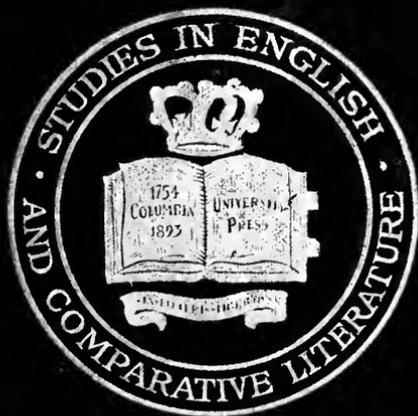


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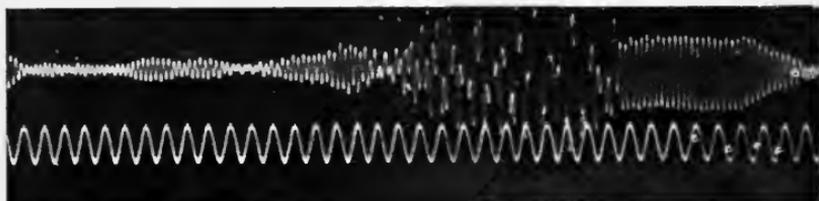
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The syllable "tah," photographed Aug. 14, 1915. The higher summits of the time-line are approximately one sixtieth of a second apart. The negative has been slightly reinforced by the engraver.



"Ah" — film at slow speed — photographed July 25, 1915. A moment of roughness in the tone is recorded near the center.



"Top! Top!", from the test for sense of rhythmic "swing." Part of the record of Observer No. 4. (See Chapter III.)

THE RHYTHM OF PROSE

AN EXPERIMENTAL INVESTIGATION OF
INDIVIDUAL DIFFERENCE IN
THE SENSE OF RHYTHM

BY
WILLIAM MORRISON PATTERSON, PH.D.
INSTRUCTOR IN ENGLISH IN COLUMBIA UNIVERSITY

SECOND EDITION



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TO

D. M. P.

M. R. L. P.

AND

C. B. A.

1343296

This Monograph has been approved by the Department of English and Comparative Literature in Columbia University as a contribution to knowledge worthy of publication.

A. H. THORNDIKE,
Executive Officer.

PREFACE TO THE FIRST EDITION

WHAT is prose and what is verse? Aristotle and Dionysius of Halicarnassus, Cicero and Quintilian, Professor Saintsbury and Professor Sievers, have all tried to tell us. No one yet, however, seems to be quite sure. Free verse and "poetic prose" are the disturbing ghosts which interpose their ambiguous outlines in the way of a decision. But, apart from this, is it any wonder that the student who dips, or, more boldly, dives into the inevitable chapter on rhythm to be found in current musical hand-books, rhetorics, treatises about versification, etc., emerges mystified, when so little account is taken of individual difference in what is one of the most "individually different" of human experiences? Rhythm is tangled up with our sense of time and our sense of intensity, both of which are not only tricky, but multifarious. Nothing is more preposterous, therefore, than that an author, the organization of whose temporal impressions is confessedly vague, should undertake to present to humanity at large a comprehensive and final statement of the art of versification. His own particular code might easily be read with interest as a document, but could hardly be expected to serve as a universal guide. On the other hand, it would be equally misleading for the experiences of an aggressively rhythmic individual, with a relatively accurate sense of temporal values, strong motor reactions, and subtle powers of discrimination in pitch and stress, to be set forth as if they were thoroughly usual. The psychologists have long since recognized that rhythm is the result of a complex process, whose operation can never be reduced to any one short formula.

Inasmuch as the writer felt convinced that a clear solution of the problem of prose rhythm would depend upon experimental data, obtained under carefully regulated conditions, the main text of the present book was not composed until after a series of experiments, described in Appendices I, II, and III, had been performed upon a group of twelve subjects, most of whom were trained observers, connected with the Department of Psychology at Columbia. Preliminary experiments upon an entirely different set of observers had already been completed during the summer of 1915. The regular tests were given in the sound-room of the Department of Psychology, and in a fairly sound-proof cabinet, specially constructed under the supervision of Professor Pegram of the Department of Physics. In this cabinet was installed apparatus for photographing the vibrations of the human voice. The object of the investigation was to determine individual difference in rhythmic experience and performance, with the particular hope of ascertaining facts that would lead toward a better understanding of the nature of prose rhythm.

Out of the facts, more or less accurately established, there has appeared the needed explanation. Past theoretical tangles are now seen to be due chiefly to a failure to take sufficiently into account individual difference in the complex of actual rhythmic experience; and a foundation is laid, based on experimental data, upon which, it is hoped, duly flexible systems, either of versification or of prose rhythm, can safely be erected. Most of the fundamental principles have already been authenticated by previous investigators. Rhythm is thus regarded as first of all an experience, established, as a rule, by motor performance, of however rudimentary a nature.¹ Only

¹ Ruckmich, C. A., *The rôle of kinæsthesia in the perception of rhythm*, *Amer. J. of Psy.*, XXIV, 1913.

in a transferred sense (as potential) can rhythm be said to exist on the printed page of a text.

Of the six chapters in the present book, Chapter II, "Historical Survey," is primarily intended for psychologists; but the account of Squire's "Genetic Study of Rhythm," and the brief reviews of Meumann, Wallin, MacDougall, Wundt, Verrier, Sievers, Schipper, and Thomson should not be omitted by the literary student. Chapter III, "The Sense of Swing," is chiefly of interest to psychologists and to musicians. Chapter IV, "Rhythmic Tunes," is indispensable to a real understanding of the subject, as it contains a detailed description of a "timer's" experience with regard to a sentence by Walter Pater. The musician should read Chapters I and III, the larger part of Chapter IV, and the first nineteen conclusions listed in Chapter VI. It is necessary to urge every reader, however, to obtain as clear as possible an understanding of "unitary pulses," "elastic units," "syncopation," "spontaneous substitution," and "rhythmic tunes." These terms are explained and discussed in various parts of the book, as shown by the references in the Index. The appendices contain a condensed description of the actual experiments, and brief comments upon their significance. The "Introductory Outline," which precedes Chapter I, gives a short review of the whole situation.

The present experiments were facilitated by the kindness of Professors Cattell and Woodworth of the Department of Psychology at Columbia, and especially by the material assistance of Professor Pegram of the Department of Physics, without whom the apparatus for voice-photography could never have been constructed. Obligations are due to Professor Woodworth, Professor Hollingworth, Dr. Poffenberger, Mr. E. B. Kinney of New York, and others who compose the group of observers that were tested. The author is especially indebted to Professor Krapp of the

English Department, under whose general supervision the work was undertaken, and whose sympathetic interest in the whole investigation is deeply valued. He is likewise indebted to Professor Lawrence and Professor Fletcher for reading the manuscript, and for help in other ways. Valuable suggestions were received from Professor Thorndike, Professor Todd of the Department of Romance Languages, and Professor Boas of the Department of Anthropology at Columbia; also, from Professor Baird of Clark University, and Professor Sabine of Harvard.

W. MORRISON PATTERSON

COLUMBIA UNIVERSITY,

May 1, 1916

PREFACE TO THE SECOND EDITION

MISS AMY LOWELL'S generous readiness to deliver, in the author's photographing laboratory, readings of what she considers typical *vers libre*, has resulted in objective measurements which indicate interesting progressive changes in the temporal intervals from one chief accent to another, but nothing, as yet, which indicates a difference in *kind* between the "cadences" of this *vers libre* and those of emotional prose. Does there exist, then, a difference in *degree*? These recent experiments have been of too brief a nature to warrant any final conclusions; but the author, after hearing Miss Lowell's effective delivery of her own compositions, might state his view of the question at issue as follows:

The segregation of the phrases in VERS LIBRE, produced by printing them on separate lines, serves chiefly as a means of keeping the focus of attention upon the RHYTHM AS RHYTHM, affecting thus both silent reading and oral delivery. This "rhythm" held before our attention is not so much the fundamental rhythmic experience, felt as prose or verse, but rather the secondary or broader rhythmic grouping, in

which phrases, long and short, are *balanced* against each other, according to that native instinct by means of which we complacently make two and two equal five, so far as interest is concerned. To the hunter the fleeing fox weighs as much as the cows blocking his way. When once the game of literary balancing is introduced, the separate spacing of the phrases in free verse reminds us, gently but inevitably: "This is a phrase! This is a phrase!" In spite of this fact, have we attained to anything that lifts us necessarily out of prose experience? What is achieved, as a rule, in Miss Lowell's case, is emotional prose, emphatically phrased, excellent and moving. "Spaced prose," we may call it. With other writers the result is often merely unrhymed verse, with irregular length of line; or, as is frequently apparent in the writings of Edgar Lee Masters, a mosaic of bits of verse and bits of prose experience.

Miss Lowell delivers her *vers libre* with much more swing and vim than one commonly hears in prose; but surely all particularly vigorous prose, if it is to be valued as a fit medium for vigorous thought and feeling, must also be thus delivered. Colonel Roosevelt, in fact, delivers his own prose with just as much "stress" and with just as much "curve" — to use Miss Lowell's defining terms in her account of *vers libre* — as Miss Lowell contributes to her "free verse." Where, then, is the preferential difference as to form? If there is any difference in *degree* of stress, the intensity is undoubtedly more pronounced in the delivery of Colonel Roosevelt. When we hear him repeat the following sentence from his *History as Literature*:

"The squat, slit-eyed, brawny horse-bowmen drew a red furrow across Hungary";

or, out of his *African Game Trails*, this:

"The dim, yellow smear in the yellow-brown grass was a lion,"

the effect is fittingly big. To space in separate lines the phrases in these sentences would, indeed, draw a "red furrow" of self-consciousness around *the rhythm as rhythm*; but would not this very process reduce to a correspondingly "dim smear" Colonel Roosevelt's splendid spontaneity?

W. M. P.

March 31, 1917.

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INTRODUCTORY OUTLINE

THE music of contemporary savages, such as that of the Kwakiutl, investigated by Professor Boas,¹ taunts us with a lost art of rhythm. Modern sophistication has inhibited many native instincts, and the mere fact that our conventional dignity usually forbids us to sway our bodies or to tap our feet when we hear effective music, has deprived us of unsuspected pleasures. Certain it is that the facility of the American Indian in the execution of syncopating rhythms is matched in most of us by a thoroughly blunted process, characterized by hesitation and awkwardness. Any attempt, accordingly, to regain an instinctive grasp over rhythmic problems, such as we may readily believe was possessed by our primitive ancestors, is quite hopeless, until we revert to the testimony of naive experience, and the progressive results of actual motor performance.

The significant fact to be gleaned from the experimental data listed in Appendix III is that the most comprehensive form of rhythmic experience occurs with individuals like Observer No. 7, a professional musician, whose mental and physical reactions may be described as "aggressively" rhythmic.² Such persons are capable of feeling a consistent and continuous experience of organized rhythm when confronted with haphazard series of sounds of any nature (within the limits of "time-discrimination thresholds" and "attention spans"). The impressions of accented and unaccented "syllables" in freely uttered

¹ Boas, F., *The Kwakiutl Indians*, U. S. Nat. Mus. Rep. for 1895.

² Of course, no two individuals ever react exactly alike. The term "type" is in many ways a highly misleading fiction.

prose usually suggest haphazard arrangement. To the aggressively rhythmic person a passage of spoken prose, whose measured intervals (between accents) display the utmost objective irregularity, can be organized subjectively and give pleasure according to the varying facility of the process and the varying emotional suggestiveness attending it. To those who are deficient in rhythmic aggressiveness, such a haphazard series frequently produces vague "impressions" of elusive rhythm, but never the consistent, more or less complete experience possible to the opposite class.

Who, then, is "aggressive"? The man who exactly remembers definite words he has uttered or precise movements he has executed in his dreams; who can not only hear the puffs of a locomotive, when they happen to be objectively even, group themselves subjectively into a tune of two's or four's, but who can also change this tune at will; who can keep strict time when he chooses, but whose confident sense of "swing" allows him also to gauge and enjoy progressive acceleration and retarding; who finds syncopation³ pleasant and easy; and, finally, who can summon without effort, like the Indian, an inner series of time-beats, "elastic"⁴ because capable of accelerating or retarding, and "unitary" because not *necessarily* grouped in a succession of two's or three's. With these "elastic unitary pulses" any haphazard series, by means of syncopation, can be readily, because instinctively, coördinated. The result is that a "rhythmic tune," compounded of time and stress and pitch relations, is created, the chief char-

³ By syncopation is meant the correlation of at least two sets of time-intervals, concomitant but not coincident — as when a negro dancer taps with his feet just half-way between the hand-claps of those who are accompanying his performance. More complicated forms occur when an Indian sings a melody in three-time, against a tom-tom accompaniment in four-time, etc.

⁴ For a discussion of "elasticity" see beginning of Chapter III.

acteristic of which is likely to be complicated syncopation. An arabesque of accentual differences, group-forming in their nature, is superimposed upon the fundamental time-divisions.

To the person who cannot easily evoke a subjective series of time-measuring pulses, such as appear objectively in the American Indian's "pulsation of the voice on sustained notes,"⁶ rhythmic experience must continue to be chiefly concerned with alternation of stress, and the patterns of "metre" familiar in routine scanning. In place of the relatively clear-cut temporal experiences of the aggressively rhythmic mind, wherein stress has an indispensable yet not overestimated function, he substitutes a reaction, capable of vigor, but innocent of subtlety; for the discrimination and measurement of intensity is acknowledged by physicists, physiologists and psychologists, as the chief snag in objective valuations. Our perception of time is blurred enough, but our perception of exact degrees of stress is hopelessly inaccurate. It turns out, therefore, that the "stresser," even in his own department of interest, is likely to rank below the aggressive "timer" with regard to precision.

In considering unitary pulses it may prove of assistance to examine our experience in listening to Schumann's "Träumerei," while attempting to beat time to it regardless of the printed notation. We need not be astonished to find that from the first to the second chief accent in the melody five quarter-note pulses occur. This group of five beats is followed by phrases which may be felt either as groupings of six, five, five, etc., or as groupings of four, four, three, five, etc. Here is a piece of music, the universally popular appeal of which is unquestioned, that shifts its successive grouping rapidly. The unifying temporal element is the series of subjective quarter-note

⁶ Curtis, N., *The Indian's book*, N. Y., 1907, p. xxvii.

beats or unitary pulses, regardless of the size of the clusters into which they are grouped, since these are significant only in the broader effects of phrasing. This principle furnishes a key to many previously unanswered problems. On no other basis, for instance, can the sudden shifts of measure in folk-dancing be explained. Such shifts are known among all races. They are "an unmistakable characteristic," says Steenstrup,⁶ "of the music of olden times, especially of folk-music." As a modern example, he cites the dancing of the peasants of Oberpfalz, which changes rapidly, back and forth, between three-time and four-time. Whatever varied effects of stress-grouping may be superimposed, the primary binding element, unfailingly potential in the aggressively rhythmic consciousness, is a series of more or less elastic unitary pulses. But, of course, our conventional notation continues to cloud all such issues.

Prose rhythm must always be classed as subjective organization of irregular, virtually haphazard, arrangements of sound.⁷ The experience, when judged by a standard of excellence, implies a requisite of fitness between thought and movement, in addition to ease and spontaneity. This appropriateness does not figure in the subjective organization of a haphazard series of drum-beats or of purely musical sounds. The ultimate basis of all rhythmic experience, however, is the same. To be clear-cut, it must rest upon a series of definite temporal units. When once we have established ease in the institution of unitary pulses, whose progressive accelerating and retarding we can

⁶ Steenstrup, J. C. H. R., *The medieval popular ballad*, trans. by Cox, E. G., N. Y., 1914, p. 165.

⁷ For a "timer" the definition of prose as distinguished from verse experience depends upon a predominance of syncopation over coincidence in the coördination of the accented syllables of the text with the measuring pulses.

gauge, it becomes possible, by means of instinctive syncopation and freely operating substitution,⁸ to coordinate rhythmically with our sense of time all the movements of our every-day existence. The dance of death is quite balanced by the possibilities of a dance of life.

⁸ The division of a pulse-interval into several equivalent shorter intervals, or the combination of several unit intervals into an equivalent longer interval. According to this latter function unitary pulses may appear in clusters — even in recurrent clusters. What remains characteristic of them is that the progression from any one pulse to the next is felt by certain observers to be part of a *fundamental* rhythmic experience underneath the grouping, whatever this happens to be. Where this feeling does not exist, unitary pulses, with a pleasurable motor reaction of their own, cannot be said to occur.

THE RHYTHM OF PROSE

CHAPTER I

THE NEW STANDARD

MOST of us respond with a thrill of pleasure to the "occult balance" of a swiftly moving sail-boat, tilted, between strain of wind and weight of ballast, at some rakish angle. Unfortunately for science, our attention wanes and our perceptions blur as soon as we attempt to analyze either the pleasure or the "balance." For the layman, the promise of new forms of pleasure is the only successful lure to assisting at such an investigation.

The tilt of rhythmic experience in connection with prose is likely to be more than rakish; there are times when to some the boat seems quite on the awkward edge of upsetting, and even when the going is at its best, the forces that make for balance are so obscure that the average mind resents any effort to single them out. It is only on the chances of hitting upon some new savor of excitement that even the literary man will consent to prowl within the neighborhood of a psychological laboratory. To learn from Wundt¹ that "no series of impressions is possible that cannot in some way be comprehended as rhythmic" is a matter of small concern until we suddenly discover that by listening for rhythm in irregular sequences, in the criss-cross lapping of many waves upon the shore, in the syncopating cries of a flock of birds, in the accelerating

¹ Wundt, W., *Grundzüge d. physiolog. Psychologie*, Leipzig, 1911, III, p. 53.

and retarding quivers of a wind-blown tree, we have found a new form of pleasure that embraces in its field every moment of our conscious life.

The first object of the present experiments² was to find out, as far as possible, how a group of twelve people, ten men and two women, differed with respect to the complex of mental processes usually designated roughly as the "sense of rhythm." After they had been ranked according to the nature of their reactions and achievements in various tests, one of the group, Observer No. 1, who had evinced a measure of ease in rapid tapping, was chosen to make drum-beat records on a phonograph. A sentence from Walter Pater, a sentence from Henry James, a passage of music from Chopin, a haphazard arrangement of words, and a haphazard arrangement of musical notes, were tapped upon a small metal drum, and the beats recorded by the phonograph. The words were tapped according to the syllables as felt, a tap for each syllable. "Hours," for instance, was given two beats. The notes were tapped, as far as possible, according to their designated time-values. Observer No. 1, having had long training as a musician, found no technical difficulty in the task. The remaining eleven observers, without being told the source of the records, heard the five series of drum-beats, and passed judgment upon them. The most significant judgment made was that of Observer No. 7, who declared that all five records gave him the impression of regular musical themes. A large number of the observers, especially on the first hearing, found all of the records, including even the passage from Chopin, elusive and more or less irregular. An attempt was then made, by means of accompanying schedules, to find out how much or how little organization each observer could be brought to feel in the beats cor-

² For a detailed account of the experiments, see Appendices I, II, and III.

responding to the passage from Walter Pater, and the passage of haphazard musical notes.

The indications are that for many observers the great secret in subjectively organizing what objectively appear to be irregular sequences, lies in the spontaneous or suggested creation of a "rhythmic tune." An attempt to hum what is heard or the hearing of humming by others helps to initiate motor response; and motor response, whether it be nodding the head, or moving the eyes, the tongue, or the throat, or beating time with the hands or feet, or anything else, tends to fall into the form of a series, accompanying the humming at points where the possibility of regular intervals is suggested. It is a commonly accepted fact that all repeated movement tends thus to become regular.³

Here is where we strike large gaps in the results of previous investigations (see Chapter II, "Historical Survey"). For some strange reason, even Meumann and Wundt fail to keep before their eyes three important factors, familiar to every musician: first, the possibility of accelerating or retarding a series of regular motions without destroying the impression of rhythm; second, the possibility of substituting at any time (i.e., spontaneously) one long time-interval for several equivalent short ones, or vice versa; third, the possibility of preserving a certain series of time-intervals, but of changing in various ways the nature of the motions or sensations that mark the beats. This last is what we mean by syncopation. To be sure, all three factors are mentioned, especially the first and second; but statements are constantly made in which their influence is neglected. As for syncopation, it is usually completely forgotten.

³ Scripture, E. W., *Elements of experimental phonetics*, N. Y., 1902, p. 525; see also Miyaki, I., *Researches on rhythmic action*, *Yale Psy. St.*, X, 1902, p. 4.

Syncopation, in itself, involves a complex of mental processes. The most essential part of the phenomenon seems to be that we keep our impression of a series of subjective time-intervals, regular, accelerating or retarding, but find a pleasure in marking the beats objectively, either by different forms of motion, such as foot-taps alternating with hand-taps, or by what appears at first as an omission of objective marking for certain beats. As a matter of fact, this is usually nothing but the interpolation of some concealed form of motor reaction, such as an eye, throat, tongue, or breath movement, which alternates with a more visible movement, such as nodding or tapping or dancing. Our ability to syncopate thus depends largely on our ability to coördinate. It is also possible for the impressions usually associated with syncopation to occur in connection with a train of mental images. In order to maintain a syncopating scheme successfully, it seems to be a universal experience that the accents dividing the series of temporal units into groups should be strongly marked. This would mean that when the last beat of a bar of regular musical notation is tied over to the first beat of the next bar, this second beat, which thus loses its objective discreteness, needs to be very firmly felt on the subjective side, by both performer and listener. The rhythmic consciousness in rag-time is "tremendous."⁴

In order for the non-musical person to understand clearly what is meant by syncopation, he should undertake the

* *

following experiment: Count 1-2-3-4-1-2-3-4- continuously to yourself with an accent on every "1" — that is, on the beginning of each group of four. After about ten seconds, begin to tap with your finger on a table every time you say "2" and "4." Internally you are still to

⁴ Puffer, E. (Mrs. Howes), *The psychology of beauty*, Boston and New York, 1905, p. 168.

accent every "1." This is a simple form of syncopation.

Now try a more difficult one. Count 1-2-3-1-2-3-, etc., to yourself with an accent on every "1." After a few seconds, while still counting, tap your finger just as you say "1" and just *after* you say "2." You will then be making a rough approximation to beating two-time against three-time — that is, the time-interval which you are dividing into three parts by suppressed articulation, you are dividing into two parts by your finger-taps. The process involves syncopation because the motions and sensations, or images of motions and sensations by means of which you mark the time, undergo a certain amount of interchange or alternation. If you were to hear another person tapping three's with one hand and two's with the other, it might be possible for you to hear the result in the form of a "rhythmic tune" in which you felt no interchange of motor response or sound sensation, but merely heard a series of taps, differing in intensity but not in kind, separated by intervals, whose size depends upon the pattern of the rhythmic tune. The element of substitution mentioned in a previous paragraph is here in operation, but the true syncopating element is absent, or, at any rate, somewhat disguised.

The importance, however, of hearing first the rhythmic tune of two's against three's, performed correctly by another person, before attempting to tap two's against counted three's (true syncopation) cannot be overestimated. As a result of the experiments described later,⁵ the writer has found that it is possible for observers with virtually no training in music to learn very quickly to tap even so complicated a syncopating scheme as five against seven with a fair degree of success, provided they approach the task, not as a mathematical problem involving five and

⁵ Appendices II and III, section xxiv in each case.

seven and their multiple, thirty-five; but by hearing some one else, who has learned to do it, perform the rhythmic tune. Actual measurements on the kymograph show that the pattern of time-intervals, if heard naively, is not difficult to reproduce. By humming the combination as "one, two-and, three, and-four, five-and, six, and-seven," and learning that the "and" in "two-and" is just a little closer to two than it is to three, that the "and" in "and-seven" is just a little closer to seven than to six, and that the "and" in "and-four" and "five-and" is exactly half as far away from its respective number as the "and" in "two-and," the rhythmic tune is ready for application in the form of syncopation. While the observer, having learned the tune with an approximation of correctness, hums the counting scheme, he taps with his finger every time he says "one," and every time he says "and." The result is that by omitting the uttered "and's" and tapping his finger in their place he is beating "five's" against "seven's" in true syncopating fashion without necessarily knowing it! The most astonishing part of the performance is that if the observer reproduces the rhythmic tune correctly, he is using intervals the smallest of which is one thirty-fifth of the distance from "one" to "one," the others ranging from two to five thirty-fifths. This means that, *without realizing it*, he is counting in thirty-fives. The process soon becomes automatic.

This would all seem to imply, then, that the mysterious awe with which we regard the rhythmic proficiency of some of our American Indians, for instance, may have to be lessened. Our astonishment should be directed, not so much at their having perpetuated what is, after all, a fairly simple trick, as at our own stupidity in losing the trick, in the use of which, for all we can guess from the ancient records of our East Indian cousins, our primitive drum-beating ancestors could leave the Western Indians

far behind. Nevertheless, speaking of the music of the Omahas, Fillmore remarks⁶ that in "rich variety and complexity of rhythm" it "excels most of our civilized music by a great deal. Our most elaborate compositions for orchestra have no rhythms more difficult or more complex than have these short songs; and our popular music is incomparably simpler in rhythm than is the popular music of the Omahas."

In this connection it should be noted that in the regular experiments⁷ even the professional musician, Observer No. 7, failed utterly at the task of beating "five's" against "seven's" so long as it was approached from the purely numerical basis; on the other hand, there were very few of the group who failed within twenty minutes to reproduce with a measure of success the seven-five rhythmic tune at a moderate tempo, and to execute the syncopating performance by means of it. The measurements listed are for their achievement at a fairly rapid rate of speed, which reduced the number of successful performances.

The way in which primitive man could have developed such facility is easy to imagine. Two men happen to be beating their drums at the same time in different quarters. One is tapping two's; the other one, three's. A third man hears the rhythmic tune of the combination, and proceeds to tap it later on his drum. It interests him; so he plays with it in different ways. Knowing that the original sounds came from a combination of two drums, he taps with his stick to represent one drum, and with his foot to represent the other. Once done, the task is easy, and, of course, it might have been suggested in a dozen ways.

The factor of "substitution" is so often mentioned, and is treated so fully in certain phases, that it seems surprising

⁶ Fillmore, J. C., *Primitive rhythms, Congr. Rep. Anthropol.*, 1893, p. 172.

⁷ Appendix III, section xxiv.

that it should ever be slighted. What seems to be forgotten chiefly is its function as an essential element in "occult balance" or "substitutional symmetry," as it is called by Puffer.⁸ A small spot of red in one corner of a Japanese print balanced against a much larger patch of gray somewhere opposite, a goose flying north weighed against a daisy bending to the south, a low, prolonged murmur heard and weighed against a short, shrill cry — these are effects of substitution or compensation.

The principle is mentioned by Wundt.⁹ He seems to be singularly averse, however, to applying it in a thorough-going way to arrangements of time-intervals. It is quite generally accepted that pitch, stress, and duration are constantly being substituted for each other as elements of "accent" (used in the sense of emphasis); but the contemplation of a series of time-intervals, varying in size, as forming occult balances just as if they were spots and spaces, seems foreign to both Wundt and Meumann. At any rate, they both leave disconcerting gaps in their discussion of rhythm, because of their failure to apply a principle to which they are already committed.

The point at which Wundt and Meumann stop so short can be made clear, perhaps, by the following rough experiment. Tap with one finger upon a table at any convenient rate. Do not vary the intensity of the taps in such a way as to form groups of two's or three's; simply beat a series of "unitary pulses": "1-1-1-1-1, etc." Now begin to substitute for a single tap all sorts of haphazard variations, in each case subdividing the unit time-interval into as many equal short time-intervals as caprice may direct.

⁸ Puffer, E., *Studies in symmetry*, *Harv. Psy. St.*, I, 1903, p. 529: "A picture composed in substitutional symmetry is more rich in its suggestions of motor impulse, and thus more beautiful, than an example of geometrical symmetry."

⁹ Wundt, *op. cit.*, III, p. 156.

In this way the "1's" will still be tapped, but between them will occur one, two, three, etc., extra taps. The sum of the short intervals will, of course, in each case equal the regular standard unit. Between every two successive sums (equivalent to two consecutive standard intervals) a judgment can be made as to the fact that although one contains three taps and the other four, for instance, the two are really equivalent. Brevity of interval compensates for excess in number. Nothing could be simpler. When the appointed time has passed, the main pulse returns, and the sense of rhythm, as the results of the experiments on the music of Cyril Scott¹⁰ clearly demonstrate, follows the march of the recurrent pulses.

This is different from the example given in a preceding paragraph, where a "low, prolonged murmur" is balanced against a "short, shrill cry." Pitch and stress elements in the latter compensate for its brevity. This form of substitution is coming to be generally understood. It is the recurrent, spontaneously varied form described in the preceding paragraph, that has been neglected. Yet once apply it to the problem of prose, and its import is far-reaching. In fact, it may be felt to include syncopation, which, together with the principle of elastic unitary pulses, explains completely the subjective organization of haphazard series.

Sievers¹¹ speaks of prose as breaking up into "Sprechakte" or "speech-bars," with a tendency to equal duration. One can even "beat time to artistic delivery." Elsewhere,¹² too, he speaks of arbitrary changes of tempo, depending on sense and mood. Of the manifold possibilities of syncopation, however, he has taken virtually no account; nor has he made any statement that goes beyond

¹⁰ Appendix III, section xxxi.

¹¹ Sievers, E., *Grundzüge d. Phonetik*, 5th ed. Leipzig, 1901, p. 266.

¹² *Ibid.*, p. 255.

Wundt and Meumann in connection with applying the principle of spontaneous substitution to a series of unitary pulses, where rhythm is maintained by a succession of *shorter* time-intervals than those that lie between the chief accents of a sentence. The truth of the matter is that this shorter pulsing temporal unit can never be felt consistently in prose unless we are keenly alive to the subtleties of syncopation. This means that time-beats will have to fall predominately upon unaccented syllables or within the pauses between words; otherwise, either the prose will be unduly "regulated" by an attempt to beat time, or else the sense of a recurrent unit will be destroyed.

At this point individual difference proves to be of the greatest significance. With those who possess or can acquire the ability to correlate speech intervals with an elastic under-unit, syncopating freely, and capable of breaking up spontaneously into "substitutional" clusters, the process either appears from the start as automatic or soon becomes so. Moreover, it is as easy and natural for a syncopating "timer" like Observer No. 7, as it is difficult, if not impossible, for No. 10, whose rhythmic limitations have been ascertained in the tests. In the first place, she is deficient in auditory types of imagery,¹³ she has difficulty in learning anything by ear, and fails to remember accurately fairly simple groups of vowel sounds.¹⁴ More significant still, her rank is quite low for all the tests in syncopation, simple and complex,¹⁵ and she finds little interest in the process. Observer No. 7, on the other hand, enjoys it thoroughly and scores high in his performance of the tasks.

Granted that one has facility and interest in syncopation, the application to prose of an elastic (accelerating and retarding) time-unit is a simple matter, and can be made

¹³ Appendix III, section iv.

¹⁴ Appendix III, section xiii.

¹⁵ Appendix III, sections xxii, xxiv.

clear by the following rough experiment: Read any prose sentence aloud several times, until what appears to be a natural, easy swing for it is established. Then begin walking up and down at a comfortable rate, capable of being accelerated or retarded moderately, that is, without reaching the extreme of being actually doubled or halved. Now begin to read the sentence aloud again, while walking, taking care, at first, to keep the two operations, reading and walking, as separate as possible. If anything, exaggerate irregularities in the reading. Then gradually allow the sets of movements to merge into a combined *impression*; in other words, catch the "rhythmic tune" of the footsteps beating against the articulatory impulses — with a definite interest in every bit of syncopation detected — that is, in every spot where a footstep falls *between* two syllables instead of coinciding with either one of them.

Having marked the most striking cases of syncopation, begin to allow the reading of the sentence to affect the rate of walking, rather than the reverse; i.e., accelerate or retard to a moderate degree the walking-step wherever the sense or the sound of the sentence may suggest. Continue reading and walking, but begin to concentrate more and more upon the rhythmic tune, with its syncopating possibilities, which will seldom fail to emerge into just such forms as are indicated by the schedules employed in the phonograph experiments.¹⁶

In the actual laboratory tests the above correlation of reading and walking-step was often obtained in a much shorter time than it has taken to describe the process. It must be remembered, however, that the walking-step (as actually performed — not imaged) is about the most inelastic unit one could select, and is, consequently, very likely to exert too much of a regulating influence on the reading. The experiment is valuable because of its ease,

¹⁶ Appendices II and III, section xxix.

and is simplified by the fact that the walking-step is more likely to be automatic in its operation, and thus not so apt to cause confusion in one's first attempt to secure a correlation.

After succeeding with the walking-step, one should take a new sentence and follow a different procedure: Read the sentence aloud until a natural swing is achieved which can be recognized and approximately repeated; then begin to tap with one finger an elastic (accelerating and retarding) serial accompaniment, *with as much syncopation as possible*. Continue this, with the whole attention concentrated on catching the rhythmic tune obtained by the combined movements of finger and voice. As soon as the rhythmic tune is caught sufficiently to be approximately repeated, let the attention rest more upon the elastic temporal unit, tapped by the finger, in order to notice its acceleration or retarding. Then, finally, direct attention upon the sense and swing of the sentence, and let the beating of time become more and more automatic.

Any objections that might be urged against the possibility of such an experience are refuted by the data obtained from the present experiments¹⁷ where most of the observers found it easy to beat time to the phonographic record of prose-beats made by Observer No. 1. The latter was in no way influenced by objective time-beating, but, quite spontaneously, with an automatic facility acquired by years of musical training, tapped upon the drum a series of beats, which on first hearing were judged by most of the observers to be thoroughly irregular.

The truth of the matter is that the liberties allowed by the introduction of an *elastic* unit, and the endless possibilities of syncopation and substitution, render quite easy to a musical observer the task of fitting a series of unitary pulses to any series of irregular sounds (provided the

¹⁷ Appendix III, sections xxvii and xxix.

sounds do not come too close together to be discriminated or so far apart that they cannot easily be grasped as the boundaries of a continuous interval). Whatever is not explained by syncopation and substitution, is easily explained by acceleration and retarding. We must add to all this the processes of so-called "subjective grouping," both voluntary and involuntary, by means of which our perception of objective conditions, up to a certain degree, comes under the distorting influence of "impressions." Such illusions are fed by our enjoyment of the variegated effects of subjective organization. What needs to be remembered, then, is that for the individual, and consequently for psychology, these illusions are in themselves important "facts" of conscious life.

It is thus that we become aware of the phenomena heralded by Wundt's general statement about the possible rhythmic conception of all series of sounds, and exemplified in the data listed in Appendix III. There are individuals for whom a series of apparently irregular sounds can be easily organized subjectively into a satisfying rhythmic tune. There are also individuals for whom the task is difficult, if not impossible. Prose thus becomes for some observers a sort of music, built upon elastic unitary pulses, sometimes grouped and always syncopating freely; but for others, it remains, and must always remain, an utter mystery, regarded either with indifference or as tantalizing because of its constant suggestion of a rhythm never fully achieved except in spots—a so-called "free" amorphous entity, identified merely by the chilling assurance that, at any rate, it is not verse.

A new standard is thus established for passing judgment upon the rhythm of a sentence or paragraph. The marking of grammatical (dictionary) accent is *by itself* misleading, except for the purpose of detecting passages of metrical patchwork such as occur in the writings of Ingersoll, or

unusually long stretches of "iambics" such as have been fished out of Dickens and Ruskin. The reason such "scanning" is misleading, is simply that a slow reading of some of our most unimpeachable prose turns it into just such iambic or trochaic drivel, while a rapid reading of some of the ridiculed passages introduces a varied swing that competes (in ease, spontaneity and appropriateness) with the very best. The stress-patterns of routine scanning have thus little more than suggestive value, when considered apart from the molding influence of tone-color and dominating mood or thought. On the other hand, the stress-patterns of actual experience have great significance, and when combined with the corresponding time, pitch, quality and thought patterns, complete what we mean by the rhythm of language.

The new standard has for its support not so much its apparent novelty, as its subservience to the psychological facts of individual difference. Observer No. 7 hears a series of irregular prose beats. At first, he pronounces them elusive; later they swing into full musical rank. The rhythmic tune is even capable of approximate notation. Observer No. 10 hears the series to the last as an elusive aggregation of approximately unrelated sounds. Between these two extremes are ranged perceptions of every degree of clarity.

To test prose-rhythm, therefore, we do not merely mark the accents with the ancient classic symbols, and admire, with an optical delight, the "pæonic" or "dochmiac" pattern presented. If rhythm means anything to the average individual, it means motor response and a sense of organized time. This is what it means in the playing of flutes, the beating of drums, the singing of songs, and in dancing. If it means something else in prose a new word should be coined. But it is idle to claim that it means anything but the same old spell the human race has always

found in regulated motion — the exciting and soothing effect of beating time, of nodding the head, of swaying the body, of tapping the feet and hands, or, finally, of substituting less obtrusive tensions and relaxations, by means of which the time is marked. Whenever pure images take the place of motor response, we feel that the rhythm is weakened; so when our whole body becomes possessed with the rhythmic pulse, the impression swells accordingly to its climax.

What is left, then, but to conclude that the sentence which has in its structure the possibility of a maximum of rhythm must be capable of evoking in us a maximum of motor response? To test it, therefore, we must tap to it, nod to it, walk to it, sway to it, chop wood to it, if necessary. To do this we must catch its drum-beat tune — or rather we must catch the most impelling of the infinite variety of rhythmic tunes which are possible for every sentence, good or bad. If it is easy for us to nod or tap or, for that matter, hoe potatoes to these salient “drum-songs” — in which syncopation and substitution have free range — the first degree of rhythmic excellence is obtained. A maximum of ease with a maximum of complication adds to this a higher degree of technical merit. If, finally, the associations and suggestions connected with the motor response are appropriate to the mood and thought of the sentence, there is nothing left to be desired.

From this pinnacle, nevertheless, we must fall to the realization that such enthusiasm means nothing and will ever mean nothing to the self-conscious individual who finds himself a prey to the inhibitions of modern society, the sedate victim of dignity, who dares not climb a tree or handle an axe, whose natural rhythmic response is attenuated, and whose images of time are consequently blurred, whose coördinating processes are so obstructed that it is impossible for syncopation to be instinctively

enjoyed, or even understood. In spite of all these "deficiencies" or "differences," such persons may occupy the highest ranks of purely intellectual eminence. To such passively rhythmic individuals, prose will continue to be prose as usually described — the mere negation of verse. To the aggressively rhythmic, it is like everything else in life — at its root lies a subjective "scheme," just as binding in its way as that of verse, only less obvious. It is the rhythm of conscious existence, announced so clearly, whether intended or not, by William James in his description of our sense of time as "Now! Now! Now!"

CHAPTER II

HISTORICAL SURVEY

EXPERIMENTAL work upon the rhythm of speech virtually begins with Brücke.¹ His conclusion, however, that the feet in verse are temporally equal, has to be disregarded, not only because of the crudity of his apparatus but because his subjects were instructed to scan in a mechanical fashion. In 1893 Bolton² produced the first and what is so far the last attempt to cover the field of rhythm as a whole. In 1894 came Meumann's signal contribution. For Meumann rhythm is a mental process by means of which we group sensations of sound into a system of images arranged upon a temporal basis.³ But besides this type of rhythm he describes a rhythm of the thoughts themselves capable of disturbing strictly temporal relations. Phrases may in this way be considered as units and similar groups recur with satisfactory effect at unequal intervals of time.⁴

Two tendencies thus appear in verse — one toward order, one toward freedom. In fact, a certain lawlessness is natural to poetic rhythm. Absolute regularity is unbearable. Meumann expresses his surprise at Hermann Paul's naive acceptance of Brücke's theory of equal bars. He concedes the validity of Bolton's statement that there

¹ Brücke, E. W., *Die physiologischen Grundlagen d. neuhochd. Verskunst*, Wien, 1871.

² Bolton, T. L., *Rhythm*, *Amer. J. of Psy.*, VI, 1894, p. 145 ff.

³ Meumann, E., *Untersuchungen z. Psych. u. Aesth. d. Rhythmus*, *Philos. Stud.*, X, 1894, p. 272 ff.

⁴ *Ibid.*, p. 305.

is a tendency to slow up or to hasten the number of elements in a group in order to make the group fit the natural attention period,⁵ and that this develops in verse as a tendency to preserve regular intervals from one chief accent to another; but he maintains that there is present also a disorganizing influence that can be traced back to three sources: melody interest, tempo changes due to feeling, and finally logical groupings, cutting across the temporal divisions. Meumann should have emphasized the fact that a similar tendency toward freedom, whatever may be regarded as its source, is present in regular music. The neglect of this incontestable truth accounts in part for the inability of all attempts up to the present to make quite clear what there is in common between music and verse—to say nothing of music and prose. Experimentally this has received very little attention.

Meumann contends that the intellectual processes are always present in rhythm and that the organic phenomena are only accompaniments.⁶ Breath adapts itself to rhythm.⁷ There is most organization when least feeling. Titchener, however, has brought to notice what seems to be a contradiction in Meumann's attitude toward rhythm, inasmuch as M. K. Smith⁸ leads us to infer that later, at least, Meumann regarded rhythm as an "emotion discharging itself in ordered movement," rather than as a perception.

To the present writer the most signal gaps in Meumann's investigation appear to result from his failure to appreciate the full meaning and possibilities of acceleration and retarding on the one hand, and of syncopation on the other, as means of bringing what are apparently temporal

⁵ Meumann, E., *Untersuchungen z. Psych. u. Aesth. d. Rhythmus*, *Philos. Stud.*, X, 1894, p. 405 ff.

⁶ *Op. cit.*, p. 272.

⁷ *Ibid.*, p. 270. -

⁸ Smith, M. K., *Rhythmus u. Arbeit*, *Philos. Stud.*, XVI, 1900.

irregularities into a musically accepted scheme that shall be both simple and clear. Throughout his work, moreover, the tremendous opportunities for adducing the principle of substitutional equivalence or occult balance as an explanatory factor in the perception of elusive rhythm, have been almost entirely disregarded.

In 1895 Binet and Courtier⁹ made researches on the irregularity of supposedly equal musical intervals when played even by expert performers. In successions of five notes it was found that the faster the notes were played the more irregular were the intervals.¹⁰ In 1897 Courtier¹¹ concluded that the memory for tones and the memory for rhythm do not always go together. About the same time Meyer¹² maintained that the rhythm of song and poetry is directly perceived only as motor rhythm and only by the person who sings or recites. In other words, it is only indirectly perceived by the auditor through the movements it provokes.

From this time on the accounts of various researches begin to multiply at an increasing rate until a sort of lull is reached after 1913. Hurst and McKay¹³ investigate the time relations in verse. Lanier's theory of regular musical relations based upon a normal bar is felt to be untenable.¹⁴ Guest is criticized for ignoring the time element, and comment is made upon Gummere's admitting time merely as a regulative element. Hurst and McKay contend that

⁹ Binet and Courtier, *Recherches graphiques sur la musique, L'Année Psychol.*, II, 1895, p. 201.

¹⁰ *Ibid.*, p. 215.

¹¹ Courtier, J., *Communication sur la memoire musicale, III Inter. Kongr. f. Psy.*, München, 1897, p. 240.

¹² Meyer, E. A., *Beiträge z. deutsch. Metrik, Die neu. Spr.*, VI, 1896, p. 122.

¹³ Hurst, A. S., and McKay, J., *Experiments on the time relations of poetical meters, Univ. of Toronto St., Psy. Ser.*, III, 1899.

¹⁴ *Ibid.*, p. 158.

both time and accent may occasionally be ignored, allowing the thought alone to regulate the rhythm.¹⁵ As a result of their research an approximately uniform length of foot is established, but the iamb is found to be longer on an average than the trochee.¹⁶

Shaw and Wrinch¹⁷ maintain that each person has for his unit of time a certain interval which may vary, however, on different occasions. This unit of time is a psychic compound and is the basis for estimating intervals. Schumann's theory is criticized. Feelings of expectation and surprise do not mediate the estimation of the intervals, as Schumann would have us believe.¹⁸ This unit of time is close to half a second,¹⁹ and corresponds to what Verrier later applies to speech rhythm as a "vocal step."

In 1901 appeared the fifth edition of Sievers's *Phonetik*. In Vorwort XI he appears inclined to oppose experimental phonetics, commenting upon the inevitable self-consciousness involved in using mouth-pieces, etc. The instrument for photographing sound, constructed by Dr. Pegram and the author, seems to obviate entirely this disadvantage. Like Meumann, Sievers²⁰ speaks of two antagonistic rhythmic tendencies, one toward freedom and variety, the other toward equal "Sprechtakte." It is significant that he mentions the possibility of beating time to artistic declamation.²¹ He finds a tendency for prose to be divided into sections of approximately equal duration, which can appear even when the separate "Sprechtakte" seem of unequal

¹⁵ Hurst, A. S., and McKay, J., *Experiments on the time relations of poetical meters*, Univ. of Toronto St., Psy. Ser., III, 1899, p. 162.

¹⁶ *Ibid.*, p. 166.

¹⁷ Shaw, M. A., and Wrinch, S. F., *A contribution to the psychology of time*, Univ. of Tor. St., Psy. Ser., II, 1899, p. 121.

¹⁸ *Ibid.*, p. 124.

¹⁹ *Ibid.*, p. 129.

²⁰ Sievers, E., *Grundzüge der Phonetik*, Leipzig, 5th ed., 1901, p. 266.

²¹ *Ibid.*, p. 266.

duration. The later work of Sievers²² is colored by his interest in speech melody, but for his generalizations in this direction he seems as yet to have adduced no definite and convincing data.

Sievers is known to have a delicate ear for musical effects, so that it is extremely puzzling that although he so often discusses the time-relations in rhythm, he should give them such scant treatment in these studies of speech melody.²³ "The individuality of a melody is absolutely dependent," says Puffer,²⁴ "on its rhythm, that is, on the relative time-value of its tones." Gurney makes similar statements. The case is plain if we take the stirring tune of "Dixie," for instance. Play it or sing it with an equal time-interval for each change in pitch, and it becomes a melancholy tune, indeed. No doubt the objective irregularity in the temporal-intervals of speech is chiefly to blame for their being shelved in the discussion. The missing key, of course, has to be supplied by a lucid explanation of the processes by means of which a highly rhythmic observer, such as No. 7 in the present series of experiments, is able to evoke subjective order out of objective chaos.

In the "Metrische Studien," Sievers, adopting Saran's definitions, refers to "time-organization and stress-gradation" as "by far the most important" among the factors in rhythm.²⁵ Elsewhere,²⁶ he indicates that the "feet" in alliterative verse approximate "equal duration." No "timer" in the past could have quarreled with this attitude.

²² *Zur älteren Judith*, Prag, 1908; *Rhythmisch-melodische Studien*, Heidelberg, 1912.

²³ Sievers, E., *Rhythmisch-melodische Studien*, Heidelberg, 1912, p. 10 ff., p. 41 ff.

²⁴ Puffer, E., *The psychology of beauty*, p. 185.

²⁵ Sievers, *Metrische Studien*, *Kön. säch. Ges. d. Wiss. Abh. phil.-hist. Kl.*, XXI, p. 31.

²⁶ Sievers, *Zur Rhyth. d. germ. Alliterationsverses*, *Beiträge z. Gesch. d. deut. Sprache*, X, 1885, p. 221.

Our wonder is consequently all the greater when we find that Sievers's two-beat theory for Old English verse, in its application, at any rate, falls back upon the assumption that time is not so important a factor as we imagined. This is discussed later in the chapter in connection with Schipper, who adopts the two-beat theory, after committing himself, more inextricably than Sievers, to a strict time basis for poetical rhythm.

Wallin²⁷ has shown to what an extent the mere visual arrangement of language in schematic lines instead of a straightforward succession of words is often the only effective aid in distinguishing verse from prose. Deprived of this aid, three subjects declared verses of Tennyson and Browning to be prose. Only one out of a group pronounced Browning poetry.²⁸ Wallin advises using the interval between centroids as a unit of measure, and thus dispenses with bar and foot as terms.²⁹ Prose observes no systematic arrangement of the intervals.³⁰ Westphal, Lotze, and Lanier emphasize time as the basis of rhythm; Guest, Gummere, and others maintain the importance of stress. The centroid theory is concerned with both time and stress. Time and rhythm, however, are not on the same basis; rhythm is less a matter of judgment than of feeling or "a rhythmic sense." The experiments show that trochaic rhythm appears more pleasing than iambic. Lovers of melody and harmony prefer slower tempos than those which appear most pleasing to observers whose endowment is chiefly rhythmical.³¹ The larger fluctuations of attention alone may possess power to attune and cadence the soul.³² Such a hypothesis would make it possible for prose to be considered as a rhythmical succession of fairly long segments marked off by the crests of attention.

²⁷ Wallin, J. E. W., *Researches on the rhythm of speech*, Yale Ps. St., IX, 1901.

²⁸ *Ibid.*, p. 64.

²⁹ *Ibid.*, p. 113.

³⁰ *Ibid.*, p. 114.

³¹ *Ibid.*, p. 216.

³² *Ibid.*, p. 142.

MacDougall³³ reviews the various estimates that have been computed for the "indifference point" or easiest interval of time in which a sensible object can be clearly grasped. According to different authorities it varies from about .375 sec. to .775 sec. The artistic effect of rhythm³⁴ is not due to any objective physical relations of time and so forth, but is simply due to arousing in an observer a feeling of pleasure, equivalence, perfection. The conditions of a rhythmic impression are recurrence, accentuation, and rate; but rhythmic forms are not rhythm until they initiate movement.³⁵ In any case there is "properly no repetition of identical sequences"; variation is always present.³⁶ "If the temporal conditions be not fulfilled (and the subject cannot create them) no impression of rhythm is possible." Accent, however, may be easily contributed by the observer.³⁷ By "rate" is meant the rate at which rhythm can be readily perceived — not too fast, not too slow. Stress alone cannot make rhythm; the sense or impression of temporal equivalence is the *sine qua non*.³⁸

Irregular movements, according to Miyaki, have a "constant tendency to become rhythmical, notwithstanding the voluntary effort of the subject to execute the movements at irregular intervals."³⁹ In this connection it should be remembered that Meumann⁴⁰ has already made clear the fact that all regular or rhythmical movements tend to become automatic and that this automatism is of great service to a performer in the matter of keeping time.

³³ MacDougall, R., *Rhythm, time, and number*, *Am. J. of Psy.*, XIII, 1902, p. 93 ff.

³⁴ MacDougall, *The structure of simple rhythm forms*, *Harv. Ps. St.*, I, 1903, p. 310.

³⁵ *Ibid.*, p. 319.

³⁶ *Ibid.*, p. 319.

³⁷ *Ibid.*, p. 321.

³⁸ *Ibid.*, p. 352.

³⁹ Miyaki, I., *Researches on rhythmic action*, *Yale Psy. St.*, X, 1902, p. 4.

⁴⁰ Meumann, *op. cit.*, p. 316.

In Miner's researches⁴¹ rhythm is found to be most pleasant when a motor response is reinforced by sensations accompanying the regular rhythms of the body. Once instituted it is fostered because it serves the purpose of economy. Rhythm is defined neither as a pure perception nor as a pure emotion, but as "the uniform perception of successive groups of objectively localized sensations, accompanied by a characteristic emotional tone." Rhythm is the "uniform recurrence of sensations of movement or tension, concurring in regular periods with sensations from an objective series of stimuli." A rhythm of smell, taste, touch, and vision is just as possible as a rhythm of hearing.⁴² Visual rhythm is less distinct than auditory rhythm, but just as direct.⁴³ "Both auditory and visual rhythm seem to be illusions due to the muscular reaction of the subject, combined with the sensations from objective serial stimuli."⁴⁴

According to Stetson,⁴⁵ rhythm assumes a movement cycle involving the activity of two opposing sets of muscles. "Every rhythm is dynamic; it consists of actual movement."⁴⁶ "If the basis of rhythm is to be found in muscular sensations, rather than in the supposed activity of some special 'mental' function, the nature of the movement cycle involved is of the greatest interest."⁴⁷ Upon this same muscular basis Bingham⁴⁸ finds his motor theory for melody. "Rise in pitch is not merely

⁴¹ Miner, J. B., *Motor, visual, and applied rhythms*, *Mon. Supp., Psy. Rev.*, V, 1903, p. 20.

⁴² Miner, *op. cit.*, p. 40.

⁴³ *Ibid.*, p. 71.

⁴⁴ *Ibid.*, p. 72.

⁴⁵ Stetson, R. H., *Rhythm and rhyme*, *Harv. Psy. St.*, I, 1903, p. 453.

⁴⁶ Stetson, *Motor theory of rhyme and discrete succession*, *Psy. Rev.*, XII, 1905.

⁴⁷ Stetson, *Rhythm and rhyme*, p. 453.

⁴⁸ Bingham, W. V. D., *Studies in melody*, *Mon. Supp., Psy. Rev.*, XII, 1910, p. 86.

a result of increased tension of the vocal apparatus: it likewise produces increased muscular tension in the hearer. A falling inflection at the close consequently serves to hasten the relaxation process which marks the completion of the melody." Two or more tones are felt to be related when there is "community of organized response." The effect of melody is a "ground-swell muscular process."

Scripture defines rhythmic movements as "movements repeated at apparently equal intervals."⁴⁹ He advocates the measurement of verse according to the centroid system.⁵⁰ Speech is a "flow of auditory and motor energy," with no possibility of division into separate blocks such as letters, syllables, words, feet, etc., except in a purely arbitrary manner that does not represent the actual case.⁵¹ A word has as many syllables as it is "felt" to have centroids; but on account of the substitutional value of pitch and duration in determining weight, "the centroid will rarely coincide with the maximum of energy."⁵² In other words, factors besides intensity will have to be considered in determining its position.

Various passages of spoken prose, recorded phonographically, have been measured at different times by Scripture; and some of them, such as the speech by Depew, he transcribes into musical notation.⁵³ No attempt is made, however, to organize the transcription into regular bars. The chief objection to be raised against his tables, in which amplitudes of vibration in the phonographic record are recorded in minute detail, is that no adequate corrections are made for the errors of resonance pertaining to the pho-

⁴⁹ Scripture, E. W., *The new psychology*, London, 1898, p. 180.

⁵⁰ Scripture, *Elements of experimental phonetics*, N. Y., 1902, p. 554 ff.

⁵¹ *Ibid.*, p. 550.

⁵² *Ibid.*, p. 451.

⁵³ Scripture, *Researches in experimental phonetics*, Washington, 1906, p. 71.

nograph diaphragms employed in recording the speeches. It is assumed that the resistance of the wax is just enough to overcome by damping the exaggeration of amplitudes at certain elevations of pitch. But even after diaphragms are carefully calibrated and approximate corrections made, any attempt to locate centroids in the continuum of ordinary speech is likely to entail results of the most untrustworthy nature. The best that objective measurement can do is to obtain maxima of pitch elevation and maxima of recorded amplitude. These together with elements of duration can be separately listed, but to obtain the real intensities or to combine the various factors making up a centroid into a point of measurable distinctness seems to be more than we can ever hope to achieve.

It was found by Sanford and Triplett⁵⁴ that when a number of children were asked to tap nursery rhymes as they recited them a variety of interpretations resulted. As an example, in the case of "Bye Baby Bunting," four of the children gave four accents to the line, ten gave three, and one gave two. It is interesting to note in this connection that in Scripture's measurement of "Who killed Cock Robin?" two centroids are assigned to the line, and this proportionment is advocated as a proper index for the schematic nature of the verse — at any rate, for the particular version of it under consideration.⁵⁵ This, of course, corresponds to the familiar theory of Coleridge, as carried into practice in the case of "Christabel." It must be remembered, however, that Scripture does not ignore the temporal element as fundamental in the conception of rhythm. Moreover, his definition of rhythmic movements, referred to above, as movements repeated at *apparently* equal intervals, shows that it is our *impression* of the

⁵⁴ Sanford, E. C., and Triplett, N., *Studies of rhythm and meter*, *Am. J. of Psy.*, VI, 1910, p. 388.

⁵⁵ Scripture, *Elements of experimental phonetics*, p. 554.

time relations, rather than their objective value, that is significant.

The rhythm of work has received attention chiefly from Bücher⁵⁶ and Miss Smith.⁵⁷ The former contends that half-animal sounds gave primitive man a feeling of relief.⁵⁸ These sounds were strengthened, and thus song developed out of a series of senseless "Lautreihen." Tone rhythm supported movement rhythm, and breath forced both to coöperate. These nonsense songs were found an assistance in primitive labor and are considered by Bücher as an origin of rhythm prior to the dance.⁵⁹ Bücher's theory⁶⁰ of a second stage in the development of rhythm, in which words and sentences were interpolated between the "Lautreihen" that accompanied work, is purely fanciful.

One interesting result of Miss Smith's research⁶¹ is that the observers *think* they are working to time-beats when they are not. The exactness with which their movements and the beats of an accompanying metronome coincide varies according to the individual difference of the subjects. In any case, the relation between the two operations is a very free one.⁶² The statement of Miss Smith's⁶³ that "there is no bad rhythm" or, as interpreted by Squire,⁶⁴ that the perception of rhythm is present in completeness or vanishes entirely, is a point of departure for the latter's genetic study of the subject. Rhythmic forms can in fact be classified in the order of their complexity.⁶⁵ The earliest rhythm, genetically, to which children respond is

⁵⁶ Bücher, K., *Arbeit und Rhythmus*, 4th edition, Leipzig, 1909.

⁵⁷ Smith, M. K., *Rhythmus und Arbeit*, *Philos. St.*, XVI, 1900.

⁵⁸ Bücher, *op. cit.*, p. 359.

⁵⁹ Bücher, *op. cit.*, p. 557 ff.

⁶⁰ *Ibid.*, p. 360.

⁶¹ Smith, *op. cit.*, p. 305.

⁶² *Ibid.*, p. 305.

⁶³ *Ibid.*, p. 392.

⁶⁴ Squire, C. R., *A genetic study of rhythm*, *Am. J. of Psy.*, XII, 1901, p. 493.

⁶⁵ *Ibid.*, p. 540.

even simpler than Poe's spondee,⁶⁶ which implies a two-syllable group. The evidence for this is that children in their first reactions to rhythm in speech give equal value to each syllable, thus creating what Squire calls "the primary form" of rhythm. This corresponds to what the author of the present treatise refers to as "unitary pulses." The second stage in the children's progress, according to Squire, who also refers to Böhme,⁶⁷ is to distribute so many accents to the line, irrespective of regularity. There is no question⁶⁸ that grouping by two's is psychologically prior to grouping by three's. One of Squire's subjects, a boy,⁶⁹ succeeds fairly well in keeping step to iambic and trochaic rhythm, but fails completely with dactylic and anapæstic forms.

Time is the basis of rhythm,⁷⁰ but the character of the grouping is not necessarily dependent on the time-order. The rhythm, however, will become unpleasant if the rate of succession exceeds "the natural rate of the individual."⁷¹ The negro's rhythmic ecstasy is not due to associative factors, such as are emphasized by Lipps and Groos, but is due to the feelings produced by the rhythm itself. Of these the simple sense feelings, most evident in the case of the negro, derive their pleasantness from "the moderate and regular functioning of the bodily organs and the resulting stimulation of the cortex."⁷² We find, however, in another place,⁷³ that feeling is not essential to the perception of rhythm, inasmuch as rhythmic groups occur in states of indifference so far as feeling is concerned. Miss Smith is considered⁷⁴ to neglect the perceptual

⁶⁶ Poe, E. A., *The rationale of verse, Works*, VI, ed. by Stedman and Woodberry, N. Y., 1908, p. 58.

⁶⁷ Böhme, F. M., *Deutsches Kinderlied*, etc., Leipzig, 1897, p. 8.

⁶⁸ Squire, *op. cit.*, p. 536. ⁶⁹ *Ibid.*, p. 573. ⁷⁰ *Ibid.*, p. 541.

⁷¹ *Ibid.*, p. 588.

⁷² *Ibid.*, p. 588 ff.

⁷³ *Ibid.*, p. 587.

⁷⁴ *Ibid.*, p. 586.

elements in rhythm; not so, Wundt. "All the phenomena of rhythm can be explained by the facts of perception."⁷⁵ "Perception of rhythm may fail because of a physiological defect, auditory or motor." It may be due to purely "psychological" causes, inability to control attention or to compare sounds or movements, etc.⁷⁶ An intelligent observer may not direct his attention upon the series of sounds, but upon the reason for the experiment,⁷⁷ and thus appear deficient in rhythmic perception.

In 1904 Marbe⁷⁸ published his investigation of rhythm in German prose. He himself scans the first and second 1000 words of Goethe's "St. Rochusfest" and Heine's "Harzreise"; the second and third 1000 are scanned by a collaborator. The method of scanning consists in marking the accented syllables. After the average number of unaccented syllables per interval is calculated, and the frequency of each variety of "foot" obtained for each 1000 words, the conclusion is drawn that the average foot is shorter in Goethe than in Heine. Following Marbe's method, Lipsky⁷⁹ undertakes an investigation of the rhythm of English prose. "Style and rhythm of prose are to a very large extent identical."⁸⁰ Passages from various English writers, including Browne, Addison, Lamb, Carlyle, Ruskin, Emerson, Howells, Spencer, Henry James, and Ingersoll are scanned according to Marbe's method, and the results tabulated. Ruskin's "Modern Painters" has the shortest foot-length; "Spencer has both the longest foot-length and word-length."⁸¹ Browne, Lamb, and Emerson use phrases of three accents, to a large extent.⁸² In the later work of Howells the measures are found to grow closer; the rhythm

⁷⁵ Squire, *op. cit.*, p. 586. ⁷⁶ *Ibid.*, p. 574. ⁷⁷ *Ibid.*, p. 575.

⁷⁸ Marbe, K., *Über d. Rhythmus d. Prosa*, Giessen, 1904.

⁷⁹ Lipsky, A., *Rhythm as a distinguishing characteristic of prose style*, N. Y., 1907.

⁸⁰ *Ibid.*, p. 40.

⁸¹ *Ibid.*, p. 29.

⁸² *Ibid.*, p. 26.

of Henry James grows more and more "open," etc. Many of the results of Marbe and Lipsky are of interest, but their procedure, as a whole, is unscientific. The conditions under which the scanning was made were not regulated with sufficient care. Very slight consideration was taken of such influences as fatigue, habit, practice, and suggestion; and too much final importance is laid upon the results of single scannings of long passages made by individuals necessarily subject to varying moods and the disturbing effects of time and place.

The danger of depending too much upon tapping methods is emphasized by Brown.⁸³ Any system of tapping as an accompaniment to sounds not made by the observer involves too much the element of expectation, and is vitiated by the observer's individual rhythmic tendency. Freely tapped rhythms are of great value in the study of the general subject but do not concern the rhythm of speech. Experiments with the phonograph involve distortion.

Brown considers the error of method up to date to be that rhythm has been treated as an art form instead of as a form of motor expression. Attention should be directed to the speaker rather than to the hearer, who is open to too many illusions and misconceptions.⁸⁴ "Meaning" interferes with estimates of duration and intensity, but Brown disclaims an attempt to investigate its effect.⁸⁵ Since tapping by the speaker controls the voice too much, he makes use of a tambour to record nonsense syllables uttered by the observer. "Grouping in rhythm is an affective experience and if we place it simply in the dimension of strain and relaxation it becomes at once clear why no regular time relations are necessary."⁸⁶ The regularity becomes a matter of recurrence of strain at the end of a

⁸³ Brown, W., *Time in English verse rhythm*, N. Y., 1908, p. 9 ff.

⁸⁴ *Ibid.*, p. 2.

⁸⁵ *Ibid.*, p. 3.

⁸⁶ *Ibid.*, p. 75.

definite cycle. The muscles may take a longer or a shorter time to accomplish their cycle and the strain may not come at equal intervals of time, but the swing is there and from one place to the next like place is a definite mental state held together by the continuous circular process."

This appears to be an attempt to remove the experience of rhythm from too definite a connection with the dimension of time, and place it in the "dimension of strain and relaxation." In 1911 Brown⁸⁷ seems to have changed his point of view. After saying that the "only undisputed character of rhythm is the impression of regularity which it occasions,"⁸⁸ he states that "all recurrence is a temporal matter,"⁸⁹ and that rhythm is "primarily temporal."⁹⁰ Accent may be necessary in order to have "points of emphasis," but it is not the distinctive feature of rhythm.⁹¹ "The accentual features while necessary are not at the root of the phenomena."⁹²

Wundt⁹³ regards the sensations in the joints and muscles as the primary origin of time-images. There is no real time-sense, but temporal properties are attached to our various ideas.⁹⁴ Thus arise images of speed and of duration. The sensations accompanying the perception of a time series of auditory stimuli are largely due to tension of the ear-drum and action of the *musculus tensor tympani*.⁹⁵ Automatic rhythmic movements do not prove a consciousness of time, as even our walking is usually timeless. Such movements are due to the "physiological rhythm of the innervation process."⁹⁶ Nevertheless from our walking-step the whole body takes a rhythm, and the steps

⁸⁷ Brown, *Temporal and accentual rhythm*, *Psy. Rev.*, XVIII, 1911.

⁸⁸ *Ibid.*, p. 336.

⁸⁹ *Ibid.*, p. 343.

⁹⁰ *Ibid.*, p. 344.

⁹¹ *Ibid.*, p. 344.

⁹² *Ibid.*, p. 346.

⁹³ Wundt, W., *Grundzüge d. physiolog. Psychol.*, Leipzig, 1911, III, p. 24.

⁹⁴ *Ibid.*, p. 2.

⁹⁵ *Ibid.*, p. 19.

⁹⁶ *Ibid.*, p. 4.

themselves give us time-images as soon as we attend to them. The lucky coincidence that the average double step is approximately one second (.98) assists us in estimating time. The interval of time most easily estimated lies between one second and one-fifth of a second. One-half a second or the duration of a single average walking-step may be considered as the most convenient unit or "indifference point," in regard to which least errors of estimation are likely to occur.⁹⁷

The coöperation of the exciting and inhibiting forces which our central functions undergo, puts all life upon a basis of vibration. Every movement has a definite regularity or law of its own. All irregular movements, accordingly, can be considered as rhythmic fragments.⁹⁸ This is of particular significance in connection with spoken prose.

In general, a falling or trochaic rhythm is usual in German unimpassioned speech; the rising or iambic form produces an exciting effect. In Romance languages, the rising rhythm is more common. In the development, however, of a sense of rhythmic "measure" we are probably below the standard of the Greeks.⁹⁹

Music and speech both have their probable common origin in a song-like form of speech.¹⁰⁰ The march-song, work-song, and dance-song are united in the primitive religious song, out of which came poetry. Going still further back, the movements of the body in walking suggested regular marching, to which sound accompaniments were later added. Work carried rhythm to a further stage on account of its demands for regular movement, and finally the dance emerges after musical motives have been conceived. Speech thus occupies a mediating position, adding more complicated motor elements to the preceding awkward movements. In walking we get a natural origin

⁹⁷ Wundt, *op. cit.*, p. 13 ff.

⁹⁸ *Ibid.*, p. 15.

⁹⁹ *Ibid.*, p. 23 ff.

¹⁰⁰ *Ibid.*, II, p. 620.

for rhythmic perception, but later, in the dance, the rhythm of sound in music reacts upon the body.¹⁰¹

Established results with regard to time illusions are reviewed by Wundt. Large intervals usually are judged too small; small intervals, too large. The "indifference point" at which they are most correctly judged averages about .6 second, corresponding to a single walking-step. When this interval is "filled," it is usually overestimated.¹⁰² Since there is no absolute time measure, illusions refer to relation and concern either temporal size (velocity illusions) or temporal displacements. A regular series often seems to get faster. A long series always seems faster than a short series, when the units are equal. This is due to attention. The difference in impression between "empty" and "filled" intervals depends upon their length. A filled interval, if short (from .5 to 1.5 seconds), seems longer than an equal empty interval; but if long (two seconds or over), it seems less. A long pause before or after a note gives the effect of an accent. No series of impressions is possible that cannot in some way be comprehended as rhythmic.¹⁰³

According to Wundt, the pleasantness of rhythm depends upon two elements: the repetition of feelings of tension and the contrast between feelings of tension and relaxation.¹⁰⁴ This is complicated by elements of speed and number of accents. Rising rhythm with very great acceleration of speed causes a feeling of unpleasantness; falling rhythm at very slow speed causes a feeling of tension. The more accents, the more excitement. Accents crowded and clashing cause great excitement; irregularly distributed, cause excitement plus unpleasantness. Rising rhythm is exciting; falling rhythm is soothing. Between these two lie series of an amphibrachic nature, in which

¹⁰¹ Wundt, *op. cit.*, III, p. 32 ff.

¹⁰² *Ibid.*, p. 39 ff.

¹⁰³ *Ibid.*, p. 48 ff.

¹⁰⁴ *Ibid.*, p. 144 ff.

the second member of a group of three is accented.¹⁰⁵ Unpleasant effects are due to exceeding the limits of easy grasp for groups, unmotivated departures from a rhythmic series, or merely monotonous repetition.¹⁰⁶ The affective tendency of rhythm, in general, is chiefly to excite or to soothe, with compensation and contrast as elements of variety.¹⁰⁷

One of the most recent investigations of the psychology of time is that of Benussi¹⁰⁸ who feels that past research has neglected too much the illusions accompanying filled intervals. A short interval, when divided in two, seems much larger; a long interval with manifold filling seems much shorter.¹⁰⁹ An interval seems shorter when filled with mental work, whether hard or easy.¹¹⁰ Subjective time-size depends usually upon the intensity degree of attention, but in forced cases, upon whether the similarity or difference of the impressions bounding a time-interval is the more striking.¹¹¹ The interval diminishes when the two limits are felt as a group. Benussi's three chief factors in time perception are: I. The "individualizing" of intervals into short, long, and indifferent. II. The distribution of attention during time perception. III. The distribution of "strikingness" upon the contending elements of filling, extension, and limits.¹¹²

In contrast to the theories for the origin of poetry advanced by Wundt, Bücher, and others, Verrier¹¹³ maintains that its origin is neither in the rhythm of work nor of dancing, but in the prose "segments" of every-day conversation. These segments, whether "short" or

¹⁰⁵ Wundt, *op. cit.*, p. 206. ¹⁰⁶ *Ibid.*, p. 142. ¹⁰⁷ *Ibid.*, p. 156.

¹⁰⁸ Benussi, V., *Psychologie d. Zeitauffassung*, Heidelberg, 1913.

¹⁰⁹ *Ibid.*, p. 419.

¹¹⁰ *Ibid.*, p. 486.

¹¹¹ *Ibid.*, p. 5.

¹¹² *Ibid.*, p. 505.

¹¹³ Verrier, P., *Essai sur les principes de la métrique anglaise*, Paris, 1909-1910, III, p. 71.

“long,”¹¹⁴ fall within the limits of the “indifference” interval in time estimation. The longer segments, thus, do not exceed three syllables or the length of a rather slow walking-step. Segments are measured from strong vowel to strong vowel and according to their average length each person is accorded his “natural rhythm” or “vocal step.” This may be regarded as his unit for speech measurement. In experimenting upon three Englishmen,¹¹⁵ Verrier finds “an unconscious tendency to bring the consecutive rhythmic segments to an equal duration.” There results “a relative shortening of sounds, according as the number of the syllables of the segments increases.” English prose¹¹⁶ modulates incessantly, in all probability, from two to three-beat rhythm. “Whether there is or not dependence between the rhythm of pronunciation and that of walking, they both have one single and same cause: the necessity of coördinating and regulating our muscular movements, in a word, of making them rhythmic, in order to diminish the expense of energy.”¹¹⁷

Emphatic pauses and variations due to feeling cause “at every instant accelerations or retardings of different kinds.”¹¹⁸ Rhythm enjoys irregularities just as harmony enjoys dissonances.¹¹⁹ The equality of time-intervals is an illusion. The individual rhythm of the speaker adapts itself to the fluctuations of sentiment without giving the impression of being unrhythmical. Rhythm is pleasing when it coincides with an individual’s inner rhythm, which in itself is subject to variations.¹²⁰ In any case, artistic rhythm depends upon the return of the beat at equal (apparently equal) intervals of time.¹²¹ “In objective

¹¹⁴ Verrier, P., *Essai sur les principes de la métrique anglaise*, Paris, 1909-1919, III, p. 63.

¹¹⁵ *Ibid.*, p. 67. ¹¹⁶ *Ibid.*, p. 70. ¹¹⁷ *Ibid.*, p. 35. ¹¹⁸ *Ibid.*, p. 325.

¹¹⁹ Verrier, *Les variations temporelles du rythme*, *J. de Psy. Norm. et Path.*, 1913, I, p. 18.

¹²⁰ Verrier, *op. cit.*, p. 16 ff.

¹²¹ *Ibid.*, p. 24.

reality the feet of our verses approximate absolute equality in the same degree as the measures of music."¹²² This conclusion is the result of experiments in French versification. In general, Verrier appears to believe that rhythm depends upon the illusion of equal time-intervals for its basis, but enjoys the introduction of a measure of irregularity *per se*. When the speaker or hearer is unconscious of objective irregularity his pleasure in the illusion of equality is what predominates.

The "weight" element is made of chief importance in the investigations of Landry.¹²³ Accent itself depends upon "energy, and, above all, duration." Rhythm is defined as "the march of energy," and "the relations of size and succession in number, energy, and duration."¹²⁴ The composite effect of number, duration, and energy of syllable constitutes weight; the composite effect of number, "ampleur," and "weight," constitutes "equilibrium."¹²⁵ Syllabic equilibrium is the basis of French declamation.¹²⁶ No very definite conclusions are drawn for the constitution of rhythm in prose, although a number of interesting measurements are made.

More theoretical in its nature is Saran's treatment of rhythm. Rhythm is described¹²⁷ as "every organization, pleasing as such, of sensuously perceptible occurrences." This organization implies three elements: a weight gradation, a time gradation, and a unification based upon pleasingness. Rhythm is purely mental in its origin.¹²⁸ The psychic impression of "weight" is due to phonetic factors, such as stress, pitch, and so forth; but it is itself an ele-

¹²² Verrier, *L'isochronisme dans le vers français*, Paris, 1912, p. 48.

¹²³ Landry, E., *La théorie du rythme et le rythme du français déclamé*, Paris, 1911.

¹²⁴ *Ibid.*, p. 40.

¹²⁵ *Ibid.*, p. 37 ff.

¹²⁶ *Ibid.*, p. 382.

¹²⁷ Saran, F., *Deutsche Verslehre*, München, 1907, p. 138.

¹²⁸ Saran, *op. cit.*, p. 139.

ment of accent which is defined as "a complex of selected and clearly organized weight, duration, and unity relations."¹²⁹ Sievers is criticized for confusing weight and accent. Artistic prose is seldom rhythmic, often "unrhythmic," but chiefly "rhythmless," containing an element of ordering that should not be called rhythm.¹³⁰ In these distinctions Saran, in spite of his view that rhythm is purely a matter of intellectual perception, appears to stress the binding qualities of the prose itself, rather than the various effects one passage might have upon a number of hearers. A motor theory seems to be distinctly foreign to his view of the subject, which as a whole he does not treat in thorough accordance with any accepted psychological system. His definition of rhythm, moreover, stressing as a condition the element of pleasantness, excludes the well-known cases, mentioned by Squire,¹³¹ where the perception of rhythm is accompanied by feelings of indifference.

Schipper¹³² defines rhythm as "regular order in the succession of different kinds of motion." "All rhythm, therefore, in our dancing, poetry, and music comes to us from ancient times, and is of the same nature in these three arts." Dancing is the typical form and source of all rhythmic movement.¹³³ The time element is plainly emphasized in his definition of poetical rhythm¹³⁴ which is a "special symmetry, easily recognizable as such, in the succession of syllables of different phonetic quality, which convey a sense, and are so arranged as to be uttered in divisions of time which are symmetrical in their relation to one another." "In prose the words follow each other in an order determined entirely, or almost entirely, by the sense"; but even in prose "a certain influence of rhythmical

¹²⁹ Saran, *op. cit.*, p. 21.

¹³⁰ *Ibid.*, p. 19.

¹³¹ Squire, *Genetic study of rhythm*, 586.

¹³² Schipper, J., *History of English versification*, Oxford, 1910, p. 3.

¹³³ *Ibid.*, p. 2.

¹³⁴ Schipper, *op. cit.*, p. 4.

order may be sometimes observable." In Schipper's historical treatment of the various theories with regard to Old English versification several interesting problems are broached, but not fully discussed. Among others is Jessen's theory,¹³⁵ developed by his successors, of substituting pauses for "beats not realized." This involves the possibilities of syncopation in connection with metrics, which have been to such a large extent neglected even by those who have sought to put the scanning of verse upon a purely musical basis.

Schipper, along with Sievers, accepts the two-beat theory for the alliterative line of Old and Middle English, relying partly upon the testimony of Gascoigne and Bishop Percy.¹³⁶ According to this view, "the alliterative line obeys only the requirements of free recitation and is built up of two hemistichs which have a rhythmical likeness to one another resulting from the presence in each of two accented syllables, but which need not have, and as a matter of fact very rarely have, complete identity of rhythm."¹³⁷ The inconsistency between this view of poetical rhythm in Old English, in which the relations of time are completely subordinated, and his straightforward definition of poetical rhythm, already quoted, in which "the divisions of time" are "symmetrical in their relation to one another" is hard to reconcile. Either the definition is false or Old English poetry has no rhythm. The supposition of Sievers that it was meant to be recited freely and not sung in no way removes the inconsistency. Perhaps the simplest way for Schipper to meet the situation would be to revise his definition of rhythm; otherwise the prestige of the two-beat theory, as a whole, is seriously impaired.

It would be difficult to attempt a psychological review

¹³⁵ Schipper, *op. cit.*, p. 17.

¹³⁶ *Ibid.*, p. 21.

¹³⁷ *Ibid.*, p. 24.

of Saintsbury's contribution to the investigation of prose rhythm,¹³⁸ inasmuch as he himself is averse to nothing more than to what he calls "parade of systematic theory."¹³⁹ His book, in places, suggests hasty composition. In the first note on the first page of his first chapter, the author refers to Isocrates as preceding Aristotle in starting the whole inquiry as to the nature of prose rhythm. Aristotle described prose as "neither possessing metre nor destitute of rhythm." He also advocated the "pæon, or four-syllabled foot, as the base-rhythm."¹⁴⁰ In a note on page 2 Isocrates is quoted as saying that prose should be "mingled with all kinds of metres, especially iambic and trochaic." On page 4, however, Dionysius of Halicarnassus is introduced as having made a "bold advance" upon Aristotle by declaring that "no rhythm whatever is banished from unmetred composition," which can hardly be considered as a bold advance, since it is almost exactly what Isocrates had said at the historical beginning of the discussion.

Any detailed attempt to discuss the nature of rhythm is absent. In view, moreover, of the long series of scanned examples of well-selected prose passages which he adduces in evidence of the "development" of rhythm in English prose, and describes in his usual pungent and entertaining style, it is surprising to find at the end of his book that he has nothing more to say with regard to the problem with which he started than that "where Variety itself is mistress and queen — the moon that governs the waves of prose, as order is the sun that directs the orbit of verse — the ear once more is judge."¹⁴¹ This, apparently, strikes a note of self-confessed defeat.

¹³⁸ Saintsbury, G., *A history of English prose rhythm*, London, 1912.

¹³⁹ *Ibid.*, p. 463.

¹⁴⁰ *Ibid.*, p. 3.

¹⁴¹ Saintsbury, *op. cit.*, p. 465.

Rhythmic feeling, as judged by pulse and breath, has been investigated by Drozynski.¹⁴² One of his most important results was that certain rhythms produced a consistently unpleasant effect.¹⁴³ A purely iambic rhythm at certain rates of speed produced unpleasant reactions. Series of anapæsts frequently produced disagreeable "tension."¹⁴⁴ Contrary to the usual opinion, rhythmic groups consisting of three clashing accents and a single unaccented member were found at certain tempos to have a quieting effect.¹⁴⁵ At other rates of speed they produced displeasure and considerable excitement. The breath was hurried and deepened, and the pulse was shortened.

Woodrow¹⁴⁶ has studied the rôle of pitch in rhythm. Intensity has a group-beginning effect; duration, a group-ending effect; but pitch has "neither a group-ending nor a group-beginning effect." Simple substitution, therefore, of the factors is impossible. The rôle of kinæsthesia in the perception of rhythm has been significantly treated by Ruckmich.¹⁴⁷ "There is evidence enough, then, that most of the investigators in the field of rhythm conclude that kinæsthesia of one sort or another plays the most prominent part in rhythmical perception and in its development."¹⁴⁸ After quoting Ribot's familiar statement:¹⁴⁹ "Thought is a word or an act in a nascent state, that is to say, the beginning of a muscular activity," Ruckmich reviews the more or less recent reaction against this ideo-

¹⁴² Drozynski, L., *Atmungs- u. Pulssymt. rhythmischer Gefühle*, *Psy. St.*, VII, 1912.

¹⁴³ *Ibid.*, p. 110.

¹⁴⁴ *Ibid.*, p. 111.

¹⁴⁵ *Ibid.*, p. 109, p. 139.

¹⁴⁶ Woodrow, H., *The rôle of pitch in rhythm*, *Psy. Rev.*, XVIII, 1911, p. 77 ff.

¹⁴⁷ Ruckmich, C. A., *The rôle of kinæsthesia in the perception of rhythm, with a bibliography of rhythm*, *Am. J. of Psy.*, 1913, XXIV.

¹⁴⁸ *Ibid.*, p. 311.

¹⁴⁹ Ribot, T., *Psychologie de l'attention*, Paris, 1889, p. 20.

motor theory on the part of Thorndike,¹⁵⁰ Titchener,¹⁵¹ and others. "The assumption of an equivalent between the psychical and the physical is an error into which the investigator is apt to fall if he insists upon too rigid an interpretation of psycho-physical data."¹⁵² As a result of his experiments it was found that, both in the case of sound and of flashes of light presented for rhythmization, kinæsthesia (motor reaction) was essential for the establishment of a rhythmical perception. "That perception once established, however, rhythm might be consciously carried, in the absence of any sort of kinæsthesia, by auditory or visual processes."¹⁵³

Weld¹⁵⁴ has made a study of the psychology of musical enjoyment. Most disturbances in the distribution of blood supply recorded during the experiments are found to be due to variations in attention and not to the emotional quality of the music as such.¹⁵⁵ Music quickens the pulse, whether the tempo be fast or slow. Under the influence of music, the chief characteristic of breathing is irregularity; there is no constant correlation between breathing and phrasing. Muscular reactions of all kinds are of great importance in the appreciation of music. Motor responses occur with every auditor, varying from the crude reaction of beating time to the "subtlest play of sheer images of non-executed movements." The complex enjoyment of music is due to timbre and tone, motor response to rhythm, association, play of imagery, pleasure in prediction, and self-projection into the music, pervasive mood, and finally

¹⁵⁰ Thorndike, E. L., *Ideomotor action*, *Psy. Rev.*, XX, 1913, p. 91 ff.

¹⁵¹ Titchener, E. B., *Psychology of feeling and attention*, N. Y., 1908, p. 309.

¹⁵² Ruckmich, *op. cit.*, p. 313.

¹⁵³ *Ibid.*, p. 359.

¹⁵⁴ Weld, H. P., *An experimental study of musical enjoyment*, *Am. J. of Ps.*, 1912, XXIII.

¹⁵⁵ *Ibid.*, p. 298.

intellectual analysis of melody and harmony, as well as of the technique of the performer. Motor imagery is the most important factor for emotional enjoyment; auditory, for intellectual enjoyment.¹⁵⁶ The individual hearers may be classified as analytic, motor, imaginative, and emotional types, with the possibility of shifting, on occasion, from one type to another.¹⁵⁷

Seashore's preliminary report on the measurement of pitch discrimination¹⁵⁸ is the basis of procedure for Vance's experiments¹⁵⁹ in this direction, some of whose results are significant. The results of previous investigation indicate that the greatest sensitiveness to small differences of pitch lies with tenors and sopranos in the lower half of their voice registers, but with singers of bass and alto parts, as a rule, in the upper half. Vance's observers are not practised singers, but the men surpass the women in discrimination of pitch at every level in the register.¹⁶⁰

Among the recent, more purely theoretical metricists, may be mentioned Liddell¹⁶¹ and Thomson.¹⁶² For the former poetry is not a rhythm of sound so much as a "rhythm of ideas," "a flow of attention stresses."¹⁶³ In the application of this theory "waves of impulse" figure instead of feet.¹⁶⁴ There are some advantages in such a point of view, which brings the multiple factors that make up so-called "accent" under the head of a comprehensive mental process rather than under the head of a single

¹⁵⁶ Weld, *op. cit.*, p. 298 ff.

¹⁵⁷ *Ibid.*, p. 300 ff.

¹⁵⁸ Seashore, C. E., *The measurement of pitch discrimination: A preliminary report*, *Psy. Monog.*, XIII, 1910.

¹⁵⁹ Vance, T. F., *Variation in pitch discrimination*, *Psy. Monog.*, 1914, *U. of Ia. St. in Ps.* VI.

¹⁶⁰ *Ibid.*, p. 148.

¹⁶¹ Liddell, M. H., *An introduction to the scientific study of English poetry*, etc., N. Y., 1902.

¹⁶² Thomson, W., *The basis of English rhythm*, Glasgow, 1904-1906.

¹⁶³ Liddell, *op. cit.*, p. 237.

¹⁶⁴ *Ibid.*, p. 304.

factor of accent such as intensity. Apart from this, Liddell has not as yet worked out his theory in such a way as to satisfy thoroughly those who regard the problem of rhythm as essentially allied to that of music.

Thomson, for instance, feels this deficiency.¹⁶⁵ All metricists before him who have used musical notation, except Lanier, impress him either as having used it in a "perverted" way or else as possessing a sense of rhythm that is "very peculiar." Lanier is criticized¹⁶⁶ for declaring that rhythm exists in a series of equal consecutive notes before they have been grouped by the addition of accents. The point he has raised is one of the greatest importance. It has been the stumbling-block of almost every student of rhythm who has neglected to investigate the contributions of specific psychological research upon the subject. It is impossible to separate in consciousness a single sound sensation from such a hypothetical ungrouped series without the double process of a focusing and slight unfocusing of attention, which in itself produces an element of rhythmic alternation. The function of this alternation need not be considered as anything more than what is necessary to produce an impression of "separateness" between the two succeeding pulses or it may be regarded as an element of "contrast," pleasant in itself. In any case, Lanier is right in announcing his impression of rhythm from such an "ungrouped" series, which is ungrouped only in a higher sense, the members of the series being considered as on an approximate level with each other. But it would have been absurdly wrong for him to deny that each member involves in itself, as a sensation, a complex of mental processes in which a certain element of contrast is inevitable. Without this contrast it would be impossible to pass from what we consider one sensation to another.

Thomson is right in demanding some sort of grouping

¹⁶⁵ Thomson, *op. cit.*, p. 34.

¹⁶⁶ *Ibid.*, p. 26.

for the rhythmic impression; but he is wrong in excluding from the possibility of such an impression a series of what the writer, in the present treatise, has called "unitary pulses," *in which the pulses are "units" only in a relative sense*, being in themselves necessarily subdivided by at least two levels in the general wave-line of attention in order to make their "separateness" possible. These unitary pulses correspond to what Squire¹⁶⁷ has found to be the primary form of rhythm for children, so that it is not surprising that Lanier, although he failed to analyze it properly, should also have felt its "primary" significance. It is hard for the present writer, moreover, to see how certain advanced forms of modern music, such as that of Cyril Scott, can be adequately grasped except upon such a basis.

It seems, accordingly, unfortunate that such composers confine themselves or are confined by the demands of their publishers to the conventional arrangements of bars in two, three, four-time, etc. When the music essentially departs from the point of view expressed by the old bar system, it is fatally misleading to the hearer and unfair to the composer to restrict him to a convention that falsifies the facts. The facts seem to be that this type of music is based upon a system of what might be written as unit-beat bars, if bars are written at all, in which the up-and-down feeling of a single pulse, recurring at apparently equal time-intervals, supplies all the necessary level-changing of sensation to complete the rhythmic impression. But the pulses, as they follow each other, can be regrouped with tremendous freedom (regarding their primary grouping as merely serial), and this is, naturally, what appeals to the so-called "modern" temperament. It remains to be seen, of course, how far such freedom can be extended without a reaction of confusion and consequent unpleasantness for the hearer.

¹⁶⁷ Squire, *op. cit.*, p. 540 ff.

As far back as Meumann,¹⁶⁸ theorists such as Lotze have been accused of confusing the conventional schedules of musical notation with music itself — the real succession, not of sounds nor even of sound sensations, but of subjective “impressions,” with their shifting factors and subtle illusions. It seems all the more strange, however, that Meumann himself and virtually every one else that has followed him should ignore, after all these warnings, the full application to the problem of speech rhythm of what music really is — not what it appears to be when trammled by conventional notation; and should fail to see that the possibilities of acceleration, syncopation, and substitutional equivalence, together with subjective illusion, quite easily cover, for the sound-organizing type of mind, every combination of discrete sounds within the ordinary limits of human sensibility and within the time-limits of grouping distance, experimentally established. Accordingly, there is no haphazard series of sounds, within these limits, that cannot be organized by certain minds, when properly attentive, upon a temporal basis. The problem necessarily remains a matter of individual difference. Where auditory and motor imagery is largely absent, where subjective rhythm is weak, where time-estimation is inaccurate, where the sense of “swing” is blurred and inefficient, where elements in connection with beating time, such as syncopation, are a source of confusion rather than of pleasure and interest, it would seem preposterous to expect an organized response. This might even be the case with the rhythm, divorced from melody and harmony, of such a passage as the selection from Chopin in the present series of experiments, which two of the observers, deficient in some of the above respects, after hearing it for the fourth time, pronounced to be haphazard.

It is only fair, however, in order to disclaim too great an

¹⁶⁸ Meumann, *op. cit.*, p. 263.

appearance of novelty in the statements contained in the above paragraph, to complete this brief historical survey with the words of Wundt: "No series of impressions is possible that cannot in some way be comprehended as rhythmic."¹⁶⁹

¹⁶⁹ Wundt, *op. cit.*, III, p. 53.

CHAPTER III

THE SENSE OF SWING

ELASTICITY, — that is, acceleration followed by compensative retarding, a tightening of speed, as it were, followed by an untightening, is the secret of a measuring scale for rhythmic experience. The “boom! boom! boom!” of subjective time-units, such as rattle along in the consciousness of an aggressively rhythmic person, may be accelerated or retarded, within certain limits defined for each such individual, without destroying their value as a subjective foot-rule with which to correlate all experience. In other words, our temporal inches, to use a spatial metaphor, are merely what we *feel* to be inches. In the same way, larger groups of time-intervals, marked off by points of subjective tension, varying in stress, may form rhythmic cycles in which elasticity (acceleration and retarding), with its accompanying sensations of tightening and untightening, is a distinguishing mark. But this acceleration is likely to be no simple phenomenon. The most complex relations of progressive change of speed are often quite evident in familiar situations. It is easy to multiply examples out of the common occurrences of ordinary life.

Every child who has felt the cutting joy of that progression of moments, from breathless tip to breathless tip of height, as he clutches the two sides of his rope swing and feels the uncanny instant of poise before the pendulum of which he is a part starts downward to its sweep past the ground-point; every boy who has watched the small gray ball fly from the pitcher's hand to “first,” while a runner,

who continues to over-dare his distance, checks with a swinging turn his forward motion, and for interminable seconds pauses before he can wind up his forces sufficiently to send himself sliding back to base; every man who has staked his fortune on some golden policy, whose repeated success has swept him over the level of stagnation, but irresistibly leads him to the balanced moments, which predestinate a new impetus; for that matter, every gibbon in the African forest, who launches his lithe body fearlessly from tree to tree, and in the last instants of his course, as the momentum of the leap dies out, extends the fingers of his paw just in time to catch the swaying branch that might have been missed, knows the feeling of elastic rhythmic swing, as complicated in its adjustments, as it is familiar. Every Sargent with his brush and every Mischa Elman with his bow dallies with its secrets. They know it as masters; the rest of us are its slaves — it enchants us in art, excites us in our sport and defeats us in the cumulative efficiency of our business competitors.

To psychology, however, especially in the field of objective measurement, not only rhythmic swing but rhythm in general has figured as a riddle. The disconcerting fact is that, up to the present, no sufficiently detailed study of individual difference in rhythmic experience and performance has been made. What reactions have been studied are chiefly in connection with particular phases of the problem. Bolton, for instance, did not attempt to rank his observers either with regard to sense of swing or ability to perform tasks in syncopation. Seashore,¹ Scripture, Andrews, and others have outlined broader programs, and many investigators have carried out special tests; but no one has felt impelled to undertake a comprehensive series. Around the general subject of rhythm, however, there has

¹ Seashore, C. E., *The measurement of musical talent*, *Mus. Quart.*, I, 1915, p. 129 ff.

developed a voluminous literature, well indicated in the bibliographies of Ruckmich, and very briefly and incompletely reviewed in Chapter II of the present volume.

Of course, as Meumann made clear,² there is no one "sense of rhythm," but rather a highly puzzling complex of mental processes, about which few psychologists are agreed. Since the matter is so complicated, the series of brief, rough tests which the present writer has instituted must be taken *merely as a beginning* in the study of individual difference in this direction. In spite of the fact that each of the twelve observers was examined at fairly long sittings on four or five days, the results of the tests can hardly count for anything but partial indications of what each observer was able to do at a certain time under certain conditions, made as uniform as the general situation permitted. Native ability, as apart from the results of practice, was only dimly ascertained, nor was it easy in so short a time to secure data with regard to possible improvement.

The questionnaires were intended to help the observers understand what was expected of them and to assist in their "sizing up," rather than to produce material for conclusive argument. The tests for types of mental imagery, pitch memory, intensity memory, etc., were meant to serve no final or accurate purpose. Their value consisted chiefly in making it reasonably plain that certain observers were at least not high, and others not low, in rank. It was thus ascertained that Observer No. 4 was at least not low in his ability to remember the pitch of a particular tone. Observer No. 10 was proved to be at least not high in memory for vowel sounds, and most definitely deficient in accurate auditory imagery. Inasmuch as all of these processes are involved in the perception and enjoyment of rhythm, some account had to be taken

² Meumann, *op. cit.*, p. 268.

of them. Complete and accurate tests, however, were out of the question. It was the same with the measurements made of the normal walking-step, rate of comfortable tapping, etc.

In two respects an effort was made to obtain objective measurements of more accurate significance; in ability to perform, on the one hand, certain syncopating tasks with average precision and steadiness (measured by Gross Constant Error in equaling a standard interval together with the Average Variable Error in attaining this average approximation), and, on the other, certain tasks in reproducing a series of six time-intervals, accelerating and retarding according to a fairly simple progression. In order, however, to make these useful as forms of tests to be given in ranking a large number of observers, it was impossible to make them anything but brief. The syncopation tasks have already been referred to in the introduction and are described in detail, together with the data obtained, in Appendices II and III. The acceleration experiment needs more explanation.

In view of the extensive literature on rhythm, it is surprising that no experimental psychologist, according to the knowledge of the writer, has brought to an objective issue the "sense of swing." It is not easy to find even among writers on musical æsthetics a penetrating analysis of the relations involved. On the other hand, it is universally conceded that there is nothing in the individual performance of a musical composition or the combined effect of an orchestral production that is so vital to its success as the power to achieve what we consider to be "the psychological moment" for a point of climax. This is at the root of all of our discussions about *tempo rubato* (stolen time). One of the most recent musicians to express himself upon the latter subject is Saint-Saëns, who, in his address at the Pan-American Exposition in 1915, decried

the modern misunderstanding and abuse of *tempo rubato*, and insisted that even in Chopin freedom in time relations can be granted only to the melody. Nevertheless, upon just what principles this freedom in the melody is to be exercised he remains impenetrably vague. It is in such situations that the mysterious "sense of swing" is supposed to officiate.

But surely the sense of swing means nothing unless it be a sense of progressive movement. When a melody is played in strict, unvarying metronome time, swing is at its lowest, and the "psychological moment" for an accent is merely a matter of remembering that two and two make four. What is usually meant by swing is really "elastic" swing, where the simple mathematical relations are complicated for purposes of expression. Compensation figures conspicuously. Time stolen in one place, is repaid in another. What Riemann calls "agogic accent" (the deliberate addition of length to a note, instead of stress, in order to give it prominence) and, of course, *tempo rubato* (stolen time), belong to this category; so, though it does not seem to be generally remembered, all effects due to accelerating and retarding the standard tempo.

No satisfactory grasp, however, can be obtained of the situation until we realize what Wundt maintains,³ that time-intervals may be considered in terms of velocity. Wundt himself has failed to clarify the final problem of swing, but his insistence on the importance of the idea of velocity (how fast something is going) is the best beginning we could have. Probably those persons who are deficient in motor types of mental imagery will never find a satisfying solution; but to an individual who can easily think of his finger as moving back and forth at various rates of speed, the problem resolves itself quite simply.

The procedure is as follows: Imagine a series of vertical

³ Wundt, *op. cit.*, III, *passim*.

bars, arranged like the palings on a fence, or the pipes of a steam radiator. Better still, if a radiator is at hand, make actual use of it. First take a stick and draw it across the pipes at right angles to their direction, so that a series of sounds results. If the velocity of the stick is perfectly even, a series of regular time-intervals will be produced by the sounds. Acceleration and retarding (increase and decrease of velocity) are the immediate result of varying the speed of the stick. Now move the stick across the pipes, rather deliberately, with some melody in mind, a sound made by the stick's hitting against a pipe corresponding to each note of the melody. If care is taken not to strike the pipes too hard, but to keep the stick, as far as possible, in continuous motion, it will become at once evident that the varying sizes of the time-intervals which produce the rhythmic tune of the melody are the direct result of varying rates of speed in the stick.

Now review the illustration for a moment: The vertical bars are at *equal* distances from each other. When the velocity of the stick is even, a series of equal time-intervals are marked off. By varying the velocity of the stick, not only effects of acceleration and retarding are produced, but rhythmic tunes as well. So long as the increase or decrease in speed is more or less gradual, we retain the impression of a regular series becoming faster or slower; as soon as the changes in speed are not only much more marked, but assume the relations of simple proportion to each other (3:1, 1:3, 2:3, 1:6, etc.), the impression of a rhythmic tune becomes possible.

Any variation in the length of the time-intervals, introduced for the purpose of musical expression (this includes "agogic accent," *tempo rubato*, *accelerando*, *ritardando*, etc.), will thus be due to varying rates of speed in the stick, in addition to a similar origin for the rhythmic tune itself. Varying rates of speed, in a broad and general sense, need

now to be distinguished from the specific form in which they can appear as "progressive motion," which means nothing more than varying rates of speed in which the variation is roughly spoken of as "gradual," and more accurately as occurring according to some law of progressive increase or decrease. An interval, for instance, of at first one second, is shortened by one tenth of a second, successively, until it becomes three tenths of a second, after which it is lengthened by similar steps until it reaches its former size. This would be a case of rapidly progressing acceleration and retarding. The rate of decrease in the interval, or the rate of increasing velocity in the moving stick, could be expressed by a mathematical equation. Another equation could express the retarding movement. The number of ways in which an interval could become progressively shorter is, of course, infinite. The point to keep clear is that every "gradual" (i.e., not jerky) progression, such as is plainly implied in what we mean by swing, must be subject to some law, instinctively felt, no matter how difficult to phrase. The "sense of swing," then, would mean the ability to move according to progressive laws, however occult, and to feel instinctively in the performances of others the lawful course of their progression, in case they conform themselves to what we mean by "proper swing." The "psychological moment" for an accent, thus, is merely the moment which the progression, as suggested by what has already occurred, seems to demand. A musician ranks, accordingly, as high in this respect if he can suggest to us such impelling progressions that we are able in a measure to anticipate the moment for the climax, and rejoice with him in his achieving the final note, without undue delay or hurry.

The chief reason for recommending the point of view of objective velocity, as illustrated by the equi-distant pipes of the steam radiator across which the stick is drawn, is

that all our familiar forms of music are likely to involve a moving object, whether it be the bow drawn across a violin or the fingers making the stops, the lips of the singer or the unseen vocal cords or the breathing movements of the body.

When an observer taps upon a key or a pianist trills, the fingers move through approximately equal distances of space; but, according to their average velocity, the taps or the trills mark off time-intervals of greater or smaller size. So when rhythmic response takes the form of dancing, the feet take steps of approximately equal size, but at different rates of speed, according to the music.

This point of view leads us to a method of testing individual difference in the sense of swing. Suppose that an observer hears a series of six time-intervals produced by relatively even, unobtrusive clicks from an electric sounder, and is asked to reproduce the series as accurately as possible by means of tapping with one finger upon an electric key attached to a kymograph, which records his reproduction. At each tap his finger moves through an approximately equal space. Whether it moves evenly or by jerks, its average velocity in covering this space is what determines whether two taps come close together or far apart. If the seven taps he makes, in order to produce six intervals, each cover this space with a certain *average* velocity, regularly repeated, the six time-intervals will be exactly equal. But, in order to make the experiment a test for swing, the standard six intervals which he is to reproduce are given objectively, according to the following progression in size: .7, .6, .5, .5, .6, .7 sec. In other words, they form an accelerating and retarding series, in which the laws of decrease and increase can be phrased. The proportion, however, between .7 and .6 is not of a sufficiently simple nature for any one to recognize it by ear in such a way that it could be announced in terms of numbers. It would

have to be caught and reproduced very largely by instinctive processes.

Each observer is thus rated according to the degree of precision with which he can reproduce this bit of acceleration and retarding. Unfortunately for the finality of the results, individuals differ in their ability to perform tapping tasks with ease, so that it is possible for an observer to make a bad record largely on account of his confusion or awkwardness when confronted with the problem of adjusting his fingers for a tapped reproduction of a sound impression. For this reason the tapped records were not taken as sufficient in themselves to determine an observer's rank. Sound-photography furnishes in some respects a tremendous improvement in the matter of obtaining more genuine information. In connection with investigating the sense of swing in speech, it seems undoubtedly to be superior to anything else.

Inasmuch as any consideration of the swing of a series leads to problems which concern the memory processes, most of the tests in this connection were planned to be memory tests (not tests in immediate discrimination). Considerable intervals elapsed, according to schedule, before the observer began his reproduction, even in the tapping records. With the records by sound-photography the following plan was carried out: After the observer has finished his tapping reproductions, and has thus heard the accelerating series twenty-four times, as given by the electric sounder,⁴ he is told to listen to it three more times, and accompany it each time, as accurately as he can, by uttering the word "top" for every click of the sounder. Then he is to tap a reproduction of the series, uttering again the word "top" each time that he taps the key. On the second day, when he hears his two "best" tapping records reproduced on the Meumann time-sense machine,

⁴ Appendix II, section vii.

with a chance to compare them with the original series in both orders (before the standard series and after it), he understands that he is hearing this standard series for the last time. One week afterward, without any tapping or voice practice between, he is to reproduce the series, as well as he can remember it, by uttering seven "top's" as he stands before the photographing machine. The measurement of his intervals is an easy matter, inasmuch as the distortions that occur through the use of diaphragms affect nothing but the relations of stress. By taking the photographs with noiseless apparatus in a virtually sound-proof room, the initial impulse from the word "top" is plainly recorded.

In Appendices II and III are explained the various measurements which are combined in a final grading value, intended merely as a convenient way of ranking observers with regard to their ability to catch and to remember and to reproduce, under the conditions of the experiment, the "swing" of the six intervals. What amount of effective swing each of them could produce as musicians, speakers, etc., if left to their own devices, is another matter. A beginning in the direction of this sort of investigation has been made with an examination of their various tapping versions of the following arrangement of words: "Prose
 * * * * * *
 is prose — prose is prose — prose is prose — while poetry
 * * * * * *
 is opposed to prose, prose-poetry is opposed to any poetry
 * *
 that may be composed in any other way than that of
 *
 prose." ⁵

It makes very little difference what the processes are by means of which an observer catches the progressive movement in question. With some the memory is achieved no doubt very largely by means of memories of judgments,

⁵ The results are listed in Appendix III, section xxv.

rather than by carrying in the mind an auditory or motor reproduction of the original series. The chief point to be determined is simply this: Did the observer catch the *rate* of progression? Would he have been able to predict "the psychological moment" at which the next click was due? If he cannot even approximate the rate, and actually falsifies the general trend of progression — that is, remembers the acceleration as retardation — we may be fairly certain that he is deficient in a sense of swing. If we find him consistently, in various forms of the test (tapping his reproduction, speaking it, drawing it by dividing a line into segments, announcing verbally his judgment, etc.), preserving the relations between the six intervals with a high degree of accuracy, and making no falsifications of general trend, we have very good reason to believe that his sense of swing is, roughly speaking, good. Since, however, we are really dealing with no one "sense," but a complex of processes, we must be careful not to put too definite or high a value upon our results, but weigh them in conjunction with all the other evidence we may be able to obtain. This means that the combination of conditions in this experiment may have been favorable to one individual at the expense of another, etc.

What it seems we can attain is a clearer attitude toward the essential elements in swing — the perception, enjoyment, and institution of progressive movement in the sphere of what we do as well as of what we hear and see. There are some who instinctively catch the modulus of change. They can sniff at an incipient climax and foretaste the end. Consequently, if the singer or violinist to whom they are listening misses his accent, their souls are wrenched. There are some, too, who can follow certain trails but not others. Perhaps it is not so much because of a lack of subtlety of sense as of a lack of interest in the species of game that is being tracked. Observer No. 11

Seconds

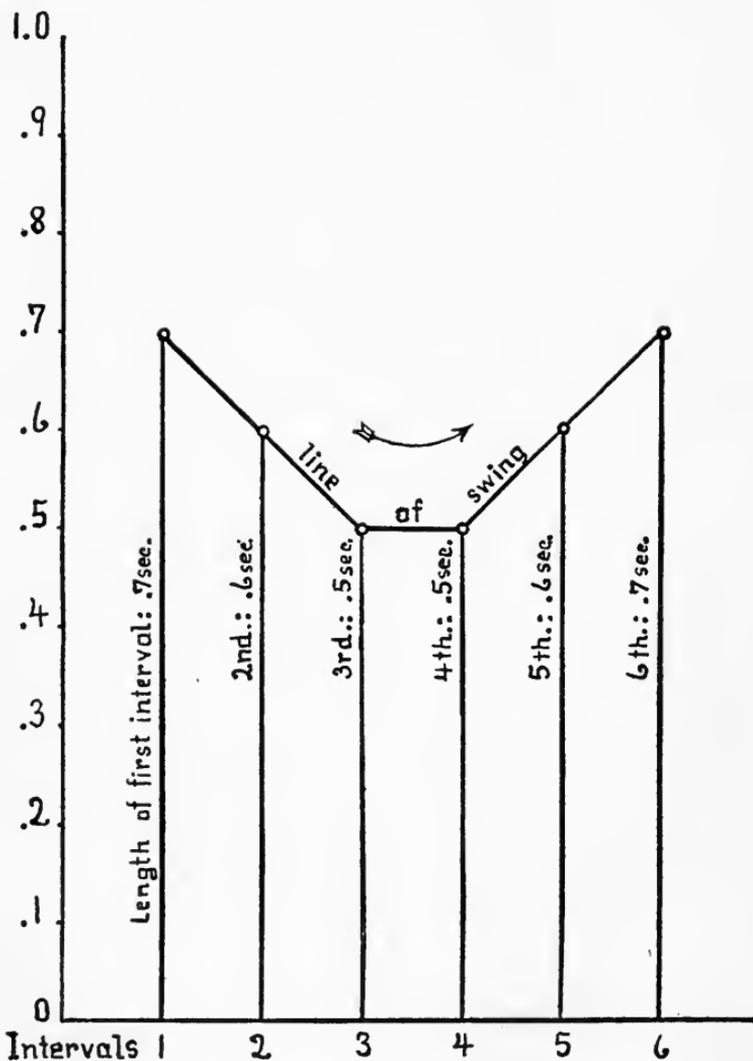


FIGURE I. — Test for the sense of "swing": Series of six accelerating and retarding intervals, produced by the time-sense machine as a standard for each O (observer) to duplicate by tapping on an electric key. The length of each interval is indicated in the graph by a vertical line.

evinces subtlety of perception in the swing of series marked by electric clicks. His personal interests are connected with research work in the psychological laboratory, where he is familiar with sounds from recording instruments. According to his own statements, the swing of verse or prose means very little to him; his interest in music is not marked. Quite different is the case of Observer No. 3, who speaks of thrilling from head to foot in response to music, and yet who fails consistently in every test for accurate perception of rhythmic swing. His sense of melody, apparently, is keen, and he ranks high in the test for memory of pitch. Since he enjoys rhythm, in general, it would be wrong to say that he lacks interest in elastic swing. It is simply that his perceptions of correlated time-intervals are inexact.

Figure 1 represents the swing of the standard series of intervals (.7, .6, .5, .5, .6, .7 sec.), hurrying steadily to a moment of poise and then slowing up to the original pace. Figure 2 shows the attempts of three observers to catch this line of swing and reproduce it by taps on the electric key.⁶ Observer No. 1 made a very good reproduction with regard to general trend, precision, and steadiness. The line in the illustration, which is the result of graphing a recorded performance, shows an elastic sweep fairly close to that of the movement of sounds that was being imitated. Observer No. 10 caught the first part of the movement, but failed to reproduce the moment of poise in the middle, and clearly falsified the swing of the last three intervals. Observer No. 2 very plainly falsified every relation involved in the progression. Instead of a sweeping dip, his line suggests the teeth of a saw.

⁶ The attainments of the various observers in reproducing the swing or progressive movement of the six standard accelerating and retarding intervals are recorded in the tabulations for general trend, average precision (Gross Constant Error), and steadiness (Average Variable Error), listed in Appendix III, section vii.

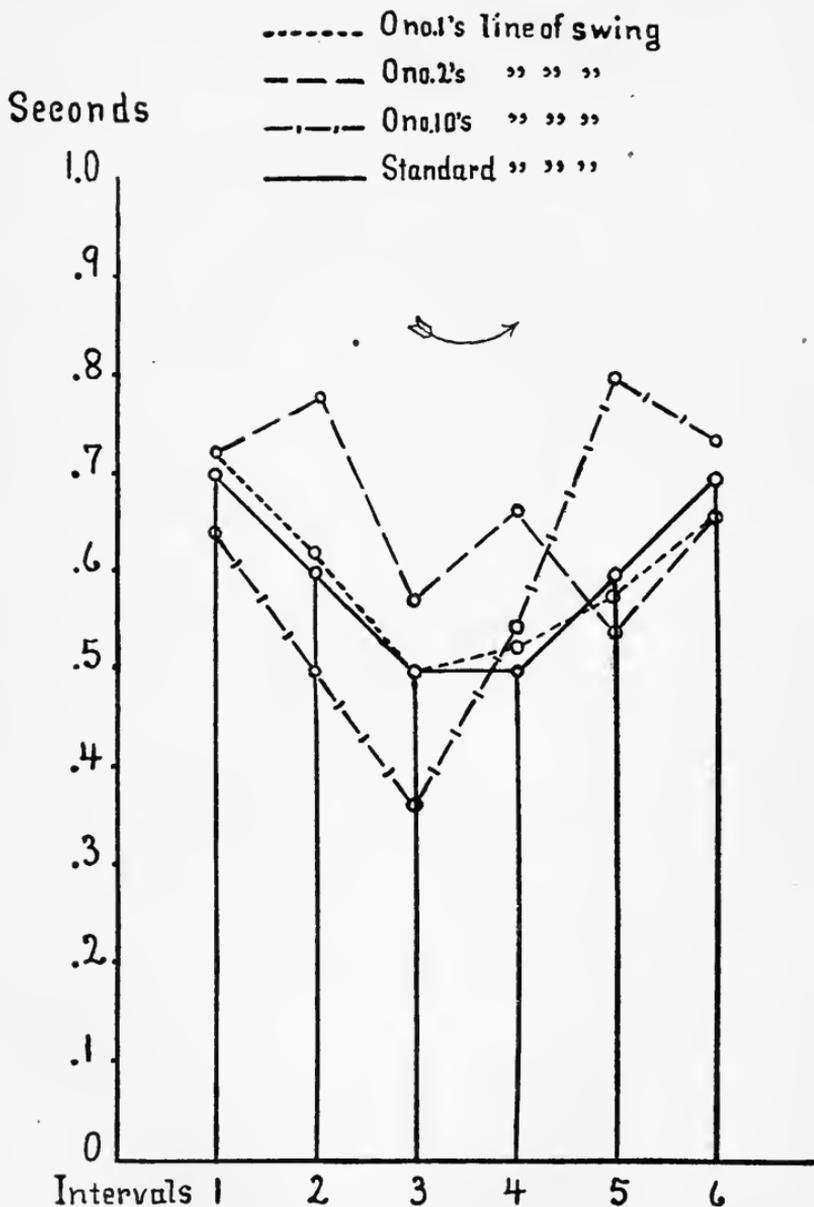


FIGURE II.—Test for the sense of “swing”: Graph of the reproductions of three individuals, attempting to catch the “swing” of the standard series of intervals given by the time-sense machine.

Imitative facility, however, is after all merely a partial aspect of the sense of swing. In addition to the ability to reproduce elastic changes of tempo, there is needed a correlation of mental processes capable of preserving in the midst of such progressive movement the impression of a unit of measure; that is, of enjoying the ebb and flow of speed in a series of unitary pulses, without losing altogether their fundamental yard-stick value. The subjective yard-stick is necessarily of rubber, but like rubber it has its normal limits of stretch and compression, which can be roughly estimated. If, then, the problem of finding rhythm in prose, as it resolves itself for those aggressively endowed, depends on the conjuring up of rhythmic tunes for apparently irregular sequences, and if the processes by means of which such tunes emerge, involve what we term elasticity in the time-units employed, it should be clear that a fair amount of the sense of swing—the ability to gauge, to reproduce, and to unify elastic sequences, including not only simple compensative effects of acceleration and retarding, but also “agogic accent” and *tempo rubato*—is one of the set of essential elements in aggressive endowment whose full quota is necessary for the ready summoning of these “tunes” that answer the ancient riddle.

CHAPTER IV

RHYTHMIC TUNES

"It is the landscape, not of dreams or of fancy, but of places far withdrawn, and hours selected from a thousand with a miracle of finesse."

THIS sentence from Walter Pater¹ was chosen as the source of the first of the five series of drum-beats, performed by Observer No. 1, and recorded on the phonograph.² A tap was made for each syllable, "hours" being given two taps. When heard by the other observers, who were ignorant of its source, this succession of taps was graded as the "most elusive" of the five sets by some observers, and by others, as second in elusiveness. Since two of the five series thus compared were haphazard arrangements, there is no reason to question the irregularity of the beats of this particular set in spite of any regulating effect that might be due to tapping or other adventitious causes.

In order to test the validity of Wundt's statement about the possibility of conceiving any succession of impressions as rhythmic, the observers were given a chance to hear the passage eight times altogether.³ On the first hearing it was graded, together with the other members of the set of five, for relative "elusiveness." On the second hearing the observers were instructed to attempt to beat strict time to each of the set, and record their success; on the

¹ *Leonardo da Vinci*, from *The Renaissance*, MacMillan ed., Lond., 1914, p. 111.

² See Appendix II, section xxvii.

³ See Appendix II, sections xxvii, xxix, xxxiv.

third, to keep the possibilities of syncopation in mind and to beat a more elastic unit, accelerating and retarding, again recording their success; on the fourth, to pronounce judgment as to which of the set represented prose, which music, and which purely haphazard arrangements, together with a second grading of each passage for "elusiveness." As a result of this, Observer No. 12, who on the first hearing had graded the Pater series as the most elusive, now judges it to be regularly musical. Observer No. 7, who had graded it as next to the most elusive, also pronounces it now to be regularly musical.

Schedule I:



Schedule II:



FIGURE 1. Rhythmic Schedules used in connection with the sentence from Walter Pater

After the fourth hearing the Pater series was heard independently of the others. Accordingly, on the fifth hearing of it the observers reported upon their affective re-

action to it at this stage of repetition. On the sixth and seventh, schedules were introduced (see Figure 1). These were simply records of two ways of subjectively organizing the beats as evolved by the experimenter after repeated hearings.

In the majority of cases, the observers received most assistance from the schedules, when the experimenter, before the actual hearing of the beats from the phonograph, not only tapped off the schedule on the phosphor-bronze drum, but hummed a simple tune (purely fictitious), suggested by the rhythm as indicated in the notation. In this way, observers who had failed to organize the series by themselves, found various degrees of satisfaction in applying to the beats the schemes of organization indicated in the two schedules. It must be remembered, however, that Observer No. 7 pronounced all the five series, including the two purely haphazard arrangements, to be thoroughly musical in their impression *before he had seen the schedules*. Furthermore, it must not be forgotten that these schedules are merely two of the many ways in which the experimenter might subjectively organize the passage in question. They happen to fall readily into elastic three-time, or a combination of three and two-time. Among such possible forms of organization, those that in his case have occurred most frequently are based, not upon a unit grouped in two's or three's, but upon unitary pulses, syncopating freely with the impressions of accent in the actual prose.

Unless the explanations already made in previous chapters about syncopations and spontaneous substitution are thoroughly understood, any statement about unitary pulses and their function will be misleading. Taking for granted, however, that this understanding has been attained, the following is an attempt to make clear the usual form of rhythmic experience felt by the writer: To begin with, there is always implicated in the complex of his

mental processes, either plainly evident or susceptible of easy evocation, a subjective time-unit, sometimes affected by heart-rate, but, as a rule, corresponding apparently to his average walking-step (a little over .7 sec.), and, like any walking-step, capable of accelerating and retarding. These unitary (ungrouped) time-intervals are marked off by a series of what appear to be muscular tensions in the region of the head, sometimes localized in the neighborhood of the ears (*musculus tensor tympani*), sometimes in the throat, or elsewhere. These tensions sometimes, *but not always*, coincide with concomitant heart-beats. In spite of the elastic nature of the intervals thus formed, they occasionally remain more or less regular, and thus serve as a standard for gauging the varying rate of the pulse, when the latter is felt. After the pulse has been felt conspicuously, however, the unitary intervals seem to be affected by its rate and tend to coincide. Apparently the memory of the normal walking-rate persists in its influence more than the memory of the normal heart-rate, which is about .9 sec. in the present case. Perhaps, as each step is taken, the concomitant tension of some obscure muscle of the head occurs, which thus furnishes the means of repeating the walking-rate, without carrying the innervation as far as the legs. Breath-rate does not seem to affect these inner pulses so much as the pulses, or their multiples, affect breath-rate; that is, the breathing muscles sometimes have a tendency to reserve their action at the moment of initiating inhalation or exhalation, in order to fall in with the phase of a unitary pulse. Usually, however, the relation of the two is one of free syncopation rather than coincidence. When attention rests upon this automatic syncopation by means of which breathing and the time-pulses are so easily coördinated, a feeling of distinct pleasure results, quite parallel to what occurs in the hearing of prose. The measurement of spontaneous tapping at a comfortable rate

showed that the writer's tapping approximated twice his walking-rate. In Appendix III, section x, several observers show similar correlations between various rates of comfortable movement. For Observer No. 1, for example, tap and sway rates, as measured, were identical, and approximately twice the walking-rate.

In the present instance, this series of elastic unitary pulses usually announces its presence at once on the appearance of objective auditory stimuli, sufficient in number to suggest serial grouping. What follows is a slight adjustment of the rate of the pulses (when the stimuli are produced by another), and a mutual adjustment of the pulses and the articulatory movement (when the stimuli are produced by the writer himself, as in reading aloud the sentence from Walter Pater). This adjustment occurs by means of instinctive processes, and, unless a repeated pattern of time and stress obtrudes itself, results, not in a predominance of coincidence, but rather in various forms of syncopating and substitutional relation such as appear in the course of regular music — for instance, the sonatas of Beethoven, or the "Scenes from Childhood" by Schumann.

What thus develops within the compass of the first few syllables continues throughout the sentence. Suggestions, however, stream rapidly into consciousness from the first grasp of the meaning and tone-color of the opening words (together with the perception that the sentence is arranged as prose), which suggestions influence appreciably the rate of the unitary pulses, and, in the case of the experimenter's own reading, the rate of the uttered syllables, as well as the form of syncopating adjustment. The instinctive desire for a maximum of ease, spontaneity (freedom from an artificial pattern), and appropriateness, joins these suggestions derived from thought, mood, and tone-color. Had the first impressions (whether derived from lines and stanzas visible to the reader, or from evidence of metrical

pattern in the rendering of another) suggested that the arrangement was intended as verse, memory and habit would at once enter as factors in assisting consciousness to pounce upon the pattern as quickly as possible, and adjust the pulses (which would now be likely to group themselves into two's or three's) to more or less coincidence with the accents of the metre. The reason, however, for such adjustment would be nothing more abstruse than that it is the easiest thing to do. In the case of a rendering of verse by another person, the pulses would probably be suppressed, as soon as an adjustment between their rate and the rate of the speaker proved uncomfortable. But in case of prose where patterns do not obtrude, the elastic possibilities of acceleration, together with those of syncopation and substitution, open loop-holes of escape in every direction. Only where the prose rendering is obviously too schematic, rather than perfectly spontaneous, does the problem of adjusting the heard syllables instinctively to the under-units become anything but a refreshing task.

After this explanation, the following purely chance type of rhythmic experience on the part of the writer, in reading aloud the sentence of Pater, may assist in making plain the procedure of a "timer" in organizing prose. A glance at the text gives the assurance that the words are at least arranged in a normal, straightforward fashion. There are no inversions, and no obvious stress-pattern presents itself. "It is the landscape, not of dreams or of fancy," is about as much as the mind at first comprehends with regard to thought, mood, and tone-color. A degree of pensiveness and the consequent appropriateness of a moderate tempo suggest themselves at once. The unitary pulses of subjective time begin to obtrude before the actual uttering of any of the words of the sentence. Their rate is about .7 sec., or less, we shall say, being quickened probably by the consciousness of an approaching problem,

through suggestions derived from accelerating heart-beats and breathing, part of the phenomena accompanying mental work. The voice begins, just after one of the pulses (i.e., syncopating), and utters the words "It is the" during the unit-interval. At the syllable "land," the voice and the subjective time-beat coincide. The next pulse registers its subjective tap, *not on the accented part of the word "dreams," but on the humming "m" sound at the end.* In this way "dre" is registered, in the combined impression, as preceding the pulse by a definitely appreciated time-interval. The fact, however, that the unit pulse falls on the "m" sound, in no way distorts the usual accentuation of the word. This phenomenon is at once understood by every musician. It is a simple case of syncopation. The fact, in this particular case, that the beat did not coincide with "dre" is due, apparently, to some suggestion in the context or perhaps merely to some spontaneous articulatory tendency, which hurried the enunciation of the word. The satisfying effect of such syncopation, when once recognized, is nothing more occult than what occurs in every bit of genuine rag-time. When talked about too much it easily assumes the guise of impenetrable mystery.

In the same way, the next pulse does not coincide with the orally accented part of "fancy" but falls upon the last syllable — another case of syncopation due to an unconstrained rendering. In the case of a person's not making these temporal correlations easily and spontaneously, a forced attempt to "beat time" would undoubtedly lead, unless otherwise directed, to a deliberate hurrying or slowing up of words in order to form coincidences with the accompanying units. This is a complete negation of the spirit of prose, and even in verse produces mechanical renderings, when the unit-series itself is maintained without a certain free play of elasticity (*accelerando* and *ritardando*), and

without a definite, though subordinated, amount of syncopation.

The combined rhythmical experience of the syllabic impressions and the under-units of time, in the present instance, is as follows:

"It is the landscape, not of dreams or of fancy, but of
 * * * *
 places far withdrawn, and hours selected from a thousand
 * * * *
 with a miracle of finesse."

We shall call this, "rhythmic experience x." The relative occurrence of unitary pulses is indicated by asterisks placed just underneath the sounds or pauses which they accompany. Reproduce by tapping off the pulses at *approximately equal intervals*, taking care that the *predominantly syncopating* relation between the pulses and the chief accents of the text is preserved.

⌈ The impression which results from the combination in consciousness of the auditory (syllabic) sensations (including their effect upon attention) and the subjective time-units, may be compared to a melody and its accompaniment, with attention focussed, not upon the pitch relations so much as upon the relations of time and stress. This is what occurs when the rhythm of a melody is tapped upon a drum. "Drum-beat tunes" and "rhythmic tunes" are merely phrases, no doubt quite old, for such a performance. "Tune" in both cases not only suggests an auditory sequence, temporally and accentually organized, but brings to mind two interesting facts — first, that even in a succession of noises, impressions of definite pitch are likely to occur; second, that even in a succession of notes of unvarying pitch, fictitious melodies, of definite tonal structure, are easily added subjectively by some observers.

The drum-beat tune, in its function of assistance in organizing irregular sequences, must be kept exactly where it belongs — as a step of great importance, but, after all,

nothing more than a step. The final impression of rhythm derived from a sentence is, to a large extent, a fusion of elements, in which actual pitch, tone-color, thought, mood, capricious or logical attention, etc., enter as factors in addition to duration, stress, and the dim element of pitch, actual or purely subjective, implicated in the drum-beat tune. Of course, one of the chief virtues of objectively tapping a drum-beat tune, or of reproducing in some outward motor form the series of subjective units, is that the overt motor performance is a help to confirming and defining the rhythmic experience.

Reverting to the sentence from Pater, and the particular rhythmic experience which is being discussed (rhythmic experience x), we should state that the series of under-units, spontaneously evoked at the first signal for the mental and motor task of reading the sentence aloud, loses its obtrusiveness very quickly, so that the result, segregated as a rhythmic experience (apart from the mere understanding and enjoyment of the meaning of the sentence) can be described only by some such phrase as the "rhythmic tune" of the rendering. This implies more or less of a fusion of the two elements furnished by the motor and auditory sensations connected with the words, on the one hand, and the pulses of subjective time on the other. It is just what happens when we whistle a melody, keeping satisfactory time (largely by means of automatic processes) without realizing the system of units we happen to be using.

The particular "tune" attained by rhythmic experience x could be roughly written in musical notation with two staves: one for the "melody," or series of beats (subjective impressions of syllables), accented in various ways, produced by the actual words; the other for the accompaniment, or series of unitary pulses. The only chance for misunderstanding would be over the matter of spontaneous substitution, which enters into every step of the progres-

sion. If this is once understood, syncopation (which may be regarded as an aspect of substitution) presents no great difficulties. Spontaneous substitution, as explained before, means here simply: first, that when two sets of time-intervals are occurring concomitantly, one a unit-series and the other a more complicated arrangement (to be coördinated with these units and then organized), the unit-intervals, in their successive occurrence, establish the fundamental continuous experience of rhythm; second, that this experience is not disturbed, but rather made more interesting by the fact that any one of the units can be accompanied by two, three, four, etc. subdivisions of a unit-interval, produced by the beats of the more complicated series.

If the series of elastic unitary pulses is thus conceived as an ungrouped succession of "boom's," the objective, more complicated series may be conceived at first as a haphazard arrangement of "bim's." Coördination is accomplished by means of the principle of spontaneous substitution, in which case the unit series continues as "boom! boom! boom!", while the objective series is felt to consist of substitutions (without premeditated pattern) of two "bim's," three "bim's," etc., to a single "boom." So, also, one "bim" may be prolonged sufficiently to cover the time occupied by several "boom's." When to these possibilities we add the possibility of suppressing any number of "bim's" in a group, let us say of three or five, and instituting in its place some subjective point of tension, marked by kinæsthesia or imagery, we have introduced the principle of syncopation. By substitution a "boom" is first accompanied, let us assume, by three "bim's"; by another form of substitution, which we call syncopation, the first and second "bim's" are suppressed, and subjective points of tension "felt" in their place. A silence thus accompanies the beginning of the "boom," but two thirds

of the way across the interval a short "bim" sounds. To a mind to which syncopation is an easy task, the occurrence of a "bim" four fifths of the way across a unit-interval at once evokes an illusion of the interval's having been divided from the beginning into five. By this is meant, not that the number five comes actually into consciousness, but that there is instituted (for how long it is impossible to say) a second temporary series, of small pulses, each equal to the short interval just perceived. At every new substitution of three's, four's, etc., or the suggestion of such substitution by the sudden introduction of an interval shorter than the fundamental "boom," the mental processes instinctively readjust themselves to the momentary form of coördination, without losing the unifying influence of the basic "boom's." It is a signal case of unity regulating multiplicity. The current belief that prose rhythm has no rule but variety is thus shown to be unfounded so far as rhythmic experience x is concerned.

Any one who wishes to see the principles above described strikingly applied in terms of the notation of regular music, should examine the first page of "The Temple of Memphis," composed for the piano by Cyril Scott. The passage containing the most noticeable series of unitary pulses in the bass, accompanied by the spontaneous substitution of two's, three's, etc., in the treble, begins with the fifth bar. Broader groupings of the unitary pulses into clusters of three, five, four, three, are indicated lower down on the page by the figures at the beginning of each bar. The recent recitals of East Indian music given in New York by Ratan Devi furnish signal examples of objective unitary pulses, played as an instrumental accompaniment to the syncopating words of the songs. But, for that matter, the "Scenes from Childhood" by Schumann, in which such familiar melodies as "Träumerei" occur, contain excellent examples.

The testimony of the data recorded in Appendix III, section xxxiv, leaves little doubt that rhythmic experience *x*, in so far as it is based upon unitary pulses, syncopation and substitution, is the sort of experience felt by Observer No. 7 (see Appendix III, section xxvii) when he subjectively organized all five of the phonograph records and pronounced them regular music. It would be a mistake of the gravest nature to confuse rhythmic experience *x*, based upon unitary pulses, with the type of musical experience resulting from the hearing of a Strauss waltz. But it would be very difficult to distinguish the sort of rhythmic tune it suggests (when this is quite divorced of voice-pitch, tone-color, thought, mood, etc.) from a similar rhythmic tune obtained from a rendering of such music as Cyril Scott's, or from Ratan Devi's singing, or from so thoroughly beloved a melody as "Träumerei."

Any objections to the use of Cyril Scott's music, as probably unpleasing in its rhythm, are completely nullified by the data recorded in Appendix III, section xxxi, where eight out of the twelve observers, although in some cases puzzled by the first hearing of the rhythmic tune as beaten on the drum, reported interest and pleasure on the second hearing. Their possible experience with regard to the melody and harmony of this music would be quite another point. Its rhythmic suggestions, however, contain enough of primeval tom-tom hypnotism to appeal even to those of us who are still savages. The same is true of the sentence of Walter Pater, regardless of the rather sophisticated rustle underneath which its beats are veiled.

CHAPTER V

VERS LIBRE

SINCE the distinction between prose and verse experience is of vital significance in the present investigation, certain claims must be considered, which have been advanced by the writers of *vers libre*, some of whom imply that what they write is merely an amplified, "freer" kind of verse, others that they are expressing themselves through a distinctive medium, which is neither prose nor verse, in the old acceptance of the term. From the point of view of the "timer," who can be brought to a clear realization of the difference between typical prose and verse experience, and who, consequently, need not feel any undue terrors with regard to the supposed "elusiveness" of the problem, these claims of the writers of *vers libre* are easily examined. There is no reason why a picture of the situation should not be painted in black and white.

Once more we must focus our attention, not upon paper theories, but upon actual experiment. From this point of view, typical prose is uttered language which, on a given occasion, produces a series of syllabic impressions, whose temporal arrangement is largely irregular, that is, haphazard, but which can be subjectively organized by an aggressive "timer." A spontaneous or automatic process of syncopation between the syllabic sounds and subjective unitary pulses secures satisfactory coördination, in the same way that a negro automatically improvises complicated syncopating melodies while he plies his hoe in the corn-field.¹

¹ The definition of prose as distinguished from verse experience, for a timer, depends upon a *predominance* of syncopation over coincidence in the coördination of the accented syllables of the text with the measuring pulses. See the following paragraph.

Felicity of phrase and vividness of imagery, which give emotional value to a poem through a complex of suggestions and associations, must be removed from the discussion except in so far as they involve time-patterns and stress-patterns, the two factors which most immediately concern us. Taking well-defined prose experience to be due to a predominance of syncopation in the relation between a "timer's" elastic measuring pulses and the syllables in which we feel impressions of accent, and regarding verse experience as due to a predominance of coincidence in this relation, we first of all conceive the rhythm of either prose or verse in the form of a rhythmic tune, combining patterns of time, stress, and, to some extent, pitch. Patterns of tone-color are superimposed, as soon as we consider the actual sounds of the words, and patterns of subjective weight, as soon as we consider the words as vehicles of thought and feeling, in addition to their auditory impression.

Patterns, not of stress as actually uttered, but as indicated by grammatical (dictionary) accent, have a great influence upon the person who utters a printed passage, in suggesting to him whether to speak the words as prose or verse. Here is where the absence of a series of similar grammatical stress-patterns is of importance in instituting the typical prose attitude. When once this prose attitude is instituted, it is quite evident in the delivery of a "timer" that he is uttering his accented syllables in a comfortably irregular fashion — comfortably, because his ability to organize subjectively such irregularities completes for him, by means of syncopation, the easiest rhythmic experience that can be evoked by such conditions. If, however, the grammatical stresses, as noticed in the particular text, arrange themselves obviously in a repeated pattern, he receives his cue therefrom, and utters the passage in question in harmony with his instinctive feeling that the predominating coincidence between accents and time-pulses

is the easiest process whenever a sequence of some one stress-pattern is involved. Thus, both in the case of prose and verse, *he follows automatically the line of least resistance*. So much for the person who reads aloud from a printed text. The hearer, on the other hand, receives his suggestions no longer from mere dictionary accent, which is easily obliterated in rapid delivery, but from the particular rendering of the one who utters the words. If he detects in this rendering a sequence of some actual stress-pattern matched by evident ease in adapting his inner pulses to the accents in a form of coördination in which coincidence predominates, he, too, follows the line of least resistance, and considers the words he hears to be verse. Naturally he does not bother his mind as to how he enjoys it, provided he actually does enjoy it. If either the hearer or the one who is reading aloud is enjoying a passage in the typical temporal attitude associated with prose and suddenly begins to feel pulling at his elbow hints of repeated patterns, whose regular sequence makes coincidence the easiest form of coördination, he may find himself out of the formal sphere of prose and, momentarily, at least, in that of verse. Whether he enjoys this shift or not is a matter of individual difference. There are some who resent it bitterly, just as there are others who may aver that they enjoy such changing back and forth.

One continuous text, then, may lead to the two types of experience, and passages may easily occur in which the suggestions of pattern may be balanced by suggestions of the absence of pattern. One person, too, might interpret the passage as verse-like, another as quite the opposite. Right here is where the chance for a tremendous fallacy occurs. The confused state of mind with regard to the general trend of the movement, that is, as to whether it is prose or verse, must not lead us into concluding that a distinct æsthetic experience has been produced essentially

different from that of prose or of regular verse. There are only two ways in which a series of measuring time-units can be coördinated with a second series of sensations — syncopation and coincidence. Either syncopation predominates, in which instance we feel the stimulus as prose, or coincidence predominates, and verse experience ensues. What room is there for a *tertium quid*? Nothing remains but the purely hypothetical case where syncopation and coincidence are exactly balanced in their occurrence, or else a mere confusion of mind in which temporal coördination practically ceases, that is, in which rhythm, so far as the “timer” is concerned, has been abrogated. Wallin’s experiments at Yale have shown how easily passages of verse, such as that of Tennyson or Browning, might be read as prose if so arranged. But there exists no actual arrangement of lines or of stress-groups in the words themselves which is capable of leading us invariably into a perfect balance between syncopation and coincidence. Accordingly, *there exists no fundamental time-rhythm experience corresponding to a tertium quid between prose and regular verse.* What actually happens in the hearing or utterance either of *vers libre* or of certain forms of so-called “rhythmic prose” is that during one phrase or group of phrases the aggressive “timer” feels syncopating temporal experiences, during the next phrase or group he begins to feel coincidence of the accents with his subjective measuring pulses. The more vague impressions of the “stresser” are significant in the study of individual difference, but hardly illuminating with regard to the distinctive experience of rhythm because of his overly blurred sense of time-values.

According to the results of our experiments, therefore, there is no psychological meaning to the claims for a third *genre* between regular verse and prose, except in the sense of a jumping back and forth from one side of the fence to the other. In spite of the fact, then, that many passages

can be felt as either prose or verse, according to the utterance or the amount of "suggestion" received through visual arrangement, grammatical (dictionary) accent, artifices of tone-color, figures of speech, elevated diction, etc., nothing more than an unstable compound can be created out of the two typical forms of temporal experience.

So far as broader grouping is concerned, prose is capable of all the subtleties of occult balance ever evinced in verse.² If the champions of *vers libre* were to stick to an obvious balance in broader groupings, with an avoidance of any regular succession of small group-patterns, such as iambs, trochees, anapæsts, etc., they would have a more consistent form, similar, *as a whole*, to neither regular prose nor regular verse. It would produce symmetrically arranged stretches of prose experience, in which free syncopation, however, would probably be checked to a large extent by the suggested see-saw of broader arrangement. Such a form exists in some of the Psalm translations. The writers of *vers libre*, however, appear to have no intention of thus curbing their freedom. So, of course the constant jerking back and forth from prose to verse may continue to produce pleasurable reactions in enough individuals to confirm the operation as a fairly usual, though surprising, combination of mental processes. All that psychology has a right to question is the distinctive unified reaction claimed for what is really an alternation of two contrasting forms of experience.

Irregular length of line and the absence of rhyme have always been features of certain types of verse, avoided by some poets, cultivated by others. Particularly with

² This secondary grouping may be symmetrical or unsymmetrical. Either verse or prose experience may thus be colored by the form of grouping superimposed. Verse experience, unsymmetrically grouped, and prose experience, symmetrically grouped, would be the more unusual and, without doubt, the more unstable varieties.

respect to irregular length of line, whether measured by stress-patterns of grammatical accent or merely by number of chief accents, there will continue to be chances for more and more "freedom" until the mathematical limit of permutation and combination for unusually long and unusually short lines has been reached. The idea, therefore, that certain individual forms of *vers libre* are merely amplifications of accepted types of conventional verse is thoroughly justified. But quite apart from irregular length of line, the arrangement of grammatical accent in the printed text of the poems of Masters, for instance, produces frequently, by the force of suggestion, an assortment of thoroughly good prose experiences sandwiched in between patches of equally good verse. This is hardly a mere amplification of accepted types of verse, since the broader interchange between verse and prose to be found in Shakespeare and the Elizabethan drama is frankly according to the facts a matter not of some new verse form, but a confessed mosaic of verse and prose. On the other hand, it must be admitted that the masquerading of prose plus verse under the name of either experience is far older than the nineteenth century. In fact, it has its counterpart in Sanskrit forms. The Sanskrit rhetoricians are quite unable to straighten out for us a final classification of certain examples in the "Gadya" style, where the "perfume of metre" is supposed to be attained without its presence, in spite of which theoretical restriction the actual metrical "pada's" are repeatedly interpolated.³

Even in its most recent developments, particularly in France, the mosaic form has appeared sometimes under the name of prose, sometimes under that of verse. In either case, it must be recognized that whenever so-called *vers libre* goes beyond mere irregularity of length of line, and alternates successions of repeated stress-patterns with

³ Regnaud, P., *La Rhétorique sanskrite*, Paris, 1884, pp. 74 ff.

stretches where the grammatical accent is sufficiently irregular to suggest a syncopating rhythmic response, there results for the "timer" a patch-work product, involving two processes which psychologically do not fuse.

In conclusion, we may say that the recent American poets who employ "free verse" give us many effective and welcome phrasings of their realistic view of life. Their independence as to form is occasionally stimulating. With regard to subtle cadence, however, which has been claimed as the chief distinction of these poets, it is still a question as to how far they have surpassed the refinement of balance that quickens the prose of Walter Pater.

A word, finally, must be added as to terminology. When regular prose becomes consistently emotional, whether through richness of tone-color, abundance of images, or conspicuous "return" of certain prose refrains, such as we find in Matthew Arnold's repetition of "sweetness and light" or De Quincey's "Fanny and the rose in June," all we need is to space the phrases on separate lines in order to obtain something which is not to be distinguished from the best "free verse." This resulting experience is different from that obtained from ordinary prose in that the spacing serves to focus our attention upon the *rhythm as rhythm*;⁴ but, in spite of this self-consciousness and its emotional consequences, our "glorified" prose still remains a *kind* of prose. What shall we call it? Since all prose has its rhythmic possibilities, "rhythmic prose" is as misleading a name as *vers libre*. Rhythmically self-conscious "spaced prose" is an uninviting but fairly accurate description of it in its more inspired manifestations, such as abound in the work of Miss Amy Lowell. Nevertheless, until the various experiments of *vers libre* strike Miss Lowell's more consistent pace, it is useless to devise names for what, at present, seems to be a shifting entity.

⁴ Rhythm in the sense of "secondary, broader rhythm." See p. 98.

CHAPTER VI

CONCLUSION

THERE is little that is permanently elusive about the rhythm of prose to an aggressively rhythmic person. The temporal part of his experience, at any rate, is clear-cut enough for musical transcription, provided we adopt a system of accelerating and retarding unitary pulses as a basis, and understand the phenomena of syncopation and spontaneous substitution. To a passively rhythmic person, however, whose time-sense is noticeably deficient, prose rhythm, as an experience, will never possess anything but an elusive aspect. The subtle pleasure he may elicit from a careful choice of words with regard to tone-color, shades of mood and thought, etc., can easily deceive him into calling his experience "rhythmic," when actually it is something else. The "stresser" imagines that he can correctly gauge a "movement" when he is merely gauging a permutation or combination of stresses and unstressed syllables. The so-called "word painter" mistakes for rhythmic sense his skill in vowel and consonant color; the "phraser," his gift in balancing against each other collocations of words, in which association of thought is the distinguishing characteristic. Such a "phraser" may have skill in duplicating the style of some well-known prose author, including, inadvertently, the possibilities of rhythm; and yet in so doing, he may have made use of processes quite distinct from those primarily connected with rhythmic experience. It would be absurd to maintain that without a discriminative sense of time there can be any real valuation of movement.

Many of the stresser's errors are avoided if we keep before our minds the difference between body-rhythm and static body-balance. The schoolboy, standing erect with heels together, ready for calisthenic drill, exemplifies symmetrical body-balance. The Indian, poised for an instant upon one foot, as he climbs the rocks, illustrates the balance of an apparently unsymmetrical or "occult" nature.¹ But let the schoolboy begin to move his arms in time to music, his motions coinciding with the temporal pulses of a tune, and rhythmic experience results, similar to that which we associate with verse. So let the Indian resume his actual climbing of the rocks, and the coördinated movements he makes, although occurring at objectively irregular intervals, are subjectively organized by an aggressively rhythmic spectator as a sort of prose tune, in which the accents in the movement predominantly syncopate with the elastic subjective temporal pulses of the onlooker, if he be a "timer." When the schoolboy and the Indian move progressively the phenomena of body-rhythm become evident, in addition to body-balance, which, of course, still operates. The "stresser," the "word painter," and the "phraser" are often capable of the most subtle appreciation of static body-balance in a sentence, and are always aware, to a certain extent, of the temporal quality of body-rhythm; but they cannot easily evoke a scale of subjective temporal measurement, and, accordingly, their attention, when they react to progressive movement in language, is on the weakness or strength of accents and their merely numerical recurrence, on the relations of tone-color, and the interplay of thought and mood associations.

The intellectual act of balancing the memory of three stress accents in one phrase against three such accents in another, regardless of their time relations, is a unifying

¹ Puffer, E., *Studies in symmetry*, *Harv. Psy. St.*, I, 1903; Gordon, K., *Esthetics*, N.Y., 1909; etc.

process similar to body-balance. Suppose that the school-boy lifts his arms above his head three times, regardless of temporal regularity. Presently let him lift them up again three times at irregular intervals, quite different from those of his first three movements. There is a mental satisfaction in being able to group his first three acts as a numerical pattern repeated in his second group of arm-liftings. We enjoy this subjective unification of the number of the boy's movements in the way that we enjoy a single act of body-balance. Similarly, we might enjoy contemplating the fact that there are five fingers on one hand and five on the other.

Stress-patterns, small and large, from the balance of two iambs to the balance of two paragraphs, similarly "grouped," figure in the rhythmic experience of every "timer"; but they are always superimposed upon time-patterns. The inveterate "stresser," however, has a much less complete experience, in that only one of the two elements is a distinct factor in the pleasure he obtains from prose and verse. As to prose, moreover, no "non-timer" seems able to make clear the nature of his own experience. To say that it is due to a generous "mixture" of "all sorts of metres" is the same as confessing that the experience is mere hodge-podge. Is it not more accurate and sincere for him to say that, while he may have a subtle sense for simple and occult balance of stress-patterns in prose, and possibly a tremendous sense for tone-color and the artistic adjustment of thought and mood association, nevertheless his sense of time is not sufficiently keen for him to organize objectively irregular series of sounds such as he confesses, by his term "mixture of all sorts of metres," are typical of prose? Such an admission is likely to be followed by a realization that one's sense of time can be sharpened by practice, and that the enrichment and completion of the rhythmic experience is worth an effort

in this direction. Our loss of time-sense is largely due to our conventionally passive enjoyment of rhythm, so that the deliberate practice in tapping schemes of syncopation, together with attempts to tap the rhythmic tunes of prose, is a ready means of leading us back to the sharpness of temporal sense no doubt possessed by our primitive ancestors.

The aggressive "timer," of course, gets his keenest delight from prose in the fact that he feels no trammels. His instinctive processes revel in the unlimited freedom assured by the possibilities of elastic pulses and automatic syncopation. The pulses dance along of their own accord, falling in with the movement of the prose syllables and creating by their predominant syncopation a rhythmic tune, which is enriched by the texture of stress-patterns, pitch-patterns, tone-color-patterns, balances of thought and mood, etc., up to the full experience of literary enjoyment. The typical "stresser" or deficient "timer," may feel that he gets just as much pleasure from his time-blurred groupings, especially since he may exceed the "timer" in his susceptibility to some of the other factors in prose style besides duration. But the *aggressively rhythmic* "timer" excels in a majority of the factors mentioned above, and, most interesting of all, can be brought to a fairly clear description of his experience. If he adds to his easy and spontaneous coördination of haphazard sounds and his instinctive sense of swing, a subtle ability to judge the *fitness* of rhythmic movement to the underlying thought and mood of a prose passage, he superimposes upon what might be considered a purely musical endowment a definitely literary gift.

One chief reason for rebelling against the two-beat theory advanced by Sievers as an explanation for Old English verse, is that its application forces upon our ancient bards the limitations of defective time-sense. As already

explained in Chapter II, Sievers and Schipper define rhythm from the point of view of "timers," but apply it in the two-beat theory from the point of view of "stressers." The contradiction in this attitude is quite flat. Schipper² defines poetical rhythm as "a succession of syllables so arranged as to be uttered in divisions of time which are symmetrical in their relation to one another." Nothing could be more definite, more exactly in line with the experience of a "timer." Similarly, Sievers declares, in no uncertain terms,³ that "by far the most important among these factors (in rhythm) are the first two named: time-organization and stress-gradation." In the face of all this, the two-beat theory is erected on the confessed assumption that the Old English bards delivered their hemistichs according to the manner of "free recitation."⁴ In other words, they did *not* utter their verse "in divisions of time which are symmetrical in their relation to one another," nor was "time-organization" one of the "by far" . . . "most important" factors. All that is important, according to Sievers and Schipper, is the fact that two syllables were stressed in each half line. Either the two-beat theory is in need of repair, or Sievers and Schipper, and so Westphal and Saran, whose definitions of rhythm they virtually adopt, will have to devise new definitions to fit the theory.

In prose, the acts of judgment, unifying and balancing succeeding phrases merely by recording the number of chief accents in each phrase, are interwoven with our progressive rhythmic experience. Simple and occult balance both come constantly into operation. The simple balance

² Schipper, *op. cit.*, p. 4.

³ Sievers, *Metrische Studien*, Kön. säch. Ges. d. Wiss. Abh. phil.-hist. Kl., XXI, p. 31.

⁴ Sievers, *Altgermanische Metrik*, Halle, 1893, p. 22: "einen freieren sprechvortrag, nicht gleichmässig taktierenden."

of an epigram is easy to detect. Straightforward increase or decrease in the length of phrases (measured by accents) can be understood by any one. So no one would find difficulty in grasping the æsthetic satisfaction of a single short phrase or sentence after many long ones, in spite of the fact that this latter form of balance is usually termed "occult."

The constant operation of hidden symmetry, of course, includes some effects which are lost upon the average reader or hearer. Yet they are based upon easily explained principles. It is chiefly a matter of attention, voluntary and involuntary. Invitations to attention, due to different sources, can accumulate upon a single syllable. In the language of everyday life: a woman passes by wearing white gaiters; we find ourselves giving more units of attention to her feet than to her face and figure. Applied to prose, one word or phrase can elicit from us enough attention to balance it evenly or more than evenly against a paragraph. The needle which pricks us unexpectedly makes us forget the haystack in which it was hidden. The invitations to attention felt in a phrase may be of the most varied nature: sensations and associations due to time, pitch, and stress-patterns, interacting with tone-color; suggestions due to striking contrasts in mood or thought; emphasis resulting from mere position at the beginning or end of a sequence, or, possibly, from some individual caprice. The less subtle person may say to himself simply: "This phrase is quite short; the rest of the sentence is much longer. I enjoy the contrast." In this case his enjoyment of the contrast gives him the equipoise which we assume to be requisite to the comfort of an erect mind.

It would be ridiculous, however, to pretend that every mind progresses to such a tune of constant balancings. The naked Hopi Indian, climbing over the rocks to his

cliff-house, moves with all the inevitable grace of a parabola, although the equations of his motion are as complicated as that of the parabola is simple. A city-bred man would probably cover the same ground with a combination of scrambling and stumbling that might easily resemble in its curve of progression the sound-photograph of some peculiar noise. To an aggressively rhythmic spectator, witnessing both performances, spontaneity, ease, and fitness between the motions and the task would characterize the Indian's movements, while awkwardness and more or less wasted effort would mark the upward advance of the city-bred man.

In verse the "timer" looks for *particular* forms of temporal and accentual "moving balance" from beat to beat, as when one dances or marches on level ground; in prose it is as if one climbed over stock and stone, where it is not a matter of any certain balance-pattern, but of maintaining an easy succession of balances, whose choice depends very largely upon economy or upon the line of least resistance. Thus it is with the rhythm of his thought, so long as it is conducted by fairly clear images and words.⁵ To the aggressively rhythmic even a train of fleeting imagery usually preserves a certain orderliness of movement, varying from the simple, wave-like curve of grace to the cumulative swing of dynamic efficiency. But the essence of the "timer's" thought-rhythm does not seem to have been heretofore described. It consists in the fusion of at least two processes: first, the consciousness of tension-summits, small and large; second, subjective impressions of temporal intervals between these summits, syncopating or coinciding with certain pulse-like impressions, marking subjective units of time. These unitary pulses are elastic, that is capable of accelerating and retarding, just as when

⁵ With regard to imageless thought, see Binet, A. and Simon, T., *Langage et pensée*, XIV, 1908, p. 339.

they assist in measuring the intervals of articulate speech; but in thought-rhythm the possibilities of speed-change seem to be tremendously increased. Such Protean rhythm leaps over chasms, dangles on the edge of precipices, swoops through abysses, shivers itself into atomic dust, or suddenly liquefies into the dignity of oceans. These measuring pulses, with their exaggerated range of elasticity, never quite forsake the "timer's" waking hours. A night of dreamless sleep shrinks into half a beat, a moment of pain plays a protracted gamut of duration; but the soul once definitely committed to the rhythm of subjective time spins on like a gyroscope, regardless of upsetting.

The general results of the present investigation, including a statement of whatever well-known principles have been confirmed, in addition to whatever new explanations and conclusions seem to be justified by the data adduced in Appendix III, may be listed as follows:

I. Rhythmic *experience*, rather than so-called objective rhythm, deserves the focus of our attention. Rhythmic performance exhibits interesting objective relations, but the vital issue, even in performance, is the nature of accompanying subjective reactions.

II. Rhythmic experience is so complex, and individuals differ so largely in the enjoyment of it, that a new phrasing of its meaning would be necessary for each person, in order to avoid errors of inaccurate generalization. Nevertheless, for all practical purposes, its varieties may be roughly grouped into three kinds: passive, passive with aggressive tendencies, and thoroughly aggressive. So, there are inaccurate and accurate manifestations; experiences based chiefly upon sensations of stress, and experiences based chiefly upon impressions of time; etc., etc.

III. "Aggressive" implies, first of all, the ability to organize subjectively into a sort of rhythmic tune any haphazard series of sounds, provided they are not too close

to be distinguished or too far apart to be held together in one wave of attention. Observer No. 7 evinces such ability. A more detailed analysis of aggressive characteristics is given further on.

IV. Since the rhythmic experience of an aggressive, fairly accurate "timer" appears to be, not only more comprehensive, but also much more definite and generally intelligible than that of any confirmed "stresser," especially with regard to irregular series of sounds such as characterize prose utterance, the description of such a "timer's" experience is the most advisable approach we can make to a working definition of rhythm, subjectively considered.

V. Rhythmic experience, in the case of the "timer," depends, primarily, upon the organization of some part of consciousness into a series of *elastic* subjective units of time (marked by subjective tension-summits or by sensations of actual muscular contraction). This is his simplest form of rhythmic experience, which may be amplified either by the coincidence of any other successive states of consciousness with this elastic series or by some more complicated form of coördination, obtained through syncopation. Elastic means accelerating or retarding, within limits subjectively determined, beyond which the impression of substitutional "grouping" takes the place of "unitary pulses." This means, for instance, that if one interval is very much faster than another it assumes the relation to its predecessor of a simple fraction such as one half or one third rather than the relation of progressive hastening. According to Squire,⁶ the most primitive form of rhythm, as evinced by children, is unitary. The evidence of certain forms of tom-tom beating, such as some of those recorded by Boas in connection with the Kwakiutl Indians, and others observed among the Apaches by the present writer, indicate that primitive peoples have an

⁶ Squire, *op. cit.*, p. 540 ff.

unmistakable fondness for series of monotonous, ungrouped drum-beats, either alone or combined, by means of syncopation, with more complicated series of sounds. At certain rates of speed, the well-known phenomena of subjective grouping into two's, three's, etc., either voluntary or involuntary, begin to operate; but it must not be forgotten that at other somewhat slower rates this subjective grouping ceases, although soothing or exciting reactions may persist. With the aggressive "timer" these affective reactions are likely to persist until the individual limit of an attention span is reached.

VI. Precise objective measurement of the syllabic intervals of ordinary prose, spoken in a natural manner, proves that these intervals must be considered, mathematically, as forming a virtually haphazard series. Such spoken prose does not produce an unbroken rhythmic experience, except for observers, like No. 7, who can subjectively organize, upon a temporal basis, an objectively irregular drum-beat series.

VII. Observer No. 7 in certain states of mind, not always, obtained a continuous, definite rhythmic experience from every series of drum-beats, however irregular, which was presented to him. Other observers showed similar tendencies, but not so clearly. (See record of Observer No. 12, who judges Pater as regular music; Appendix III, section xxvii.)

VIII. Wundt's statement, that no series of impressions exists that cannot in some way be *conceived* as rhythmic, is experimentally established, but with the limitation that no clear, continuous rhythmic experience is possible in connection with haphazard series, except for individuals especially endowed.

IX. When this experience of rhythm is *easily* produced by repeated renderings of a passage of prose, and is accompanied by suggestions of *spontaneity* (judged by

surprise) in the organization of the time-intervals, stress-groups, and complex-tension-groups, which are coördinated with the under-unit of time, two standards (ease and spontaneity) are attained which may be regarded as musical. When, however, it becomes possible to judge the *appropriateness* of the rhythmic movement to the underlying thought and mood, a specific literary standard is added to the musical point of view. A passage of prose may thus be said to have rhythmic "possibilities," the sum of which may be graded high or low according to the "literary" standard of fitness, in addition to its grading as purely musical.

X. Language is regarded by a "timer" as rhythmically "prose" (in its sum of possibilities when uttered) so long as syncopation and substitution predominate over coincidence between the accented syllables and an under-unit series of subjective time-intervals. When coincidence predominates, language is rhythmically "verse." The division into lines and stanzas is sufficient often to suggest to the mind the combination of processes by means of which potential prose is regarded or felt as verse. This explains Wallin's experiments.⁷

XI. Meumann's statement that there is no one sense of rhythm, but rather a complex of mental processes, is confirmed by the results of the tests. Rhythmic experience may thus be roughly described as a complex of perception, emotion, and sensation, with all three elements subjected to the moulding processes of attention, both voluntary and involuntary. *Correlation with a subjective temporal unit*, however, is indispensable to the clear-cut rhythmic satisfaction felt by a "timer." "Suggestions" of rhythm, to be sure, are easily derived by the mere repetition of an accentual sequence — such as two accents in one phrase, matched by two accents in another. But if we examine

⁷ Wallin, *op. cit.*, p. 64 ff. See also Chapter II, above.

closely any actual experience, we find that time relations are inevitably implicated. The "stresser" is consequently seen to be a "timer" in spite of himself. What makes his rhythmic experience vague is not that time-sense is absent, but merely that it is deficient.

XII. Syncopation is an accepted musical term of great significance in the analysis of rhythmic experience.⁸ Sound rhythm, of course, deals with sounds and silences; but concomitant with purely sound rhythm is motor rhythm, thought rhythm, etc. Concomitant sets of time-intervals, accordingly, when not coinciding, institute one form of syncopation. Another form occurs when there is interchange in the nature of the sensations or movements which mark off time-intervals. Finger-taps alternating with spoken syllables are an illustration. The series of tapped intervals laps over the series marked by syllables.

XIII. "Spontaneous substitution" is a term, used in the present work, for a principle illustrated almost anywhere in the sonatas of Beethoven, the nocturnes of Chopin, or such familiar music as the "Scenes from Childhood" by Schumann. It occurs whenever a triplet, for instance, enters unexpectedly into the course of a melody already announced, as a substitute for an equivalent single note. If this triplet were to occur in each half of the melody at an expected point, it would, of course, be merely a case of "schematic substitution." The principle is illustrated very clearly on the first page of "The Temple of Memphis," composed for the piano by Cyril Scott. Toward the beginning of the piece we can see the unit-interval, supposed to be pulsing regularly in the bass, spontaneously subdivided in the

⁸ This must not be confused with the limited use of "Syncope," as employed by Sievers (*Rhythmische-melodische Studien*, Heidelberg, 1912, p. 10) to mean the omission of an unaccented syllable in a "foot," on account of which omission an accented syllable does duty for the two, etc.

treble, at one time into two, at another into three or four smaller intervals. Further on we find the unitary pulses themselves grouped into clusters of varying size. The majority of observers, in the present tests, without knowing the source of what they were judging, pronounced the rhythm to be interesting and pleasant, feeling the unitary pulses as the dominant impression. Applied as an organizing factor to the haphazard beats of prose, the principle was accredited by the observers with considerable value.

XIV. A "subjective accent" in speech is a complex tension-summit, in which impressions of stress, pitch; duration, and tone-color, in addition to associations due to thought and feeling, collaborate in various proportions to produce a more or less conspicuous foothold for attention. "Grammatical accent" has been used as a term for the conventional stress relations between the syllables of a word, as recorded in dictionaries. Syllables have no integrity as sensations corresponding to their values as assigned by convention. Some observers "feel" a three-syllable word as a continuum with a single crest. It appears that most observers, influenced largely by convention, experience a three-syllable word as a continuum with three crests, one higher than the others. Some observers, however, feel three or four crests in a word of only two syllables such as "swarming." The same is true for a series of words uttered together in the continuum of a phrase. So far as objective measurements are concerned the sound-photograph of a single vowel frequently exhibits half a dozen crests.

A subjective accent in which either grammatical or fortuitous stress predominates may be pitted against an accent due to logical or rhetorical import. So pitch may be balanced against duration. This is usually called a form of "substitutional" or "occult" balance. The observers differ in the pleasure they elicit from the general

operation of this principle by degrees ranging from enthusiasm to resentment.

XV. "Aggressively rhythmic" is a term applied to those who, like Observer No. 7, not only attain a fair degree of reproductive precision in the tests, but evince a marked pleasure in rhythmic exercises and a marked tendency to organize upon a temporal subjective basis all of their conscious life. Abundance and vividness of auditory and motor imagery; unit accuracy; sense of swing and ability to syncopate, especially in complex tasks; pleasure in the effects of acceleration and syncopation; pleasure in unitary pulses as well as in groupings superimposed upon them; and, finally, strength of voluntary and involuntary "subjective rhythm," seem to be the conditions of this ability to organize, upon a time basis, any haphazard series.

Observer No. 7 is "aggressively rhythmic." Observers No. 1 and 12 show some of the aggressive characteristics, though not all. "Accurately rhythmic, but passive" describes Observer No. 11. "Fairly accurate, passively rhythmic, but with aggressive possibilities" classifies roughly Observers No. 4, 6, and 8; "inaccurately rhythmic, with varying degrees of passiveness," Observers No. 2, 3, 5, 9, and 10. This grouping stands, of course, for results of limited tests. A later set of experiments might easily change the arrangement.

XVI. An elastic under-unit (either strictly "unitary" or grouped in two's or three's), spontaneous substitution, and the imposition of a humming tune, seem to give most assistance to the present group of observers, taken as a whole, in obtaining a *continuous rhythmic experience out of haphazard material*. But for those who score highest in the requirements listed under XV for "aggressive rhythmic sense" (Observer No. 7 and to some extent No. 12) syncopation is of prime importance. No. 12 grades it higher than any of the other organizing factors.

XVII. The experiments in syncopation practice with seven's against five's, together with the judgments passed by the observers in connection with hearing haphazard series, point very strongly to the combination of a time-beating motor performance, such as tapping unitary pulses with the hand, and the syncopating hummed performance of the haphazard beats, as the quickest means whereby an aggressively rhythmic observer can organize the series upon a basis capable of approximately accurate repetition.

XVIII. For a passively rhythmic observer, the hearing of such tunes from others, and the watching of their performance, is of great service in developing aggressiveness.

XIX. For aggressively rhythmic states of mind and for these alone, it is true that "no series of impressions exists that cannot in some way be conceived as rhythmic"; but the secret can be made clear to those with aggressive possibilities, by beating and humming syncopating rhythmic tunes, in which there is added to the haphazard series the *properly elastic* series of unitary pulses.

XX. The tests for individual difference in imitative "sense of swing" and ability to perform tasks in simple and complex syncopation show a close correlation in some cases. But there are marked exceptions. (See Appendix III, sections vii, viii, xxii, and xxiv.)

XXI. Evident deficiency in auditory imagery is accompanied in the present tests by marked inability to syncopate, but not necessarily by marked inability to catch the swing of a series. The indications are that motor imagery may be of more assistance in the latter operation than in syncopation. (See Appendix III, sections iv, vii, viii, xxii, and xxiv.)

XXII. It is a mathematical fact, due merely to the possibilities of permutation and combination, that all the conceivable changes in the stress-patterns of language could easily have been rung long ago. Subtlety of adjustment,

appropriateness of rhythm to sense, especially in larger grouping, has "developed"; but until the true psychological attitude toward rhythm as an experience is observed, any so-called "history of the development of rhythm" is certain to be founded upon misconceptions.⁹

XXIII. How idle it is to depend on any one "scanning" of a passage is proved by the tests on "possibility scanning" described in Appendix III, section xvii. By one observer a short group of words was found susceptible of being marked for stress, pitch, duration, and weight, in seven hundred ways! By two others the number was found to be much larger. The marking of grammatical accents often serves a useful purpose in assisting us to locate unpleasant monotony, tricks of style, etc., but we should not forget that rapidity of utterance can smooth out most of the grammatical accents, while a slow delivery may create unexpected summits of stress.

XXIV. The recent study of sentence melody, elaborated by Sievers, is open to similar objections. As the hobby of a great scholar it is interesting, and as a poetic speculation it is no doubt alluring; but as an accurate basis for textual criticism nothing could be more shaky. It appears fantastic enough to get the "one right" melody out of a printed stanza of modern verse, but to attempt such necromancy for an ancient text¹⁰ seems hardly in keeping with the scientific aims of modern scholarship.

⁹ Nothing is more astonishing than to find the evidence for some "remarkable rhythm" adduced in the form of bare conventional scanning. In a previous study, the writer undertook to mark grammatical accent, according to the rules of approved philology, in a few passages taken out of our oldest Kentish and West-Saxon charters, about as dry business documents as we possess, and found very shortly the most varied and entertaining combinations of "pæonics" and "dochmiacs." To see, therefore, these same stress-patterns, or rather sequences of eye-rhythm, pointed out in a passage of Walter Pater as an evidence of "development," would be disconcerting.

¹⁰ Sievers, E., *Zur älteren Judith*, Prag, 1908.

XXV. Three standards — ease, spontaneity, and fitness — have been mentioned in section IX, according to which we pass judgment on rhythmic experience. When we tap the drum-beat tune of a sentence and establish our synco-pating under-unit of time, we are in a position to detect clumsiness, artifice, or impropriety in the swing suggested by the spoken text. Degree of ease is soon determined by the facility with which we can nod or tap or move our feet to the movement of the drum-beat tune. The highest value, in such a case, would be put upon a sentence in which the greatest ease was combined with a maximum of complexity in structure. Our judgments for spontaneity would depend upon our ability to establish evidence of technical trickery in the shape of repeated patterns, etc. Fitness is the most difficult of the three standards to apply. With a militant theme the propriety of a martial rhythm would be easy to estimate; but with subtle and suggestive thought material, it would take almost as much ability to detect a degree of fitness as to create it. Here, too, is where tone-color and nicety of diction may be easily mistaken for the actual rhythmic movement, which, of course, they influence.

XXVI. All judgments of rhythmic experience connected with prose depend upon individual renderings of the passage, which must be read aloud repeatedly, as well as tapped. Underlying the variations resulting from such a series of renderings, three causes or motives may be mentioned: caprice, economy, and artistic adjustment. In the first place, a certain tempo or a certain sequence of stress-groups may easily depend upon a whim. The second motive rests upon the fact that good form is economical. Efficiency in delivering a message demands sometimes balance, sometimes contrast; sometimes progressive increase or the reverse; sometimes speed, sometimes more dignity of pace. The third motive implies, not simply specific attempts at an appropriate rhythm, but a sportive interest

in the problem of multiplying complications without sacrificing ease, as if it were all a sort of game. This verges readily into artifice.

XXVII. Fundamental rhythmic experience, in the case of a timer, listening to spoken language, is either the result of coincidence or syncopation between the measuring pulses and the objective stimulus; i.e., *it is either verse or prose experience*, according to the form of coördination which predominates. A secondary broader rhythm may be superimposed in which the arrangement of groups is either symmetrical or unsymmetrical. The enjoyment of this is often more a matter of sensations of static balance than of temporal succession. Only when the temporal intervals involved are in the forefront is the resulting experience strictly rhythmical. In any case, these four elements—fundamental prose and fundamental verse experience, superimposed symmetrical and superimposed unsymmetrical broader grouping—make possible four combinations: prose experience, grouped symmetrically, as in the reaction from parts of the Authorized Version where verses match each other; prose experience, grouped unsymmetrically, as in the reaction from ordinary conversation or the reading of average so-called “prose”; verse experience, grouped symmetrically, as in the reaction from ordinary “poetry”; verse experience, grouped unsymmetrically, as in the reaction from “freer” forms of poetry and from passages of would-be prose. This applies to “timers.” As soon as we substitute for their clear-cut forms of temporal coördination the vague impressions of a “stresser” with defective time-sense, it is impossible to make distinctions, and all the delusions of certain writers of “vers libre” and “poetic prose” take possession of the field.

XXVIII. The student of rhetoric who wishes to develop possibilities of rhythmic excellence in his attempts to write verse, even though he be by nature deficient in time-sense,

may be brought to feel the difference between compositions that are merely "correct" and "duly varied," both syllabically and metrically, and verse in which ease, spontaneity, and fitness in the drum-beat tunes are also included among the criteria. It is presupposed, of course, that a satisfactory adjustment of vowel and consonant color, as well as of associations due to fundamental thought and feeling, must be likewise attained.

So there needs to be a new procedure in the study of prose composition. It is here that a native "stresser," with defective time-sense, particularly needs to sharpen his blunted perceptions. While he reads the standard authors he should walk or tap or nod an accompaniment, with his attention fixed on syncopation rather than coincidence. If he really wishes to develop his time-sense systematically, he should make himself expert in the automatic performance of syncopating tasks, such as tapping two's against three's or even five's against seven's (a comparatively easy feat if only he can be assisted by some one who himself has mastered it, and who can let him hear the drum-beat tune of a fairly correct performance, as is indicated roughly in Appendix II, section xxiv, sub-sections 2 and 3). In any case let him tap off the drum-beat rhythm of his most impelling experience with a sentence till he learns it; then let him hum it as a sort of tune, while he establishes, by beating time with his hand, the proper accelerating and retarding series of unitary pulses with which it is freely to syncopate. The rhythmic tunes thus learned from Sir Thomas Browne, De Quincey, or Pater will sing themselves in his head while he does his own writing, so that without knowing it, he will be guided in his choice of words toward whatever rhythmic facility it is in him to acquire. The last step would be to reclothe the drum-beat tunes with the complicated veil of tone-color and sense-association due to their original words, and let them dance themselves, by

means of repeated practice, into the automatic processes of the brain. If they help us at all, they probably help us most when thus hidden.

XXIX. Many of the methods of literary criticism need to be revised in a similar way. Any judgment passed upon the rhythmic possibilities of an author's style, is of no value psychologically, if motor response is neglected as a test.¹¹ Vague impressions from a person whose musical ear is abnormally keen may easily be considered of greater value than mechanical analysis on the part of some unmusical, unliterary hair-splitter; but the time is surely past when any man of unusual endowment is willing to throw away the advantages of efficient method or to oppose his so-called "intuition," subject as all human senses are to countless illusions, to the cumulative evidence of experimental data.

Any experimental undertaking, however, which is not based upon a thorough understanding of syncopation and its multiform possibilities, of spontaneous substitution, of acceleration and retarding, and the "sense of swing," will find the problem slippery. Fortunately, all of these factors, once made plain even to a passively rhythmic mind, are much easier to apply in the actual study of a bit of prose, than the ancient trumpery of skeleton scanning — "amphibrachs," "bacchics," "anti-bacchics," "antispasts," "molossi," "dochmiacs," and "proceleusmatics" — which heretofore have been brandished before our eyes, as if they were anything more than, as stress-patterns, merely half the story.

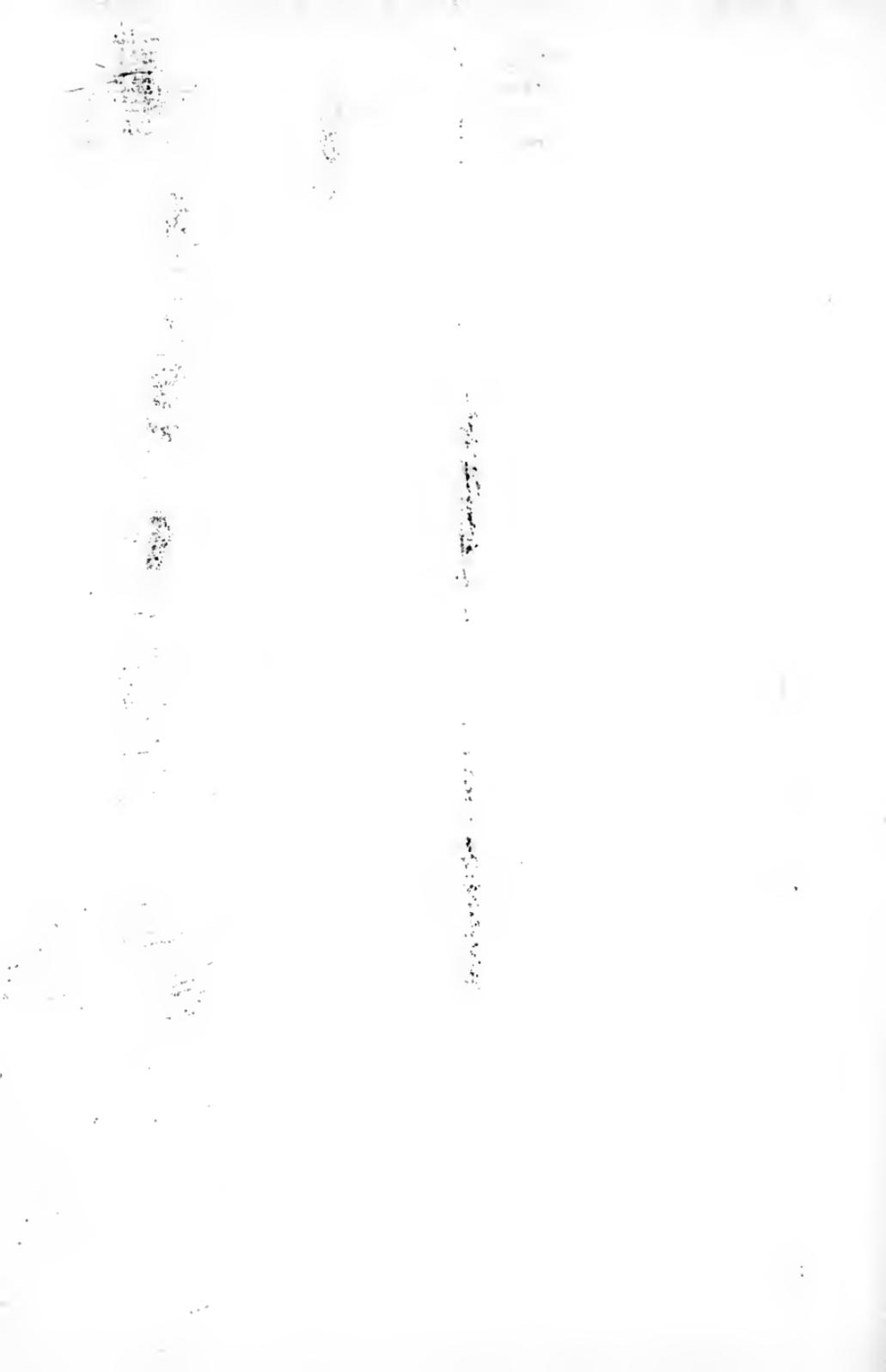
Each individual must make his own rhythmic judgments as to spontaneity, ease, and fitness. The judgments as to fitness, involving every form of association and suggestion,

¹¹ According to Stetson, "Every rhythm is dynamic; it consists of actual movements." See Chapter II, above, for statements from various psychologists.

would include descriptive terms for any particular movement, as well as for special types of subjective syncopation. Adjectives of all degrees of definiteness (such as "cumulative," "undulating," "rugged," "languorous," "martial," "galloping," "soothing," "exciting," "dignified," or "boisterous") would still be used to illustrate motor and sensory suggestions. "Falling" and "rising," as terms descriptive of patterns in which the precedence of accented or unaccented syllables is emphasized, possess just as much significance, and, in fact, much more when the temporal element is duly valued.

Finally, to make a shift from literary criticism to broader fields, there may issue from investigations similar to the present one, as a possible result — significant for music, for literature, and for living in general — a more or less fruitful interest, on the part of the *moderately* rhythmic, in their chance to breathe the air of a garden, from which they were before excluded. There is still for them a wall to be climbed, but at least there are no "proceleusmatic" palings on the top of it. The condition imposed, that we should learn to syncopate, if we wish to advance into the secret places of rhythmic experience, is not so forbidding as it sounds. So far as the requisite technique is concerned, every optimistic little African who performs the double-shuffle has, in a measure, "attained." For instruments, all we need is a table, and two fingers with which to practice tapping.

XXX. To what an extent an individual whose rhythmic proficiency is less than moderate can develop the characteristics of an aggressive "timer," is a matter for further investigation and experiment. It seems, at any rate, assured from the tests already made in syncopation practice (see Appendix III, section xxiv) that an observer, apparently deficient in temporal perception, can very quickly surprise himself by his achievements, when assisted by the harmless magic of a drum-beat tune.



APPENDIX I

DESCRIPTION OF APPARATUS

For the purpose of the experiments two rooms were used: one the regular sound-room belonging to the Department of Psychology at Columbia; the other, an especially constructed, fairly sound-proof cabinet built into one end of an underground room belonging to the Department of Physics. Within this cabinet a second cabinet was set up, with mattresses and thick padding for walls and ceiling, and several inches of sawdust on the floor. Loose curtains of canton-flannel were hung inside to assist in preventing reflection of sound. Within these surroundings, devised to exclude as much as possible of external noise, and to destroy as much as possible of internal reflection, were installed the instruments for transforming by means of a diaphragm and small mirrors,¹ the vibrations of the voice into vibrations of a light-ray, susceptible of being photographed. The camera, including the machinery for regulating the motion of the film, was placed on the other side of a padded partition which cut off the larger cabinet from the rest of the room. A very small plate-glass window, set into the partition, allowed the ray of light used in the photographs to pass from the inner cabinet into the camera, containing the moving film.

One of the chief difficulties in securing accurate sound-photographs consists in getting a source of light which is not only sufficiently strong, but sufficiently quiet. The spluttering of an arc-light, which seems to have been used in similar photography, previous to our experiments in the summer of 1915, is in itself sufficient to communicate sound vibrations to a highly sensitive diaphragm. Our experiments, accordingly, appear to have been the first in which the photography of continuous speech, involving the possibility for several hundred feet of rapidly moving film to pass by without intermission, was accomplished with a system of convenient, noiseless, steady sources of light.

¹ As far back as 1878, the time of Blake's experiments, and probably earlier, such instruments have been in use. See also Rigollot, H., and Chavanon, A., *Projection des phénomènes acoustiques*, *Journal de physique*, II, 1883.

In order to carry out our purpose, small Mazda lights were used and burned at an abnormally high voltage. Each lamp was placed in a cylindrical case of metal and a ray from a portion of the straight filament was allowed to escape through a slit in the side of the case. This ray was conveyed through a converging lens to a small mirror attached to a very light steel axle turning upon bearings of glass. This axle was connected with a mica diaphragm by means of a human hair wound once about the axle, with one end fastened to the diaphragm and the other to a metal spring which projected in front of the mirror. The system of connecting diaphragms with mirrors of this nature has been in use for some time. D. C. Miller² describes such a diaphragm connected with the axle by means of a quartz thread. Miller, in his very well known investigations, has made many photographs of sound with an arc-ray as a source of light. Oscillographs have, of course, been in use for a number of years.

In order to secure a time-line sufficiently accurate for the purposes of the present experiments, a similar ray from a Mazda light was conveyed to a mirror mounted upon a spring in front of a small magnet, through which a weak, alternating current was passed.³ By means of this a rate of approximately sixty vibrations per second could be counted upon in the ray of light reflected from the mirror. This vibrating ray was directed, by means of a lens and a second mirror, through the window in the partition to a horizontal slit just in front of the moving film. The image from the ray, being a vertical line of light, crossed the slit at right angles. A similar ray from the mirror in front of the diaphragm was projected so that the image fell at right angles to the slit, a little to one side of the vibrating time-line image. The intersections of these two lines with the slit formed two points of light, vibrating in a horizontal direction, and photographing themselves upon the vertically moving film in the form of two continuous curves. By means of rheostats, the electrically driven machinery within the camera could be adjusted to carry the film past the slit at varying rates of speed.

The chief object in the present set of experiments was to obtain as

² Miller, D. C., in *Engineering*, 1912, p. 550 ff. Some time after the present experiments were finished, Miller's latest investigations have appeared in the form of a book, *The Science of Musical Sounds*, N. Y., 1916. This contains a detailed description of his "phonodeik."

³ The disadvantage connected with a time-line produced by the vibrations of a tuning-fork is that even a very faint humming sound will affect a sensitive diaphragm.

accurate and as measurable a record of the human voice as possible without the restraint and artificiality imposed by having to speak into voice-keys or mouth-pieces of any kind. By employing a rather sensitive mica diaphragm it was possible, on account of the noiselessness of the machinery employed, for an observer to stand inside of the cabinet at a comfortable distance from the instrument and have his speech recorded, without his even knowing it. A complete solution, consequently, seems to have been found to the problem whose difficulty prevented Sievers, in the *Vorwort* to his *Phonetik*, edition of 1901, from giving his sanction to experimental phonetics.

In addition to other precautions that seemed to be advisable, the diaphragm was roughly calibrated. The points of pitch at which phenomena of resonance occurred were located and graphs of the results were made for purposes of correction in any later measurement of amplitudes. The testing of the diaphragm was effected by means of organ pipes under pneumatic pressure. During this operation, as well as during the process of making photographs, an attempt was made to keep the cabinet at a constant temperature of about 18 degrees Centigrade.

The apparatus made use of in the series of experiments carried out in the sound-room of the Psychological Department included, first of all, a Leipzig time-sense machine, driven by clock-work, which also governed the motion of a kymograph. The adjustments were made so that the revolving bar of the time-machine made one revolution in four seconds, .06 of a second being registered by one millimeter on the surface of the smoked drum operated by the kymograph. By means of a microscope, readings to .01 of a second were easily possible. For the purposes of the experiments, however, an accuracy of .02 of a second was all that was desired. This, too, is a safer basis of estimate, when the slight irregularities of all kymographs, even when driven by clockwork, are taken into consideration.

The seven mercury contacts on the circumference of the time-sense machine were used in several ways. For the experiment in simple syncopation six of them were placed at equal intervals of sixty degrees, while the seventh one was sufficiently depressed to avoid a response from the electric sounder attached to the machine. By this means, as the bar revolved, a series of successive clicks, .66 sec. apart, was produced by the sounder. A pointer resting on the revolving drum and connected with the sounder registered upon the drum the series of clicks. A second pointer, connected with an electric key for tapping, registered the attempts of the observer to introduce syncopating taps halfway between the clicks of the sounder.

The same setting of the contacts was used when the observer was asked to tap five times, as regularly as possible, during the time that the machine produced seven clicks. For the acceleration experiment the seven contacts were set in such a way that their intervals produced a series of clicks whose spacing, in terms of time, was as follows: .7 sec., .6 sec., .5 sec., .5 sec., .6 sec., .7 sec. After the reproductions of this series made by the observer had been measured, according to the system explained in Appendix II, the contacts were set from time to time so that the observer could himself hear from the machine those of his reproductions chosen for final judgment and comparison with the original series as given by the machine. This procedure made it possible to carry out to some extent Müller's suggestion⁴ in his *Methodik* that in experiments with time-sense an observer might by some such means be given an opportunity to compare his reproductions with the original stimulus in both orders of time.

In addition to the time-sense machine and kymograph with its attachments, a sound pendulum, a soundless pendulum, a box metronome, an outside metronome mounted upon felt, a Stern variator with pneumatic tank attachments, an Edison four-minute cylinder phonograph, and finally a small specially constructed metal drum about five centimeters in diameter, covered at one end with a thin sheet of phosphor-bronze, were employed in the various tests. The drum was calculated to produce, when struck by a stick tipped with a small piece of hard rubber, a clear but not obtrusively loud sound, with as little suggestion of musical tone as possible. When the drum was tapped, accordingly, the attention of the hearer could be concentrated upon the length of the time intervals between the blows and the variations in the intensity of the latter. A series of taps upon this drum, performed by Observer No. 1 (in accordance with "felt" syllables in passages of prose, and notes in music), were recorded upon the phonograph. Judgments were passed upon the nature and presumable origin of these taps, by the remaining observers. A tunable reed-organ was used in the harmony tests. Some of the tests for types of imagery and time-estimation were made in the padded cabinet in which the sound-photographing apparatus was installed.

⁴ Müller, G. E., *Die Gesichtspunkte und d. Tatsachen d. psychophysischen Methodik*, Wiesbaden, 1904, p. 205.

APPENDIX II
EXPERIMENTAL PROCEDURE

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*(First Day)***I. Preliminary questionnaire:**

1. Age, descent, profession, amount of musical training.
2. Describe your favorite type or types of music and your mental and physical reactions on hearing such music.
3. Do you consider yourself as of a more or less even temperament or given to moods?
4. Are you slow or quick in forming likes and dislikes?
5. Have you ever been affected by music in a manner that could have been plainly visible to others?
6. Describe your interest in dancing.
7. Can you imagine yourself as interested in complicated drum-beating? To what extent?
8. If interested in verse at all, mention one of your favorite poets.
9. If interested in prose style at all, mention one of your favorite authors in this connection.
10. Have you ever written original verse?
11. Describe the sort of events that usually occur in your dreams. Do you see things, do things, or hear things, chiefly?
12. Can you mention any actual word or words you have heard in a dream?
13. Can you name any sort of activity in which you could take a definite interest because of subtlety in its form? In

other words, could you enjoy a pattern or a problem just because it was elusive?

14. Do you consider that your scientific or artistic or practical interests predominate?

II. **Pulse-rate** (rough): Determined with stop-watch for two ten-second stretches and one thirty-second stretch.

III. **Breath-rate** (rough): Observer raises finger at the beginning of each inspiration, while the experimenter records the number indicated during thirty seconds.

IV. **Image-type test** (rough):

First half: The observer is given a list of printed words concealed by a loose sheet of paper. He slips the sheet down so as to expose one word at a time. The instant he has read the word he closes his eyes and attempts to identify the first image that comes into his mind after the image of the printed word itself, if this happens to persevere. Thereupon he opens his eyes and marks the nature of the image according to the following abbreviations:

V - visual	Temp - temperature
A - auditory	P - pain
Olf - olfactory	Org - organic
G - gustatory	K - kinæsthetic
T - touch	O - nothing at all

All images of actual *words*, seen, heard, or spoken, are to be marked as such: V-verb, or K-verb, A-verb. Units of vividness are also to be added: 3 for vivid, 2 for medium, 1 for dim.

Second half: The observer, with his eyes closed, hears a list of words read by the experimenter. After each word the observer reports the kind of image evoked according to the above classification.

LIST OF STIMULUS words:

- (read by observer): hurry, fountain, clover, yawn, pool, steam, decayed tooth, wind, rooster, whistle.
- (heard by observer): plunge, bell, breathing, spool, ice, flutter, skate, fish, owl, crush.

Observer No. 1, who was chosen to figure in a special way in the latter part of the experiments, was given an additional test several days after the first one. Both tests were given in the padded cabinet, with the following list of words for the second test:

1. (read by observer): dynamite, syllable, splash, coffee, swift, lion, thrash, bumble-bee, plaster, salt.
2. (heard by observer): storm, waltz, apple-tree, rain-drops, health, lemonade, drum, sea-gull, donkey, splinter.

V. Unit-accuracy — simple form:

Task: To reproduce at once, as the unit of a regular series lasting for fifteen seconds, an interval given by two clicks of the sounder in connection with the time-sense machine. Observer to hold himself in readiness for an interval of any size between one fifth of a second and two seconds, adjusting himself as quickly as he can, so that the interval between the last click of the sounder and his first tap shall be as close as possible in size to the stimulus interval he is attempting to reproduce. The signals are: "Close your eyes!" "Ready!", "Now!", and "Stop!".

1. *Preliminary:* E (experimenter) produces rough .2 sec. interval by moving bar across one of the contacts twice. O (observer) begins at once to tap on key till E says "Stop!"
2. *Preliminary:* E produces rough 2 sec. interval. O reproduces in the form of a series, according to directions.
3. *Regular:* O is instructed to be prepared for any length of interval between the limits assigned. Immediately after "Now!" sounder connected with time-sense machine produces .2 sec. interval as the standard. O taps series for fifteen seconds.
4. *Regular:* Time-sense machine (tsm) produces .7 sec. as a standard. O taps series.

(The apparatus is provided with a switch, cutting off the sounder from the mercury contacts until the revolving bar has attained its normal speed.)

VI. Subjective rhythm: (metronome in padded box)

1. *Involuntary:*

(a) No suggestion:

Instruction: "You are going to hear a series of sounds for about forty-five seconds. When it is over you are to dictate a brief account of your state of consciousness during the series — what you hear, how it affects you, etc."

Signals: "Close your eyes!", "Ready!", "Now!", "All-right!".

Metronome at .3 sec. (approx.) for forty-five seconds.

O dictates introspection.

(b) With suggestion of grouping idea:

Instruction: "Describe as exactly as you can the relative duration and intensity of the sounds you are about to hear. Notice whether the series appears to be a succession of perfectly even sounds, or whether any particular form of grouping is evident."

- (1) Metronome at .8 sec. (approx.) for forty-five seconds.
O dictates introspection.
- (2) Metronome at .3 sec. (approx.) for forty-five seconds.
O dictates introspection.

2. *Voluntary:*

Metronome at .3 sec. O to close eyes and raise finger as soon as he has clearly established (by imposition) the following groupings:

- (a) 3's
- (b) 5's

(O's No. 1, 2, and 3 were also tested for 2's, 7's, and 11's in voluntary rhythm and for additional rates of .5 sec. and .8 sec. for involuntary rhythm.)

VII. **Acceleration experiment** (test for "swing"): (tsm, kymo, metr)

Task: To hear a series of regular intervals given by a metronome (at .7 sec.) until a subordinate second beat has been felt (subjectively) between every two beats of the metronome. If O finds this difficult he is asked to say to himself the word "Top" (with distinct enunciation of the final consonant) each time he hears the click of the metronome. The letter "p" thus marks the secondary beat required. As soon as this transformation of the beats of the metronome into a series of subjective bars or groups of two is either attained or found to be impossible, the experiment proceeds at once.

O is to hear from the tsm sounder a series of six intervals, marked by seven clicks. He understands that the first of these intervals is the same which he has been subjectively cutting in two during the beats of the metronome. He also understands that the succeeding five intervals are faster or slower variations of the standard interval, and that it is his task to catch the progression in speed, whether positive or negative, and reproduce it by a series of seven taps upon the key connected with the kymograph. He has been told the reason for imaging a secondary after-beat for each click; i.e., the after-beat is to prevent him from instinctively regarding the series of six intervals as a rhythmic group of long and short intervals bearing relations of simple

proportion to each other, instead of as a series of accelerating and retarding values of the standard interval. The need of these precautions was determined by preliminary experiments.

After E is convinced, by signals or otherwise, that O is able to regard the metronome series as a succession of bars or that the achievement is in his particular case an impossibility (which did not occur in the course of the experiments), the metronome is stopped, and after the lapse of a few seconds, the time-sense machine produces the series of six intervals, arranged according to the following progression: .7 sec., .6 sec., .5 sec., .5 sec., .6 sec., .7 sec., — in other words, an acceleration of the standard interval up to a momentary level of .5 sec., followed by a retardation back to the standard interval. This series is given by tsm three times, with an interval of about four seconds between. After the third time, O first images what he has just heard, then taps upon his key, to the best of his ability, a reproduction of the six intervals.

Immediately after this, O announces "a" or "b" degree of confidence in having expressed his feeling of the swing of R (the series of intervals as given by tsm). Eight such reproductions are recorded, after every two of which O chooses one as the "better" of the two, or at any rate his "choice" for purposes of measurement.

E's procedure in measurement is determined as follows: In any case, only the four reproductions judged as "better" are to be measured, and the two most approximately accurate, selected for the later continuation of the experiment; but precedence is given in this choice to those of the four "better" reproductions which are also marked with an "a" (degree of confidence). If three or more "a's" occur, the two most accurate are taken; if only two "a's" occur they are taken, irrespective of measurement; otherwise, the one "a" that occurs and the most accurate "b," or, if no "a's" occur, the two most accurate "b's." The two reproductions thus selected are kept, after being measured, for the second day, when O is given a chance to hear them reproduced by tsm and to compare them with the original series in both orders of time, according to the suggestion derived from Müller's *Methodik*.¹

The acceleration experiment (first day) is concluded as follows: Tsm gives R again three times. At every click of the machine O murmurs "Top" aloud, adjusting his "top's" as well as he can

¹ Müller, *op. cit.* p. 205.

to the clicks of the sounder, with the attempt to utter the final "p" each time as a secondary beat between the clicks. After he has thus accompanied R three times, he records as before his memory of R, uttering "top" again each time that he taps his key. Finally, he is told to keep R in mind for future experiment.

VIII. Schedule syncopation: (metr and kymo)

O listens to metr at .5 sec. interval for ten seconds; then, after the regular signals, taps according to schedule, omitting a tap where the schedule contains a zero, and substituting for it a subjective beat, in such a way as to approximate as closely as possible to the standard interval, as given by the metronome, in the execution of his recorded taps and the subjective beats interpolated.

1. *Preliminary*: O taps 0'0 00'0 0'00 '00', etc. (repeated) for twenty seconds.
2. *Regular*: O taps same schedule for twenty seconds.

IX. Complex coördination, involving unit accuracy: (metr, kymo, foot-key)

O to accompany metr at .5 sec. and follow schedule.

RF = right foot rf = right finger

LF = left foot lf = left finger

"Ta" and "clo" are to be uttered where they occur in the schedule, and taps by feet or fingers omitted. Time is given for O to understand schedule thoroughly, then metronome is started, and after the usual signals from E, O begins.

1. *Preliminary*: O accompanies metr according to the following schedule: RF rf lf "ta," LF rf lf "clo," etc. (repeated) for twenty seconds.
2. *Regular*: O follows same schedule for twenty seconds.

X. Walking-rate, etc. (rough):

O is asked to walk up and down the main hall of the building until he has attained what he considers a normal, comfortable walking gait, such as he would fall into if he were walking for pleasure. He is to keep up this gait, as far as he is able, when he reënters the laboratory, where his rate is measured by E with a stop-watch, according to the number of steps he takes within thirty seconds.

Similarly, O is asked to nod with his head, tap with his finger, sway with his hips from side to side as he stands erect, and finally to utter the syllable "ta," at what he considers comfortable

rates, such as he would find easy to keep up for some time. Each of the rates is determined by counting the number of movements made within a stretch of ten seconds. O is also asked to specify which of the above measured forms of motion he prefers. Longer tests would, of course, be more accurate.

XI. Pitch memory (rough): (Stern variator):

O hears a tone from the variator at a certain pitch. It is given three times, with a duration of about one second and an interval of about one second. Then comes an interval of about three seconds, after which ten notes are sounded, three of them at the original pitch and the rest above or below it. O is asked to identify the position of the notes corresponding to the original stimulus on a blank schedule which is given to him.

1. *Preliminary*: Instructions accompanying schedule:

"The following ten spaces correspond to the series of ten notes you will hear, after the original R has been given three times. This original R will occur altogether three times in the series. Mark the spaces where you think it occurs with an R."

Schedule: — — — — — — — — — —

In giving R and the subsequent series E's schedule is as follows:
R = 240 (given three times)

Series: 241 239 **240** 242 238 **240** 237 **240** 243 239

2. *Regular*: A similar procedure is followed except that O hears the giving of the stimulus and the subsequent series repeated as a whole three times. During each time he marks upon a schedule the places where he thinks R occurs. A final line of ten blank spaces occurs upon the schedule on which he is to record his final revision of judgment, for which he is given twenty seconds.

E's schedule: R = 250

Series: 247 **250** 253 **250** 252 248 **250** 255 252 248

O's No. 1, 2, and 3 were also given the following test with a broader range. R occurred once in five.

E's schedule: R = 275.

Series: (a) 270 300 280 270 **275**

(b) 250 280 **275** 285 270

(c) 300 250 285 **275** 280

XII. Harmony memory, (rough): (tunable reed-organ)

O is to recognize where a given chord occurs in a series of ten. He is supplied with schedule blanks as before.

1. *Preliminary*: R = c g c' e' (c being middle c; c', the octave above).

Series: bgb'e' c#gc#e' cgc'e' bg#b'e' cgc'e' bg#b'e' c#gc'e'
 bgb'e' bg#b'e' cgc'e'

2. *Regular*: R = b#d#g#b'

Series: bd#g'b' bd#f#b' bdgb' begb' bd#f#b' begb' bdgb' bd#g'b'
 bd#f#b' bdgb'

XIII. Vowel-quality memory, (rough):

E chants vowels at low C. O is to identify a certain group of vowel sounds, containing five discrete members, as it occurs in a series of five such groups. Schedules are used as before.

1. *Preliminary*: R = ee ay ee oo oh (rate of about two vowels per second, given three times, 1.5 sec. interval)

Series: ee ee ay oh oo
 oh ay ee oo oh
ee ay ee oo oh
 ee ay ee oh oo
 oo ee ay oo oh

(1.5 sec. interval between groups, 10 seconds at end for checking)

2. *Regular*:

- (a) R = ah ay ee oo oh (given three times)

Series: ah ay oo ee oh
 ay oo ee ay oo
 ay ah oo ay oh
ah ay ee oo oh
 ay ah ee oh oo

- (b) R = ay ee ay ah ee

Series: ah ee ee ah ay
 ah ee ay ah ee
ay ee ay ah ee
 ay ee ah ee ay
 ah ee ay ah ee

- (c) R = oo oh oh ah oo

Series: oh oo oo ah oh
 oo oh oh oo ah
 oo ah oh oh oo
 ah oh oh ah oo
oo oh oh ah oo

(*Second Day*)

XIV. Choice of "swing" reproductions: (tsm)

O's two reproductions selected from the first day's measurements are referred to as 1 and 2; the original six intervals, as given by the machine, are referred to as R.

E sets contacts for R, then for 1; then for R again, and then for 2. O hears all four with closed eyes, being instructed to compare 1 and 2, as he hears them in this order, with the original stimulus. An interval of about thirty seconds occurs between every two series of clicks that he hears.

E now sets contacts first for 1, and then for R; then for 2, and then for R again. O makes a final choice between 1 and 2, as to which comes closer to his feeling for the "swing" of R.

O is asked not to practise for a week his memory of R, either by tapping or with the voice, but to be ready at the expiration of that time to utter, by means of seven consecutive "tops," his memory of it. This reproduction, spoken in the sound-photographing cabinet, will be recorded on the film.

XV. Intensity memory (rough): (sound-pendulum)

O hears a stimulus intensity, roughly produced by the blow of a pendulum, weighted with a ball of metal at the end, falling through a certain distance upon a piece of stationary metal. He is then asked to identify its triple recurrence in a series of ten such impacts. Five degrees of intensity (rough) are produced by allowing the sound-pendulum to fall from positions of varying height. In the present test, which was meant to be nothing more than suggestive, the pendulum was allowed to fall from these five positions by the right hand of E. His left hand was used to catch the pendulum on its rebound. The sound-pendulum apparatus was encased in a box lined with heavy felt, in order to prevent as much reflection of sound as possible. O first heard the five intensities given in order, beginning with the weakest. After a pause of a few seconds, E gave the stimulus intensity three times, about two seconds apart. Then, after a pause of about three seconds, the series was given. A soundless pendulum was in sight of E, to assist in determining the pauses. The sounds in the series were given about two seconds apart. The following is E's schedule, in which 1 represents the weakest intensity; 5, the strongest.

Stimulus or standard intensity: 3 (given three times)

Series: 4 2 5 3 4 3 2 1 3 5

XVI. Drum-beat rhythm of texts:

Three sentences, marked A, B, and C, were used in this experiment:

- A. De Quincey, "Our Lady of Darkness," from *Confessions of an English Opium-Eater*, Masson's edition of De Quincey's works, London, 1890, Vol. XIII, p. 368:

"For she can approach only those in whom a profound nature has been upheaved by central convulsions; in whom the heart trembles and the brain rocks under conspiracies of tempest from without and tempest from within."

- B. Newman, "Grammar of Assent," Longmans, Green, & Co., 1909, p. 78:

"Then he comes to understand how it is that lines, the birth of some chance morning or evening at an Ionian festival, or among the Sabine hills, have lasted generation after generation, for thousands of years with a power over the mind, and a charm which the current literature of his own day, with all its obvious advantages, is utterly unable to rival."

- C. Pater, "Leonardo da Vinci," from *The Renaissance*, Mac-Millan's ed., London, 1914, p. 110:

"He who thus penetrated into the most secret parts of nature preferred always the more to the less remote, what, seeming exceptional, was an instance of law more refined, the construction about things of a peculiar atmosphere and mixed lights."

E gives the three sentences to O with a word or two of explanation of the connection in which they were written, but with no information as to the author or the name of the essay or book in which they occur. O glances over A, B, and C, and dictates a brief account of what he considers to be the quality of each with regard to mood (as stormy, calm, solemn, gay, poetic, matter-of-fact, etc.); thought (simple, complex, etc.); and, finally, vowel and consonant color (dark, light, or mixed; smooth, rugged, or mixed; etc.).

O then beats on the phosphor-bronze drum (not more than three times) the syllabic rhythm of A, B, and C, as he reads them to himself. After the first drum-beating he is to pass judgment on his own performance, so that, as far as possible he may be able to answer the following questions: How would the series of drum-beats you have just performed affect you, if you heard someone else beating it upon a drum, and had no idea of its being connected with a passage of prose? If it would interest you, can you say

why? If not, can you say why? Does your drum-beating fall into parts? If so, are they related?

O then grades A, B, and C, with units (3 = high, 2 = moderate, 1 = low) in respect to three different qualities:

1. Fitness of form (rhythm and tone-color) with regard to content (mood and thought);
2. Ease and spontaneity of rhythmic flow;
3. Complexity of thought and mood problem (O is to grade as "low" a sentence in which it would appear to be an easy task to find fitting rhythm for the underlying thought and feeling, if one were the author).

O then adds a grade of 3, 2, or 1 (in this case units of *relative order*), with respect to the pleasure he derives from the drum-beat rhythm of each of the sentences.

XVII. "Possibility" scanning:

O's No. 1, 2, and 3 were the only ones that took part in this experiment. They were asked to scan texts A, B, and C of the previous experiment upon the following basis:

Each syllable and pause, felt as such, is to be marked with units (3 = high, 2 = moderate, 1 = low) of "possible" intensity, "possible" pitch, "possible" duration, and "possible" additional weight or interest, due either to thought and mood or to details of tone-color, etc. "Possible" is understood to mean also "probable" — that is, it includes the degrees of these four qualities which the observer can *easily* imagine himself as attaining under different moods. The object of this experiment is to determine the safety or danger of announcing any one scanning of a passage as an indication of its final "rhythmic" value.

(Third Day, one week after Second Day)

XVIII. Pulse consciousness:

O sits in the dark, inside of the padded cabinet, in a relaxed position. At a signal from E, there begins a stretch of forty seconds, at the end of which O is to report whether he was conscious at all of his heart-beats or of pulse-beats in any part of his body.

XIX. Breath-segments:

O is now asked the following question: "Do you ever think of your breath as divided into parts in any way?"

O is asked to breathe for thirty seconds and report again. He is then asked more definitely if he thinks of his inspirations as

bearing a simple mathematical relation to his expirations, or, rather, as bearing a vague relation to each other.

XX. Photograph of seven-day-memory reproduction of acceleration series:

O is reminded that the stimulus consisted of seven clicks, involving acceleration and retarding. They are to be reproduced, in as exact a manner as possible, by uttering the word "top" seven times. The final consonant in "top" is to be pronounced distinctly so as to cut the intervals approximately in half. O is to hear, for about ten seconds, a metronome beating regularly the first interval of the series. He has no information except his memory as to the extent of acceleration and retarding to which this interval was subjected in the original series. He first makes a preliminary trial, after which his next reproduction is regularly photographed.

XXI. Judgment and line-division:

O is given a card on which are drawn three lines, 60 mm. in length. The first two are for practice; upon the third, O is to indicate a division of the space into six intervals, corresponding in their relations to the intervals in the standard acceleration series. He is then asked to report his judgment as to the general relations which these intervals bear to each other: a is greater than b, b is greater than c, c is equal to d, etc.

(Fourth Day)

XXII. Simple syncopation:

Six of the mercury contacts of the time-sense machine are set at a distance of 60 degrees from each other, so that a continuous series of clicks from the sounder are produced at an interval of .66 sec. These successive clicks are recorded upon the smoked drum. Any clicks made by O, when he taps upon his key, are recorded in a line parallel to the first. In this way, when the lines are viewed horizontally, O's record is directly under that of the standard clicks.

O is instructed to begin tapping, after the signal "now," just halfway between the taps of the sounder, and continue this form of syncopation until he hears (after fifteen seconds) the signal for stopping. His task is, of course, to tap just .33 sec. after each tap of the sounder; so his individual taps are measured from a point on his record-line directly under a tap-record on the standard line, and rated according to how they correspond to the distance

on the drum representing .33 sec. In this way, his first ten taps are taken; their distances from the measuring points just described, averaged; and thus their Gross Constant Error and Average Variable Error, determined. One preliminary test is given.

XXIII. Reaction to five's and seven's:

E watches soundless pendulum marking seconds, and taps groups of five's on the phosphor-bronze drum at the rate of five taps to two swings of the pendulum. The first tap of each group is accented. Similar procedure for seven's.

Instruction: "Listen to the following series of sounds, and raise your finger when you have clearly established the nature of whatever motor reaction, if any, they produce. Note also, as carefully as you can after this, whatever phenomena of muscle tension and breath affection, if any, occur. This done, begin to inhibit as far as you are able the motor reaction instituted, so that later you may be able to grade it as 3, 2, or 1, with respect to difficulty in inhibiting. You will have about fifteen seconds for this after raising your finger."

XXIV. Complex syncopation (involving regulated practice):

The task is for O to tap groups of five's on his key, while the time-sense machine is clicking seven's. The contacts are set as for simple syncopation — so that the clicks will be .66 sec. apart. The experiment is divided into six stages:

1. At every seventh click of the sounder E says "One!". At E's third "One!". O is to begin quite roughly, tapping, as well as he can, five equal taps between E's "One's." He is thus tapping five against seven. This continues for ten seconds.
2. E now taps upon the phosphor-bronze drum an approximation of the way the two sets of clicks should sound when played together. In order to do this, E has practised the task for several months, until he is able to do it in more or less of an automatic fashion. As he taps this "rhythmic tune" upon the drum, he counts aloud as follows, giving numbers for the seven's and saying "and" for the five's (on "one," of course, the two coincide):

"One, two-and, three, and-four, five-and, six, and-seven."
The "and" between two and three is closer to two than it is to three and so, the "and" between six and seven is closer to seven; but the "and's" just before four and just after five are exactly twice as close to their respective numbers as the first pair.

O now taps his five's as before, but counts aloud as he taps, uttering numbers for the taps of the machine and saying "and" for his own taps. E still marks off every seventh click of the machine by saying "One!", O having begun upon his third "One!".

3. E now explains a black and white chart hanging on the wall, which is meant to indicate the effect (in terms of space, mathematically divided), of superimposing five intervals upon seven. E counts as before, following with a pointer the spaces on the chart. *He adds, however, a simple humming tune to the counting, so that two bars of the five-seven syncopation form an easily remembered melody.* O is asked to do likewise, accompanying E, until the two-bar melody has been hummed three times. O is also asked to tap with his left hand for the seven's, and with his right on a dead key for the five's.
4. O is now instructed to be ready for another trial, the results of which are to be recorded on the drum. E hums, counts, and beats with a pointer the rhythmic melody once more, and then starts the serial clicks of the time-sense machine. O is expected to begin as soon as he is comfortably ready, and to tap five's to the machine's seven's, counting and humming the rhythmic tune. E no longer marks off the groups. This is accomplished by O's first tap, which starts the syncopating group.

O is to continue his syncopation until stopped by signal from E at the end of fifteen seconds. In the meantime, O is expected to tap off the clicks of the machine with his left finger on the table, while he makes recorded taps of five's, with his right. He is no longer expected to think of himself as tapping five's against seven's, but as *tapping the tune he has heard*, with the accents (numbers) assigned to his left hand and the unaccented "and's" to his right. Both, of course, come down together on "One."

5. O is now instructed to watch E, and, in at least an incipient form, imitate everything he does. E then, as he hums the rhythmic melody, taps the seven's with his left index-finger and the five's with his right; and follows this with a performance in which all the fingers of both hands are used. Thereupon he performs a sort of rhythmic step, divided into two phrases of seven, at the same time that he executes with his arms two phrases of five. While he is doing this, O is asked to place his hands upon his knees, and beat five's while he taps

series in relative order of merit as pleasing. You will then grade them again as 'elusive' or puzzling."

After O hears the reproduction of the series upon the phonograph, the grades are recorded upon a schedule blank provided. The five sets of taps, of course, simply represent O No. 1's interpretation of the tasks assigned. E had given O No. 1 five schedules to follow in the order prescribed, with the instruction to tap, in a perfectly natural manner, the duration and intensity of the notes and syllables as *felt*. According to these instructions, for instance, the word "hours" was tapped as two syllables.

After this first hearing of the series and after the recording of the grades O is asked: "Did it occur to you while listening to any one of the series to beat time to it (by nodding, tapping, etc.), in other words, to respond to it with any form of regular motor accompaniment? Did the idea of syncopation occur to you?"

Before the second hearing of the series, O is instructed as follows: "See if you can beat strict time, with a degree of satisfaction, to any of the series. Be prepared to grade the five with units (3, 2, or 1) for ease and satisfaction in this respect." At the end of the phonograph reproduction, O is asked if he felt any effects of syncopation.

Before the third hearing of the drum-beats, the instructions are: "Keep the possibilities of syncopation in mind, and see also if there are any of the five arrangements of sounds to which you can, with a degree of satisfaction, beat a less strict time-unit — that is, one which accelerates or retards within the limits of what strikes you as merely an appropriate adjustment, with just such liberty as you could enjoy in regular music."

Schedules are provided on which O grades the five series, as directed.

Before the fourth hearing, O is told that regular prose is the source of two of the series of drum-beats; regular music, haphazard words, and haphazard music, the sources of the other three. He is asked to mark upon a schedule provided, his judgment as to which is which. He is also to grade each judgment with "a," "b," or "c" degree of certainty. After that he is once more to grade the five in relative order: first, as pleasing; and second, as elusive.

XXVIII. Questionnaire:

1. Do you clearly understand the possibilities of syncopation in connection with motor response to a series of drum-beats? (E explains the subject, in case of a negative response.)

2. Do you enjoy its introduction, or do you usually resent it?
3. Do you understand the possibilities of acceleration and retarding? Describe their effect upon you in the "swing" experiment.
4. Would a certain amount of acceleration or retarding in a series of drum-beats add any possible interest to the series? Could you think of its adding great interest?
5. Do you take pleasure at all in the idea of making equivalences or substitutions rather than simple balancings of two equal masses against each other? Does the idea of weighing a pound of lead, small in size, against a pound of feathers, large in size, interest you aesthetically?
6. What sort of motor response would you most enjoy making to a series of sounds that impressed you as in any way rhythmical? Would the response be segregated or serial?
7. If a series possessed merely an elusive charm, hard to analyze, just how can you imagine yourself as responding?
8. Can you imagine yourself as taking pleasure at all in a series of "unitary" pulses (not grouped into two's and three's, etc.)?
9. If each of these pulse intervals were filled in with varying numbers of smaller intervals, without blurring the larger, dominant pulses, would it add interest or detract?

XXIX. Schedule tests

A. Drum-beat series No. 5:

O listens again to phonograph reproduction of drum-beat series No. 5 (haphazard music), and states its effect upon him (pleasant, unpleasant, or indifferent). O has not yet been told in any way that it is haphazard music.

E now gives O a schedule, recording one of E's own forms of organization of this objectively irregular series:

Schedule I:² 000' '00 0000 0'0' 00'0 '0'0 0'00 '0''
 *000 *000 *000 *000 *000 *000 *000 *000

This is a way of counting four-time (rapidly) to the series. The lower line represents the counts, and the upper line the way in which the beats in the record can be regarded as falling into the system. Each beat is marked by an accent. Three chief accents are also indicated.

E explains the schedule, then taps it on the phosphor-bronze drum, humming a simple tune as he taps. This is done three

² The schedule actually employed was very slightly different, but was not quite so clear as the above. The difference is unessential.

XXX. Questionnaire:

1. Did you at any point enjoy, or can you think of enjoying, record No. 1's rhythm without any motor response at all?
2. Can you think of any comfortable or satisfying motor response except beating time in some way?
3. Can you conceive of any possible way of beating time to the rhythm of a prose passage (without distorting the natural grouping of the words) except on the basis of an *elastic* under-unit, accelerating and retarding according to the mood?
4. When small groups of beats recur, either as exact echoes and suggestions of echoes, or obvious inversions and suggestions of inversions, irrespective of a time-unit, can you respond to them by a motor reaction with so high a degree of pleasure as when such groups recur in some recognizable connection with a time-unit?

XXXI. Unitary music: (first test)

Instruction: "Listen to the following series of beats with closed eyes, and state how it affects you."

E beats on drum the rhythm of bars six, seven, and eight (plus) of *The Temple of Memphis*, by Cyril Scott, after which O is asked whether or not he felt the recurrence of any time-interval throughout the series. E then instructs O to be ready to answer the following questions, after a second hearing:

1. (same question about the time-unit)
2. Did you respond with a motor reaction?
3. Did you notice that any group of the time-interval was *repeated* in a series?
4. Did you notice the subdivision of a dominating time-unit into groupings of two, three, four, etc?
5. State again how the drum-beats affect you.

XXXII. Unitary pulses:

Instruction: "Take your favorite type of motor reaction and continue it, at a rate which seems *pleasant* to you, for about ten seconds."

Question: "Did you think of the series of motions you made as in any way divided into groups?"

A negative answer means the presence of unitary pulses.

XXXIII. Unitary music: (second test)

E beats last five bars (tempo alone) of page 1 of *The Temple of Memphis*, and then asks the following questions:

1. What was the effect upon you?

2. Did the arrangement of beats in groups of varying size destroy your feeling that there was a unit to the series?
3. Did the variety in size of these groups add or detract interest from the series?

E instructs O to keep the last two questions in mind, and listen to the beats again. After a second report from O, E shows the text of the music to him and explains what is meant by the "unitary" basis.

XXXIV. Factors in organizing drum-beat series:

Instruction: "After hearing record No. 1 again, you will be asked: To what extent do the following suppositions assist or not assist in your case, to explain, or render less puzzling, *elusive* impressions of rhythm in prose beats such as you have just heard:

1. An elastic under-unit of time (accelerating and retarding), recurring in a series of similar groups, such as two's, three's, four's, five's, etc.?
2. The possibility of changing back and forth from a series of units grouped in two's, to a series grouped in three's, etc., as occurs in regular music? (See Schedule II, section XXIX, B)
3. The possibilities of syncopation, as a means of correlating with a time-unit what would otherwise be merely interfering elements?
4. The possibility of substituting for any unit-interval an equivalent group of smaller intervals, varying freely and unexpectedly in number from pulse to pulse, as occurred in the first experiment with the music of Cyril Scott? (Spontaneous substitution)
5. The consideration of the time-unit as forming in its recurrence, not necessarily a series of two's or of three's or of five's, but of *unitary pulses* (more or less elastic), capable of grouping themselves into clusters of varying size, depending upon the repetition of the unit itself, rather than upon the repetition of its groupings, for the fundamental organizing influence (as occurred in the second experiment with Cyril Scott)?
6. The imposition of a fictitious humming tune upon the series?

O then hears drum-beat record No. 1 (Walter Pater), after which he grades the six hypothetical factors with units (3, 2, 1), according to the degree in which each of them figures in whatever subjective organization of the series of drum-beats he experiences.

APPENDIX III

EXPERIMENTAL DATA

The table of contents prefixed to Appendix II applies also to this appendix, since the enumeration of results and brief comments upon them are given in sections corresponding to the steps in the experimental procedure. A large amount of material is included in the tabulations of data, which is not discussed in the main text. Just as the procedure was given almost in full, in order that whatever therein needs to be criticized might be frankly disclosed, so here an opportunity is afforded for careful sifting on the part of sufficiently interested readers. Such a mass of varied material can hardly fail to contain errors, of method or of computation or of statement.

Section I contains a rough description of the group of observers who took part in the tests. Section vii applies to the sense of "swing"; ix shows at the end the marked ability of Observer No. 7 to keep accurate time, in spite of various disturbances; xxii and xxiv, the excellence of No's. 1, 4, 7, 8, 11, and 12, in tests concerned with simple and complex syncopation. Toward the end of xxvii occurs the tabulation of judgments passed upon the five phonograph records, among which are listed the five judgments recorded by No. 7, who subjectively organized each of the records into an impression of regular music. xxxi, xxxii, and xxxiii furnish data with regard to unitary pulses. xxxiv shows the large amount of difference among the observers with regard to the subjective organization of haphazard series and the factors employed. It is of the greatest significance that No. 7 and No. 12, who have evinced aggressively rhythmic tendencies, both grade syncopation high. No. 12 makes it the chief factor.

*(First Day)***I. Preliminary questionnaire:**

Comparative estimates, obtained by grading answers with rough units. 3 = high, 2 = moderate, 1 = low.

Observer No.	1	2	3	4	5	6	7	8	9	10	11	12
Rough estimate of musical training:	3	0	2	2	0	1	3	1	0	1	1	3
musical interest:	3	2	3	3	1	2	3	2	3	1	2	3
interest in rhythm:	3	1	3	2	0	0	3	2	1	1	1	3
int. in literary style:	3	2	2	3	2	1	3	0	2	1	0	2
int. in artistic technique:	2	2	3	3	1	0	3	0	1	1	0	1
vividness of auditory imagery:	3	1	2	2	1	1	3	2	2	0	1	3
amount of motor response:	2	1	2	2	1	1	2	1	1	1	1	2
summary of rough units:	19	9	17	17	6	6	20	8	10	6	6	17

(presumably favorable to the perception or enjoyment of rhythm)

Observers arranged in relative order: (in % of 21 possible units)

O No. 7:	.95%
1:	.90
3, 4, 12:	.81
9:	.48
2:	.43
8:	.38
5, 6, 10, 11:	.29

Observer No. 1 is an amateur musician; O No. 4 is an English professor; O's No. 3, 5, 10, 11 are research students in the Department of Psychology at Columbia; O's No. 2 and 6 are instructors, and O's No. 8 and 12, professors in this department; O No. 7 is a professional musician; O No. 9 is a Japanese graduate student in Oriental Philology. The above list of preliminary grades has only suggestive value. O No. 11, for instance, in spite of his low position, ranks high in a number of the subsequent tests.

II. Pulse rate: O No. 1 2 3 4 5 6 7 8 9 10 11 12
(length of single pulse in seconds) .80 .76 1.00 .86 .725 .735 .59 .83 1.16 .64 .82 .89

III. Breath rate: 6.00 5.00 3.75 3.75 4.29 4.62 3.75 10.0 3.75 5.72 5.00 3.33
(length of single breath in seconds)

IV. Image-type test (rough):

V = visual, K = kinæsthetic (motor), Aud = auditory, Org = organic, etc.

- O No. 1: V 62 %, Aud 20 %, K 15 %, (others scattered)
- 2: V 60 %, Aud 20 %, K 15 %, " "
- 3: Aud-verbal 55 %, (others vague and scattered)
- 4: V 55 %, Aud 15 %, K 10 %, Aud-verbal suggestions
- 5: V 80 %. (rough result of previous tests)
- 6: V 60 %, " " " " "
- 7: K 40 %, V 20 %, Aud-verbal 20 %, Org 20 %
- 8: K predominates, then Aud (rough result of previous tests)
- 9: V 80 %, Aud 20 %
- 10: V 70 %, K-verbal 20 %, K 10 %, (distinctly deficient in auditory imagery)
- 11: V 60 %, Aud 20 %, K 10 %, (others scattered)
- 12: Aud predominates, then K, then V, (result of previous tests)

V. Unit-accuracy — simple form: (uas)

O's first ten serial reproductions of the standard interval in the second regular test are measured, their average obtained, and their average deviation from this average computed by means of the well-known formula discussed by Müller:¹

$$\text{Average Variable Error} = \frac{SD}{\sqrt{n(n-1)}}$$

This particular formula arbitrarily increases the obtained value for AVE, and is therefore advisable when the number of measurements is limited. The Gross Constant Error is obtained by subtracting the average of O's reproductions from the standard interval. The AVE and the GCE thus obtained are turned into per cents of the standard interval, and the O's are arranged by means of these values into two series of relative order.

S (standard interval) = .7 sec.

O's arranged in relative order: (where the values are the same for several O's, the latter are arranged, for convenience, in their serial order).

GCE uas (unit-accuracy — simple)	Ave uas
O No. 1: -.002 (% of S)	O No. 1: .02 (% of S)
7: -.01	9: .02

¹ Müller, *Methodik*, p. 192.

5: +.01 +	7: .03	9: -.14 +	5: .05
6: -.02	8: .03	4: -.15	4: .06
11: +.02	11: .04	3: -.17	12: .07
8: -.06	6: .045	10: +.21	10: .09
12: +.14	3: .05	2: -.30	2: .12

Under conditions of accuracy in the present experiment a difference between two observers of .005 is not enough to produce a real distinction. Observers No. 1 and 9 have the smallest average variable error, which means that they are steadiest in this particular test in adhering to whatever reproduction they tend to make of the standard interval. O's No. 1 and 7 and 5 have the smallest gross constant error, which means that their average reproduction is most nearly equal in size to the standard interval. O's Nos. 1 and 7 have slightly underestimated it, as is indicated by the negative signs; O No. 5 has overestimated it. O's No. 10 and 2 are both the most unsteady of the group (in this particular test) and the most inexact.

VI. Subjective rhythm:

1. *Involuntary* (non-suggested, and suggested):

System of grading:

Grade 1: Observer mentions perceptions of rhythmic grouping in the non-suggestion series and in both the suggestion series.

Grade 2: O mentions perception of grouping in the non-suggestion series and in one of the suggestion series.

Grade 3: Groups mentioned only in the two suggestion series.

Grade 4: Groups mentioned on only one of the suggestion series.

Grade 5: No groups mentioned in any of the series.

Observers arranged according to grades:

Grade 1: O's No. 1 3 4 8 11 12

Grade 2: 5 6 7

Grade 3: 2

Grade 4: 10

Grade 5: 9

Observer No. 9 seemed to have no tendency to subjective involuntary rhythm in this test.

2. *Voluntary:*

System of grading:

Grade 1: Observer signals the establishment of subjective groups of 3 in the first test and of 5 in the second, both within ten seconds.

Grade 2: O announces 3's and 5's within thirty seconds.

Grade 3: O fails in one of the tests, but announces the desired grouping in the other within ten seconds.

Grade 4: O fails in one, but announces grouping in the other within thirty seconds.

Grade 5: O fails in both.

Observers arranged according to grades:

Grade 1: O's No. 2 5 12

Grade 2: 7 8 10

Grade 3: 1

Grade 4: 3 11

Grade 5: 4 6 9

Some of the observers announced that their failure to establish groups of 3 or 5 was due to the overpowering strength of subjective 2's or 4's. This was especially true with O's No. 4 and 6. O No. 9 announced that he could not force odd rhythms of any sort.

VII. Acceleration experiment (test for "swing"):

Standard series: .7 .6 .5 .5 .6 .7 sec. (Sum = 3.6 sec.)

A. *Equations of trend:*

1. (for first three diminishing — i.e., accelerating — intervals)

$$y = \frac{8-x}{10} \quad (y = \text{length of interval, } x = \text{position in the series})$$

2. (for last three increasing — i.e., retarding — intervals)

$$y = \frac{x+1}{10}$$

B. *System of grading:*

1. Gross Constant Error: the difference in seconds between O's reproduction of the whole series and the sum of the six standard intervals (3.6 sec.). The result is finally expressed in % of 3.6.
2. General Trend: Approximation of O's reproduction to standard series. a, b, c, d, e, f, represent the six intervals of the

standard series in succession; a' , b' , c' , d' , e' , f' , represent O's reproductions. Errors in approximation less than .06 sec. (1 mm. on the smoked-drum record) are not regarded as falsifications. This, of course, simply puts an arbitrary interpretation upon the meaning of general trend. Two successive intervals, equalling each other in the standard series, are considered as equal in O's reproduction, if within .06 sec. of each other. Where the relation between two standard intervals is a difference of .1 sec., a difference of .1 sec., plus or minus .06 sec., between O's reproductions of these two intervals, is not regarded as a falsification in general trend. In other words, $a' - b'$ must be at least .04. and not more than .16, in order not to be regarded as a falsification. Where b is less than a , b' must be less than a' , within these limits.

The six standard intervals involve thus seven conditions of trend: $a - b = .1$, $b - c = .1$, $c = d$, $e - d = .1$, $f - e = .1$, $a = f$, and $b = e$. Observers are graded according to the approximate conformity of their reproductions to these seven conditions. This results in seven intervals of merit value between 0 and 7/7 (100%), or eight grades including the levels of 0 and 100, into which observers fall for the present purposes of classification. The grades have no final value corresponding to their appearance of accuracy.

Grade 1, in which no falsifications occur, is thus marked as 7/7, or 100%; Grade 2, in which one falsification occurs, is marked as 6/7, or 86%; Grade 3, as 5/7; Grade 4, as 4/7; Grade 5, as 3/7; Grade 6, as 2/7; Grade 7, as 1/7; and, finally, Grade 8, in which all the seven conditions are falsified completely, or else not observed within the limits of .06 sec., as described above, is marked as 0. This zero is, of course, not absolute.

3. Average of Deviations $\left(\frac{\text{Sum D \%s}}{7} \right)$ from the seven "Relativity Conditions," each deviation being expressed in % of the respective relativity condition from which it deviates:

The "Relativity Conditions" are the relations, obtained by division, between the six standard intervals. Only seven of these relations are chosen as significant. They are as follows:

$$a/b = f/e = 1.17$$

$$b/c = e/d = 1.20$$

$$c/d = a/f = b/e = 1.00$$

Let $a'/b' = L$ (the proportion existing between the first and second interval of the observer's reproduction)

$$\begin{array}{ll} b'/c' = M & f'/e = P \\ c'/d' = N & a'/f' = Q \\ e'/d' = O & b'/e' = R \end{array}$$

Then $\frac{1.17 - L}{1.17} = D' \%$ (deviation of a'/b' from a/b in % of a/b)

$$\frac{1.20 - M}{1.20} = D'' \%$$

$$\frac{1.00 - N}{1.00} = D''' \%, \text{ etc.}$$

Sum $D \%$'s = $SD \%$ = $D' \%$ + $D'' \%$ + $D''' \%$, etc.

$$AVE_{sd} = AVE \text{ for } \frac{SD\%}{7} = \frac{\text{Sum} \left(\frac{SD\%}{7} - D' \% \right)}{6.5(-\sqrt{n(n-1)})} = \frac{Sd}{6.5}$$

The grading value for approximation to the seven Relativity Conditions is marked as GV_{rc} , and calculated as follows:

$$GV_{rc} = 2AVE_{sd} + \frac{SD\%}{7} + GCE \text{ (see sub-section 1, above)}$$

This is an arbitrary equation, devised for the purpose of convenience in ranking the observers. AVE_{sd} is doubled in order to give special weight to steady achievement. GV_{rc} is thus a compound, weighted expression of error. An observer ranks high according to the smallness of this value.

4. General Trend in judgment and line-division: (GTld)

Same system of grading as for General Trend in section 2.

Grade 1: no falsifications, 7/7 or 100 %

Grade 2: one falsification, 6/7 or 86 %

Grade 3: two falsifications, 5/7 or 72 %

etc. etc.

Each observer, thus, according to his grade, receives his $GT\%$ for LD (general trend % for line-division) or $GTld\%$.

5. General Trend in photographed reproduction: (GTph)

Same system as for 4. Each observer receives $GTph\%$.

6. General Trend in kymograph reproduction (one week after the second-day experiment): (G**Tk**)

Same system as above. Each observer receives his G**Tk** %. O's No. 3, 10, and 12, whose photograph reproductions, through accidents, proved inadmissible for measurement, can be rated with the rest of the group only by substituting their grade in kymograph reproduction for their missing grade in photograph reproduction. This, of course, involves inaccuracies, although both the photograph and the kymograph records are based upon O's memory of the original series after the lapse of a week.

7. Final Grading Value for accuracy in reproduction of the Standard Series, corrected by General Trend per cent in judgment and line-division (G**Vacc**)

$$G_{Vacc} = \frac{\left(100 - \frac{4GT\% + 2GTld\% + GTph\%}{7}\right) + GVrc}{2}$$

This equation is, of course, arbitrary and merely represents one way of weighting the results of the various records, in order to come to a rough conclusion as to each observer's ability, under the special conditions of the test, to perceive and remember the accelerating progression, or "swing," of the six standard intervals.

$$\frac{4GT\% + 2GTld\% + GTph\%}{7} \text{ simply means the average grade,}$$

expressed in %, assigned to an observer for his ability in approximating the general trend of the series, with least weight upon GTph%, twice as much upon GTld%, and twice that amount upon GT%. There are thus seven units of weight in all. The deviation of this average % from 100% is given equal weight with the grading value for conformity to the seven relativity conditions (G**Vrc**). Their sum, accordingly, divided by 2, gives an average, which is taken as a convenient grading value for individual difference in accuracy of perception and memory of the acceleration series. Its nature is that of a compound, weighted error.

C: Results:

1. Gross Constant Error:

Observers arranged in relative order according to GCE:

S

O No. 1:	3.60 -3.60 sec.	= .00 sec.	= .00 (% of S)
3:	3.57 -3.60	= -.03	= -.01
10:	3.57 -3.60	= -.03	= -.01
8:	3.64 -3.60	= +.04	= +.01
12:	3.65 -3.60	= +.05	= +.01
11:	3.68 -3.60	= +.08	= +.02
7:	3.47 -3.60	= -.13	= -.04
5:	3.44 -3.60	= -.16	= -.04
2:	3.93 -3.60	= +.33	= +.09
4:	3.96 -3.60	= +.36	= +.10
9:	4.04 -3.60	= +.44	= +.12
6:	4.29 -3.60	= +.69	= +.19

O's No. 3, 8, 10 and 12 are virtually on the same level; so, No. 7 and 5.

2. General Trend:

Observers graded according to conformity to the seven conditions of General Trend (a - b = .1 sec., b - c = .1, c - d = 0, d - e = -.1, e - f = -.1, a - f = 0, b - e = 0) within the limits of .06 sec., as already explained.

The seven conditions are represented by seven symbols following the number of each observer. An asterisk (*) represents a condition approximately fulfilled, a zero (0) represents a falsification.

Condition:	1	2	3	4	5	6	7	
								GT%
O No. 1:	*	*	*	*	*	*	*	Grade 1 = 7/7 or 100%
12:	*	*	*	*	*	*	0	Grade 2 = 6/7
5:	0	*	*	*	0	0	*	Grade 4 = 4/7
7:	*	*	0	0	*	*	0	Grade 4 = 4/7
8:	*	0	*	0	0	*	*	Grade 4 = 4/7
11:	*	*	*	0	0	*	0	Grade 4 = 4/7
4:	0	0	0	*	*	0	*	Grade 5 = 3/7
2:	0	0	0	0	*	*	0	Grade 6 = 2/7
6:	*	0	0	0	0	0	*	Grade 6 = 2/7
9:	0	0	*	0	*	0	0	Grade 6 = 2/7
10:	*	*	0	0	0	0	0	Grade 6 = 2/7
3:	0	0	*	0	0	0	0	Grade 7 = 1/7
								times fulfilled
	7	6	7	4	6	6	5	

The first and third conditions ($a - b = .1$ sec, and $c - d = 0$) were thus most frequently fulfilled. The fourth condition ($d - e = -.1$) was most frequently falsified.

3. Average of Deviations from the seven "Relativity Conditions":
Observers arranged in relative order according to Average

of Deviations $\frac{(SD\%)}{7}$ from the 7 Rel. Cond. (1.17, 1.20, 1.00,

1.20, 1.17, 1.00, 1.00):

O No. 1:	.06 = $\frac{SD\%}{7}$
12:	.07
11:	.08
8:	.13
5:	.14
4:	.14 +
7:	.16
6:	.19
2:	.20
10:	.23
9:	.35
3:	.435

Observers No. 1, 11, and 12, thus come closest, *on an average*, to fulfilling the Relativity Conditions.

Arranged according to their average variable error in attaining their individual average approximation to fulfilling the conditions, the observers rank as follows:

O No. 1:	.03 = AVEsd
12:	.05
5:	.06
4:	.065
11:	.07
7:	.075
8:	.09
10:	.10
2:	.12
6:	.17
9:	.27
3:	.28

Observers No. 1 and 12 are thus found to be *steadiest*, in this particular test, in attaining for each condition their aver-

age degree of approximation. In other words, they are likely to make a number of small errors rather than one large error counterbalanced by several very small ones.

Observers arranged in relative order according to the grading value for fulfillment of relativity conditions (GVrc)

$$GVrc = 2AVE_{sd} + \frac{SD\%}{7} + GCE$$

O No. 1:	.13 = GVrc	O No. 10:	.44 = GVrc
12:	.18	4:	.50
11:	.24	2:	.53
5:	.31	6:	.73
8:	.32	3:	1.00
7:	.35	9:	1.01

Observers No. 1 and 12 thus attain the highest degree of combined steadiness and average relative accuracy in perceiving and reproducing the "swing" of the original series, together with accuracy in estimating the gross value of its duration. The average variable error in the formula employed above has been arbitrarily weighted, in order to put a premium upon steadiness in the final valuation.

4. General Trend in judgment and line-division: (GTld)

As in section 2 an asterisk (*) represents the fulfillment; a zero (0), the falsification of a general trend condition (a-b = .1 sec., etc.)

Observers graded according to conformity to the seven general trend conditions:

Condition:	1	2	3	4	5	6	7	GTld%
O No. 1:	*	*	0	*	*	*	*	Grade 2 = 6/7 = .86%
2:	*	*	0	*	*	*	0	Grade 3 = 5/7 = .72%
6:	*	0	*	0	*	*	*	Grade 3 etc. etc.
10:	*	*	0	*	*	0	*	Grade 3
4:	*	*	0	*	0	*	0	Grade 4
7:	0	*	0	*	*	*	0	Grade 4
9:	*	0	*	0	*	0	*	Grade 4
5:	*	*	0	*	0	0	0	Grade 5
8:	0	0	*	0	0	*	*	Grade 5
11:	0	*	0	*	0	*	0	Grade 5
12:	*	*	0	0	*	0	0	Grade 5
3:	0	0	0	*	0	0	0	Grade 7
	8	8	3	8	7	7	5	times fulfilled

It is interesting to note that the third condition, which in section 2 was found to be one of the most frequently fulfilled, is here the most frequently falsified. This condition is the one of equality between c and d, the third and fourth intervals of the series. On the other hand, the fourth condition ($d - e = -.1$), which before was most frequently falsified, is here one of the three most frequently fulfilled. Various causes produced a certain amount of irregularity in the time-interval that elapsed between the hearing of the original series and the operation of line-division; but with the exception of O No. 7, the latter was performed after at least a week had elapsed subsequent to the last hearing of the series. In this way the results, with one exception, can be considered as affected by dimness of memory in general, combined with effects of judgment persisting, in some cases, over sensation images. Since the declaration of judgments upon the intervals was required, in addition to the line-division, there seems to be good reason for considering the results obtained as largely matters of judgment, backed up by whatever facility was given to the task by the addition of a visual scheme. It would be an error, however, to put any great reliance upon the line division test by itself. If the observer merely remembers that the six intervals first grew shorter and then longer, the task of dividing the line into six intervals may by mere chance lead him into approximations of great accuracy, or, on the other hand, into a different type of error from what occurred in his immediate reproduction of the series a week before.

5. General Trend in photographed reproduction: (GTph)

Observers graded as before:

Condition:	1	2	3	4	5	6	7	GTph%
O No. 11:	*	*	*	*	0	*	0	Grade 3 = 5/7 (72%)
1:	0	*	*	*	0	0	*	Grade 4 = 4/7
2:	0	0	*	0	*	*	*	Grade 4 = 4/7
9:	0	*	*	0	0	*	*	Grade 4 = 4/7
4:	0	*	*	0	0	0	*	Grade 5 = 3/7
8:	*	0	0	*	0	0	*	Grade 5 = 3/7
(12:	0	*	*	*	0	0	0	Grade 5 = 3/7)
5:	*	0	0	*	0	0	0	Grade 6 = 2/7
(10:	*	*	0	0	0	0	0	Grade 6 = 2/7)
6:	0	0	0	*	0	0	0	Grade 7 = 1/7
(3:	0	*	0	0	0	0	0	Grade 7 = 1/7)
	4	7	6	6	1	3	5	times fulfilled

The spoken reproductions made by O's No. **12**, **10**, and **3** were unsuccessfully recorded, so that kymograph reproductions tapped on the same day, are substituted in the above table. This irregularity must be taken into consideration whenever the results are applied. The most striking fact about the table is that the fifth condition ($e - f = -.1$) is misjudged in 11 cases out of 12. In both the previous tables it was 6 times right and 6 times wrong.

Sound-photograph measurements: (six-interval series of seven "top's")

O No. 11 :	.76	.64	.49	.51	.56	.74 sec.
1:	.77	.60	.52	.57	.63	.65
2:	.68	.50	.50	.55	.52	.67
9:	.57	.33	.27	.32	.32	.62
4:	.43	.53	.44	.39	.57	.57
8:	.79	.70	.45	.52	.72	.70
5:	.86	.75	.52	.59	.63	.63
6:	.93	.92	.55	.48	.63	.58

The above order is that of general trend, according to the degree in which the reproductions correspond to the original series:

.7 .6 .5 .5 .6 .7 sec. S = 3.60

On account of fluctuations in the time-line employed, these measurements must not be considered accurate beyond .02 sec. for an interval of .75 sec. For the purposes of the present experiment, however, an even larger margin could be permitted.

6. Kymograph-reproduction:

This record was made simply as a precaution, in order to have objective evidence of the observer's memory of the acceleration series, in case the photographic record happened to be spoiled. This was the case with O's No. **3**, **10**, and **12**, whose kymograph memory records are subjoined:

O No. 12 :	.60	.62	.51	.50	.54	.84 sec.
3:	.70	.30	.36	.54	.42	.60
10:	.81	.70	.54	.70	1.00	.99

The photograph and kymograph memory reproductions were made one week after the last hearing of the standard series. To what extent any factors outside of judgment and memories

of judgment come into play is a problem left unanswered. In any case, the function of memory, even when dim and uncertain in its source, is of much importance in determining individual difference in connection with so-called "swing." The ability to strike a certain note at what impresses the hearers as "exactly the psychological moment" undoubtedly requires a complex of more or less accurate memories of the preceding notes in the series. In order that a progression of intervals may lead to a definite "point," apparently inevitable when once attained, the performer can hardly be expected to qualify for the task unless he be provided with fairly accurate memory-images, involving the "relations" as well as the absolute values of the series he is completing.

7. Final *Grading Value* for accuracy in reproduction, corrected by general trend % in judgment and line-division, and general trend % in photograph reproduction (memory of S after 7 days): (GVacc)

$$GVacc = \frac{\left(100 - \frac{4GT\% + 2GTld\% + GTph\%}{7} \right) + GVrc}{2}$$

Observers arranged in relative order:

O No. 1:	12.1 = GVacc (compound, weighted error)	
12:	25.5	
11:	34.5	
5:	40.0	
8:	40.5	
7:	45.9	Average = 49.62
4:	51.3	
10:	51.5	
2:	53.85	
6:	67.1	
9:	80.2	
3:	93.0	

It is surprising to find to what an extent the twelve observers, according to the above figures, appear to represent a fairly broad and comprehensive range of individual difference. The two extremes represent about as even a deviation from the average (49.6) as one could hope to find out of a much larger group of persons. O No. 12, the second in the list, is almost exactly as far from the first in the list as O No. 9, the next to

the last, is from the last. The same sort of relative position exists for O No. 11, and O No. 6. The remaining six observers are found between the comparatively narrow range of 40.0 and 53.85. The arithmetical mean is 49.62, or virtually 50. In other words, the distribution of the observers happens to suggest the normal probability curve, with a slight skew to one side. The median comes between O No. 7 and O No. 4, very close to the mean; and the mode or point of greatest density is not far away, in the neighborhood of O No. 4. O No. 4 may thus be regarded, roughly, as having a normal degree of proficiency in accuracy of "swing" perception and memory; those below him, as being to some extent deficient in this respect; those above him, as being more or less unusual in their proficiency. *All systems of grading, however, are highly dangerous and likely to be misleading if too much reliance is put upon them.* About the only fact that is really certain in the above list of figures is the following: Under the conditions of the present experiment, without regard to possible improvement in performance, O's No. 1, 12, and 11 made a consistently more accurate record of their perception and memory of a certain series of accelerating and retarding intervals, than was achieved by O's No. 6, 9, and 3. Many other deductions can be made, some of them useful; but it must be remembered that all of them will be tinged with a measure of uncertainty. It must also be emphasized that in the above list of grading values, the average (49.6) is the point of departure for ranking the observers. GVacc, being a compound error, can exceed 100 numerically.

VIII. Schedule syncopation:

Schedule: 0''0 00'0 0'00 '00' (fifteen intervals)

The intervals between O's taps (marked in the schedule by accents) are measured as far as the fifth tap. The first interval represents O's reproduction of the standard interval (5. sec), as given by the metronome. The second interval represents four separate subjective untapped intervals. It is consequently divided by four, after measurement. The next two intervals both represent three subjective intervals; so each of them is divided by three. This makes eleven consecutive intervals to which a value has been assigned. The first ten of them are taken and averaged in order to represent O's ability to carry out a syncopation schedule, based upon an assigned unit, which he is to reproduce "as exactly as possible."

Observers arranged in relative order, first with regard to Gross Constant Error (GCE), and then with regard to Average Variable Error (AVE) in attaining their average reproduction:

GCEss (schedule sync.)		AVEss	
O No. 11:	-.02 (% of S)	O No. 6:	.01 (% of S)
10:	-.02 +	12:	.02
8:	-.09	8:	.03
12:	-.10	1:	.04
7:	-.13	4:	.04 +
2:	-.14	2:	.05
9:	-.14 +	11:	.05 +
5:	-.15	9:	.06
1:	-.15 +	3:	.06 +
3:	-.20	5:	.09
6:	-.25	10:	.13
4:	-.27	7:	.50

The observers, without exception, underestimated the standard interval in their reproductions. In other words, they went faster than the metronome in their combined rate of tapped and untapped intervals. O No. 10 stands high in *average* precision of interval (GCE), but next to the last in steadiness. O No. 6 is next to the last in average precision, but first in steadiness; i.e., his rate was entirely too fast, but he maintained it consistently. O No. 7 was the most unsteady of all in maintaining his average rate. O No. 8 was consistently high in both respects.

IX. Complex coördination, involving Unit Accuracy. (CC and CCua)

O accompanies metronome, beating at .5 sec. interval, according to the following schedule:

RF rf lf "ta," LF rf lf "clo," (repeated for twenty seconds)

RF = right foot (taps foot key)

rf = right finger

lf = left finger

"ta," uttered by voice, taps omitted, etc., etc.

A. Complex coördination: (CC%)

Method of grading:

Grade 1: no taps added or omitted, and no confusion of "ta" with "clo," between the first and fifth right-finger tap, as it recurs in the series. (7/7 or 100%)

Grade 2:	one tap added or omitted.	(6/7 or 86%)
Grade 3:	two tap errors.	(5/7)
Grade 4:	"clo" and "ta" confused,	or three tap errors. (4/7)
Grade 5:	" " " " and one tap error,	or four tap errors. (3/7)
Grade 6:	" " " " and two tap errors,	or five tap errors. (2/7)
Grade 7:	" " " " and three tap errors,	or six tap errors. (1/7)
Grade 8:	" " " " and four or more errors.	(0)

Observers arranged according to grades:

Grade 1:	O's No. 4	10	11			
Grade 2:	1	3	6	8	9	12
Grade 3:	7					
Grade 5:	2	5				

Grades 4, 6, 7, and 8 are not represented. The above grades can in no way be taken as final. In nearly every case, the observers made a strenuous effort to attain the result expected. This was particularly true with regard to O's No. 3, 4, and 7. On the other hand, O's No. 1, 10, and 11 achieved their results with comparative ease. There is no doubt that after a week of practise, many of the observers would have changed their relative position.

In the present set of experiments a longer test was out of the question. As it stands, the grading is merely suggestive. It is fairly certain that O's No. 1, 10, and 11, who responded to the test with a visible degree of ease, possess at least a moderately high measure of facility, native or acquired, in executing this particular task. O's No. 2 and 5 show deficiency.

B. Complex coördination, as affecting Unit Accuracy: (CCua, or ccua)

System of measurement:

The intervals between the right and left finger taps are measured as far as the fifth such interval. These five measurements are averaged; their Gross Constant Error determined in percent of .5 sec. (the metronome interval they are supposed to equal); and, finally, their Average Variable Error (written as AVEccua) in attaining the average reproduction estimated according to the formula used before.

Observers arranged in relative order, first with regard to GCEccua and then with regard to AVEccua:

GCEccua		AVEccua	
O No 12:	-.08 (% of S)	O No. 11:	.02 (% of S)
4:	-.10	3:	.03
11:	-.105	4:	.03
3:	-.11	7:	.03
7:	-.11	12:	.06
1:	-.12	1:	.07
10:	-.13	5:	.07
5:	-.21	10:	.08
9:	-.24	6:	.12
6:	-.27	2:	.28
2:	-.32	8:	.32
8:	-.35	9:	.34

The Gross Constant Errors are all of them relatively large and indicate a universal tendency to make the interval between the right and left finger taps shorter than the interval of the metronome which the observers are attempting to accompany. O's No. 11, 4, 3, and 7 are consistently high in both columns. O No. 12 might also be included. O's No. 2, 6, 8, and 9 are consistently low. These relations are of value in checking up the results of the preceding gradings under A.

The two sets of results are combined into a grading value for Complex Coördination (GVcc) according to the following arbitrary formula:

$$GV_{cc} = \frac{100\% - CC\%}{100} + GCE_{ccua} + AVE_{ccua}$$

In this formula three error values are added together and given equal weight in determining the relative position of the observers; but since the second and third both refer to results obtained under B for Unit Accuracy, the grade obtained for coördination under A (CC%) plays a subordinate rôle. This seems to be justified by the less accurate nature of the results obtained under A.

Observers arranged in relative order, according to the grading values (GVcc) obtained by combining the results of A and B:

O No. 11:	.13 GVcc (compound error)	O No. 7:	.43 GVcc
4:	.14	6:	.53
10:	.21	9:	.73
12:	.28	8:	.82
3:	.29	5:	.85
1:	.33	2:	1.17

Average = .49

It must be remembered that GV_{cc} is the sum of three errors. For some purposes $\frac{GV_{cc}}{3}$ might be considered a more logical grading value. In this case the average amount of error would be rated as $\frac{.49}{3} = .16$.

The results for *Unit Accuracy* in the tables under B can be correlated with similar results obtained in section V (AVE_{uas} and GCE_{uas}), according to the following formulas:

$$AVE_{uat} (\text{Unit-accuracy Totals}) = \frac{AVE_{uas} + AVE_{ccua}}{2}$$

$$GCE_{uat} = \frac{GCE_{uas} + GCE_{ccua}}{2}$$

$$GV_{ua} (\text{grading value}) = 2AVE_{uat} + GCE_{uat}$$

This formula for GV gives special weight to steadiness, rather than to merely *average* precision (GCE).

Observers arranged in relative order, according to the grading values obtained for Unit Accuracy, both under simple conditions and under the disturbances caused by the necessities of Complex Coördination:

O No. 7:	.12	GV_{ua} (compound error)
11:	.13	
1:	.15	
3:	.20	
4:	.20 +	
12:	.22	
5:	.23	Average = .30
6:	.31	
10:	.31 +	
9:	.53	
8:	.55	
2:	.66	

The final emergence to the top of O No. 7, the professional musician, is due to his consistently high rank. O No. 10's proficiency under the difficulties of coördination was relatively much greater than when relieved of these difficulties, under the conditions of the earlier test. Variation in the state of attention may have been a factor in this discrepancy. The more difficult task may have spurred her on to greater relative precision.

O No. 2 remains consistently last, and O No. 11 consistently toward the first.

X. Walking-rate, etc.:

Observers arranged according to *time of walking-step*, with other "rates" in parallel columns:

	Walk	Nod	Tap	Sway	Ta-Ta	Pulse	Breath
O No. 1:	.545 or .55	.81	1.03	1.03	.71	.80	6.00 sec.
3:	.555	.56	1.11	.38	1.03	.77	1.00
10:	.588	.6	1.25	.91	1.43	.59	.64
8:	.625	.6	1.43	.25	1.67	.25	.83
2:	.667	.7	3.33	.35	4.00	.42	.76
6:	.714	.7	1.67	.17	1.11	.25	.74
7:	.714	.7	1.00	.39	.91	.39	.57
11:	.789	.8	.91	.19	.91	.31	.82
9:	.811	.8	1.11	.63	1.05	.56	1.16
12:	.811	.8	1.67	.56	1.54	.40	.89
4:	.833	.8	1.82	.53	1.11	.36	.86
5:	.090	.9	.83	.50	1.25	.71	.73

The most striking apparent correlations are as follows:

- O No. 1: Tap and sway are identical, and approximately twice walk. Pulse and nod approx. the same. Breath is approx. six times tap.
- 2: Tap is approximately half of walk.
- 3: Nod is exactly twice walk, Ta-ta is twice tap.
- 4: Sway is approximately twice tap.
- 5: Ta-ta and pulse approximately equal. Breath, six times ta-ta.
- 6: Ta-ta is one third of pulse.
- 7: Tap and ta-ta exactly alike.
- 8: Tap and ta-ta exactly alike. Sway is twice pulse.
- 9: Nod is twice ta-ta, and approximately equal to pulse.
- 10: Ta-ta and walk the same. Nod approx. twice pulse.
- 11: Sway and nod exactly the same. Sway is approx. three times ta-ta. Pulse and walk approximately equal.
- 12: Nod is approx. twice walk, and three times tap. Breath is twice nod.

These correlations are all more or less dubious, especially for such short tests as the experiment demanded. The pulse-rates are particularly unreliable. It is interesting, however, to form a rough classification of the observers, according to the number of correlations suggested.

Arrangement of O's in relative order:

O No. 1: four correlations.

O's No. 11 and 12: three correlations.

O's No. 3, 5, 8, 9, and 10: two correlations.

O's No. 2, 4, 6, and 7: one correlation.

It should be kept in mind that with seven sets of figures some of the correlations might be easily due to mere chance. Of the seven rates determined the walking rate is perhaps the most reliable. The observers were not in any way hurried, but were asked to walk up and down the main hall of the building until they were sure they had attained what they could call a normal, comfortable rate, such as they would employ if they were walking for pleasure. They were to maintain this rate, on entering the laboratory, until measured with a stop-watch by the experimenter. It should be mentioned that their various rates, as measured, do not carry out Wundt's theory of correlation of walking rate with length of leg. The length of the leg of O No. 9 is 37 inches, measured from his hip-bone to the floor. That of O No. 6 is five inches longer, yet instead of 9's rate being faster than 6's, it is considerable slower, as can be seen from the tables. The legs of O's No. 1 and 3 are both two inches longer than O No. 9's, yet their rate of walking is very much faster.

Wundt² gives .98 as the "usual" length of a double step, which would make a single step equal .49 sec. The average of the steps of the twelve observers in the present experiment amounts to .71 for a single step, or 1.42 for a double step. O No. 5, moreover, has a single step almost equal to Wundt's "usual" double step. Other investigators beside Wundt have announced average rates more nearly in accord with the above results.

XI. Pitch memory:

Method of grading: The observer hears the original tone and then a series of ten, three of which are repetitions of the stimulus tone. These he is to identify, as explained in Appendix II.

Grade 1: 3 exactly right.

Grade 2: 2 right, 1 within 2 vibrations.

Grade 3: 2 " 1 " 3 "

Grade 4: 1 " 2 " 2 "

Grade 5: 1 " 1 " 2 " and 1 within 3 vibrations.

Grade 6: 1 " 2 " 3 "

² Wundt, *op. cit.*, pp. 7 and 22.

Grade 7:	0	"	3	"	2	"			
Grade 8:	0	"	2	"	2	"	"	1	"
Grade 9:	0	"	1	"	2	"	"	2	"
Grade 10:	All combinations in which one of the errors is 5 vibrations from the original tone.								

The element of chance is, of course, a factor in so short and rough a test as the present one, which can hardly be considered as more than suggestive. Those, however, who fall within grades 8, 9, and 10, can be considered without much danger of error as more or less deficient in pitch memory.

Observers arranged according to grades:

Grade 1:	O No. 4
Grade 2:	3
Grade 3:	9
Grade 4:	2 7 8 11 12
Grade 5:	1
Grade 6:	not represented
Grade 7:	" "
Grade 8:	6 10
Grade 9:	not represented
Grade 10:	5

It is clear that O No. 4 is excellent, and that O's No. 6, 10, and 5 are more or less deficient. There is also a probability that O No. 3 is excellent and O No. 9 not far behind him. The status of O's No. 2, 7, 8, 11, 12, and 1 is rather doubtful, except as definitely neither very high nor very low.

XII. Harmony memory:

Method of grading: O is to recognize a stimulus chord, repeated three times in a series of ten. The test is fairly easy, and chiefly calculated to bring out marked deficiency, rather than to establish any detailed system of gradation among the observers.

- Grade 1: all three right.
- Grade 2: two right.
- Grade 3: one right.
- Grade 4: none right.

O's arranged according to grade:

Grade 1:	O's No. 1, 2, 3, 4, 6, 7, 8, 9, 11, 12
Grade 2:	O No. 5
Grade 3:	O No. 10

On account of the easiness of the task it is evident that O's No. 5 and 10 are more or less deficient. O No. 10's complete lack of types of auditory imagery in the image-type test is confirmed.

XIII. Vowel-quality memory:

Method of grading: O is to identify three stimulus groups of vowel sounds as they recur.

Grade 1: all three right.

Grade 2: two right.

Grade 3: one right.

Grade 4: none right.

O's arranged according to grade:

Grade 1: O's No. 1, 2, 5, 6, 8, 9, 12

Grade 2: O's No. 4, 7

Grade 3: O's No. 3, 11

Grade 4: O No. 10

O No. 10 continues to show consistently the effects of a lack of auditory imagery. The large number of those who made no errors shows that the test was comparatively easy. This leads one to infer that, at any rate, those who fell into grade 3 and 4 show a marked inability to remember groups of vowel sounds. It is surprising, however, to find among this number O No. 11, who was first in the list in the test for complex coördination (GVcc) and high in the list in the Acceleration Experiment (GVacc). In the later tests for syncopation (GVs) he also heads the list. According to the rough image-type test, it is plain that he possesses a certain amount of auditory imagery. His test in pitch-memory shows no marked deficiency in that respect. It is of great significance, however, that in answer to the rough preliminary questionnaire he reported that he had no interest at all in verse and no interest in the style of prose. The extent to which vowel quality in the form of "tone-color" enters into the style of both verse and prose is quite obvious. It is hard to say, however, just how far "interest" may affect accuracy of perception in vowel quality, or how far accuracy of perception may affect interest.

XIV. Choice of "swing" reproductions:

The results under this heading have been already tabulated under section VII.

XV. Intensity memory:

Method of grading: O hears a stimulus intensity, roughly produced by the sound-pendulum, and then identifies its triple occur-

rence in a series of ten. Five degrees of intensity (rough) are employed.

Grade 1: all three right.

Grade 2: 2 right, 1 within 1 degree of intensity.

Grade 3: 2 " 1 " 2 " " "

Grade 4: 1 " 2 " 1 " " "

Grade 5: 1 " 1 " 1, 1 within 2 degrees.

1 " 2 " 2

0 " 3 " 1

0 " 2 " 1, 1 within 2, or 1 within 3.

} doubtful

Grade 6: all other combinations.

O's arranged according to grade:

Grade 1: O's No. 1, 2, 3, 4, 8, 10, 11

Grade 2: O's No. 7, 9

Grade 3: O No. 5

Grade 4: O No. 12

Grade 5: O No. 6

Grade 6: not represented

The inaccuracies connected with the use of a sound-pendulum even when encased in a box of heavy felt (as was the case in the present experiment) render the above grades nothing more than very rough approximations. The necessity for a short test is, of course, an even greater source of unreliability in the results, which must be taken as merely suggestive. It is interesting to note that O No. 10 and O No. 2, whose grades are low in some of the earlier tests, are high in respect to Intensity Memory. O No. 10, according to the image-type test, has a certain amount of kinæsthetic imagery which, in spite of her lack of auditory imagery, is, no doubt, of assistance in the present case.

XVI. Drum-beat rhythm of texts:

The statements dictated by each observer, with regard to the thought, mood, and tone-color of the three sentences (A, B, and C), were intended merely to lead up to the grading by units. The following statements made by O's No. 3 and 10 are given as examples.

O No. 3: Sentence A (de Quincey): "Thought seems strange — solemn mood — ghostly — an uneasy feeling when I read it — tone-color seems at first sombre and at the end harsh."

Sentence B (Newman): "Thought seems progressive — mood lively — tone-color varied, the first thing that struck

me — suggests blare of trumpet — a lot of redness — more difference in the a's and e's than in the others."

Sentence C (Pater): "As to thought, nothing occurs to say — don't see much mood in it — variety of vowels and consonants noticeable, but that's all."

O No. 10: Sentence A (de Quincey): "Author's mood dreamy — seems to speak metaphorically — doesn't seem able to transfer his mood at all — he's quite sincere, I think, but doesn't interest me at all — rather annoys me, I think — does not make his thought effective by his use of metaphorical language — seems to bury it in words — vowel-color dark — general tone-color smooth, with several rather sharp interruptions which break the monotony."

Sentence B (Newman): "Much more pleasing — seems to dance along — a certain amount of swinging speed to it — thought distinct — author seems able to transmit his thought very nicely — isn't abrupt or awkward — rather polished — thought involves visual images which the author has not seen himself, but which he makes his own — light vowel-color — light consonant-color — seems to flow along."

Sentence (Pater): "Rather profound thought — idea of depth — a little bit vague in transferring his thought — a little bit wordy — vowels rather light — the whole thing seems to lose by that lightness — it would have been better if he had used darker vowels — consonants give mixed effect."

The replies given to the questions asked on drum-beat rhythm ("How would the series of drum-beats you have just performed affect you, if you had heard someone else beating it, etc.") were also meant merely to lead up to the final grading. The following abbreviated version of O No. 8's replies is appended as an example:

Sentence A: Enjoys — would like it to continue — it falls into parts, definitely related, but dissimilar — a definite crescendo from rapid to slow, powerful beats — the beats began to group themselves into definite periods (when repeated) — in the beginning this was not true — "The third time I tapped it, the whole thing became a unit, with secondary complications" — recurrence of periods which were similar and other periods which if not similar had definite accents and speeds — O is interested because it

is not just a mechanical beating — special interest in beating “central convulsions,” because it seems to be bringing things to a climax and is a variation of the rather undifferentiated rapid beats that came before — the whole thing represents a definite increase toward a maximum of force and vigor.

Sentence B: Much less interesting in form, though distinctly smoother, livelier and lighter — rather monotonous — no form as a whole — it could have stopped in the middle or gone on all day — falls into unrelated parts — O gets more “mood” from tapping it out than from reading it — a musing mood — O adds that sentence A, in the same way, seemed to suggest something which is evident only in the drum beating, not in the sense.

Sentence C: First impression is that C improves on acquaintance — the first tapping seemed a succession of homogeneous strokes — later a certain amount of form, intermediate between A and B — O had a feeling that if he had tapped a few more times, something more would emerge — was reminded of mood one gets from hearing a Catholic priest recite a litany.

The result of the grading is as follows:

	I (fitness of form)	II (ease)	III (complexity)	IV (pleas- ingness)	S'	S''
Sentence A:						
O No. 1:	3	3	1	2	9	10
2:	3	3	3	3	12	15
3:	3	2	2	1	8	10
4:	2	2	2	2	8	10
5:	3	1	3	2	9	12
6:	3	3	2	3	11	13
7:	3	1	3	3	10	13
8:	3	3	1	3	10	11
9:	3	1	1	3	8	9
10:	2	2	3	3	10	13
11:	3	2	1	2	8	9
12:	3	3	2	3	11	13
			24		114	138

(The sum of units assigned by each observer to a sentence is listed under S'. The same sum with a weight of 2 attached to the

grade in Column III, is listed under S''. This counting twice of the grade given for complexity of problem, puts a premium, in the final estimate (S''), upon the *technical* merit of the sentence from the point of view of rhythm. Fitting rhythm for a difficult problem deserves more credit than fitting rhythm for an easy one.)

Sentence B:

	I	II	III	IV	S''	S'
O No. 1:	2	2	2	3	9	11
2:	2	2	1	2	7	8
3:	2	1	3	3	9	12
4:	3	3	3	3	12	15
5:	3	3	3	3	12	15
6:	3	2	3	2	10	13
7:	1	2	3	1	7	10
8:	2	2	3	2	9	12
9:	2	3	3	2	10	13
10:	2	3	2	1	8	10
11:	2	1	1	1	5	6
12:	1	1	1	2	5	6
			<u>28</u>		<u>103</u>	<u>131</u>

Sentence C:

	I	II	III	IV	S'	S''
O No. 1:	1	1	3	1	9	11
2:	2	1	1	1	5	6
3:	1	3	3	2	9	12
4:	1	1	3	1	6	9
5:	3	2	1	1	7	8
6:	2	1	2	1	6	8
7:	2	2	3	2	9	12
8:	1	1	3	1	6	9
9:	1	1	2	1	5	7
10:	1	1	3	2	7	10
11:	1	2	1	3	7	8
12:	2	1	3	1	7	10
			<u>28</u>		<u>80</u>	<u>108</u>

The maximum number of units any sentence can receive is as follows:

III	S'	S''
36	144	180

The number of units each sentence received, expressed in percent of the maximum in each case, is as follows:

	III	S'	S''
Sentence A:	.67	.79	.77 (de Quincey)
B:	.78	.72	.73 (Newman)
C:	.78	.56	.60 (Pater)

The sentence from de Quincey thus receives a lower grade for difficulty of the problem involved, but, in any case, a higher final grade than B or C. Another group of observers, or this same group on another occasion, might have graded the sentences much differently. It in no way follows that, because the sentence from Walter Pater was graded low, some other sentence of his might not have been graded very high. This particular sentence was chosen because it happens to be the first in a paragraph much praised by Saintsbury (*op. cit.* p. 424): "in the second paragraph a further, a more obvious, but a much more dazzling and wonderful transformation is effected."

O's No. 6 and 12 agreed exactly in their distribution of units for A; O's No. 4 and 5, for B; O's No. 1, 4, and 8, for C. In the following list of agreements in the final gradings (S'') it may be well to remember the personnel of the group. O No. 4, professor of English; O No. 12, professor of Psychology; O No. 7, professional musician; O No. 1, amateur musician; O No. 9, Japanese student of philology; O No. 3, graduate student of Psychology with strong musical tastes; O No. 10, former instructor in Psychology, quite clearly deficient in auditory imagery; O No. 8, professor of Psychology, with extensive experience in tapping experiments; O No. 11, research student in Psychology, with no interest in verse or literary style; O No. 5, research student in Psychology, with little interest in music; O No. 6, instructor in Psychology, with some interest in music, but practically no musical training; and O No. 2, with an interest in music, but no training.

List of agreements in final grading of the sentences: (S'')

A: O's No. 9, 11	A and B: 7, 10
1, 3, 4	
6, 7, 10, 12	
B: O's No. 11, 12	B and C: none
7, 10	
3, 8	
6, 9	
4, 5	

C: O's No.	1, 4, 8	A and C:	1, 4
	5, 6, 11		10, 12
	10, 12		
	3, 7		

XVII. "Possibility" scanning:

The elements considered are intensity (I), pitch (P), duration (D), additional "weight" (W). The units are 3, 2, 1, with the understanding that 1 means anything from low to very low. Absolute zero is excluded except in the case of pauses, which when so graded, are simply regarded as not existing.

As explained in Appendix II, section XVII, the observer states the maximum and minimum number of units, for each of the four elements, which he considers as both possible and probable in his particular case.

O's No. 1, 2, and 3 were the only ones who took part in this experiment. Their results are tabulated below for the following opening phrase of the sentence from de Quincey:

(from A) "For she can approach only those"

for (pause) she (p) can (p) approach (p) only (p) those

O No. 1:

I:	2-1	2-1	1-1	1-1	3-2	2-1	1-1	2-1
P:	2-1	2-1	1-1	1-1	3-1	2-1	1-1	2-1
D:	3-1 (1-0)	1-1 (0)	1-1 (0)	1-1	3-1 (2-0)	2-1	1-1 (0)	2-1
W:	1-1	1-1	1-1	1-1	3-1	2-1	1-1 (0)	2-1
	8-4 (1-0)	6-4 (0)	4-4 (0)	4-4	12-5 (2-0)	6-4	4-4 (0)	6-4

O No. 2:

I:	1-1	2-1	2-1	1-1	3-1	3-1	1-1	3-1
P:	2-1	3-1	2-1	2-2	3-2	2-1	2-2	2-1
D:	1-1 (1)	3-1 (0)	1-1 (0)	1-1	3-1 (2)	3-1	2-1 (0)	3-1
W:	3-2	3-2	3-1	1-1	3-2	3-1	1-1	3-1
	7-5 (1)	11-5 (0)	8-4 (0)	5-5	12-6 (2)	11-4	6-4 (0)	11-4

O No. 3:

I:	2-1	3-1	3-1	1-1	3-3	3-1	1-1	3-1
P:	1-1	1-1	1-1	1-1	3-3	3-1	1-1	1-1
D:	1-1 (0)	1-1 (0)	1-1 (0)	3-1	3-3 (2)	3-1	1-1 (0)	3-1
W:	3-1	3-1	3-1	3-1	3-3	3-3	3-1	3-1
	7-4 (0)	8-4 (0)	8-4 (0)	8-4	12-12 (2)	12-6	6-4 (0)	10-4

Maximum and
minimum

possibilities 12-4 12-4 12-4 12-4 12-4 12-4 12-4 12-4

(This would include a range extending from a soft, low-voiced, even chant to a loud, high-voiced, even chant. Pause possibilities are omitted.)

The number of permutations and combinations possible within these limits (eight syllables; nine choices, from 4 to 12 inclusive) amounts to 81 choices for the first two syllables, or 9 raised to the eighth power for the group of eight syllables, which is 43,046,721 choices altogether. The total number of scannings possible from the markings as given by O No. 1 amount to 720. If figures for pauses are added, the number is greater. It must be remembered, however, that a large number of "possible" combinations derived from separate "probable" maxima and minima would be highly improbable, inasmuch as they would be conceived by the observer to be limited to certain sequences. In this way, 720 must be regarded as an overestimation. The fact remains, however, that the number of choices is tremendous, and enough to destroy utterly the possibility of depending on any one scanning for the "rhythm" of a passage.

For O's No. 2 and 3 the case is even stronger. The gross figure for O No. 2's number of choices is 140,352; for O No. 3, 73,500. The actual number of probable scannings is, of course, much less, owing to the fact that many of the gradings would be valid only for certain sequences. Psychological investigations of the facts of rhythmic experience have proved beyond any doubt that pitch, duration, and other elements besides intensity, are factors that cannot be disregarded. Any treatise that confines itself to so-called "scanning," on the basis of intensity alone, is sure to be misleading and unscientific.

XVIII. Pulse consciousness:

O's No. 1, 7, 8, and 12 are easily conscious of pulse or heart-beats.

O's No. 3 and 9 are dimly so. The results for the rest are negative.

Data for O's No. 2 and 11 is lacking.

XIX. Breath-segments:

O No. 1 feels exhalation as four times longer than inhalation. This makes a rhythm of five for the two. O No. 10 feels inhalation as four and exhalation as three. This makes a rhythm of seven. O No. 8 feels inhalation as one, exhalation as two (rhythm of three). O No. 12: inhalation four, exhalation five (rhythm of nine). O No. 7: inhalation is vaguely longer. O No. 5 is conscious of no

breath-segments. The data for some of the subjects is lacking. It is of great interest, however, to notice that even in this rough experiment, certain observers breathe in a rhythm which is very far from the usual idea of bodily rhythms as simple or multiples of two. Careful objective measurement would in every case, no doubt, show that the relation of inhalation to exhalation is actually too irregular to fall exactly into any simple proportion. It is of the greatest importance, nevertheless, to discover that certain observers *feel* a relation between the two that comes very close to committing them to a rhythm of 5, 7, or 9 in their breathing. Much might develop from a more careful investigation of subjective valuation for breath-segments, when such a valuation exists at all. Of course, an observer might value his exhalation at three and his inhalation at four, and yet deny that he was conscious of a rhythm of seven in successive breaths.

XX. Photograph of seven-day memory reproduction of acceleration test:

The results are tabulated under section VII, sub-section 5.

XXI. Judgment and line-division:

See section VII, sub-section 4.

XXII. Simple syncopation: (SIS)

O taps half-way between the clicks of a series given by the time-sense machine in which the intervals are .66 sec. O's tap, accordingly, should come .33 sec after the click from the machine. His Gross Constant Error, plus or minus, and his Average Variable Error are calculated upon this basis.

Arrangement of O's in relative order: (S = .33 sec)

GCEsis		AVEsis	
O No. 7:	-.03 (% of S)	O No. 11:	.03 (% of S)
11:	-.04	1:	.05
8:	+.05	12:	.05 +
1:	+.07	3:	.08
4:	+.07	9:	.10
6:	-.07 +	7:	.11
12:	-.10	6:	.24
5:	-.10 +	8:	.44
3:	+.13	4:	.65
10:	+.13	2:	.68
9:	+.17	5:	.73
2:	-.20	10:	.73

O No. 7, the professional musician, has the least GCE, and is therefore on an average more precise than the rest of the group; in steadiness (AVE), he is sixth in the list. O No. 11 is high, both in average precision and steadiness. O's No. 10 and 2 are low in both respects.

O's No. 1, 3, 7, 8, 11, and 12 found the task of syncopation pleasant; the rest failed to find it consistently pleasant; O's No. 4, 9, and 10 found it distinctly unpleasant; O No. 5 was indifferent.

XXIII. Reaction to 5's and 7's:

O No. 1: reacted to both 5's and 7's, within ten seconds, by kinæsthetic feeling in the throat. Kinæsthesia for 5's was more difficult to inhibit than for 7's.

O No. 2: no reaction for 5's; throat kinæsthesia for 7 rhythm, within ten seconds, very difficult to inhibit.

O No. 3: head and larynx movements for 5 rhythm, within ten seconds, — fairly easy to inhibit. No consciousness of breath affection. Responded to 7's by twitch on left side of face, within twenty seconds, — fairly easy to inhibit. Breath vaguely affected.

O No. 4: unpleasant but uncontrollable motor reaction, impulse to "pull away," established for 5's, within ten seconds. The unpleasantness was largely due to the timbre of the drum-beats, but not entirely. The same motor reaction for 7's, not quite so unpleasant, was established within fifteen seconds, and proved very difficult to inhibit.

O No. 5: no reaction to 5's or 7's.

O No. 6: reacted to 5's, within twenty seconds, by dip of head for the accents, and vague eye or eyelid or throat movements for the smaller beats, difficult to inhibit. Reacted for 7's, within ten seconds, with same type of movements as before, very difficult to inhibit.

O No. 7: reacted to 5's at once by wave movement up his back; established 7's, within ten seconds, by movement of "stiffening," easy to inhibit.

O No. 8: 5's within twenty seconds, nodding of head up and down. An upward movement on the accent and forward movements in segments that roughly coincided with the following beats — all difficult to inhibit. 7's within ten seconds, motor reaction localized in eyeball as motion up and to the left on the accent of each group, then more slowly downward but not in any definite segments — all difficult to inhibit. After well under way, O inhaled on one accent, exhaled on the next.

O No. 9: 5's within fifteen seconds, head movements, easy to inhibit; 7's within fifteen seconds, head movements, more difficult to inhibit.

O No. 10: no motor response to 5's or 7's.

O No. 11: 5's within twenty-five seconds, movement of left hand for accents, nothing for subordinate beats, no breath affection. Reaction easy to inhibit. No reaction for 7's.

O No. 12: uncontrollable motor response in throat for 5's, followed the rhythm with a kind of visual diagram; "too introspective" for motor reaction to 7's, though it would have been "natural to beat time."

O's No. 5 and 10 were the only ones who did not react to either 5's or 7's. O No. 4 reacted, but found it unpleasant. O No. 2 reacted only to 7's; O's No. 11 and 12, only to 5's.

XXIV. Complex syncopation (involving regulated practice):

O attempts to tap 5's while the machine clicks 7's. E gives him various helps, all connected with the substitution of a "rhythmic tune" instead of any conscious "thinking out" of the task. The correct length of interval (.936 sec), for a fifth of the gross time covered by seven clicks of the machine, is taken as the standard which O is to approach. His GCE and AVE are determined with reference to the average of his first five intervals.

Arrangement of O's in relative order:

	GCEs		AVEs
O No. 1:	-.009 (% of .936 sec)	O No. 4:	.06
11:	+.01	11:	.09
12:	+.015	7:	.11
7:	-.02	1:	.12
8:	-.03	8:	.13
5:	-.06	12:	.18
3:	-.08	2:	.18 +
4:	-.08 +	6:	.18 +
10:	-.16	3:	.21
9:	+.20	5:	.21 +
2:	+.28	10:	.31
6:	-.40	9:	.48

O's No. 1, 7, 11, and 12 rank highest in average precision; O's No. 4, 11, 7, and 1, in steadiness. O's No. 10 and 9 are consistently low. All of the observers improved tremendously during the stages of practice allowed them before the final record. Both O's

It would be easy to draw misleading inferences from the above figures, especially since subjective impressions so largely determine rhythmic values. Two intervals can seem equal which differ considerably in objective measurement, and the nature of "filling" in language is infinitely more complex than a mere enumeration of syllables. The subjective value of an interval in speech depends upon the distractive value, reacting upon attention, not only of "filling" but also of the two limits or boundaries of the interval.⁴ In the case of speech, the nature of the filling and the boundaries involves elements of too subtle a quality ever to be detected in a quantitative form. With such precautions duly in mind, however, it is only proper that the objective relations should be examined at least.

Intervals 1, 3, and 5, for instance, present on the surface similar filling and similar boundaries. The same is true of intervals 2 and 4. Interval 9 is different because of the nature of the material beyond the boundaries — a situation which has certainly not been fully investigated even in the most recent treatises on time-estimation. Intervals 12, 13, and 14 represent in mere syllable filling an obvious, not necessarily regular, progression in length. It is, accordingly, of interest to see what objective treatment in the matter of mere duration they receive from the various observers, especially those who, in other tests, have shown marked tendencies in any direction. O's No. 1, 6, 11, and 12 ranked high in both syncopation and acceleration. O's No. 2, 9, and 10 were fairly low in both. Their records, accordingly, would be particularly significant.

Table I: Intervals 1, 3, 5, and 2, 4: (Instances of regularity)

1, 3, 5 equal in the case of O's No. 1 and 11 (approx.)

1, 5 " " " " " " " " 2 " 4

2, 4 " " " " " " " " 1, 3, 4, 8, 9, 12

1, 3, 5 form a regularly retarding progression in the case of O's No. 10 and 12

O's No. 1 and 12 are the only ones in which both groups of intervals display objective regularity. The regularity is one of equality with O No. 1; it is partly one of equality and one of progression with O No. 12. O's No. 4 and 11 rank next, perhaps, to O's No. 1 and 12. O No. 7 shows an irregularly retarding progression; while O's No. 6 and 9 show an irregularly accelerating

⁴ Benussi, *op. cit.*, p. 481.

progression, in the relations of intervals 1, 3, 5. O No. 10 is about on the same level with O No. 2, but her regular retarding progression is significant, especially since in all the tests where the subject came up, she professed an interest in acceleration and retardation, as opposed to her lack of interest in syncopation.

Table II: Intervals 12, 13, 14 (a, b, c):

$$\text{Let } L = c/b - b/a$$

$$M = (c - b) - (b - a)$$

$$N = \frac{c/b}{b/a}$$

	b/a	c/b	L	M	N
O No. 1:	1.715	1.333	-38	+12 sec.	5: 4 (approx.)
2:	1.54	1.18	-36	-12	11: 8
3:	1.54	1.69	+15	+48	15: 17
4:	1.56	1.52	-04	+24	1: 1
5:	1.16	1.67	+51	+66	7: 10
6:	2.00	1.47	-53	-03	4: 3
7:	1.77	1.35	-42	-12	4: 3
8:	1.64	1.35	-29	-06	5: 4
9:	1.333	1.41	+08	+24	13: 14
10:	1.06	1.20	+14	+24	5: 6
11:	1.35	1.54	+29	+42	5: 4
12:	1.52	1.47	-05	+21	1: 1

With regard to intervals 12, 13, 14, the greatest caution is necessary before pronouncing judgments. All three intervals are "filled" to a high degree — that is, they contain no imperative punctuational pauses, and can be considered as a succession of syllables with pauses that are likely to be short, when introduced at all. It is perfectly possible to cover the three intervals with one breath. The "boundaries" of the intervals are fairly important syllables with approximate equality of timbre ("po," "po," "po," and "pro"). According to Benussi⁵ the subjective time value of an interval *diminishes* when the two limits are held together firmly as a group, with striking similarity as their bond. Since this condition applies fairly well to all three of the intervals, it may be inferred that their *relations* to each other will not be disturbed by this particular factor, however much shorter their gross sum might appear to consciousness on account of the ease with which their boundaries can be held together.

⁵ Benussi, *op. cit.*, p. 481.

Intervals filled with mental work, whether hard or easy, according to Benussi,⁶ appear shorter for this reason. In this matter again the relations of the three intervals are not disturbed. Wundt⁷ gives the following general tendencies in connection with filling: a "short" filled interval (from .5 to 1.5 sec. in length) seems longer than an equal empty one; a "long" filled interval (over 2 sec.) seems usually shorter. An interval measuring no more than 25 mm on the drum (1.5 sec.), would, accordingly, seem longer or slower; one measuring over 34 mm (2.04 sec.) would be likely to seem shorter or faster than its objective length would indicate. Between 25 mm and 34 mm would lie an indifference point where subjective distortion, on this particular ground, would not be likely to occur. This, of course, is a condition quite capable of distorting relations between two intervals such as 1 second and 3 seconds, in which the first might seem like 1.1, for instance, and the second like 2.9. The objective simple proportion of 1:3 would thus be quite destroyed. If, however, none of the three intervals are less than 14 mm or greater than 38 mm, which covers most of the measurements for the group of observers, it might be taken for granted that the amount of distortion due to this particular factor in the *relations* of the intervals would be comparatively small. The really great and forever unmeasurable factor is the individual distribution of attention over the objective field, never alike for any two persons and practically never alike for the same person on two different occasions. The only satisfaction we can extract from the discovery of objective regularity in the measurements of the intervals is due to the fact that, however much we may resent long stretches of mechanically regular rhythms, we all respond more or less to short stretches of exact rhythm. We should probably find it very hard to distinguish at all between longer stretches of regularly accelerating or retarding beats and the slightly varied progressions which would occur when our favorite pianist, for instance, performed the acceleration or retarding in question. In considering this matter we must be very careful to remember that we are thinking of rhythm apart from tone and other factors.

Keeping all this in mind as a check upon the final value of any rough inferences that may be made, the most interesting thing to notice in the table for intervals 12, 13, and 14, is that O's No. 4 and 12, especially O No. 4, come very close to a perfectly regular geometrical progression with the same moving ratio in both cases:

⁶ Benussi, *op. cit.*, p. 286.

⁷ Wundt, *op. cit.*, III, p. 49.

a: b : : b: c : : 2: 3. Expressed as $N(c/b: b/a)$ this becomes, as in the table, 1: 1.

O's No. 2, 3, and 9, who were low in the results for syncopation and acceleration in previous tests, are in this case the furthest from reaching simple ratios. O's No. 5, 6, and 10, however, who were low in the tests referred to, achieve fairly simple ratios. O No. 5's figures, according to one form of approximation, come close to a ratio of 2: 3. O No. 7, the professional musician, has one of the more simple ratios.

The matter of increase or decrease in the size of the increment of retardation, which occurs in all cases, is rather puzzling. With O's No. 2 and 7 it decreases in size; with O's No. 6 and 8 it remains about the same; but with all the other eight observers it increases, the increase varying from .12 sec. to .66 sec. (O No. 5). The larger amounts, of course, indicate a tendency to a pronounced retarding. It must not be forgotten, however, that although interval 14 may be made much longer than its predecessors, it is perfectly possible for the observer to have felt it, not at all as an experience of retarded articulatory motion, but rather as an experience of great hurry on account of having to utter so many syllables between the two marked accents. This sense of hurry probably begins for nearly every one, according to Wundt's figures for filled intervals, as soon as the interval exceeds 2 seconds in length. Such intervals occurred as the last of the series of three for O's No. 3, 4, 5, 9, and 12. O No. 5, accordingly, may easily have had this feeling of hurry to some extent, although he was retarding relatively more than any one else in the whole group in his last interval.

Comparing the results from both tables (with regard to intervals 1, 3, 5; 2, 4; and 12, 13, 14), it is clear, at any rate, that O No. 1 shows objective precision in both; O No. 12, precision and regularity in progression; O No. 7 shows irregularity in the first table, but is one of the four whose N values in the second table suggest the most simple forms of progression; O No. 4 shows regularity of progression; and some precision; O No. 11, some precision and some regularity of progression; O No. 10, a good deal of regularity of progression; O's No. 2 and 9, a good deal of irregularity; O's No. 5 and 6, some regularity but little precision; O No. 8, regularity and some precision; O No. 3, some precision, but much irregularity of progression. Just what any of them really "felt" in the way of a rhythmic experience during their performance, is another matter entirely.

XXVI. Musical "swing":

The object of this experiment is chiefly to make clear the fact that the conventional notation, when denoting a perfectly precise relation, is attended by all sorts of irregularities in the actual performance. If tapping, according to Wallin and others, "triples" the regularity of rhythmic performances, any irregularities found when such a form of reproduction is employed should be given all the more weight. Their source, either in cases of so-called "agogic" accent (in which added duration is used as a means of emphasis in the place of added stress) or in mere inaccuracy on the part of the performer, is not discussed at present.

The following figures represent drum-record measurements of the first three notes in the melody of "My Country 'tis of Thee," which in the conventional notation are written as of equal value:

O No. 1:	.36	.42	.38 sec.	Range: .06 sec.
2:	.30	.33	.33	.03
3:	.72	.72	.78	.06
4:	.60	.54	.48	.12
5:	.30	.30	.30	.00
6:	.45	.24	.30	.23
7:	.42	.45	.48	.06
8:	.60	.51	.50	.10
9:	.51	.57	.60	.09
10:	.78	.72	.60	.18
11:	.48	.48	.42	.06
12:	.54	.54	.54	.00

O's No. 5 and 12 gave the notes equal value; the other ten observers covered a range of from .03 sec. (O No. 2) to .23 (O. No. 6).

O No. 1 made the second note the longest.

O's No. 3, 7, 9 made the last note longest.

O's No. 4, 6, 8, 10 made the first note longest.

O No. 11 made the first and second equal and longer than the third.

O No. 2 made the second and third equal and longer than the first.

It is easy to find reasons in Riemann's "agogic" accent to explain the distortions in the case of O's No. 1, 4, 6, 8, and 10. In the case of O's No. 3, 7, and 9 another form of "agogic" accent in which the interval before the note to be accented is lengthened, comes into play.

If the above results are obtained in spite of the regulating effect

of tapping, it ought to be quite clear that music of a simple metrical pattern involves objective irregularities that cover a comparatively large range in a short space of time. This fact should be kept constantly in mind by those who fail to see how easy it is to organize subjectively, upon an essentially musical basis, the irregular intervals of prose. It can hardly be expected, however, that the more or less unmusical or unrhythmical person can ever thoroughly organize anything upon a musical basis. For such a person prose, and verse, and music itself, may give something approaching a rhythmic satisfaction, but never the really complete experience.

XXVII. Phonograph test:

O hears five series of drum-beats reproduced by the phonograph. He has no information as to their source. The first is a sentence from Walter Pater; the second, a passage of music by Chopin; the third, a sentence from Henry James; the fourth, a haphazard arrangement of words; the fifth, a haphazard arrangement of musical notes. These are referred to below as Series 1, 2, 3, 4, 5.

Grading of series for pleasantness:

Units of relative rank (5, 4, 3, 2, 1) were assigned by O's after the first hearing and after the fourth. 5 stands for highest and 1 for lowest. Some of the O's were unable to grade the series after only one hearing. S (series) 2 and 4 were graded as most pleasant twice (by two O's). No other two O's agreed on their choice of the most pleasant. After the fourth hearing, S 1 and 2, the passage from Pater and the music from Chopin, were graded as most pleasant by three O's; S 5, the haphazard music, was graded as most pleasant on the fourth hearing by O's No. 4 and 5. S 3 and 4, James and the haphazard prose, were not graded as most pleasant by anyone, but James was graded with four units by O's No. 3, 8, and 11; and haphazard prose, with four units by O's No. 4 and 12.

Grading for elusiveness:

On the first hearing, *Pater* was graded as the most elusive by O's No. 6, 10, and 12; and with four units, by O's No. 4, 5, and 7. The regular music and haphazard prose were graded 5 by two O's. On the fourth hearing, the haphazard music was graded as most elusive by O's No. 3, 4, 9, and 10; Chopin, by O's No. 2 and 8; haphazard prose, by O's No. 11 and 12; Pater, by O No. 5; James, by no one. The highest number of units of elusiveness assigned to James was three, given by O's No. 5, 8, and 9. O No. 7 insisted that, after a fourth hearing, none of the series could be graded as elusive.

They all suggested to him definite musical themes.

Grading for ease in beating time:

Each of the series was assigned units (3, 2, 1) for ease and satisfaction on the part of O, in his attempt to beat time to them. 1 includes very "low"; absolute zero is excluded.

Arrangement of series in regular order:

A: strict unit:	Series 2:	17	(total number of units received)
	" 1:	16	
	" 5:	15	
	" 4:	14	
	" 3:	12	
B: elastic unit:	Series 3:	19	
	" 5:	19	
	" 2:	18	
	" 4:	16	
	" 1:	15	

With a strict unit, the Chopin music and the passage from Pater were considered the most satisfactory. James was rated last. With an elastic unit most of the records received higher grades, but the haphazard music was found to be most satisfactory. Haphazard music received a grade of three, meaning "a high degree of satisfaction," from O's No. 2, 4, 5, and 8. James received a grade of three from O's No. 6, 8, 10, and 12. The haphazard prose received three from O's No. 4 and 8. Chopin received the lowest grade from O's No. 2, 4, and 5. O No. 1, having made the records, did not take part in the test.

The results for identifying the source of each of the five series were as follows: (P = prose, M = music, HP = haphazard prose, HM = haphazard music)

O's No.	2	3	4	5	6	7	8	9	10	11	12	(actually)
S 1	M	P	P	HP	P	M	P	P	P	P	P	(P)
S 2	HM	M	M	HM	M	M	M	M	M	M	P	(M)
S 3	P	P	HM	P	P	M	P	HP	HP	HM	P	(P)
S 4	HP	HP	P	P	HP	M	HP	P	P	HP	HP	(HP)
S 5	M	HM	HP	M	HM	M	HP	HM	HM	HP	HM	(HM)

O's No. 2, 9, and 10 were the only ones who marked any of their judgments with an "a" (implying certainty).

As a result of the above tabulation, it is evident that Pater was marked as prose seven times, as music three times, and as haphazard prose once. James was marked once as music, and twice as hap-

hazard music; six times as regular prose, twice as haphazard prose. The total markings are as follows:

(marked as)	P	M	HP	HM
S 1 (Pater)	7	3	1	0
S 2 (Chopin)	1	8	0	2
S 3 (James)	6	1	2	2
S 4 (Haph. P)	5	1	4	1
S 5 (Haph. M)	0	3	3	5

O No. 7 insisted on marking all five as giving him the impression of regular music. No one marked haphazard music as prose.

XXVIII. Questionnaire:

Results:

- O's No. 2, 3, 4, 5, 6, 7, 8, 9, 11, 12 enjoy effects of syncopation when understood:
O No. 10 enjoys very little:
- O's No. 2, 3, 4, 5, 6, 7, 8, 10, 12 enjoy effects of acceleration:
O's No. 2, 3, 4, 5, 6, 7 very much:
O's No. 8 and 12 fairly well:
O No. 11 very little:
O No. 9 not at all:
- O's No. 1 (data from section I), 5, 6, 8, 11 prefer simple balance:
O's No. 2, 4, 7, 10 prefer occult balance:
O's No. 3, 9, 12 express a divided interest:
- O's No. 3, 4, 5, 7, 8, 9, 12 enjoy "unitary" pulses:
O's No. 2, (4), (8), (9), (12) not very much:
O's No. 6, 10, 11 not at all:

O's No 3, 5, and 7 are the only ones who clearly committed themselves to real enjoyment. The value of these rough answers must not be pressed too far. Perhaps the most interesting thing to notice is the small amount of pleasure that O No. 11 derives from effects of acceleration, after having scored so high in the tests in which it figures.

XXIX. Schedule tests:

- Series 5: O hears S 5 (haphazard music) again, and states its effect upon him (pleasant, unpleasant, or indifferent). He then hears it with schedule I (section XXIX, Appendix II), and later grades the schedule with units (3, 2, 1) for the amount of interest it adds to his hearing of the drum-beats. In case the schedule clearly adds no interest, which was reported by one observer, a grade of zero is allowed. It should be remembered, however,

that in all cases where 3, 2, and 1 are used as units, 1 is supposed to cover the grade of "very low." After reporting on schedule I, O is given a similar test with schedule II.

Results:

- O's No. 4, 7, 8 announce pleasant effect from Series 5 (without schedules)
O's No. 3, 5, 6, 10, 11, indifference or "very little interest":
O's No. 2, 9, 12, unpleasant effect:

- Schedule I: (units of interest added to S 5)

O's No. 2 3 4 5 6 7 8 9 10 11 12

1 3 3 1 1 3 0 2 (1) 0 1 Total = 16 units.

O No. 10 failed to express her grading in units, but reported that E's humming the schedule added a small amount of interest.

- Schedule II:

O's No. 2 3 4 5 6 7 8 9 10 11 12

3 1 3 2 1 1 2 1 (2) 1 1 Total = 18 units.

O No. 10 found no interest in Schedule II except when hummed, but in that case it added more interest than Schedule I.

B. Series 1: (Pater)

- O's No. 3, 4, 8, 10, 11 announce pleasant effect from S 1 (without schedules):
O's No. 2, 5, 6, 7, indifference:
O No. 9, unpleasant effect:
(no report was received from O No. 12):

- Schedule I:

O's No. 2 3 4 5 6 7 8 9 10 11 12

3 2 3 2 2 3 2 2 (1) 0 2 Total = 21 units.

- Schedule II:

O's No. 2 3 4 5 6 7 8 9 10 11 12

2 3 3 1 1 2 0 1 (0) 1 2 Total = 16 units.

The reports for Schedule I in connection with the passage of prose from Pater is significant. It means that ten observers out of eleven (O No. 1, having made the drum-beat records, could not take part in the test) found various degrees of satisfaction in listening to a series of prose beats, according to a

schedule which imposed upon the series an elastic temporal unit, grouped in three-time. What is more significant is that *three of the observers reported the highest grade of added interest (3 meaning "very much") and six reported a grade of 2.* One notable fact, of course, is that O No. 11, whose rank in the tests for accuracy in syncopation and the reproduction of the "swing" series was among the highest, reports so little interest in the schedules, as a means of organizing elusive impressions of rhythm. On the other hand, it should be remembered that this observer professes no interest either in verse or literary style.

XXX. Questionnaire:

1. O's No. 4, 7, and 12 feel that they can enjoy the rhythm of a passage, at times, without any motor response. O No. 4's enjoyment is concerned with the discovery of amusing or unexpected organization (as in following the drum-beat records with a schedule). O No. 12's experience seems to be concerned with sound images; O No. 7's, with images of a more indefinite nature. All the other eight observers depend upon motor response for their rhythmic experiences.
2. All the O's, except No. 3, find that *a motor response must be continued in the form of a series in order to be satisfactory.* It must always be equivalent to "beating time" in some way.
3. *All the O's report that an elastic unit (accelerating and retarding) is necessary in attempting to beat time to prose.* O No. 8 makes the qualification that for short passages one can conceive of beating a strict time-unit.
4. All the O's, except O No. 2, who failed to find the question clear, agree that the recurrence of groups of beats irrespective of a time-unit is not so pleasurable as when the groups recur in connection with a time-unit. Some of the O's are very emphatic about this. O No. 10 declares that the recurrence would be "very disagreeable" unless "periodic." This seems to be very strong evidence against the possibility of founding a theory of versification upon anything but a temporal basis (time, of course, meaning not objective, but *subjective* time). It must not be denied, however, that a certain amount of pleasure ensues from the recognition of mere recurrence. The point is that every rhythmic "impression" seems, with this group of O's, to be heightened as soon as it is felt to be organized upon a time basis.

XXXI. Unitary music: (first test)

The O's pass judgment upon passages in the music of Cyril Scott, in which the rhythm is delivered separately from the melody and harmony.

"Unitary" means that the time unit is *felt* as a series of pulses, not grouped according to a fixed scheme, such as two-time, three-time, etc., continued throughout. The unit, therefore, in its conception, is more like the "boom" — "boom" — "boom" of a tom-tom, very much reduced, of course. It continually falls into groups of some sort, but the point is that no one form of grouping is repeated throughout, as a fixed pattern.

The results for the passage used in the first test are as follows:

- O No. 1: first hearing: rhythm interesting, but the unit vague.
 second hearing: rhythm more interesting, fundamental unit clear, not repeated as a group; i.e., repeated as "unitary pulses."
- O No. 2: 1st: partly pleasant.
 2nd: agreeable, O felt unitary pulses.
- O No. 3: 1st: indifferent, O felt unit (?).
 2nd: more pleasant.
- O No. 4: 1st: very pleasant, O felt a unit.
 2nd: element of surprise gives pleasure.
- O No. 5: 1st: pleasant, O felt a unit.
 2nd: interested, O felt unitary pulses.
- O No. 6: 1st: unpleasant, O felt no pulse.
 2nd: confused, O felt no pulse.
- O No. 7: 1st: pleasant, O felt a unit.
 2nd: pleasant.
- O No. 8: 1st: indifferent, O felt no unit.
 2nd: pleasant, felt a unit.
- O No. 9: 1st: unpleasant, O felt no unit.
 2nd: more pleasant, O felt unitary pulses.
- O No. 10: 1st: interesting because of "acceleration," unit vague.
 2nd: more interesting because of "variety," O felt two units.
- O No. 11: 1st: pleasant, O felt unitary pulses.
 2nd: more interesting, O still felt the unitary pulses.
- O No. 12: 1st: interesting, unit vague.
 2nd: interesting, O felt unitary pulses.

Eight of the O's found the rhythm of the passage to some extent pleasant on the first hearing; *all of the O's, with the*

exception of O No. 6, found it pleasant on a second hearing. Six of them felt unitary pulses as the underlying temporal basis for the series of beats.

XXXII. Unitary pulses: (as a form of motor reaction)

The following O's reported the recurrence of groups in a ten-second exercise of their "most natural" motor reaction:

O No. 1: complicated groups.

O's No. 2, 4, 8: groups of fours.

O's No. 10 and 12: groups of fours.

The following felt unitary pulses:

O's No. 3, 5, 6, 7, 9, and 11.

In other words, six felt groups and six felt unitary pulses. O's were asked to take their "favorite" type of motor reaction and continue it "at a rate which seems pleasant" to them. Those who deny that the pleasant experience of O's No. 3, 5, 6, 7, 9, and 11 is "rhythmic" will have to invent new terms to cover the case. As it is, there is little room for attacking Lanier's statement that there is "rhythm" in a recurring temporal series, whether the unit be grouped or not by the superimposition of accents. The real facts about such a series of unitary pulses have been stated before. No series can exist without some element of contrast, since we cannot become conscious of recurrence until cessation has occurred. The very word pulse implies gradation of intensity. What we mean by unitary pulses, however, is that we do not consciously separate this gradation into clear-cut segments, labelled "one" and "two," or "one, two, three," etc. When we group these pulses into two's and three's, we have changed the smooth up-and-down pulse curve into a more angular progression, with two or more well-defined steps for each dip of the line. The individual steps can be in themselves either smooth unitary pulses, or be redivided into recognizable, smaller steps.

XXXIII. Unitary music: (second test)

The O's pass judgment upon the rhythm of a second passage from the music of Cyril Scott.

Results:

O No. 1: 1st hearing: pleasant, the arrangement of beats in groups of varying size confused the unit to some extent.

2nd hearing: pleasant, unit no longer confused by the group changes.

- O No. 2: 1st: unpleasant, unit confused.
2nd: more interesting, unit felt.
- O No. 3: 1st: pleasant, unit felt.
2nd: indifferent, unit lost.
- O No. 4: 1st: pleasant, unit felt.
2nd: pleasant, unit felt.
- O No. 5: 1st: pleasant, vague unit felt.
2nd: pleasant, vague unit felt.
- O No. 6: 1st: pleasant, unitary pulses felt.
2nd: more pleasant, unit felt.
- O No. 7: 1st: pleasant, unit felt.
2nd: pleasant, unit felt.
- O No. 8: 1st: interesting, vague unit felt.
2nd: interesting, unit felt. (objected to variety of groups)
- O No. 9: 1st: indifferent, unit felt.
2nd: indifferent, unit felt. (objected to variety of groups)
- O No. 10: 1st: (statement of affection omitted), unit felt.
2nd: (statement of affection omitted), unit felt.
- O No. 11: (pleasant, unit felt) data incomplete.
2nd: pleasant, unit felt.
- O No. 12: 1st: indifferent, unit vague.
2nd: pleasant, unit vague.

Eight of the O's found the rhythm of the passage either pleasant or "interesting" on the first hearing; *nine found it pleasant or interesting on the second hearing*. On the first hearing O No. 2 found it unpleasant. O's No. 3 and 9 found it indifferent on the second hearing, but no one found it unpleasant.

XXXIV. Factors in organizing drum-beat series:

Each of the six organizing factors, or "suppositions" presented to the observers, were graded by them with units (3, 2, 1, 0), according to the degree that they "assist or do not assist" in explaining, or rendering less "puzzling," elusive impressions or rhythm in prose-beats such as those in Series 1 (Walter Pater). 3 means "very much assistance"; 2, "considerable assistance"; 1, "a small amount of assistance"; 0, "none."

Hypothetical factors:

1. An elastic time-unit, grouped throughout in two's, or throughout in three's, etc.
2. An elastic unit, grouped in stretches of some one smaller group,

but capable of changing from a stretch of two's to a stretch of three's, etc.

3. The possibilities of syncopation, as a means of correlating seemingly irregular beats with an under-unit of time.
4. The possibilities of dividing the fundamental time-intervals into smaller intervals, but quite spontaneously (as occurred in the first passage from the music of Cyril Scott) — not according to a scheme that could be anticipated.
5. Elastic unitary pulses (as occurred in both passages from Cyril Scott), with the *added possibility*, evidently in the second passage, of grouping the pulses in clusters of constantly varying size.
6. The imposition of a humming tune upon the series.

The grades for the six organizing factors, in their degree of helpfulness, are as follows:

O's No.	2	3	4	5	6	7	8	9	10	11	12	
Factor 1:	2	1	1	2	2	3	2	3	1	2	2	= 21 units
2:	2	3	0	0	0	3	0	2	1	3	1	= 15
3:	1	0	2	1	0	3	1	1	0	1	3	= 13
4:	1	2	0	3	2	3	2	2	1	2	2	= 20
5:	2	3	3	0	2	3	0	2	0	1	1	= 17
6:	3	3	3	0	3	3	1	2	0	0	2	= 20
	11	12	9	6	9	18	6	12	3	9	11	

The maximum possibility is 18 units of assistance (roughly estimated).

Arrangement of O's in relative order, according to gross amount of assistance, reported as obtainable from the suppositions:

O No.	7:	100% of the maximum (18)
	3, 9:	67
	2, 12:	61
	4, 6, 11:	50
	5, 8:	33
	10:	17

Arrangement of the six factors in relative order, according to the total number of units assigned to each (out of a possible 33):

Factor	1:	64% of the maximum (33)
	4, 6:	61
	5:	52
	2:	45
	3:	39

An *elastic* unit (factor 1), accelerating and retarding, but grouped consistently, was judged by all the observers, without exception, to be of more or less assistance in the subjective organization of prose-beats. Spontaneous substitution (factor 4) and tune-humming (factor 6) were very close to it in value. No. 10 graded syn-copation (factor 3) zero, as might have been expected. So also, one or two others who would be classified as passively rhythmic. No. 7 and No. 12, both of whom may be regarded as, at any rate, not passive, gave it the highest grade. All the factors, including unitary pulses, figure prominently in the experiences of No. 7.

Nothing would be more misleading than to put too general an interpretation upon the data listed in this appendix. The tables must be regarded simply as the recorded results for twelve observers, superficially tested, with regard to a few of the complex processes which contribute to rhythmic experience. Suggestion, no doubt, influenced many of the judgments announced. Some of the tests for individual difference, as, for instance, the one for accuracy in reproducing an accelerating series of intervals (Appendix III, section vii, 7) indicate that in some particulars, at least, the errors of the twelve observers represent a distribution abnormally ideal for so limited a group. It approaches the kind of distribution that the old-time theorists took pleasure in claiming for humanity at large. But this particular grouping may easily be regarded as a matter of coincidence. In some tests, in fact, the deviations have completely failed to follow the "normal" arrangement, crowding together first at one extreme, and then at the other. The experimenter feels, however, that the observers, as a whole, were a very satisfactory lot. They appear to be, at any rate, more representative, in certain points of individual difference, than one usually dares to hope for in so small a sampling.



ABBREVIATIONS

I. In "Experimental Procedure" and "Experimental Data" (Appendices II and III):

E = the experimenter

O = the observer or subject upon whom the experiment is made

tsm = the time-sense machine

kymo = kymograph

metr = metronome

AVE = Average Variable Error (see p. 131)

GCE = Gross Constant Error (see p. 131)

uas = unit-accuracy — simple

GV = Grading Value, etc., etc. (see p. 131 ff.)

II. In "Bibliography" and notes throughout the text:

Abh. = Abhandlung

Am. = American

Angew. = angewandt

Arch. = Archiv or Archives

Assoc. = Association

Ber. = Bericht

d. = der, die, das, etc.

Ges. = Gesellschaft

Inter. = International, etc.

J. = Journal

Kl. = Klasse

kön. = königlich

Mod. = Modern

Monog. = Monograph

N. S. = New Series

Norm. = Normale

Path. = Pathologique

Phil. = Philosophy, etc.

Psy. = Psychology, etc.

Rep. = Report

Rev. = Review

Ser. = Series

St. = Studies, Studien

Trans. = Transactions

u. = und

Wiss. = Wissenschaft

z. = zur, zum

Zeitsch. = Zeitschrift

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