THE SCIENCE

OF

ENGLISH VERSE

BY

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So prayе I God that non myswrite the,
No the myssetere for defaute of tonge.
CHAUCER: *Troylus and Cryseyde.*

If . . . some perfect platform or Prosodia of versifying were . . . ratifyed and . . . downe. — WEBBE: *Discourse of Eng. Poetrie.*

A Poet, no industrie can make, if his owne Genius bee not carried unto it. . . . Yet . . . must the highest flying wit have a *Dedalus* to guide him. — SIR PHILIP SIDNEY: *Apol. for Poetrie.*

. . . Gif Nature be nocht the cheif worker in this airt, Reulis wilbe bot a bund to Nature . . . : quhair as, gif Nature be cheif, and bent to it, reulis will ... me help and staff. . . . — KING JAMES I.: *Reulis and Cautills, &c.*

Poesie therefore may be an Art in our vulgar, and that verie methodicall and co...mendable. — PUTTENHAM (?): *Arte of Eng. Poesie.*

But the best conceptions cannot be, save where science and genius are. — *Trans. from* DANTE: *De Vul. Eloq.*

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SCIENCE OF ENGLISH VERSE.

CHAPTER I.

INVESTIGATION OF SOUND AS ARTISTIC MATERIAL.

PERHAPS no one will find difficulty in accepting the assertion that when formal poetry, or verse, — two terms which will be always used here as convertible, — is repeated aloud, it impresses itself upon the ear as verse only by means of certain relations existing among its component words considered purely as sounds, without reference to their associated ideas. If the least doubt upon this point should be entertained, it may be dispelled by observing that all ideas may be abolished out of a poem without disturbing its effect upon the ear as verse. This may be practically demonstrated by the simple experiment of substituting for the words of a formal poem any other words which preserve the accentuation, alliteration, and rhyme, but which convey no ideas to the mind, — words of some foreign language not understood by the experimenter being the most effective for this purpose. Upon repeating aloud the poem thus treated it will be found that the verse-structure has not been impaired. If, therefore, the ear accepts as perfect verse a series of words from which ideas are wholly absent, — that is to say, a series of

sounds, — it is clear that what we call "verse" is a set of specially related sounds, at least in the case of a formal poem repeated aloud.

But a much more sweeping proposition is true. If we advance from the case of formal poetry repeated aloud to that of formal poetry silently perused by the eye of a reader, a slight examination will show the proposition good that here, as before, verse is still a set of specially related sounds. For, in this instance, the characters of print or writing in which the words are embodied are simply signs of sounds; and although originally received by the eye, they are handed over to the ear, are interpreted by the auditory sense, and take their final lodgement, not at all as conceptions of sight, but as conceptions of hearing. The function of the eye is now purely ministerial: it merely purveys for the ear. An analogous process is indicated in the Arabian saw which affirms that "that is the best description which makes the ear an eye." In general, the reader will do well to recall that each sense has not only what is ordinarily called its physical province, but also its corresponding imaginative province; the eye has its imagination, the ear its imagination; and when the term "imagination of the ear" is hereinafter used it must be understood to suggest those perceptions of sound which come to exist in the mind, not by virtue of actual vibratory impact upon the tympanum immediately preceding the perception, but by virtue of indirect causes (such as the characters of print and of writing) which in any way amount to practical equivalents of such impact. Now these signs convey, along with their corresponding sounds, the same relations between those sounds which are suggested to the ear when the sounds

themselves fall upon the tympanum. It is therefore strictly true that, although the great majority of formal poems in modern times are perceived by the mind through the original agency of the eye, the relations indicated by the term "verse" are still relations between sounds.

Nor — to call the briefest attention to the only other case in which this fundamental proposition could seem at all doubtful — is this connection of verse with sound less essential when the formal poem is merely conceived in the thought of its author without ever reaching either visible or audible embodiment. For the formal poem is necessarily conceived in words, and in the imagination of the sounds (words) is necessarily involved the imagination of the relations between the sounds, that is, of verse.

In short, when we hear verse, we *hear* a set of relations between sounds; when we silently read verse, we *see* that which brings to us a set of relations between sounds; when we imagine verse, we *imagine* a set of relations between sounds.

Approached in this way, the proposition given below will probably not seem difficult of acceptance; indeed it is possible many will be surprised that the ideas leading to it have been dwelt upon so long. In point of fact, however, it is the very failure to recognize verse as in all respects a phenomenon of sound and to appreciate the necessary consequences thereof which has caused the non-existence of a science of formal poetry. Occasion will presently arise to show how this has happened, with some detail; meantime, we are now prepared to formulate a proposition which will serve as the basis of a science of verse.

The term "verse" denotes a set of specially related sounds.

It is clear that if we can now ascertain all the possible relations between sounds we will have discovered all the possible determinants of verse, and will have secured physical principles for the classification of all verse-effects from which there can be no appeal. This investigation can fortunately be carried on with the confidence attaching to the methods of physical science. For it involves mainly the observation of sensible appearances; and these are, furthermore, in the present instance not complex.

The study of verse must therefore begin with the study of sounds.

Sounds may be studied with reference to four and only four, particulars. We may observe —

(1) How long a sound lasts (*duration*);

(2) How loud a sound is (*intensity*);

(3) How shrill — that is, how high, as to bass or treble — a sound is (*pitch*);

and

(4) Of what sounds a given sound is composed — for, as in studying colors we find purple composed of red and violet, and the like, so many sounds have been discovered to be made up of other sounds (*tone-color*).

These differences in sounds, although really so distinct from each other as to be the origin of some of the most striking and widely-separated phenomena both in art and in our daily life, are so confused by most persons who have had no special occasion to examine them that there are no terms of ordinary use in which they can be expressed with scientific precision. The reader, however, will not only advance with ease, but

will win a whole new world of possible delight,[1] by acquiring at the outset such a familiarity with the sound-relations above termed duration, intensity, pitch, and tone-color, that the ear will immediately and intelligently refer every sound heard to all those particulars and measure its relations to the preceding or succeeding sound in terms of them. The remarkable powers which the human ear possesses of making perfectly accurate comparisons of sound with sound in three of these particulars will presently be detailed.

Meantime the reader will receive great assistance towards a clear conception of these differences by observing exactly how they are caused by the vibrating body producing the given sound; that is, by attending to the physical explanation of duration, intensity, pitch, and tone-color.

For this purpose: remembering that all sounds are caused by the vibrations of some vibrating body, which are impressed upon the air, and through the air upon the drum-membrane, or tympanum, stretched inside the ear, whence, after being conveyed along a complex arrangement of bones and fluids, they are sent to the brain and are perceived as sound: remembering, further, that what we call "sound," the physicist only recognizes as "vibrations:" let us consider the behavior of a vibrating string, as the type of all sound-producing bodies.

If a stretched string be plucked out of its position and thus set to vibrating, we can, in observing its

[1] See particularly the discussion of the Tunes of Verse in Part II. recommending the habit of consciously co-ordinating those remarkable tunes of the speaking-voice which constitute, perhaps, a greater element in modern speech than words, and which are giving rise to the modern art of spoken recitation.

vibrations, direct our attention to the following four matters, which include all the possible classes of such phenomena.

(1)[1] We can observe how long the string vibrates, or the duration of its activity.

(2) We can observe how far to one side and the other its swing, or "excursion," is extended. Upon this distance depends the loudness, or intensity, of the resulting sound. The reader must associate clearly the ideas of distance of swing (called in the science of sound "excursion") and intensity of sound. The greater the excursion, the greater the intensity (or loudness) of the sound. It is easy to see that if the string be pulled very far out of its position and let go, it will vibrate with more force than when pulled only a little way out. The measure of the far-ness is therefore the measure of the force; and, of course, the impression on the ear, when the vibrations reach it, will be more intense according as they are more forcible. In short, stated technically, the intensity of the sound depends upon the vibratory excursion.

(3) But, instead of observing how long the string continues to vibrate (*duration*), or how far to one side and the other it vibrates (*intensity*), we may observe, thirdly, how fast it vibrates. The pitch of the sound depends upon this circumstance. Slow vibrations give sounds of low pitch, or bass sounds: the faster the vibrations become, the higher, or more treble, are the

[1] These numbers in parentheses are repetitions of those accompanying the terms "duration," "intensity," &c., and are merely intended as an additional association, helpful to the reader, between the physical phenomena of vibration and the mental phenomena of sound, — the term "sound" implying the perception by the ear, while the term "vibrations" has reference only to the phenomena occurring up to that point.

corresponding sounds. Of course, this observation of the rapidity of vibrations could not be carried on by the unassisted eye. Every reader, whether specially interested in acoustics or not, would do well to be at some pains in becoming familiar with the beautiful series of apparatus [1] which has been devised by modern physicists for counting the vibrations of sounding bodies and for confirming and extending many of the wonderful facts revealed to us by the knowledge of these rates of vibration, particularly the fact of tone-color, to be explained in the next paragraph. It would not be proper to detail these inquiries here, further than to call the reader's attention to the fact that the art of sound, with which we are at present concerned, has for its materials a body of tones which range in pitch from the tone which is produced by a body vibrating about twenty-four times in a second to that which is produced by a body vibrating about four thousand seven hundred times in a second. If one sits in front of a low-tuned piano, and presses down the key farthest to the left, the string struck by that key will vibrate about twenty-four times to the second, and will give forth a tone so low in pitch that many ears are almost unable to distinguish its tone from that of the next key to it. If the key at the extreme right be pressed down, the string which it strikes will vibrate about three thousand five hundred times to the second. Higher tones than the latter — reaching to about four

[1] The main book to be read for this purpose is, of course, Professor Helmholtz's monumental work, *Die Lehre von den Tonempfindungen*, which has recently been translated into English, with very important additions, by Mr. Alexander J. Ellis. Smaller, and perhaps more accessible, books, are Tyndall's Lectures *On Sound*, Mayer's work on the same subject (Appleton), and Blaserna's *Theory of Sound* (Appleton).

thousand seven hundred vibrations per second — can be obtained on the piccolo.

But the sounds with which we shall presently be more specially concerned — namely, the sounds of the human speaking-voice, in which the art of verse finds its primary material — range within narrower limits. To produce the lowest tone of a man's bass voice, the vibrations must be about sixty-five in a second; while, for the highest tones of a woman's voice, the upper limit — leaving out exceptional cases — may be taken as lying at about a thousand and forty-four vibrations in a second. These are the limits for the human singing-voice; but, as will be seen in the discussion of the tunes of verse following, they are also substantially the limits of the speaking-voice. To sum up these details before proceeding to the next paragraph: the reader is asked to form the clearest conception of the difference between the *intensity* of sounds — that is, their loudness or softness — and the *pitch* of sounds — that is, their bass-ness or treble-ness. We shall presently find that great confusion has arisen in the discussion of what is called "accent" from inexact ideas upon this point. For this reason, the physical explanations of intensity and pitch have been dwelt upon in the preceding and present paragraphs. The reader can always accurately distinguish them by associating the *intensity* of a sound with the *distance* of the vibratory excursion, and the *pitch* of a sound with the *rapidity* of the vibration.

(4) We have now arrived at the last of the particulars in regard to which we may observe the vibrations of a string. This is the particular called by some physicists "quality," by others "timbre," by Mr. Tyndall

(whose explanation of it is perhaps the clearest to the general reader: see his Lectures on Sound, cited in the last paragraph) "clang-tint," in translation of the German term *Klang-farbe;* and by still others "tone-color." The analogy to the corresponding phenomenon in light seems to make the term tone-color a desirable one, and it will be adopted in this book. It has been discovered that such tones as constitute material for the art of sound[1] are not simple, but are made up of subordinate tones, much as the color purple consists of two other colors — red and violet — in combination, and as many other hues are formed by combining different tints. The complete physical explanation of this phenomenon would require much more space than can be given here; but a partial insight into its nature may be gained from the behavior of our stretched string when plucked. If the string be observed closely, it will be found to be carrying on several sets of vibration at the same time: it is not only vibrating as a whole between its two extreme fixed points, but, in consequence of the reflections to and fro of the force applied in plucking the string — which runs along the string to the fixed end, and is then reflected along the string, thence back again, and so on — certain other practically-fixed points are set up, and the string actually vibrates in smaller segments between these points — called "nodes of vibration" — as if it consisted of

[1] This term, "the art of sound," is used as designating a genus, of which music and verse are the two species. Purposes of the utmost value to the present system are subserved by discussing, as the reader observes is being done, this genus until a point is reached where the differentiation of the two species sharply presents itself. They will be found separated by a line much less broad than has been commonly supposed.

several shorter strings: now each of these segments vibrates at a different rate per second from the rate of the whole string, and therefore makes a tone different in pitch (see the last paragraph) from that of the whole string which is called the "fundamental tone:" so that the tone made by each segment combines with the fundamental tone and all are heard by the ear as one tone. But, while heard as one tone along with the fundamental tone, the segment-tones influence the resulting tone in a manner very striking to the ear according as they are more numerous in some vibrating bodies than in others, or according as one segment-tone becomes (as is found to be the case) more prominent in some bodies than in others. It is found, for instance, that when the vibrating body is the column of air in a flute, instead of a string, the column of air presents a different set of segment-tones (or "harmonics," or "partial tones," as they are variously called) from the set presented by the string; and it is precisely this difference which enables our ear to recognize the flute-tone as distinct from the string-tone. So of all instruments: the reed-instruments, such as the clarinet, hautboy, and bassoon, cause the air within them to vibrate in different sets of segments from the air in a flute, or a horn, and from the string of a violin: each segment giving its own tone, the different sets of segments give different resulting tones, that is, different tone-colors: and it is by these different tone-colors that we discriminate flute from violin, horn from clarinet, and the like, when they are played out of our sight. This principle makes such delicate shades of variations that even instruments of the same class differ from each other very strikingly in this particular, so that of two violins we often prefer the

"tone" (by which we mean the "tone-color") of one to the other, and so of two flutes, two pianos, and the like. The delicate distinctions due to tone-color reach a most interesting phase, which is specially used throughout the present treatise, in language. It has been found that the ability of the ear to discriminate one vowel-sound from another, and one consonant-sound from another, is due to the fact that the vowels and consonants differ from each other in tone-color just as violin-tones differ from flute-tones, or from reed-tones, in tone-color. The human voice is practically a reed-instrument of the hautboy class, the vocal chords being the two thin vibrating reeds, and the mouth and throat (the buccal cavity) constituting the tube. Now it is found that the tone-color of wind-instruments will vary according to the shape of their tubes: a column of air vibrating in a tube like that of the clarinet, for instance, gives a different set of prominent segment-tones, that is, a different tone-color, from a column in a tube like that of the flute. It is thus that the voice produces those sounds of differing tone-color which we call vowels and consonants; for the voice is a reed-instrument which can alter the shape of its tube (the buccal cavity) at pleasure, and which in so doing alters its tone-color at pleasure. The general fact that we alter the shape of the mouth and throat in pronouncing each vowel and consonant must lie within the observation of every person. The precise proof, however, that tone-color is the principle by which we discriminate the constituent sounds of speech, and the scientific analysis of the phenomenon, constitute one of the most brilliant achievements of modern science, which should not be mentioned without specifying the

names of Charles Wheatstone, who first suggested the idea, and of Helmholtz, who demonstrated it in a series of the most beautiful studies and experiments ever made.

The fact that each vowel-tone in speech is compound, being the resultant of a number of subsidiary tones in combination; the fact that now one, now another, of these subsidiary tones comes into prominence according as we alter the shape of the mouth-cavity, and thus varies the tone-color of the voice; and the fact that our ear recognizes a certain tone-color as the vowel *a*, another as the vowel *e*, another as the vowel *i*, another as the vowel *o*, another as the vowel *u*: were established and verified in a complete manner by Helmholtz, who applied the principle in constructing an apparatus of tubes and membranes which imitated several of the vowels with much exactness.

To sum up the results of this division, therefore: whenever, in discussing the general art of sound, the term tone-color is used, it should bring into the reader's mind the principle of segmentary or partial vibrations which combine with the fundamental vibrations (of a string or of a column of air in an instrumental tube) to form a composite tone, — as different light-vibrations combine to form a composite color, like purple, — resulting in that peculiar set of differences by which we discriminate flute-tone from violin-tone, horn-tone from clarinet-tone, *a* from *o*, *i* from *u*.

The following, then, comprise all the possible relations between sounds, namely: (1) the relative duration of sounds, in which the reader must carefully remember to include the correlative duration of the *silences* between sounds, which are called "rests," and which are quite as

necessary to many forms of verse as are the sounds thereof; (2) the relative intensity of sounds; (3) the relative pitch of sounds; and (4) the relative tone-color of sounds.

It will now be useful to combine the two last propositions in a statement made from a different point of view. *A formal poem is always composed of such sounds and silences*[1] *(or of the signs, or of the conceptions, of such sounds and silences) as can be co-ordinated by the ear.*

By "sounds which can be co-ordinated by the ear" are meant sounds which the ear can perceive with such clearness that it is able to compare them with reference to some one or more particulars. For example, if, in strolling, we hear first the quick chirp of a sparrow and then the slow shrilling of the field-cricket in the grass, our ear can compare the two sounds as to *time*, and can decide that the latter is longer than the former: that is to say, the ear can co-ordinate these two sounds with reference to the particular of their *duration*.

Again: if, immediately afterwards, we hear the cry of a jay, our ear can compare it with the previous sounds as to the point of *loudness*, and can decide that the jay's sound is louder than the other two: that is to say, the ear can co-ordinate these three sounds with reference to the particular of their *intensity*.

[1] These "silences" are included in Proposition 1, under the term "specially related sounds." For example, if a couplet of sounds be separated by a silence of one minute in duration, while another couplet is separated by a silence of two minutes in duration, these differing silences constitute an independent means of comparison between the two couplets; and, as such, the measured silence or rest may be considered one species of relations between sounds with sufficient accuracy for a proposition in which the most general terms are desirable.

Again: if we now hear in succession the grave coo of a dove and the keen piping of a field-lark, our ear can compare them as to the point of their relative *shrillness* or trebleness, and can decide that the latter is the shriller, or more treble, of the two: that is to say, the ear can co-ordinate these two sounds with reference to the particular of their *pitch*.

Again: if we now hear in succession the whirr of the grasshopper poised above the grass and the whistle of the partridge down the field, our ear can compare the two sounds as to the point of *tone-color*, and can decide that the grasshopper's note is somewhat like the low tones of the clarinet (having a certain fluttering quality characteristic of the reed-instruments), while the partridge's note has more likeness to the smoother flute: that is to say, the ear can co-ordinate these two tones with reference to the particular of their tone-color.

The foregoing are examples of the general co-ordination, or indefinite comparison, of sounds. But the reader is now asked to observe that in none of the instances given could the ear make any *exact co-ordination*, or definite measurement, of the sounds compared. To recur to the first example: while the ear could recognize that the song of the cricket was in a general way longer than that of the sparrow, it was unable to pronounce exactly how many times as long. So, in the second example, though we could say immediately that the jay's cry was more intense — that is, louder — than the sparrow's, we could not say how much more intense. In the third example, while we could pronounce the field-lark's note certainly higher in pitch than the dove's, we have no scale of degrees, like the musical scale, to which we could refer these two tones and as-

certain their precise distance from each other, or musical "interval." And finally, in the fourth example, while the tone-color of the grasshopper's whirr is sufficiently distinct from that of the partridge's whistle, it is not so distinct as to admit of more than a general classification as reedy.

But the art of tone, which includes the art of music and the art of verse, depends upon exact co-ordinations by the ear. It is therefore necessary for us to advance beyond the consideration of such sounds as are capable merely of general co-ordination, or indefinite comparison, by the ear, to the consideration of such sounds as are further capable of exact co-ordination, or definite measurement, by the ear.

Let it be here noticed that in the preceding propositions all that has been said generally of verse applies equally to music, — the other art of sound, — and that this will be the case for several propositions to come; though each proposition will be found to contain some limitation of the preceding one, so that we can presently arrive, by the method of successive limitations, at a point where a single step will separate the definition of verse from that of music. This method is of importance. It will presently be found that the sound-relations which constitute music are the same with those which constitute verse, and that the main distinction between music and verse is, when stated with scientific precision, the difference between the scale of tones used in music and the scale of tones used by the human speaking-voice.

But this is by anticipation. It is now necessary to ascertain what are the capacities of the ear for the definite measurement, or exact co-ordination, of sounds.

Stating the same purpose in different terms: since the four particulars mentioned (duration, intensity, pitch, and tone-color) comprise all the possible variations of sound and of silence, let us now inquire as to which of these particulars, if any, the ear of average persons has the power of *exactly co-ordinating* sounds. By the power of exact co-ordination is meant the power of conceiving the relations of sounds in terms of number, or in terms of degree. Thus if, of two sounds occupying different lengths of time, the ear is able to perceive that one was exactly twice as long as the other, it may be said that the ear has exactly co-ordinated, or definitely measured, those two sounds as to their duration, and has conceived the result in terms of number. If, again, any key of a piano be struck, and then another, and the ear recognizes the latter tone as lying at exactly six degrees (according to the musical scale of degrees) above the former, it may be said that the ear has exactly co-ordinated, or definitely measured, these two sounds with reference to their pitch, and has arrived at a conception of such co-ordination in terms of a precise scale of degrees. These illustrations will be carried farther in the next proposition.

Actual observation reveals that there are three particulars, and only three, as to which the ear has the power of exactly co-ordinating sounds. These three are duration, pitch, and tone-color.

Example of exact co-ordination with reference to the particular of duration. If a musician be asked to strike any key of a piano so that two of its sounds will exactly fill the time of one second, as marked off by a clock ticking seconds, he is able to do so without trouble: if, between any two ticks of the clock, he should hold

the key down longer than its legitimate time of half a second, the deviation from the proper time is immediately observed: if he be told to make four sounds to the second, instead of two, he distributes them thus with ease: indeed, these are the simplest forms of example, and the musician can interpose between each tick of the clock, with unerring precision, sounds bearing to each other much more complex relations of duration. It is obvious that his power to do so, as well as the power to recognize *when* he does so, depends upon the remarkable capacity of the ear (affirmed in the first clause of this proposition) to co-ordinate sounds exactly with reference to their duration.

Example of exact co-ordination with reference to the particular of pitch. If any two keys of a piano be struck in succession, the musician will immediately name the relation of the latter to the former in terms of the musical scale, by his ear alone. Thus if the first key struck be the middle C, and the next be the second white key to the right of it, he will announce the second as a major third above the first, or E: if the second key struck be the seventh white key to the right, he will announce it as the octave of the first; and so on. In other words, the human ear has the power of exactly co-ordinating sounds with reference to the particular of pitch, and of forming precise conceptions thereof which can be accurately expressed in degrees of the musical scale.

Example of exact co-ordination with reference to the particular of tone-color. If a given tone, say the middle C, be sounded on the piano, and the same tone — that is to say, a tone of the same duration (or length), of the same intensity (or loudness), and of the same

pitch — be sounded on the violin, the ear instantly recognizes a difference; if the same tone be then sounded on the flute, the ear recognizes a difference from both the others; if it be further sounded on the clarinet, the ear recognizes a difference from all the preceding. This difference, being by the supposition neither a difference of duration nor of intensity nor of pitch, must belong to the only other class of differences of which sounds are capable, namely, the class known as tone-color. We have already found that the difference between one vowel-sound and another in speech — the difference between *a*, for instance, and *o*, or that between *i* and *e* — belongs to this class of sound relations. The ability of the ear to discriminate the most delicate shades of difference in this particular constitutes one of the most remarkable of our faculties, and leads to some very interesting fields of thought. All the phenomena of rhyme and of alliteration, and several allied verse-effects which will be found herein treated for the first time, are due to this capacity of the ear for exactly co-ordinating sounds with reference to their tone-color.

While, as noted in the last proposition, the ear is capable of exactly co-ordinating sounds with reference to their duration, their pitch, and their tone-color, it is not capable of exactly co-ordinating them with reference to the other particular mentioned — intensity. We have already seen that a general or inexact co-ordination in respect of intensity was possible: indeed, it is not a matter requiring further illustration, that of two given sounds every ear can in a general way pronounce one to be louder or softer than the other. But *how much* louder or softer; whether twice as loud, or three times as soft; whether louder or softer according to the de-

grees of any given scale or standard of measurement: for such exact co-ordinations of intensity in sounds the ear has no means. There is here possible neither an appeal to terms of number, as when, in the case of duration, we can say that two sounds occupying a given time are followed by two sounds occupying exactly the same time, and so on; nor an appeal to a given scale of degrees, as when, in the case of pitch, the musician's ear pronounces definitely the relation of one tone to another by referring them to the fixed degrees of the musical scale (which is really a kind of primordial tune, always carried in the memory of the ear, and always available as a sort of graduated auditory yard-stick for measurement); nor, finally, an appeal to those easily-preserved and fixed conceptions of tone-color which the ear retains, and by which it compares a given tone with recollected tones so as instantly to recognize them as flute-tones, as piano-tones, as violin-tones, and so on. We have no standard within the mind for the precise measurement of intensity in sound; that is, the ear is not capable of exactly co-ordinating sounds with reference to the particular of intensity.

Since an art of sound must depend primarily upon exact co-ordinations by the ear, and since these exact co-ordinations are, as just shown, possible only in respect of duration, pitch, and tone-color, it is evident that these three sound-relations constitute three distinct principles to one or the other of which all the primary phenomena of this art must be referred. They thus afford us three fundamental principles of classification for the effects of sound in art. The effects ordinarily known as "rhythm" depend primarily upon duration;[1] those

[1] For detailed proof of which see the special discussion of rhythm in Part I. following.

known as "tune" depend upon pitch; those known as "colors" in music, and as "rhymes" and "alliterations" in verse, — besides many allied effects of verse which have never been named, — depend upon tone-color. Stated in other terms: —

I.

When the ear exactly co-ordinates a series of sounds and silences with primary reference to their duration, the result is a conception of . . . . RHYTHM.

II.

When the ear exactly co-ordinates a series of sounds with primary reference to their pitch, the result is a conception of . . . . . TUNE.

III.

When the ear exactly co-ordinates a series of sounds with primary reference to their tone-color, the result is a conception of (in music, flute-tone as distinct from violin-tone, and the like; in verse, rhyme as opposed to rhyme, vowel varied with vowel, phonetic syzygy, and the like), in general . . . TONE-COLOR.

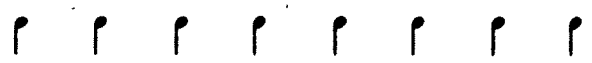
The term "primary reference" in the last proposition hints at a secondary use which is made, not only of the inexact relation, intensity, but also of the three exact relations, in the art of sound. As soon as this secondary use is explained, — as will now be done, — actual illustrations of all the preceding abstract propositions can be given, which will clear them of obscurity.

The secondary use of the four relations — duration, intensity, pitch, and tone-color — occurs only by way of adjunct in that great class of sound-effects marked I. above, — the class known as rhythm.

For the purpose of enabling the ear to make exact co-ordinations of a long and complex series of sounds

with reference to their duration, it becomes convenient to arrange the sounds so that the whole body may be grouped by the ear into smaller bodies which can be, as it were, handled with more ease. It is to effect this grouping that the secondary use of the sound-relations is made. How they are employed for this purpose will appear from the following illustration, which is arranged with two purposes: one, to explain certain effects upon the ear which have been greatly misconceived, by showing exactly parallel effects upon the eye which no one ever confuses; and the other, to begin acquainting the student with the musical system of notation — a system which is adequate to all the phenomena of rhythm, that is, adequate to express in visible characters all the conceptions which result when the ear co-ordinates a series of sounds with primary reference to their duration and with secondary reference to any or all the other sound-relations.

The following scheme presents a series of eight characters exactly similar in size and in distance apart:—



Let it be proposed to mark off for the eye groups of two characters each along the whole series. This might be done in several ways. For example, we might make the stem of the first character *longer* than that of the second, and repeat this variation through the series:—

or we might begin with the second character, and effect the same result by lengthening every second stem in the series:—

either method dividing the series for the eye into groups, of two characters in each. It is obvious that we might have effected the same grouping for the eye by *shortening* either every first or every second stem in each group, or, in general, by any recurrent variation in length. Further: we might apply the same method, not to the characters, but to the distances between them. Thus we might mark them off into groups for the eye by lengthening or shortening, or in any way consistently varying, the spaces between the couplets;

that is to say, in general, a series of characters may be marked off into groups for the eye by any recurrent variation in length, either of the characters, or of the spaces between them.

Before proceeding to other methods of grouping, let us now transfer these conceptions of the eye to the ear. Suppose the eight characters used above to be eight signs of sounds, as they in fact are, being the "quarter-notes" of the musical system of noting rhythm to be presently explained in full. Now the series of eight sounds represented by eight such characters could be marked off into groups of two each for the ear, just as the characters themselves were marked off for the eye, either by varying the length of every second sound (as we varied the length of every second sound-sign), or by varying the length of the interval of silence between every two sounds, as we varied the length of the distance between the couplets of sound-signs.

Thus the ear, having co-ordinated a series of eight sounds with primary reference to their duration, and having thus set up what we may call a primary rhythmus among the *individual* units of sound, may again co-ordinate the same sounds with secondary reference to their duration in order to divide them into *groups* of two or more units; each group being distinguished by some variation in the duration of either of its sounds, or in the duration of the silences between them.

But again recurring to the eight characters as merely visible signs: they might be marked off into groups for the eye by variations in their intensity. Suppose, for example, the first be printed in ink of an intenser black than the second, and this variation be consistently carried on through the eight: —

It is obvious, without carrying this process through the details of the last, that a grouping could be marked off for the eye by any recurring variation of intensity. It is easy to transfer this process, as before, from the eye to the ear.

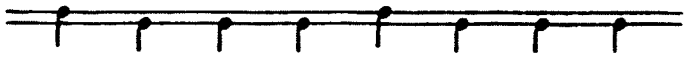
Given a series of eight sounds already co-ordinated by the ear with reference to their duration, and thus already established as primarily rhythmical: such a series could be marked off into groups by making any sound of each group louder or softer than the other sound or sounds of that group, that is, by any recurrent variation in the intensity of that sound. Here it may be seen how the exact co-ordinations which were necessary to the artistic use of the other sound-relations, duration, pitch, and tone-color, are not necessary in this use of intensity, which, we found, cannot be exactly co-

ordinated by the ear; for the use of intensity in grouping sounds does not require exact co-ordination. If, for example, every second sound in the series be in any degree louder or softer than its fellow, the series will be grouped into twos; if every third sound be in any degree louder or softer than its adjacent two, the series will be grouped into threes, and so on; no particular degree of intensity being needed for the mere purpose of making the ear notice every second, every third, every fourth sound, and so on.

Here, too, an important additional consideration may now be mentioned, namely, that both these methods (or, as we shall afterwards see, any three or all four of the methods) may be used at once, to give greater distinctness to the grouping of sounds for the ear. It is easy to see that in grouping the above-mentioned eight characters for the eye, we might both vary the stem and vary the blackness (intensity) of every other character, and so group them into twos by both the methods of duration and intensity; and, similarly, we can group the corresponding series of sounds into twos by making every other sound both longer (duration) and louder (intensity), or both shorter (duration) and softer (intensity): in short by varying every other sound in both the particulars of duration and intensity. So we might group into threes, fours, &c., by varying every third, fourth, &c., sound in both these particulars. Of course, such a grouping would be all the more strikingly marked off for the ear by the use of the two methods to distinguish the leading sound in each group.

But, to recur to the eight characters as affecting the sense of sight: they might be marked off into groups

for the eye by making every second, third, fourth, &c., character *higher or lower* than the rest of its group. Thus the scheme



plainly divides the eight into two groups of four by making the first a little higher than the next three, and so on. Transferring to the sense of hearing: we might group these eight sounds for the ear by making every first, second, third, &c., sound *higher or lower in pitch* than its neighbor or neighbors. Thus we make a secondary use of pitch in grouping sounds for rhythm, which may be at the same time primarily co-ordinated by the ear with reference to the same relation, — pitch, — for a wholly different purpose, namely, tune — always the primary conception resulting from any change of pitch.

It is scarcely necessary to say that this method, as before, can be superadded to the others; that is to say, a series of sounds and silences already co-ordinated primarily with reference to duration, to establish their general rhythmic nature, may be secondarily co-ordinated or grouped (and it may be well to notice that these two terms, "secondary co-ordination" and "grouping," are always convertible) by making any given sound — say the first in every group of two, the second in every group of three, and so on — vary from the rest of its group in all the three particulars of duration, intensity, and of pitch. Of course, each superimposed variation upon a given sound would attract the ear's attention to the recurrence of that sound all the more strongly.

It remains to notice the possible secondary use of the only other sound-relation, tone-color, in grouping

sounds. The illustration as to the eye readily suggests that the eight notes might be grouped for the sense of sight by making every second, third, &c., note of a certain color, say red, while the other note or notes of each group were blue. It is easy to see that we could group our eight *sounds* in any manner we pleased by the similar process of a recurrent variation in tone-color. Suppose, for example, that the first tone should be struck on the piano, the next three on a guitar, the next on the piano, the next three on the guitar, &c., the series of sounds would necessarily divide itself for the ear into two groups of four, the varying tone-color of the piano from that of the guitar serving to effect the division. In the case of verse this varying tone-color would take the form of a recurrent vowel-sound, a recurrent rhyme, and the like tone-colors.

It is scarcely necessary to add that this secondary use of tone-color in grouping sounds can be superimposed upon the three others. In the grouping into fours last suggested, for example, each controlling tone struck on the piano might be both longer (duration), louder (intensity), and higher (pitch) than the three struck on the guitar. Rhythmic groups thus marked off would of course command the ear's attention in a very powerful way.

We have now reached a point where we can profitably inquire as to the precise differentiation between the two species of the art of sound — music and verse. We have found that the art of sound, in general, embraces phenomena of rhythm, of tune, and of tone-color. Many will be disposed to think that the second class of these phenomena just named — tune — is not found in verse, and that the absence of it should be one of the first differences to be noted as between music and verse.

Tune is, however, quite as essential a constituent of verse as of music; and the disposition to believe otherwise is due only to the complete unconsciousness with which we come to use these tunes after the myriad repetitions of them which occur in all our daily intercourse by words. We will presently find, from numerous proofs and illustrations which are submitted in Part II., on the Tunes of Verse, that our modern speech is made up quite as much of tunes as of words, and that our ability to convey our thoughts depends upon the existence of a great number of curious melodies of speech which have somehow acquired form and significance. These "tunes" are not mere vague variations of pitch in successive words, — which would deserve the name of tune only in the most general sense of that term, — but they are perfectly definite and organized melodies of the speaking-voice, composed of exact variations of pitch so well marked as to be instantly recognized by every ear. If they were *not* thus recognized a large portion of the ideas which we now convey with ease would be wholly inexpressible. Reserving, then, all details upon this matter until their appropriate place under the head of the Tunes of Verse, in Part II. above cited, it will be sufficient here if the reader is asked to realize them in a practical way by first attempting to utter any significant sentences of prose or verse in an absolutely unchanging voice from beginning to end. This will be found quite difficult, and when successfully executed produces an impression of strangeness which all the more clearly illustrates how habitually and how unconsciously the tunes of speech are used. If, having uttered the sentences in a rigidly unvarying tone, the reader will then

utter them in the tunes which we feel — by some inward perceptions too subtle for treatment here — to be appropriate to them, it will be easily seen that definite successions of tones are being used, — so definite that they are kept in mind for their appropriate occasions just as words are, and so regular in their organizations as to be in all respects worthy the name of "tunes," instead of the vague terms "intonation," or "inflection," which have so long concealed the real function of these wonderful melodies of the speaking-voice.

The art of verse, then, as well as the art of music, — the two species of the genus art of sound, — includes all the three great classes of phenomena summed up under the terms rhythm, tune, and tone-color. We will presently find many problems solved by the full recognition of this fact that there is absolutely no difference between the sound-relations used in music and those used in verse.

If this be true, — if the sound-relations of music and verse are the same, — we are necessarily forced to look for the difference between the two arts in the nature of the *sounds* themselves with which they deal. Here, indeed, the difference lies. Expressed, as far as possible, in popular terms, it is as follows: —

When those exact co-ordinations which the ear perceives as rhythm, tune, and tone-color, are suggested to the ear by a series of *musical sounds*, the result is . . . MUSIC.

When those exact co-ordinations which the ear perceives as rhythm, tune, and tone-color, are suggested to the ear by a series of *spoken words*, the result is . . . VERSE.

But it is necessary to attain a very much more philosophical view of the relation between "musical sounds" and "words" than is generally implied in the

popular use of those terms; for a slight examination will show that words are themselves musical sounds. They are the results of regular vibrations; they are capable of the exactest co-ordination in respect of their duration, their pitch, and their tone-color; they are capable of as exact co-ordination in respect of their intensity (loudness or softness) as any other sounds; they give pleasure to the ear by their fall: in short, without here attempting a definition of musical sounds, it must be said that from a scientific point of view there is no incident of them which is not also an incident of words. For all purposes of verse, words are unquestionably musical sounds produced by a reed-instrument — the human voice. It must therefore be clearly understood by the reader that, in the above distinction between music and verse, what are called musical sounds are only one set out of the possible body of musical sounds; while what are called words are another set; that is, that "words" (in the sense of the above distinction) means simply one kind of musical sounds, and "musical sounds" means simply another kind. It is to be regretted that our language does not afford us more precise terms for these purposes. Music, although a very old art, has only recently been investigated by exact methods: the same may be said of poetry; and it is probably owing to this circumstance that we have no terms which embody precise relations between spoken words and musical tones. The terms "vocal" and "instrumental" are not satisfactory, because they hide one of the most important facts to be kept in view in all such investigations as the present, namely, the purely instrumental character of the speaking-voice and of its tones (words). "Vocal" here *is*

"instrumental." Let the reader always conceive, first, a general body of musical tones; then let the speaking-voice be conceived as an instrument consisting of a tube (the mouth, nose, and throat) and a pair of reeds (the vocal chords), which produces a certain set of these musical sounds. It is true that this certain set has received a special name, "words," because it has come to be used for a special purpose, namely, that of communicating ideas from man to man. It will assist the reader to a clearer conception of this matter, if the fact be called to mind that the selection of vocal sounds for the purpose of communicating ideas was not at all a necessary one. Other sets of musical sounds might have been selected for this purpose, those of whistles or flutes, for instance; or no sounds at all might have been used, and "words" might have been entirely eye-signs, as is actually the case with the deaf and dumb. In fine, when the term "words" is used as describing the peculiar set of sounds used in verse, the reader must understand it merely as a convenient method of singling out that specialized set of musical sounds made by the musical instrument called "the human speaking-voice."

But what, then, are the distinguishing characteristics of these sounds which specialize them into a set distinct from the general body of musical sounds?

These characteristics are two: (*a*) the generic and specific tone-colors of the human speaking-voice; and (*b*) the peculiar scale of tones used by the human speaking-voice.

(*a*) By "the generic tone-color" of an instrument let us understand that general peculiarity of tone-color which enables us to distinguish tones made upon any instrument of that class as distinguished from tones

made upon any instrument of a different class; for instance, the violin has its generic tone-color as distinguished from the generic tone-color of the flute, or from the generic tone-color of the piano. But subject to this general resemblance of tone-color among all the instruments of a class, enabling us to distinguish the violin-class, the flute-class, the piano-class, &c., there exists a great variety of minor or specific tone-colors, which not only distinguish one particular instrument from another of the same class, but even the tones evoked from the same instrument by two different players. Thus we not only say, "The tone of this violin is better than that one, the tone of this piano is poorer than that" (the "tone" in such expressions meaning the tone-color); but we say of two persons playing on the same violin or piano, "I like So-and-So's tone better than the other's," and so on; the word "tone" always being used for tone-color.

But — and this is the point to which the foregoing considerations have been gradually bringing the reader's notice — not only do these differences of tone-color exist as between instrument and instrument of the same class, and as between player and player upon the same instrument, but the same player upon the same instrument may produce tones of the same pitch, yet of different tone-color; and the tones of any instrument differ in tone-color as they are high or low, or made upon different parts of the instrument. Thus on the violin, for example, a player may make the tone D either by playing the next to the lowest string *open* (that is, without any finger on that string), or by putting his little finger in the First Position on the lowest string; but the two D's made in this way will differ

greatly in tone-color. Similarly, on the piano, if the D key be first struck with a short, sharp blow by the finger, and then with a lingering, gradual touch, the two tones resulting, though the same in pitch, will differ greatly in tone-color. Now, in this capacity of varying the tone-color of sounds made on the same instrument the human speaking-voice is very wonderful, and excels all other instruments. Every vowel-sound, every consonant, every combination of letters in a syllable, every shade of pronunciation, is simply a difference of tone-color made by the almost instantaneous changes which the muscles of the mouth and throat can effect in the shape of the buccal cavity. It is this facility in the production of tone-colors which gives the human vocal apparatus pre-eminence as a speech-instrument. No other instrument could be devised which would furnish such a copious variety of elements for a language with such ease and quickness.

These considerations have now brought us to a principle which will be largely used in the present work, and which may be stated as follows:—

Print and writing are systems of notation for the tone-colors of the human speaking-voice. The sign *a*, for instance, gives us to understand a tone-color produced by a certain adjustment of muscles which we have all learned to make when we see that sign, and which results in a certain shape of the buccal cavity, giving the tone-color indicated. When we see the sign *n*, we understand (though we have done it so often as to become wholly unconscious of the separate steps of the process unless our attention is specially fixed on them) that we are to take away from the inner end of the nostrils the membrane which divides them

from the mouth-cavity and thus add the length of the whole nostril-tube to the length of the mouth-and-throat tube, so producing that hollow and resonant tone-color which we associate with *n*.

This view of written or printed letters as a system of notation for tone-color brings into sharp form the difference (*a*) between music and verse. Music has no such system for tone-color. The generic tone-color in music is, of course, indicated by stating the instrument upon which the strain is to be played, as "flute" for this strain, "violin" for that, "horn" for another, and so on. But beyond certain marks for indicating upon what string of the stringed instruments a certain strain is to be played, and a few other signs which more or less incidentally convey ideas of tone-color, music has no system of tone-color notation; and many uses[1] of tone-color are made in verse which are not known in music.

(*b*) But we must now go on to discuss the second above-mentioned difference between music and verse, namely, the different scale of tones used in verse from that used in music. It is this difference which renders the tunes of verse so much more subtle than those of music.

In explaining it: the reader unfamiliar with music must understand that that art does not use by any means all the musical tones which are possible, but only a particular set of tones which have been chosen out of the possible body of tones according to certain principles of selection. A list of the particular set of tones thus chosen is called a "scale." This may be illustrated in the following manner:—

[1] See particularly the uses of rhyme and alliteration for purely rhythmic effects, detailed in Part I.

Consider the harp-shaped frame of strings arranged side by side which is seen when the top of a piano-forte is raised. Upon an ordinary piano (tuned usually a little below concert-pitch) the lowest of these strings — that which is set in vibration by the key lying at the extreme left as one faces the piano — will make about twenty-four vibrations in a second; the next string — that which is set in vibration by the shorter black key lying next to the first — will make about twenty-five and one-half [1] vibrations per second; and if one should go on striking the black and white keys in succession until the first thirteen keys were struck, the strings thus set in motion would execute nearly [2] the series of vibrations presented in the following list: —

STRING.	VIBRATIONS IN A SECOND.
1	24
2	25½
3	27
4	28½
5	30
6	32
7	34
8	36
9	38
10	40
11	42½
12	45
13	48

[1] Of course it would be out of place, in an explanation which at its simplest is somewhat complex, to go into the question of enharmonic differences. The piano was selected for the present illustration on account of the clearness afforded by carrying out its theory of equal temperament with only slight inexactness.

[2] This series is arranged with a view to presenting as nearly a set of round numbers as possible, small fractions being rejected.

But, confining the attention for a moment to the thirteen tones produced by these thirteen rates of vibration, it is clear that several strings might be stretched alongside *each of* these thirteen, which would vibrate at different rates, and give different tones. For example, observe that, while the first string vibrates 24 times in a second, the next string, instead of vibrating 24½ times, or 25 times, in a second, vibrates 25½ times: that is to say, the scale *omits* the tones produced by the possible intermediate rates of vibration (24½, 25, to take no smaller fraction than ½, though, of course, they might be 24¼, 24⅓, 24¾, 25, 25¼, and so on), and *selects* the rate 25½ to come immediately after 24. And, going on with this argument, the next tone beyond 25½ shows us a jump over the possible intermediate rates to the rate 27 in a second; the next jumps over the possible intermediate rates to the rate 28½ in a second; and so on, until the jump from the next last to the last is from 45 in a second to 48 in a second. Now these jumps, which proceed, as the reader easily observes, with a certain regularity, show us the principle of selection according to which the tones of the scale are chosen by the European ear. The procedure, as shown, is to start with a given tone for the first, and take for the second a tone which is to the first as 25½ is to 24; for the third, a tone which is to the first as 27 is to 24; and so on, until the thirteenth tone is to the first as 48 is to 24, that is, made by exactly twice as many vibrations as the first. This tone, made by twice as many vibrations as the first, is called the "octave;" and, when we reach the octave, we take that tone for a new starting-point, making the next tone bear to it the proportion which exists between the first two

tones considered, that is, the proportion of 25½ to 24; the next tone must be to the octave (48) as 27 to 24; the next as 28½ to 24; and so on until we reach the tone represented by 96 vibrations to the second, or the octave of 48; then we repeat the same proportions, until we have tuned all the strings of the piano. The first octave, it will be noticed (that is, the first thirteen tones considered), gave all the proportions necessary for arranging the whole scale of the piano according to the musical principle of selection; and the series of tones included in thirteen[1] successive ones thus arranged is called a scale.

In short, European music employs only a small portion of the tones theoretically capable of being employed, since the intervals of the received scale omit many possible intermediate tones.

But the scale used in verse — that is, the list of all the tones employed by the speaking-voice — rejects these intervals and includes every tone perceptible by the ear within the limits of its range. That is to say: if we should set about forming the scale of the speaking-voice as we did that of the piano, we would begin with (say) the lowest tone of a man's voice — a tone produced by about 65 vibrations in a second — for the first tone of the scale; for the second tone we would not skip, as in the case of the piano, to another tone lying at a distance of several possible intermediate tones from the first, but we must take the next possible tone, that is, the tone which is so near the first in pitch that if it were any nearer our ear could per-

[1] For the sake of students who are here studying the scale for the first time, all complications of diatonic and chromatic scales are omitted, being, indeed, details not the least necessary to the demonstration.

ceive no difference. Referring the reader to the discussion of The Tunes of Verse in Part II., for the proofs that the voice does use such a scale, as well as for the limits of the ear's perceptive capacity in distinguishing between the pitch of tones nearly alike, we can now formulate this second difference between music and verse into the somewhat more definite proposition that —

The scale of music omits many possible tones between its limits, selecting only certain tones according to a definitely arranged order of intervals: the scale of verse embraces all the tones possible within the limits of the human speaking-voice.[1]

The foregoing proposition aims only to state the distinctions between music and verse: it will not be found complete for other purposes. For example, it would not serve to discriminate verse and prose. Prose has its rhythms, its tunes, and its tone-colors, like verse; and, while the extreme forms of prose and verse are sufficiently unlike each other, there are such near grades of intermediate forms that they may be said to run into each other, and any line claiming to be distinctive must necessarily be more or less arbitrary. The art of sound must always be regarded the genus, and music and verse its two species. Prose, scientifically considered, is a wild variety of verse.

[1] The author hopes in a future edition to present experimental verifications of this doctrine as to the scale of verse. The process of arriving at the average capacity of the ear for discriminating slight differences of pitch involves many personal equations, as may easily be seen; and a satisfactory result could be obtained only from a large number of experiments. Meantime perhaps the considerations offered in support of the doctrine in Part II. will be accepted as giving it at least the position of a working hypothesis.

The science of verse, then, observes and classifies all the phenomena of rhythm, of tune, and of tone-color, so far as they can be exhibited to the ear directly by spoken words, — or to the ear, through the eye, by written or printed signs of spoken words, — or to the mind by the conception of spoken words; and,

The science of *English* verse observes and classifies these phenomena so far as they can be indicated through the medium of spoken English words.

Here the general subject seems sufficiently divided. The phenomena having been primarily classified upon the principle of referring them to the physical processes which cause them, the more special investigations which follow naturally arrange themselves into three parts, to wit:

Part I. . . .	The Rhythms of English Verse;
Part II. . . .	The Tunes of English Verse;
Part III. . . .	The Colors of English Verse.