, however, be obtained by considering them in two classes :—

I. Simple disc figures—viz., those obtained simply by the distribution of material on the disc itself, through its own vibrations; and,

II. Impression figures, taken upon other surfaces, brought into contact with the disc in vibration :—

and dividing both these classes into groups arranged, for convenience, according to the substances in which the figures are formed.



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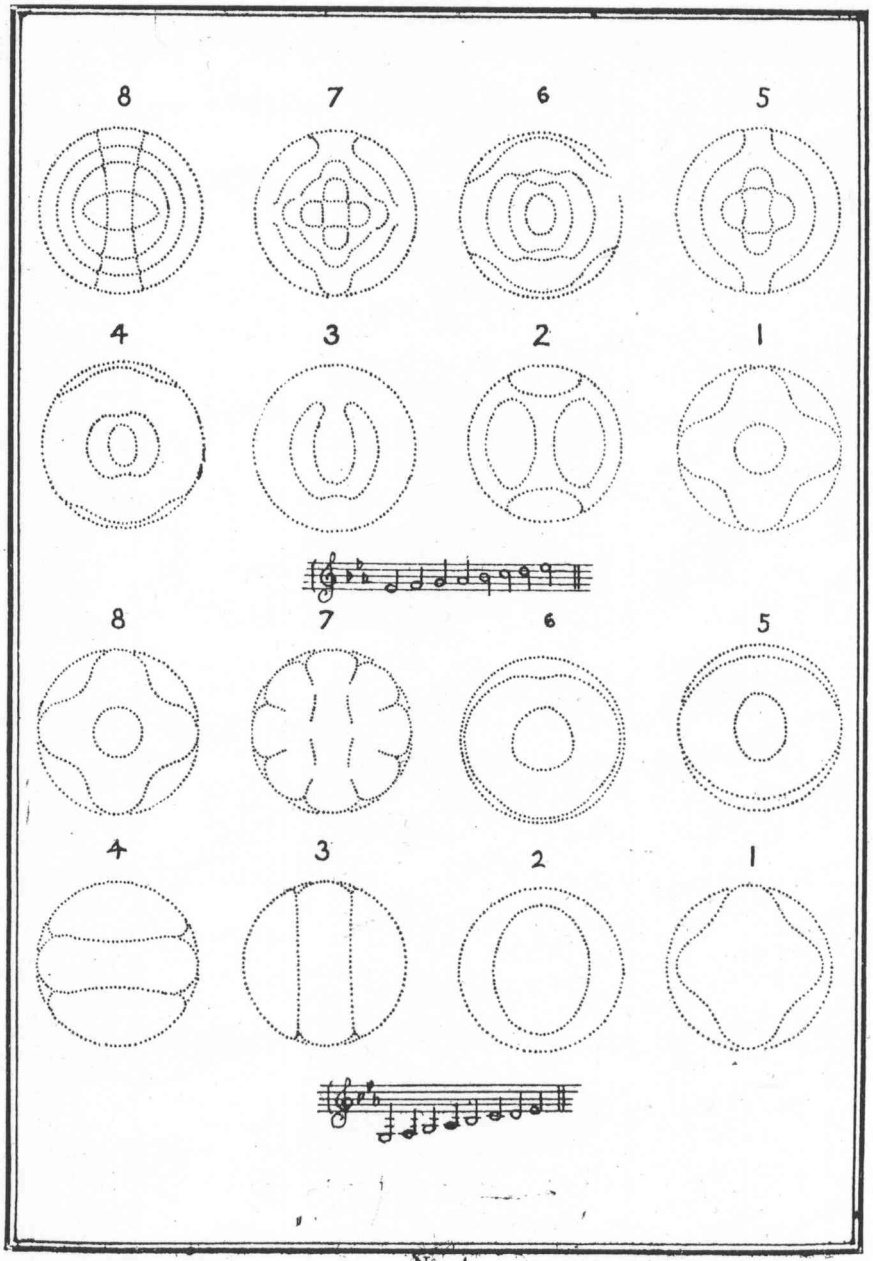

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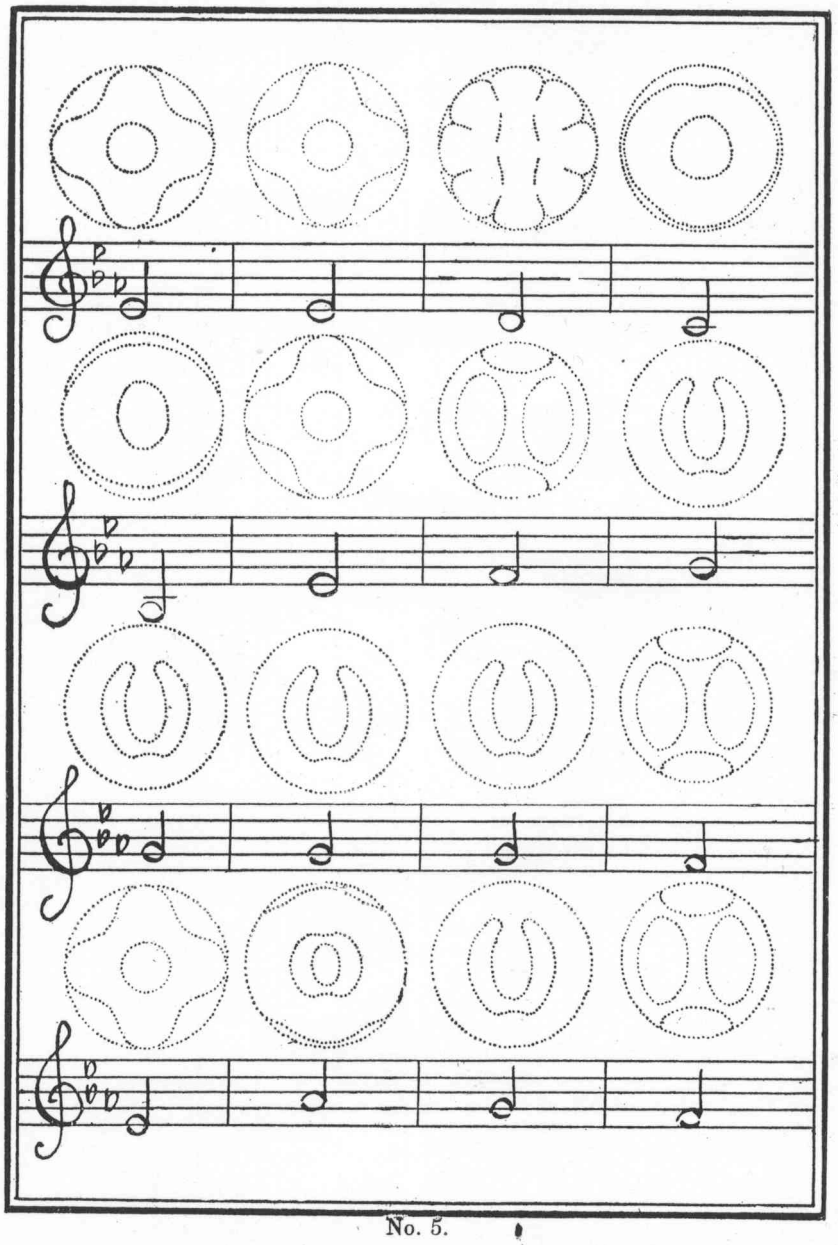
"The Old Hundredth."



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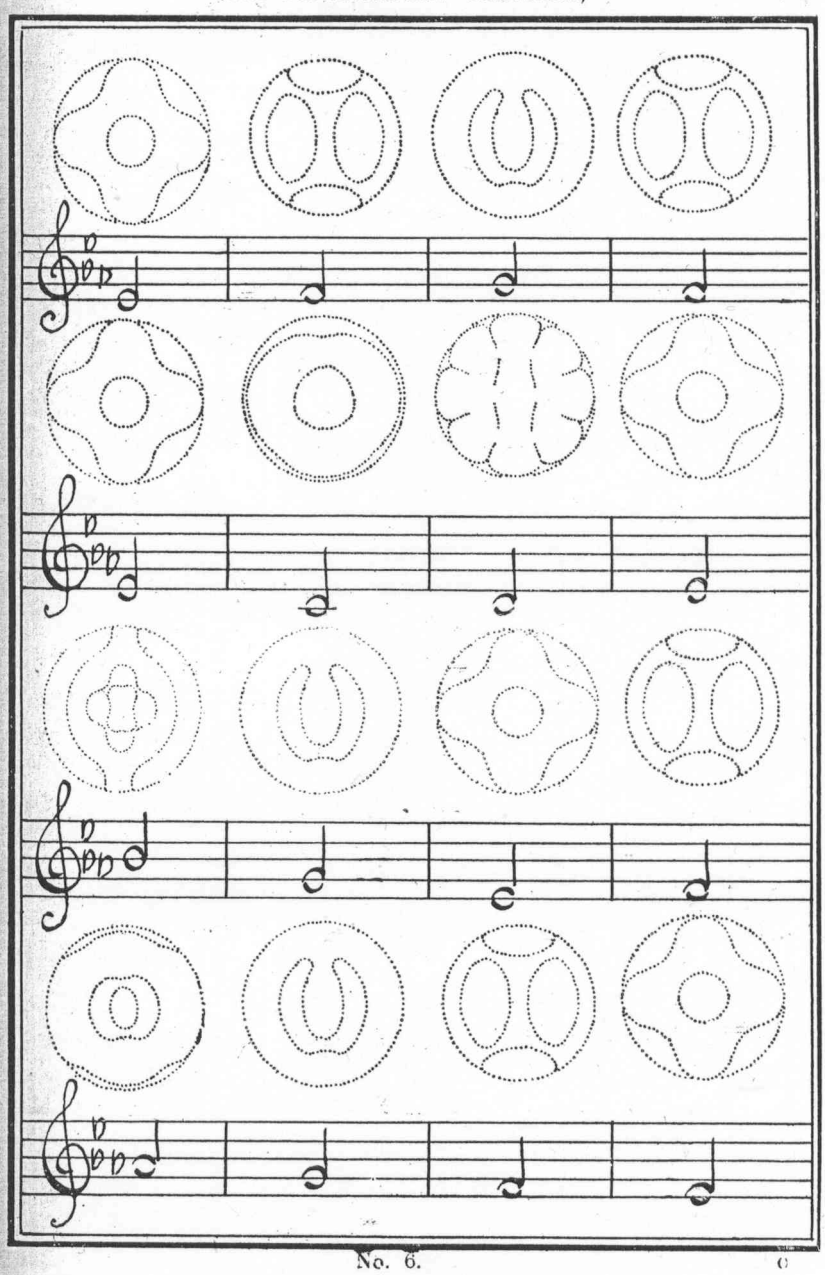

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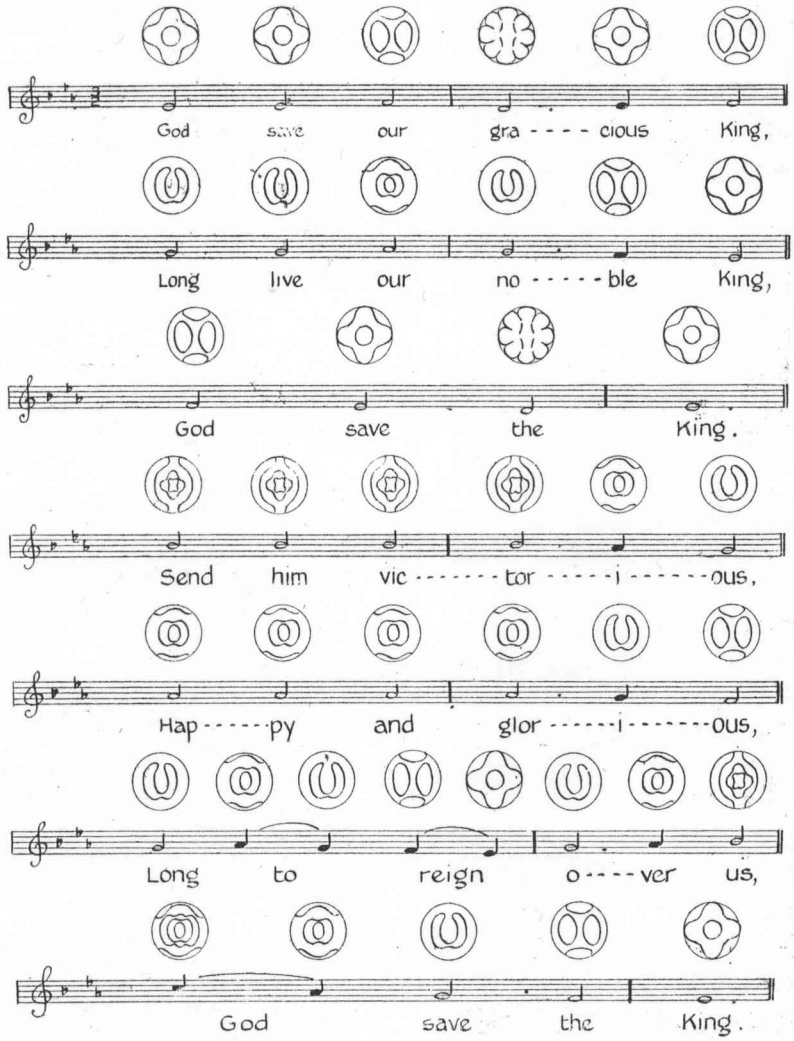


No. 7.

PART I.—SIMPLE DISC FIGURES.

Sand Figures.

When sand or other heavy powder is lightly strewn on the elastic disc, and suitable notes are sung into the tube, the sand or powder is seen to scatter away from the centre or centres of motion, and to remain upon or near the nodal lines of rest; so forming figures upon the disc, which, subject to certain limitations, alter in pattern or in position with each change of pitch, as already noted, and increase in complexity of pattern as the pitch rises.

Sand figures do not afford much scope for intensity of sound, owing to the readiness with which sand scatters. A loud note will often drive the whole off the disc, while a softer sound would leave a definite figure on the nodal lines.

The series of figures on page 6 (No. 3) I obtained with membranes which varied in thickness. The two diatonic scales on page 7 (No. 4) were sung on the same membrane, which measured fifteen inches in circumference. They are numbered in the order in which they appeared with each rise in pitch.

Lycopodium Figures.

If instead of a heavy powder, such as sand, we scatter on the disc a small quantity of *lycopodium*—the impalpably fine seeds of the puff ball—we have a different class of figures, the lightness of this substance causing it (for reasons which have been explained by Faraday) to gather at the points where vibration is greatest, and to leave the nodal lines bare.

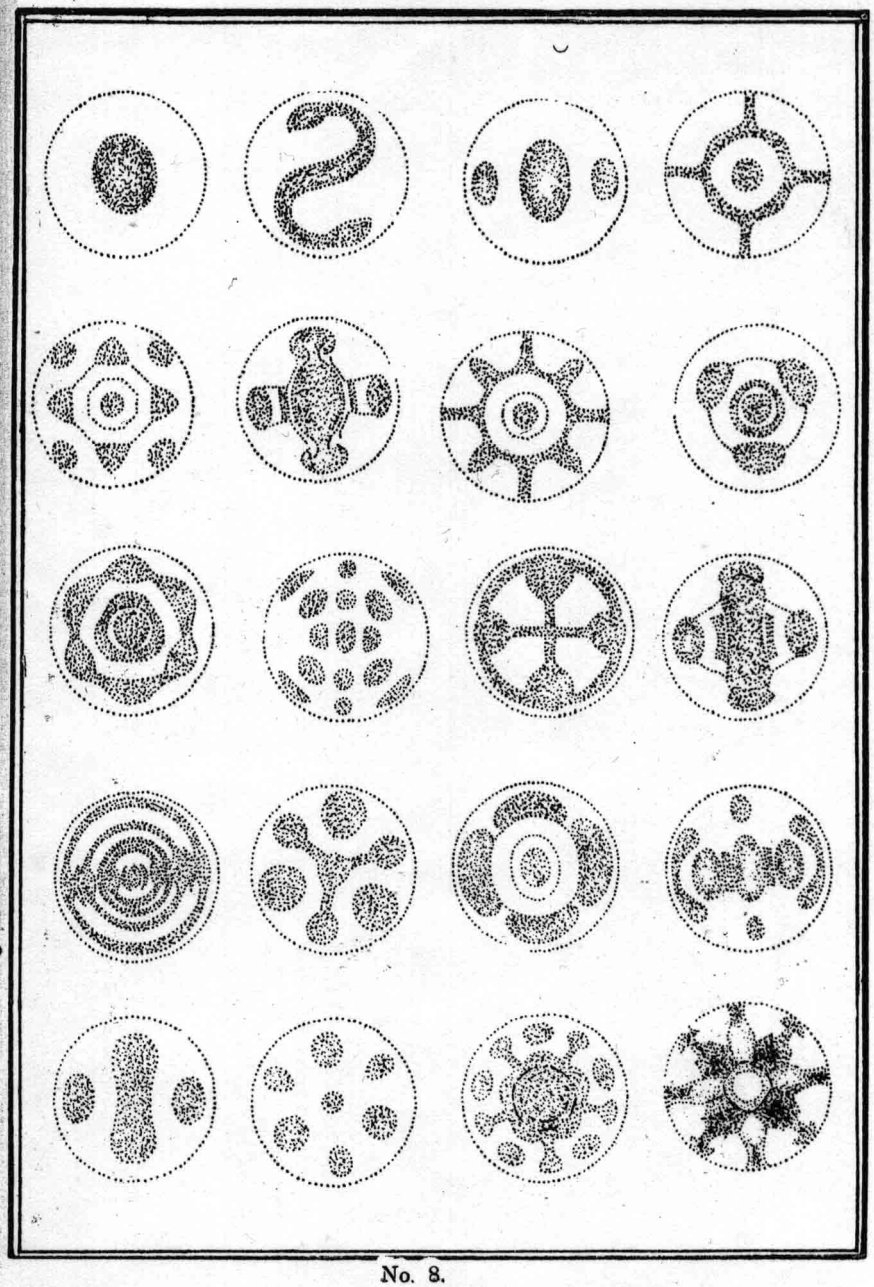
The tendency of this fine dust to cling to the centres of motion enables the singer to test the intensity of the notes sustained; for, as they increase in strength, the fine dust spreads itself farther and farther

from the centre outwards, until the whole of the vibration circle is covered. When the diminuendo is effected, the lycopodium is once more disturbed, and this time collects into a number of tiny mounds, all of which finally retreat into one central heap as at first. (See illustrations Nos. 8, 9, and 10.)

Upon one occasion, while singing notes with which I had many times previously produced figures with perfect ease, I witnessed a curious phenomenon. All at once the disc became unusually agitated, and, instead of the customary figure appearing, the lycopodium flew hither and thither about the surface of the disc, at one moment as if struggling to shape itself into the regular figure, and at another moment as if trying to form a different figure. I was perplexed to account for this unusual wavering of the disc, but another sustention of the same note abated the excitement and left on the disc the figure I had looked for. I noticed, however, that the intensity of the last note was less than that of my previous efforts. I therefore concluded that the cause of the unusual commotion was the presence of overtones, through singing too loudly. Singing then the octave above, I at once saw before me the very figure which had been struggling for predominance with its companion octave below.

By repeated experiment I have since found that every figure requires not only its exact pitch, but also its exact intensity, although each intensity will admit of a certain degree of crescendo and diminuendo. Any intensity beyond that requisite to cause the lycopodium to cover the whole of the vibrating circle is likely to excite overtones, and so to prevent the accurate formation of the figure belonging to the tone itself. Certain figures, indeed, will form only under the influence of simple tones; others will form to notes whose overtones may be present, but are too faint to affect the disc. But when the note sung and any of its overtones happen to be about equal in capacity, then the difficulties referred to may be expected.

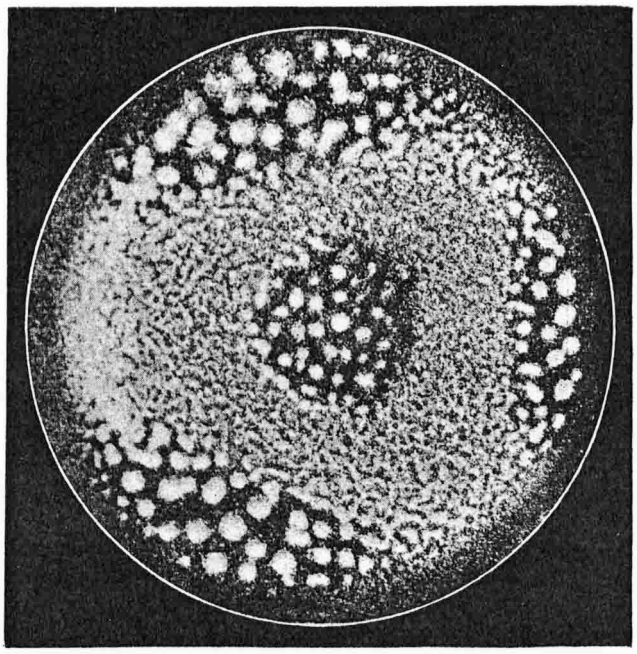
In connection with this class of figures, the student of singing might, by careful attention, become acquainted not only with the action of *overtones*, but with *notes of interference*, *beats*, and *combinational notes*, besides other interesting points relating to voice-production and acoustics.



No. 8.

In singing these two classes of figures, in dry powders, the sand employed should not be too coarse, nor too fine, when obtained in its rough state; it should be thoroughly washed in clean water, and, after draining, placed in an oven, or on some clean paper in front of the fire to dry, being afterwards kept in a jar ready for use. Sand should be scattered lightly on the disc at first, and a soft note sung, which may be increased in intensity, and the sand also in quantity, according to the conditions of the operations.

The lycopodium may be used in various ways: (1) By strewing it lightly over the surface of the membrane; (2) By rubbing it into the surface of the membrane; and (3) By sprinkling it thickly over the whole surface. These different modes of using this fine dust will yield some most interesting results to the singer who desires to study the effect of voice vibrations in this department.



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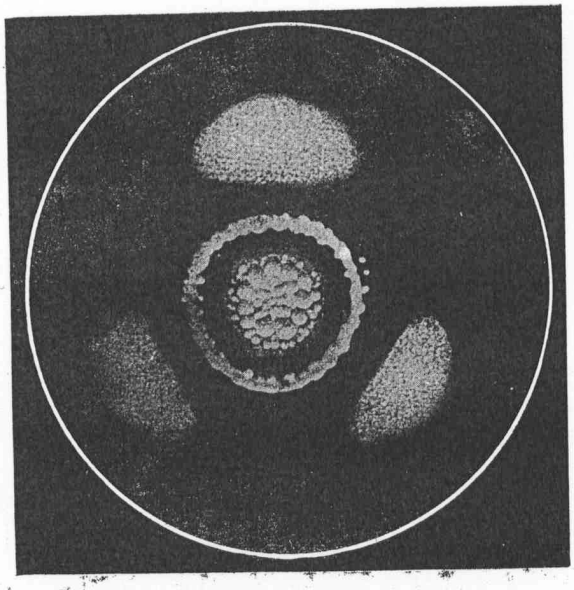


No. 10.

Figures in Liquids.

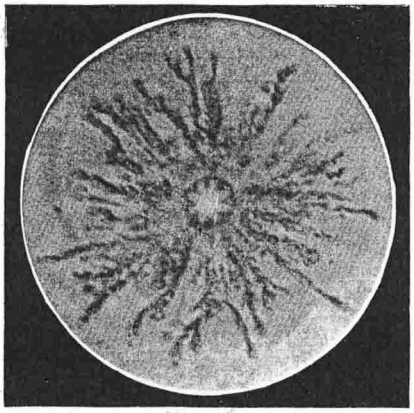
If we flood the surface of the disc with water or milk, and then sing through the tube, we find the liquid surface at once covered by regular crispations or wavelets, in straight or curved lines that form complex and beautiful patterns.

A little observation will show that these vary according to the number of vibrations of the notes sung, the tiny wavelets diminishing in size, but increasing in number and complexity of pattern, as the vocal pitch rises.

Figures in Semi-Liquids.

Instead of employing liquids, if the membrane is rubbed over carefully with moistened colour (such as flake white or red lead) and a powerful note is sung into the tube, some of the figures made visible by lycopodium may be witnessed in a still more interesting form. Not only are the centres of motion and their boundaries to be seen, but every movement of the disc may now be studied. Some of the curves are highly

suggestive of roots, branches, or foliage of plants, or, again, the beautiful curves such as may be witnessed on frosted window-panes on a wintry morning. (See illustrations Nos. 11, 12, 13, 14, and 15).



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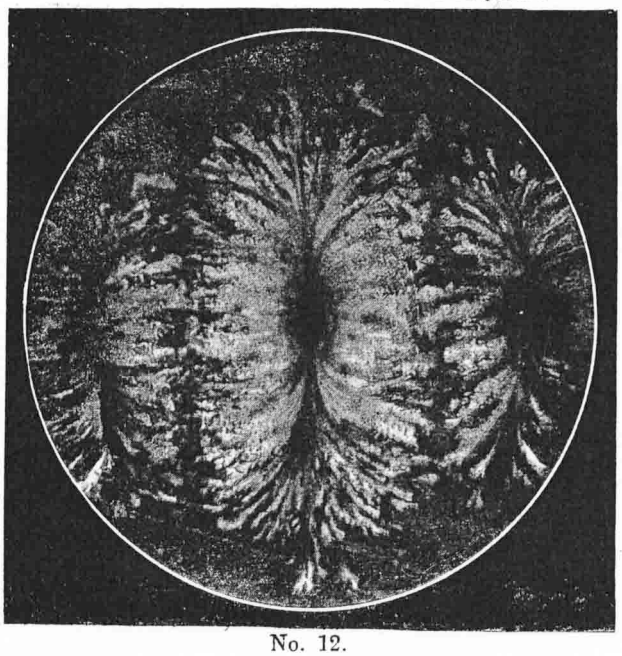
CENTRE OF MOTION IN SEMI-LIQUIDS.



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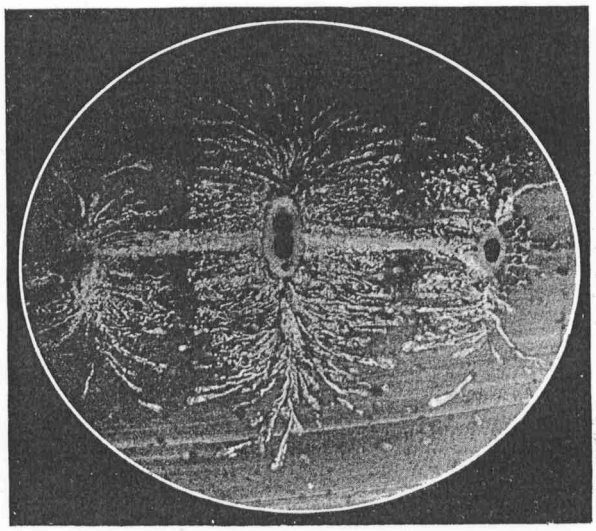

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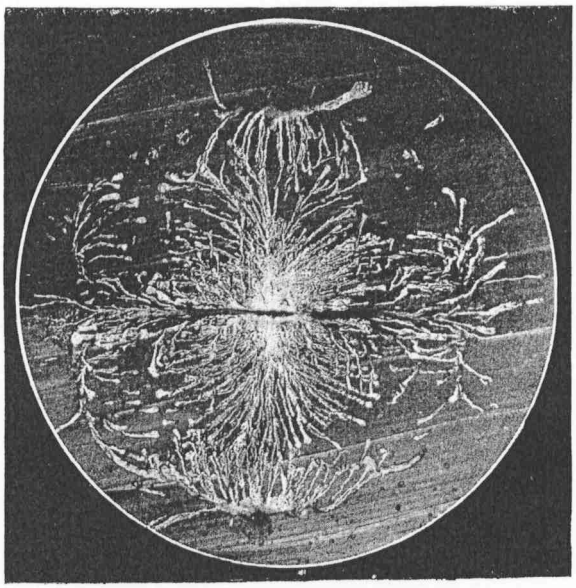

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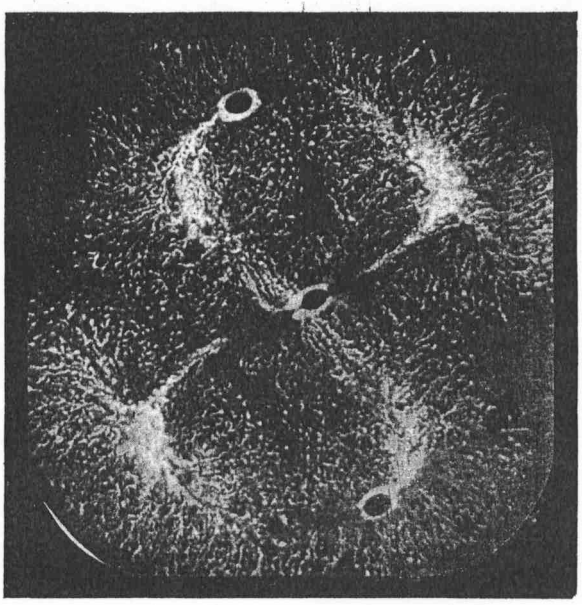


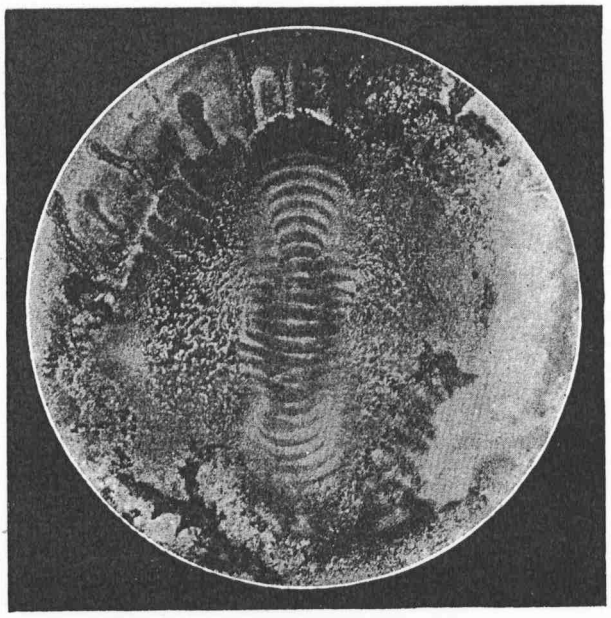
No. 15.

PRIMITIVE FORMS.

Taking now a smaller disc and flooding it as before, while slightly colouring the liquid with a small quantity of powdered water-colour, if we sing one of the lowest notes capable of affecting it, we find a result that is quite different. The coloured liquid changes its forms, not with change of pitch, as did the sand and lycopodium figures, but with each change of intensity.

To this class of figures belong a variety of highly interesting forms, so peculiar in behaviour that they seem particularly to invite scientific investigation.

They may be considered, so far as my own investigations extend, as primitive forms of the semi-liquid class, and are produced in a liquid but slightly removed from the state of water. They require extremely soft notes of steady *equal* power for their production. (See illustration on page 19.)



No. 16.

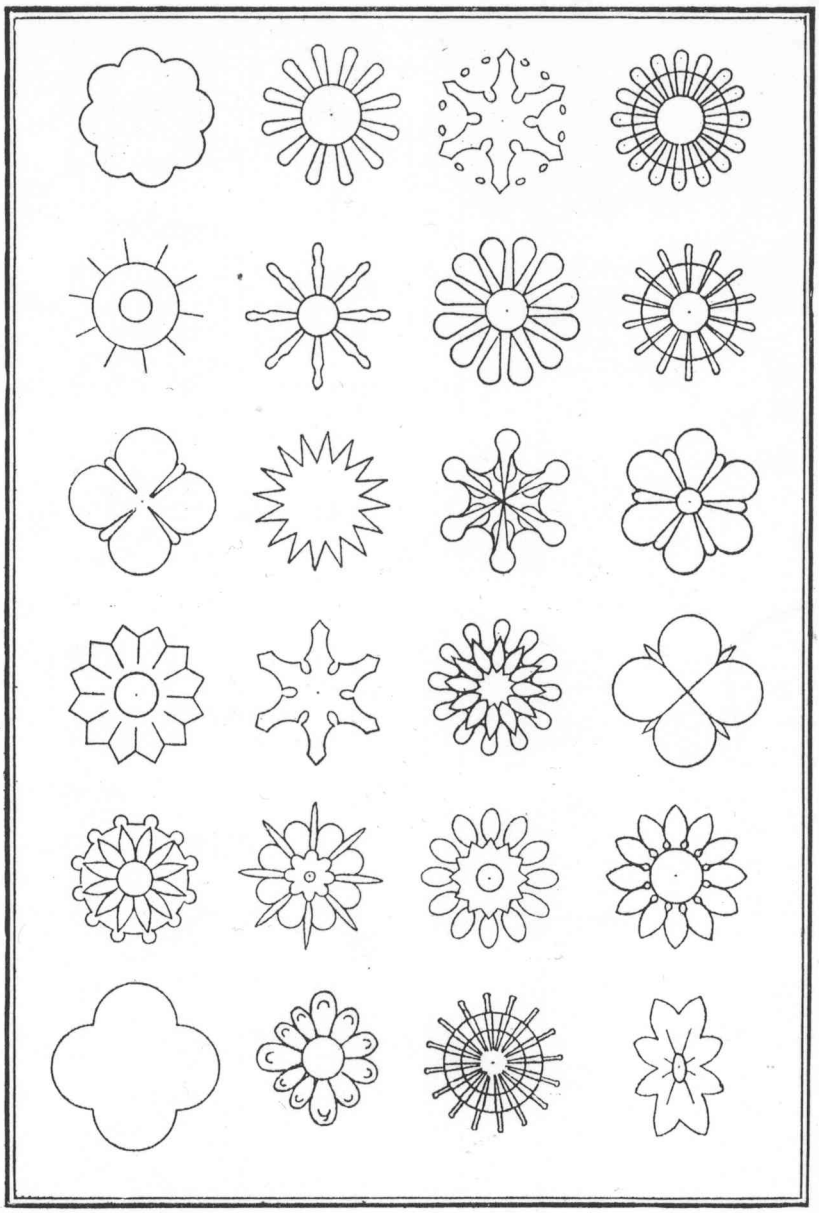
GEOMETRICAL FORMS.

When a rather larger quantity of powdered water-colour is added to the water employed, figures are obtained which, for want of a better name, I call *geometrical*.

Placing on the centre of the disc a very small quantity of the thickened liquid, we find that, under the influence of a suitable note, it is capable of the most perfect and symmetrical arrangements, by division and subdivision.

This class gives a variety of very tiny figures of different sizes and shapes ; some starlike in appearance, varying in the number of their rays from six upwards, some having curved lines and delicate markings on their surfaces.

Many of these forms somewhat resemble snow crystals, both in appearance and in their behaviour (*vide* an article on Snow Crystals by J. Glaisher, F.S.A., in the *Leisure Hour*, 1872).



No. 17.

Figures of this class sometimes appear on the disc in rapid succession during the steady sustention of a single note of high pitch, changing form with kaleidoscopic effect, though I have not yet been able to ascertain the cause. The extraordinary rapidity with which they sometimes appear to whirl on the centre of motion on the disc, clinging to one particular spot, is even dazzling. Occasionally the tiny mass appears to the eye as though poising on the waves of a miniature whirlwind, some quarter of an inch above the disc, rather than resting upon its surface.

All figures of this description are produced by high notes and with a high tension of the disc. In size they range from that of a small pin's head to that of an ordinary-sized snow crystal.

Owing to the fragile nature of the most beautiful of these tiny forms, I have found it impossible to preserve them in their original beauty, as seen a few seconds after being sung. The illustrations (No. 17) have been sketched and enlarged in scale, and were sung with notes lying between the upper G of the Soprano and C Sharp.

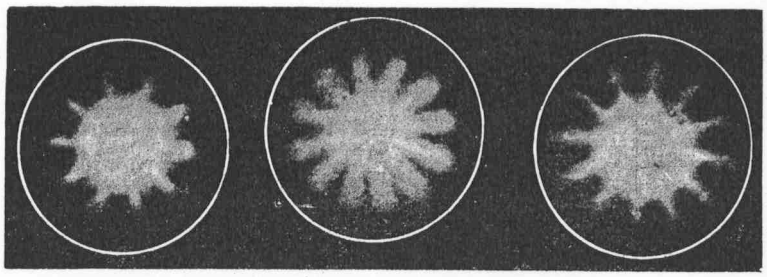
It is obvious that the alterations of form in this class of figures are due to the condition of the substance used, or, at least, to something other than a change in the number of vibrations.

By further increasing the quantity of colour in proportion to water, we have again different results, and the forms now produced we may call

Floral Forms.

First stage of the Daisy.

A small heap of colour paste, mixed to proper consistency, is placed on the centre of the disc, and a suitable note sets it in motion. The note is continued, and ere long we see the paste take the form of a little flower with petals. Instead, however, of altering its form like the "geometrical" figures, during the sustention of a single note, we observe this floral form remaining apparently unaltered while the note is held on, and apparently falling back every time, with each diminuendo of the note, into the same little heap from which it sprang, only to reappear with each renewal and slight crescendo of the note; and we further notice that it becomes each time more and more developed in shape, up to a point



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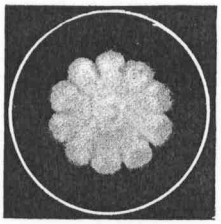

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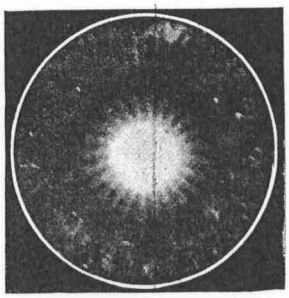
No 20.



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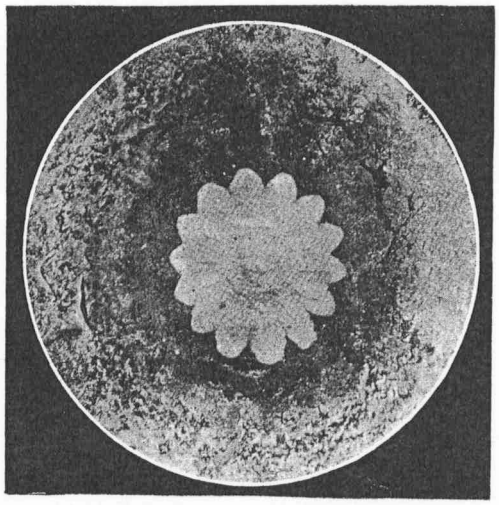
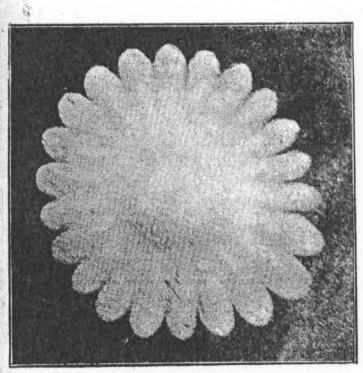


No. 22.

when the surrounding air has absorbed so much of its moisture as to leave it too solid for free movements. (See illustrations, Nos. 18 to 23.

Fully Developed Daisy.

If we now place on the disc a still larger quantity of this colour paste—*e.g.*, a mass the size of a small bean—exactly upon a centre of vibration, as before, and sing a suitable note, we first see the heap gather itself closely together. After a short time it will be seen slightly agitated around its edge, and, by continuing to sing, suddenly, in obedience to



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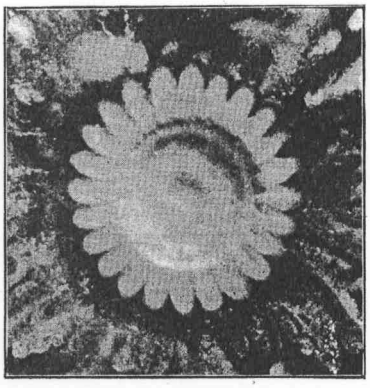

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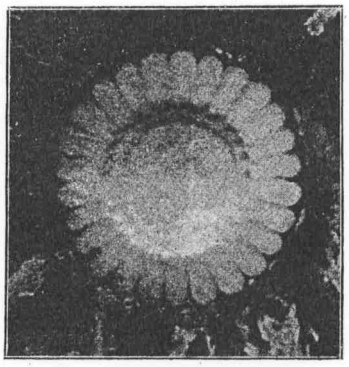
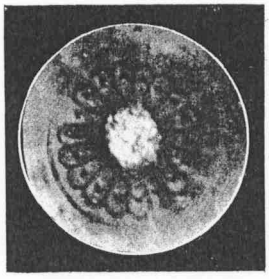


No. 25.

a careful crescendo, beautifully-shaped petals dart out, with perfect regularity and symmetry, in a floral form which, when fully developed, closely resembles a daisy.

No. 26.



No. 27.

But here again we find stages of development. It is indeed very seldom that a perfectly-shaped daisy is obtained with the first crescendo. In order therefore to secure the full development of a figure of the daisy class, the note should be repeated diminuendo, when the petals will retreat into a central heap, and there remain so long as the note sustained is equal in power. Immediately, however, that a crescendo is again executed, the petals will dart out anew, more perfect in appearance than at first. Still continuing the alternate diminuendo and crescendo necessary to the involving and revolving movements which are to be observed in the central heap, in course of time we find the figure reaches its perfection. (See Nos. 24, 25, and 26.)

Some of the most perfect daisy forms are delicately marked on their petals with vein-like lines, both straight and curved. Others show around the base of the petals one or two rows of very tiny dots, which I am inclined to think are themselves centres of vibration, and capable (if one only knew *how*) of development into tiny flowers. Some daisy forms exhibit two, three, and even more rows of petals overlapping each other. I have failed to observe, while singing these more complex forms, any difference of note from those which produce the simpler daisy forms. I think there must be a difference, but the necessity of closely observing a number of other particulars when singing these forms, especially some of them, has so far prevented me from determining this

and some other points of interest. The eyes are acutely watching the movements of the heap, the ear is noticing the character of the sound which is to influence it; intensity has to be controlled, the fixings of the vocal organs have to be considered, along with other points of delicate arrangement—all during the momentary crescendo of a note. To do all this with sufficient accuracy for exact comparison with another experiment is indeed almost impossible.

The singing of the daisy form is, however, in itself a useful study, which would well repay the vocalist. It affords scope for the practice of crescendo and diminuendo in almost every degree of intensity, and gives a rare opportunity to the vocalist of noticing the peculiar sensations belonging to the formation of notes of different character. Here I would remark that, although the action of the vocal organs must of necessity be the same in the crescendo of the semi-liquid heap as in that employed when controlling the lycopodium heap, the sensation felt, so far as my experience goes, is very different. I suppose this to be due to the difference in the substance upon which the vibrations of the note are directed to act. I wish I could clearly describe a sensation I have often experienced when singing these daisy heaps into shape, but I fear I can be understood only by vocalists who know something of the sensations peculiar to certain notes when produced in some parts of the vocal range with an adjustment of the organs that permits the character of the notes to be varied with the most perfect ease. I may say that the sensations now mentioned are something similar, but greatly intensified.

Other sensations experienced while singing these forms are equally remarkable, and quite unlike anything I have ever felt in ordinary vocalisation, but they are still more difficult to describe adequately.

At first, when directing the voice against the semi-liquid mass upon the centre of the disc, there is a feeling as if some impassable barrier were encountered, and that it would be as easy to move a mountain with a push of the hand as to set that colour heap moving by the action of a note. The next sustention seems only to confirm the first impression; but after several attempts one comes to feel that it *could* be done if only the right *kind* of sound could be employed. Persevering, the seemingly ponderous, inert mass is at last disturbed, and shows some susceptibility of control. Still continuing, it now begins to move, and

ere long comes under complete control, expanding in petals after every repeated crescendo. When the mass moves thus easily the sensation of the singer is completely changed. The feeling is now as if all at once the air in the tube, in the receiver, upon the disc, and all around, were acting in concert for the singer's purpose, and had taken possession of every corner of space.

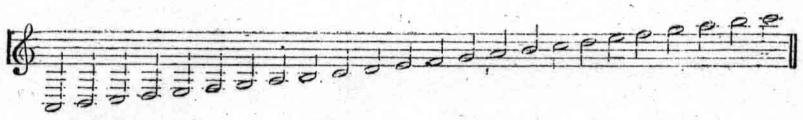
During this state of things the apparent resistance of the semi-liquid heap upon the disc becomes so slight that it seems to move as if on wheels, and a most perfect physical control over the aerial movements is realised, the sensation of which is at the same time most peculiar and most agreeable.

In some instances in which I have found the pasty mass gather itself together more compactly than usual, I have seen the whole, unaided by any crescendo of my note, suddenly quit its ordinary place on the centre of the disc and travel over the surface in a most mysterious way. During its movements about the disc, the mass has shot out its petals just as usual in obedience to the crescendo, and with as perfect a result as though it had been at rest in the centre of the disc.

All the larger-sized heaps require very low notes, varying in pitch according to their weight and mobility.

The lowest note with which I have been able to sing a successful daisy form has been B flat, an octave below.

Continued practice in the sustention of notes of different pitch and intensities has enabled me to produce a compass of notes which I had no idea could have been obtained with my own vocal range, or, indeed, that of any female voice. I have been able to form figures on every semitone, and indeed, I may say, on almost every shade of tone, within rather more than three octaves—*i.e.*, from



I look forward to further results whenever this subject is taken up by vocalists with voices differing from my own, as voices *do* differ from each other, in almost every point connected with vocal sounds. It

would, for example, be interesting to see a figure produced by a bass voice singing a note an octave below the usually considered limit of the bass vocal range, and to observe also a figure produced by the highest *soprano sopracuto* notes of the female range.

Vocalists will certainly find many points of special interest in connection with these figures, whatever may be their value or claims for enquiry in relation to natural science.

Before quitting the subject of floral forms, I wish to refer to another variety, belonging to a different condition of the material employed.

The Pansy.

This figure has its own special behaviour, and will take shape only under particular conditions.

A small quantity of water-colour, mixed to proper consistency, is placed on the disc, and water is poured around the colour mass. Then, if a suitable note is sung into the tube, the colour paste in the centre shoots out in petals through the surrounding water, but, instead of emitting small petals all around, as with the daisy form, in this case the petals are larger, and there are only three, six, or nine. These pansy forms vary both according to the condition of the colour paste and the character of the note which influences it. Some are composite, having two or three rows of overlapping petals. Owing to their tenuity, however, the upper layers of petals are unavoidably effaced as the water dries off, so that I have been unable to preserve the most elaborate specimens. It is, indeed, only when the thicker layers of petals are sufficiently solid to bear gentle pressure that they can be fixed at all.

The pansy is peculiar, in that its divisions are always three or a multiple of three, and that it will expand only if surrounded by liquid. As the petals spread out in the water, there is left in the centre of the disc a smaller triangular heap the points of which are connected with the bases of the larger petals. Sometimes around these three points, as well as on the surface of the heap, and on the petals, there are delicate patterns. Both upon and around the petals there is often a succession of curves, and streaks, and fluted markings. Sometimes the larger petals are partially divided at their outer edges. In other cases a narrower petal appears between each large petal, adding considerably to the beauty of the figure, and to its floral appearance.

The notes that produce the pansy figures are softer throughout, and require a more *gradual* crescendo than those which produce the lycopodium and daisy forms. It is only, however, by much practice that a singer can become acquainted with, and gain control over, all that is necessary for their formation. It is requisite to learn how far to use crescendo, and *when* to cease, for while the petals are spreading out through the water, the crescendo must be kept up; and it requires as much art to know when and how to stop as it does to sustain the note. If the note is not terminated at the right moment, and *carefully*, without a jerk, the central heap will give out another set of petals in a different direction, before the first has been completely withdrawn into it, so rendering the figure imperfect. (See Nos. 28 to 31.)

The floral figures afford a considerable variety of forms, taking into consideration the different degrees of consistency in material, and the different quantities which can be employed.

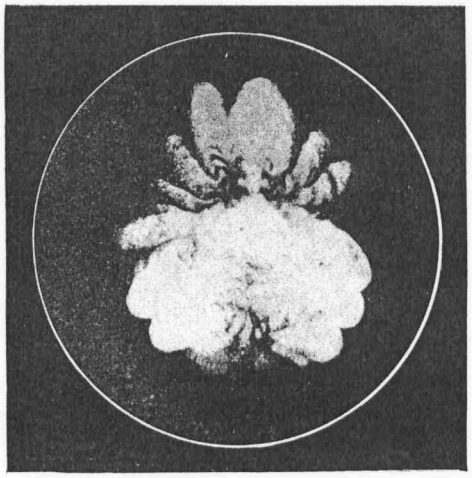
The quantity of colour paste used in the tiny floral forms is, of course, very much less than that for the larger daisy forms. The most noticeable difference resulting is in the petals of the figures, of which many are strikingly like some of our well-known flowers, both wild and garden.

I have observed, in addition to the daisy and pansy forms—which represent two distinct classes of figures—others of various sizes, and with petals resembling those of the primrose, the buttercup, the chrysanthemum, the rose, and the geranium.

The general appearance of some of these figures, immediately they are sung, is also remarkable. If the moist colour be thoroughly mixed, so that every particle of the heap can be set in regular vibration, the surface of the mass displays a delicate softness, of such perfection that I can compare it only to the bloom on a beautiful flower.

Other interesting figures can be obtained by means of moistened *plaster-of-Paris*; these are of a different character, although produced in the same manner as some of the previous figures.

In closing my remarks upon the *simple disc figures*, I may say that I have found the study of them absorbingly fascinating. From the moment that I have sung a note into the Eidophone, one suggestion upon another has persistently crowded into my thoughts. In the



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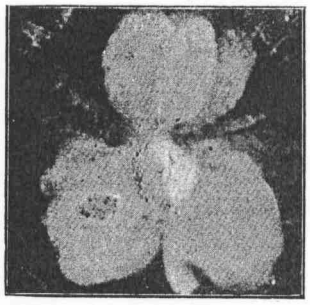

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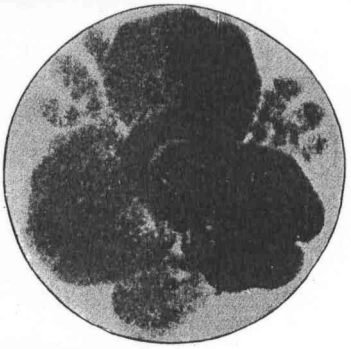

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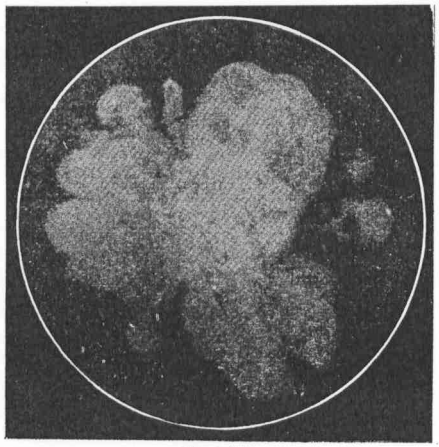


No. 31.

act of singing shapeless matter into such symmetry and beauty of form, one cannot help feeling the presence of a power that is very strange, and greatly admiring the simplicity of the laws ruling the production of these figures, and the multiform variety of the results.

PART II.—IMPRESSION FIGURES.

Soon after the production by singing of the semi-liquid forms, a great desire took hold of me to find a method of rendering them permanent, for it seemed obvious that if the whole motion of the disc under the influence of vocal notes could be preserved, this might prove not only interesting and pleasing to the sight, but also of advantage to science. But how to proceed to this end? After many attempts and many failures, it occurred to me to experiment by way of glass. I therefore took a small piece and coated it with colour, and the disc in a similar manner. I placed it downwards on the membrane, at the same time singing a note into the tube. On lifting it up I found the glass covered with some interesting adhesion vein lines, but showing no trace of the vibrations of my voice. After continued practice, both in singing and in manipulating the necessary operations, on a certain occasion, when the plate was lifted up from the disc, the underlines showed that the note I had sung had been sufficiently powerful to leave a distinct impression on the glass, which could be retained and made permanent.

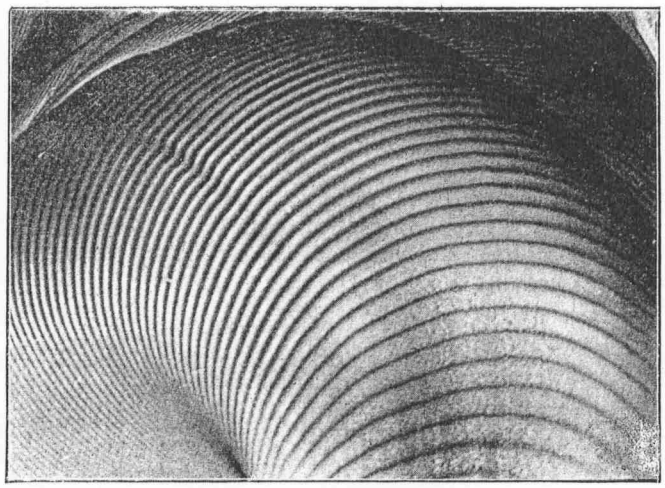
This experiment, with the practice it involved, led to the discovery of all the classes of figures and their variety belonging to this department, including those named trees, ferns, cross vibrations, and the forms which will now be described under the name of

Linear Curves.
(First Method.)

Having succeeded in obtaining impressions of the linear curves on glass, my next step was to ascertain what would be the effect of moving the glass in straight or curvilinear directions on the surface of the mem-

brane. I found great difficulty in obtaining satisfactory results until it occurred to me to do one thing—to blow into the tube *before* singing, so that the pressure of the air in the receiver might cause the membrane to rise slightly above the level of its edges. By so doing the glass could be moved in any direction freely and unfettered.

After some considerable practice I found it was possible not only to retain the lines, but also that with every change of pitch the number of the lines varied. If, therefore, the glass is moved in straight or curvilinear course, at the same rate, an approximate record of the number of vibrations of the different intervals of the scale may be obtained (Nos. 32 to 36).

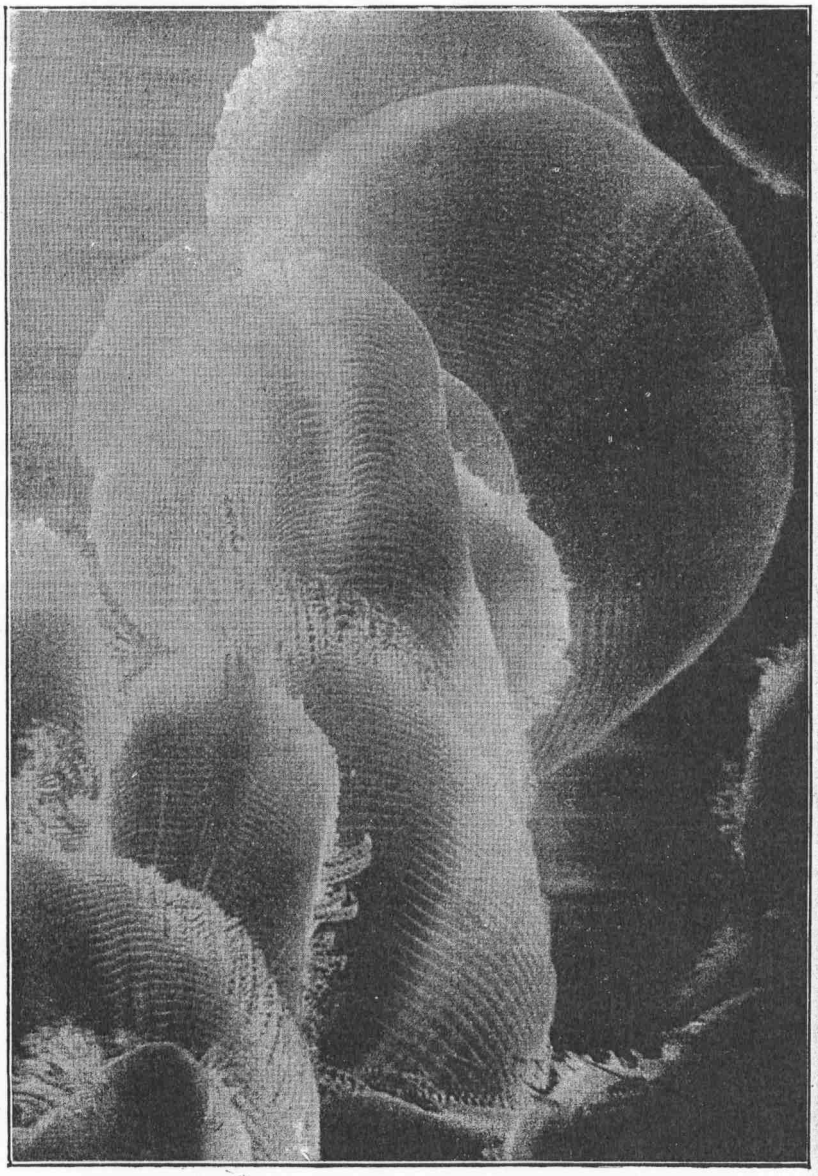


No. 32.

Linear Curves.

(Second Method.)

On finding the disc capable of recording the line impressions by moving the glass over its surface, I was wishful to see if it were possible to leave the line impressions on the glass by bringing the membrane into contact with the plate from above. After much practice I have found this reversed order in the operations to be more satisfactory than the



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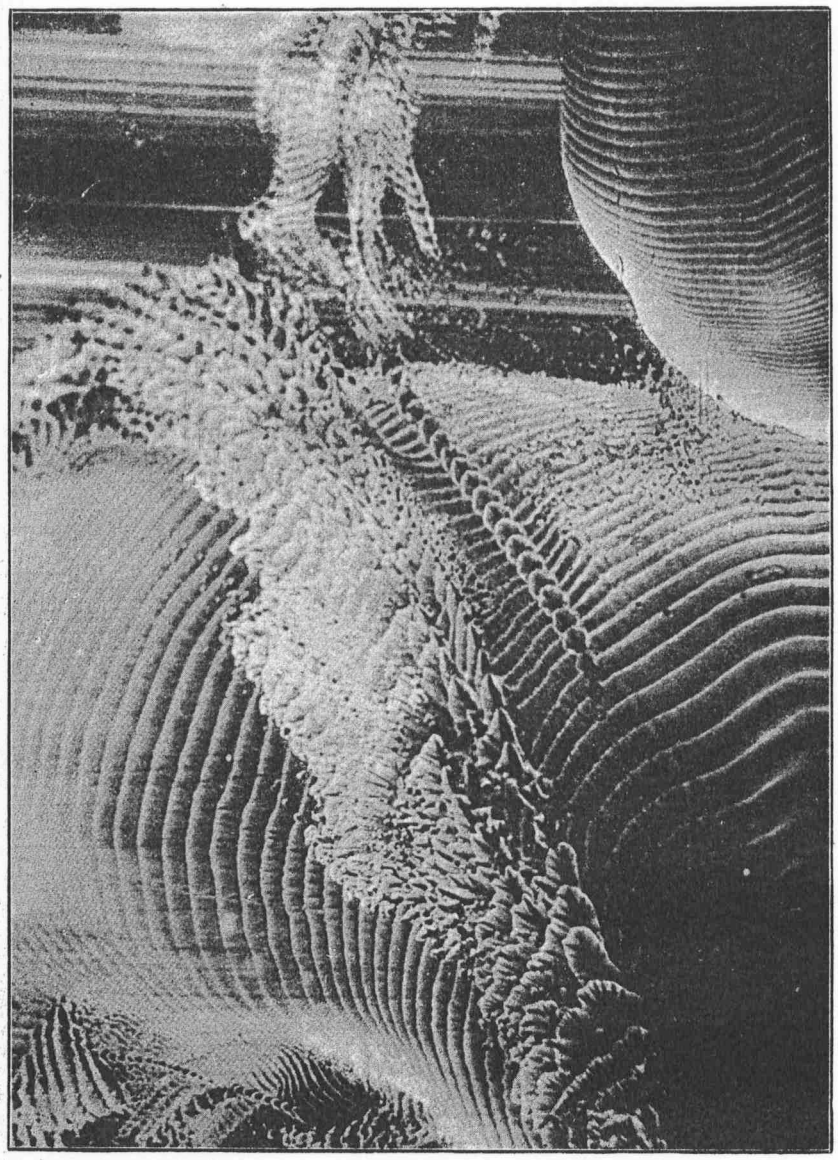

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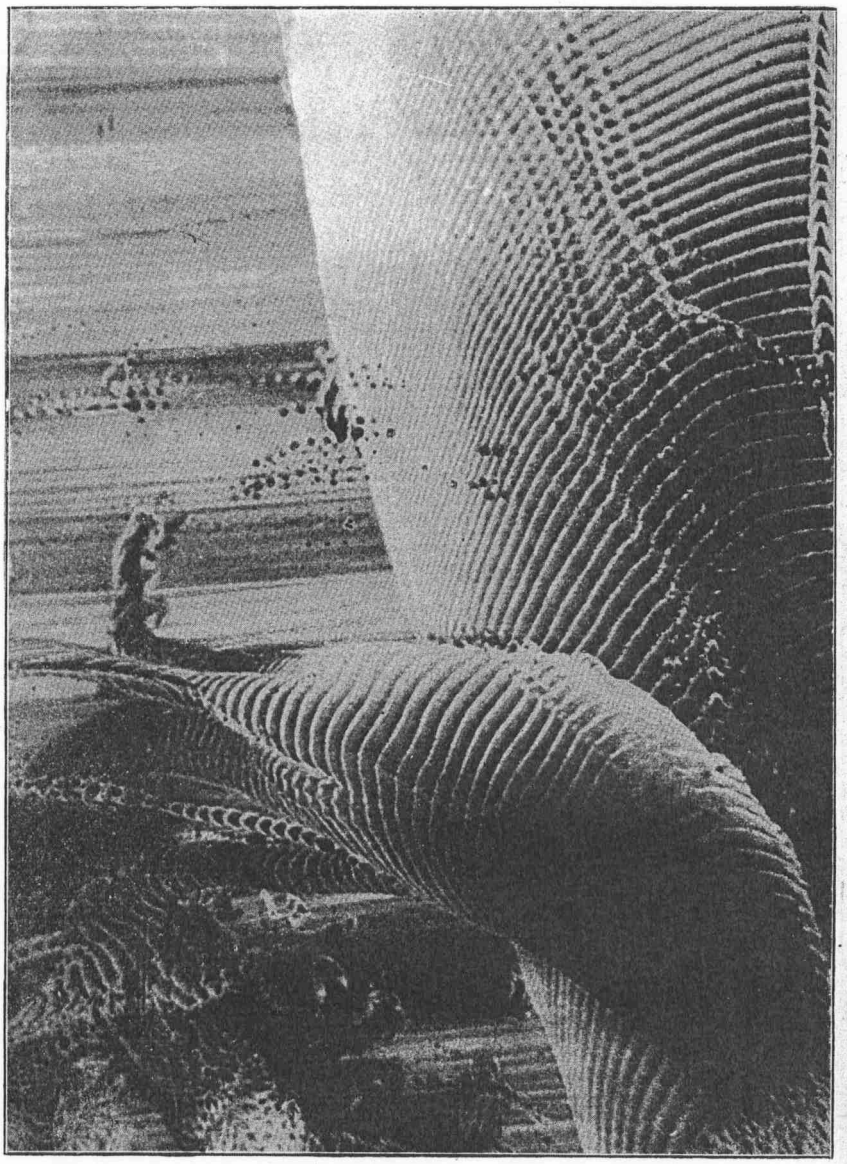
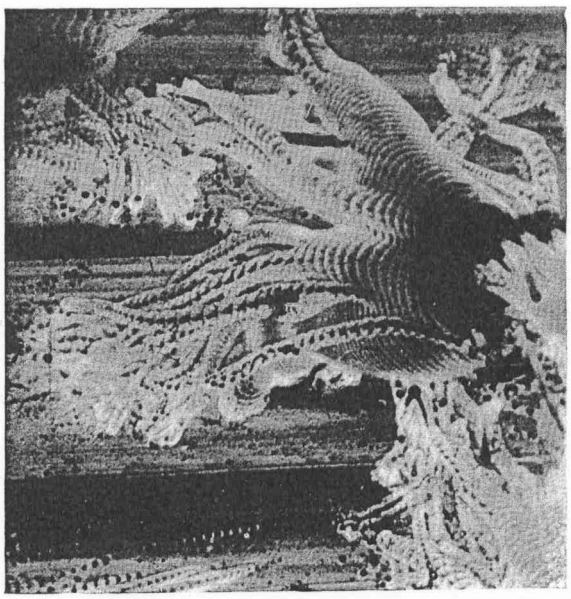


No. 35.

former, and that the hand Eidophone has become indispensable in producing these interesting figures.

The plate and disc being both coated as before, the plate is laid upon the table, the wet colour side uppermost. The disc is now reversed, set vibrating, and, while vibrating, is moved along the surface of the wet plate. As it glides over the moist surface, while a steady note is sustained, it leaves behind it a register of every vibration, recorded with the strictest accuracy.



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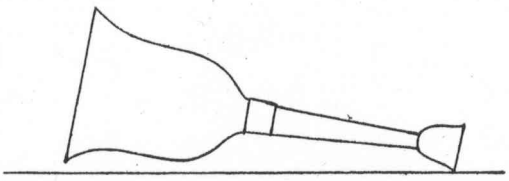
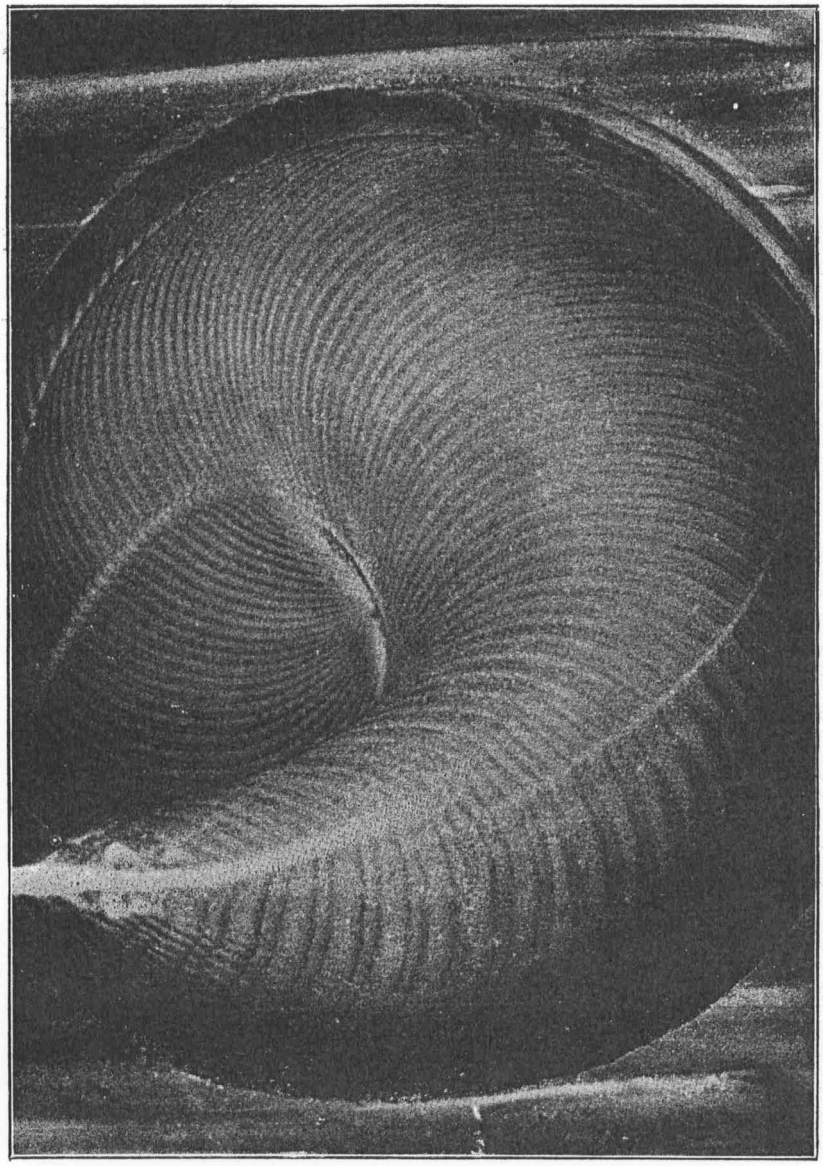


The Hand Eidophone. (No. 37.)

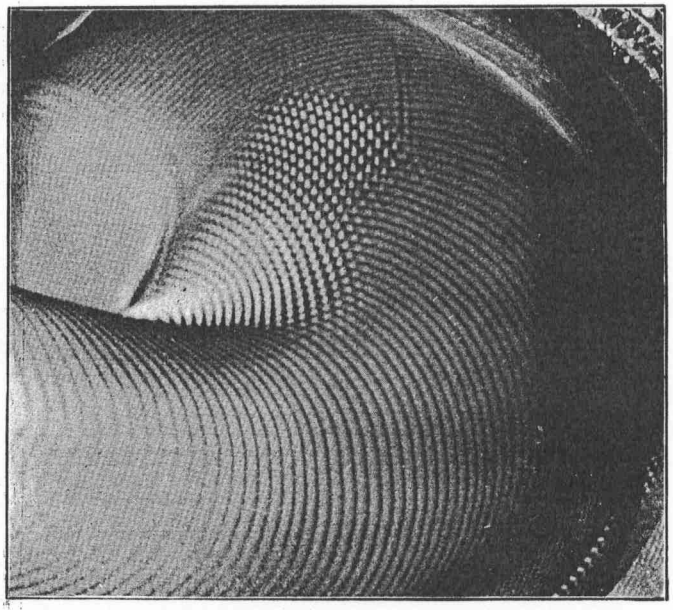
Using this form of the Eidophone, we are able to deal with a much larger plate than could be conveniently held above the disc, and by



No. 38.

passing the disc over the plate in curvilinear directions a much larger figure can be obtained than any straight course would permit. The gradations of shade in these figures are strikingly beautiful, and some curious perspective effects are produced, arising, I presume, from differences of pressure as the disc travels over the plate.

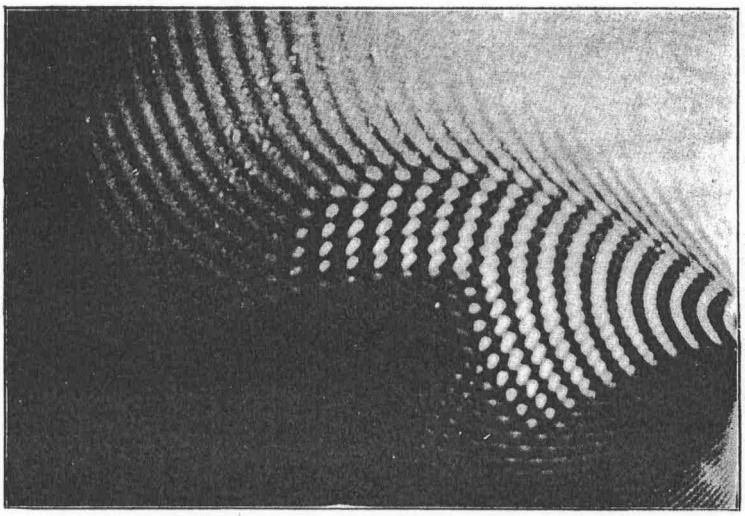
By being careful to move the Eidophone at equal speed over the plate, it is easy in this way to obtain a series of figures giving pictorially, with approximate accuracy, the ratio of vibrations of each note of different pitch. (Nos. 38 and 39.)



No. 39.

CROSS VIBRATIONS.

The same method is proceeded with in the production of these figures. The plate of glass, after being coated with colour, is moved lightly over the membrane, and according to the character or condition of the colour, and the quality of the note sung, some interesting forms are produced, specimens of which are seen in Nos. 40 to 44.



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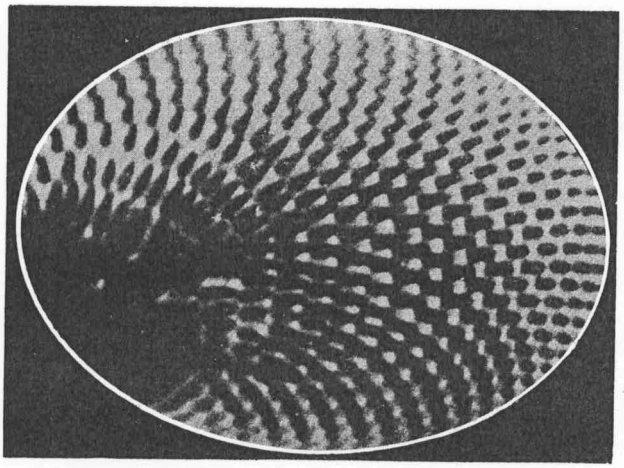

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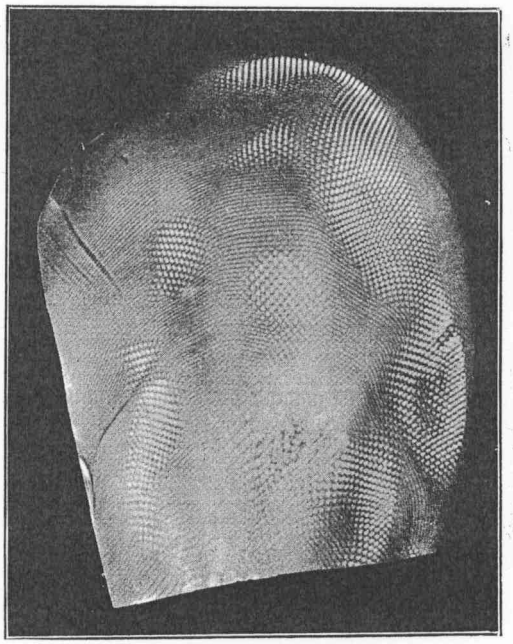

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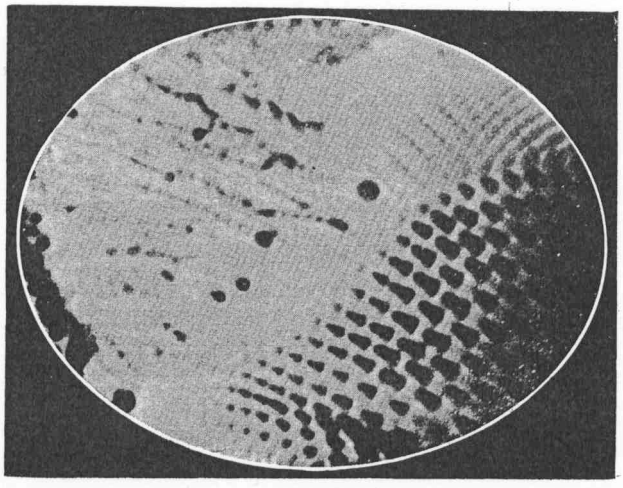

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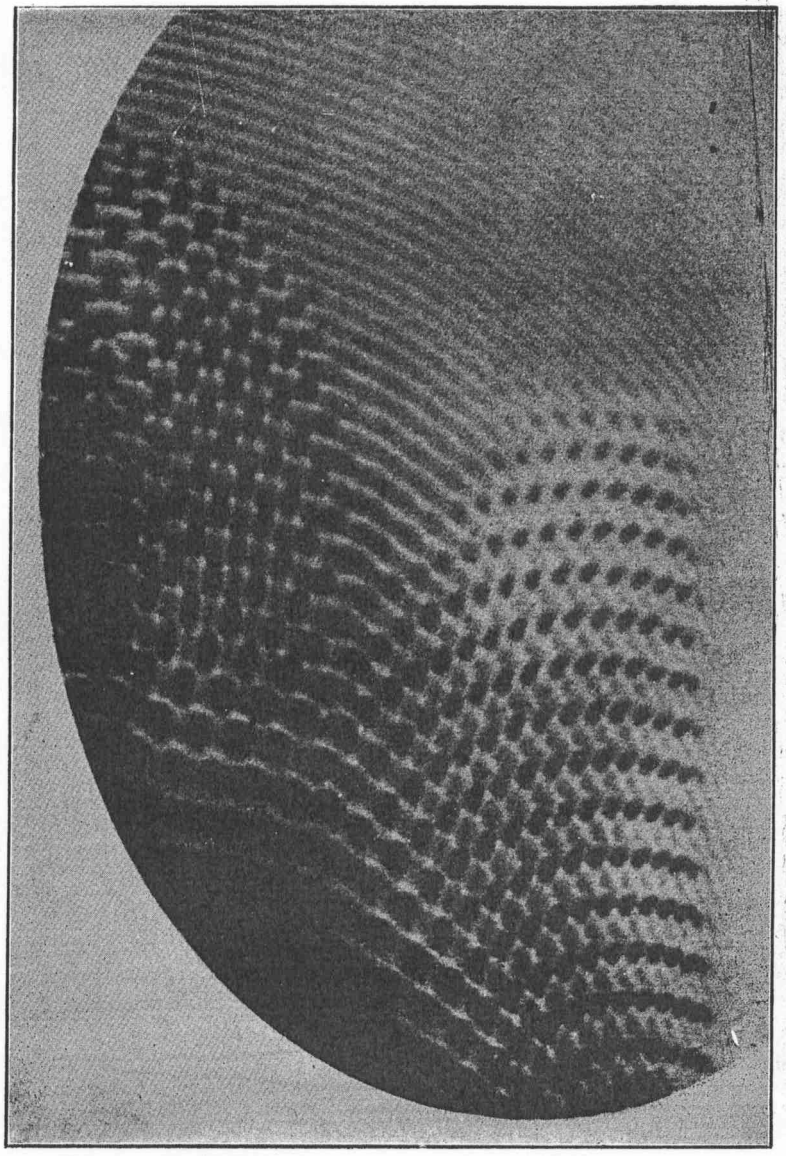
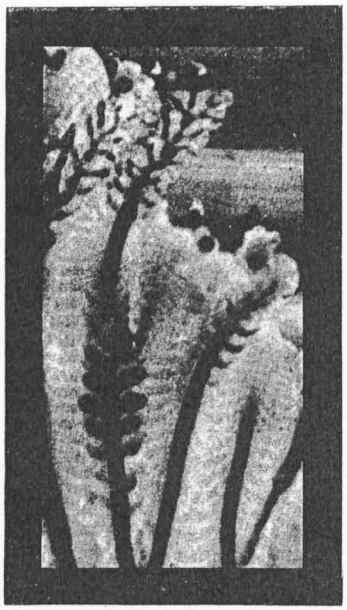


No. 44.

The Hugh-Lloyd Fern Variety.

If the plate be coated afresh with colour in a more liquid condition than that described in the first method of the linear curves, in response to the singing of a powerful note the result will again differ. Here we find an appearance resembling a fern or catkin, the moist colour showing as it were an inclination to arrange itself in a form resembling some vegetable growth. With suitable notes and skilful manipulation a variety of such forms can be produced. (See illustrations Nos. 45 to 52.)

No. 45.



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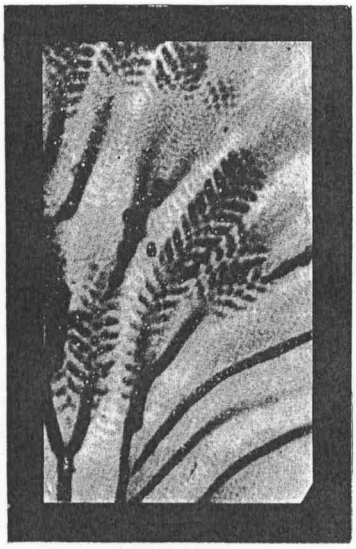

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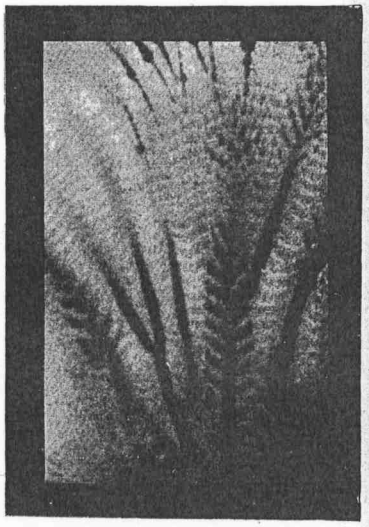

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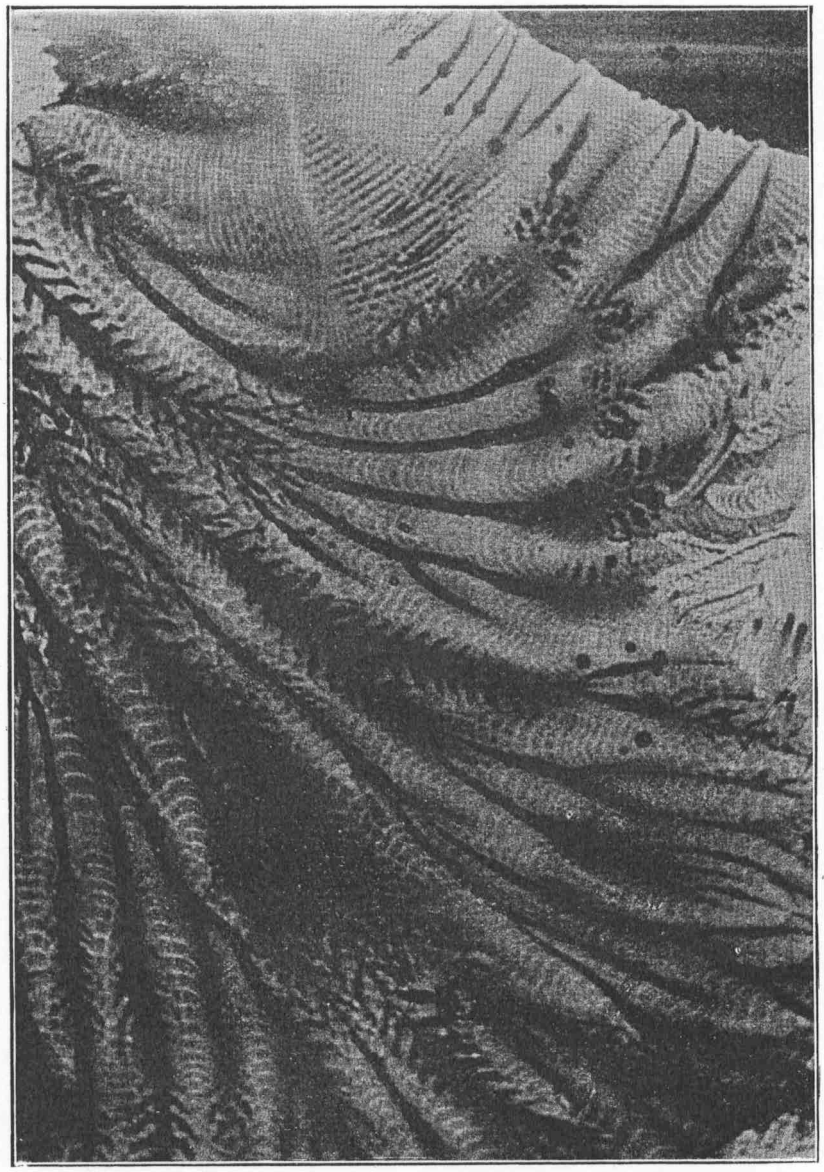

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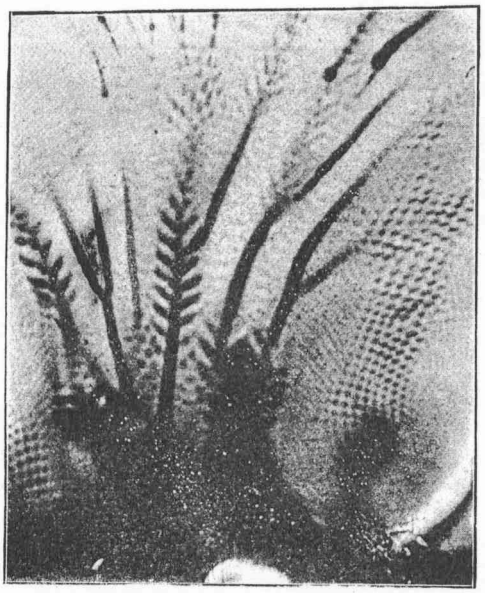

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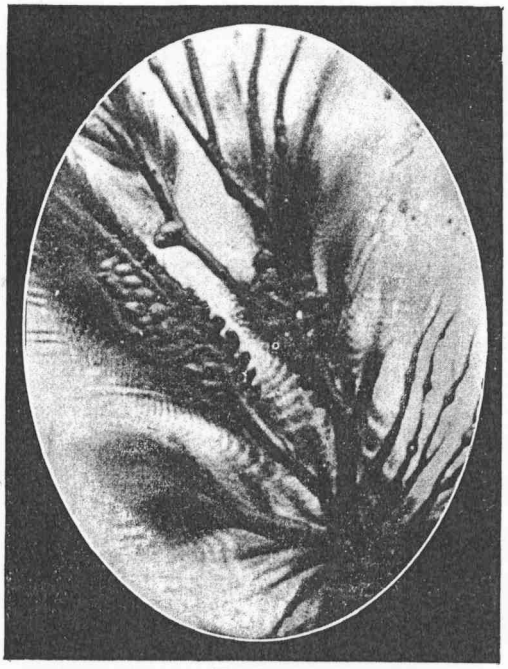
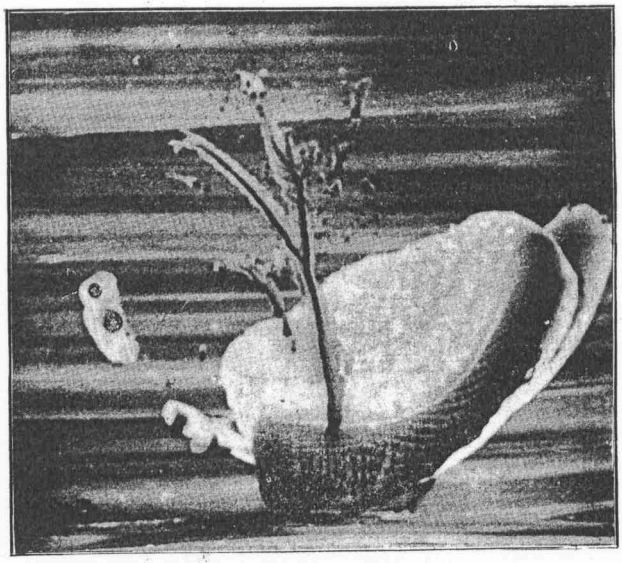


No. 52.

TREE FORMS.

Taking now a smaller disc and a smaller plate, and thinly coating these with moist colour in a similar manner, the result of singing into the tube a powerful note of suitable pitch is the instant formation of a figure resembling a tree. (See illustrations Nos. 53 to 56.)



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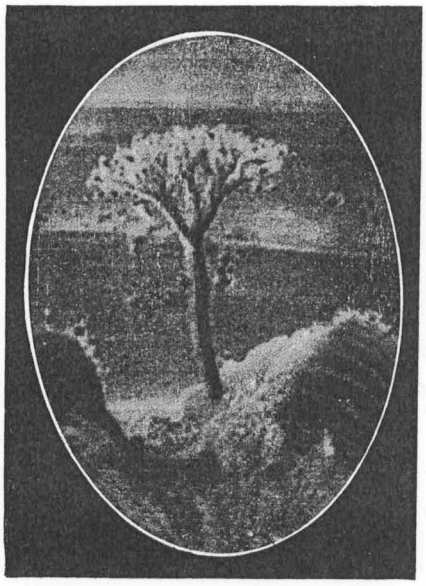

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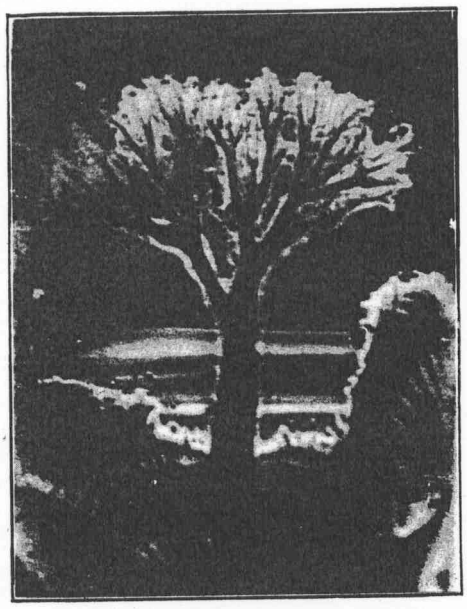

No. 56.

Although these tree forms appear very simple in the mode of their production, they are perhaps the hardest to evoke of all the impression figures, owing to some practical difficulties which can scarcely be explained without experimental demonstration.

This subject, as a whole, is far too wide to be treated here exhaustively, but I have now given an outline sketch of the different classes of Voice Figures that I have been able to produce.

As already said, the principles of their production are quite simple, but, in concluding, I must add that their successful production demands, in addition to such an explanation as given above, very considerable practice in singing, and untiring perseverance in its employment.

MARGARET WATTS-HUGHES.