

NOTE TO USERS

This reproduction is the best copy available.

UMI[®]

UM Number: DF10679

THE INFLUENCE OF MUSIC ON BEHAVIOR.

-by- INFORMATION NO. 10000

CHARLES M. DISERENS.

The quality of this reproduction is a consequence of the quality of the copy submitted. Broken or indistinct type, and other imperfections, such as ink and photographic, print, and other errors, are not to be held responsible for any alignment or other errors.

In the unlikely event that the reproduction is not complete, and there are related reports, the reproduction is not to be held responsible for any errors.

A THESIS

Presented as part of the requirements for
the degree of Doctor of Philosophy in the
Department of Psychology of the University
of Cincinnati.

Cincinnati, Ohio.
June 1922.

--- UMI Microform DF-10679
Copyright 2000 by University of Cincinnati
All rights reserved. No part of this publication may be reproduced
without the written permission of The University of Cincinnati

UNIVERSITY OF CINCINNATI

10000 INFORMATION NO. 10000

10000 INFORMATION NO. 10000

10000 INFORMATION NO. 10000

UMI Number: DP16679

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI[®]

UMI Microform DP16679
Copyright 2009 by ProQuest LLC
All rights reserved. This microform edition is protected against
unauthorized copying under Title 17, United States Code.

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

TABLE OF CONTENTS.

- I. Introduction.
- II. The Reaction of Animals to Music.
- III. Music and Myth.
- IV. Music in Magic.
- V. The Influence of Music on the Sick.
- VI. The Influence of Music on Work.
- VII. History of Experimental Work on reactions to musical stimuli.
- VIII. An Experimental Study of the Influence of Music on Behavior.
- IX. General Summary and Conclusion.
- X. Bibliography.

092959

THE INFLUENCE OF MUSIC ON BEHAVIOR

Introduction

The influence of music on man and his emotions has been recognized and made use of from the earliest periods of recorded history, while the indirect evidence of prehistoric archaeology, in the form of rude musical instruments found in mounds, barrows, and caverns(1) points to a still earlier recognition of the power of music, going back, perhaps, to the anthropoid ancestors of the human race.

Indeed, Darwin and many later biologists of the evolutionary school, assert that music among other aesthetic factors played an important role in sexual selection, which was assumed as a necessary supplement to natural selection. Among many species of animals, particularly those with elaborate vocal apparatus, such as birds and primates, a favorable variation in vocal utterance like a favorable variation in color, plumage, or other aesthetic features, is supposed to give to its possessor, generally the male, an advantage in the struggle for a desirable mate. Musical utterance was thus an eugenic factor, unimportant for individual survival, it is true, but definitely conditioning the survival of his particular variety of the species. The ultimate development of a variable amount of musical faculty in entire species is thus accounted for. This faculty, of course, will vary within wide limits from species to species and within individuals of the

(1) Wallaschek, R. --- Primitive Music p. 80-83

same species, but its universal presence in some degree will thus come to constitute a characteristic of the species. Darwin presents a wide range of evidence in favor of this view, at the same time indicating the principal difficulties involved. For birds and insects the evidence is almost conclusive. The development of vocal organs is superior in male birds, and the period of song is generally limited to the season of courtship(2). Even in insects the stridulating organs are confined to the male(p.560). In mammals the evidence for music as a means of sexual selection is more doubtful(p.548) but seems to have operated in the case of the anthropoids and Simians where the male vocal organs are larger and the voice may be a charm to the female(3). On the whole, it seems that "musical tones and rythm" were first acquired by the male or female progenitor of mankind for the sake of charming the opposite sex. Thus musical tones became firmly associated with some of the strongest passions an animal is capable of feeling, and are consequently used instinctively or through association when strong emotions are expressed in speech."(4). In short, musical Reaction and Response become phylogenetic associations. While this theory is doubtless inadequate to completely explain the genesis of Music or of anyone of the arts, it will not do to merely laugh it down as Ernst Mach seems to do in his criticism

(2) Darwin, Chas. -- Descent of Man p. 363-375

(3) " " " " " p. 522-523

(4) " " " " " p. 567

of H. Berg's failure to define the agreeable quality of music in the latter's attempt to "derive music from the amatory cries of monkeys".--- "Seeing that in the matter of harmony he (Berg) adopts Helmholtz's position of the avoidance of beats and assumes that the males who howled least disagreeably received the preference, we may be justified in wondering why the most intelligent of these animals were not prompted to maintain silence altogether".(5)

But this is confusing the entire question---assuming the absolute nature of aesthetic taste, and the presence of aesthetic judgments on the part of the animal, similar to our own. It is virtually a denial of Evolution. If aesthetic judgments were formed by the animal they would inevitably be much more elementary than ours, while, the conditions of pleasure and its opposite would be considerably different.

More energetic tonal elements, and rythms, like more intense and stimulating colors, would tend to be pleasurable to more elementary organisms. Even in the case of the more fully developed human being, we find this preference for ruder and more energetic stimuli among the less cultivated, notably children and savages who appear to delight in sound or color combinations which pain the cultivated ear. The difference in development between the latter is, however, very much less than between man's hypothetical ancestors and any normal human being of today, so that the organic conditions of agreeableness would necessarily be different though of the same general order. Darwin, indeed, commented on "the curious fact that in the same class of animals, sounds so different

(5) Mach, Ernst --- Analysis of the Sensations p. 120

as the drumming of the snipe's tail, the tapping of the wood-pecker's beak, the harsh trumpet-like cry of certain water fowl, the cooings of the turtle dove and the song of the nightingale, should all be pleasing to the female of the several species."(p.375). But, he goes on to say that "we should not judge of the tastes of distinct species by a uniform standard; nor must we judge by the standard of man's taste. Even with man we should remember what discordant noises the beating of tomtoms, and the shrill notes of reeds please the ear of savages."(6).

The warning of the naturalist is confirmed by the observations of professional musicians of note. Thus J. Salvador Daniel who made a thorough investigation of Arab music says: "Where I heard nothing but noise, the Arabs found a pleasing melody, in which they would often join their voices; and where I could distinguish no measure, I was compelled to admit of one by the dance."(p.45) (7). The incomprehensible complexity of the measure and rythm of Malay music has been experimentally investigated by Myers who found real, though very complex rythms perceptible to native, but imperceptible to European ears.(8). Salvador Daniel calls this an interesting problem in the difference of musical sensations, and tells how he finally came to revel in Arab music, not as a mere technical conquest, but as a genuine enjoyment. He concludes that musical taste is always relative, being based on the "habit of hearing". Lane

(6) Darwin, Chas. --- Descent of Man p. 375.

(7) Salvador, Daniel, J. --Arab Music and Musical Instruments. p. 45.

(8) Myers, Charles --- A Study of Rythm in Primitive Music
Brit. J. of Psych. Vol. 1, pp.397-406.

also noted that pleasure in Egyptian music increased with habituation to the style(9) altho the majority of Europeans find it unintelligible, execrable, revolting to the ear, indescribable, disagreeable, and barbarous. A historical illustration of this is the evolution of consonances.(10) The Greeks regarded the octave as the only genuine consonance, which was restful, the 5th and 4th were not wholly restful, while the 3rd was dissonant. In the 5th century A.D., the fifth and fourth were classed with octaves; the 3rd intermediate; while other intervals are dissonant. In the 11th century, the major third is a complete consonance, but the minor 3rd is not accepted till the 12th century, while modern music adds the 7th to the list of consonances. Experiment explains this evolution by demonstrating that "a persistent hearing of tone combinations really produces a change in the mental disposition by which the feeling of consonances is shifted".(11). Great composers, - music innovators- are condemned by contemporaries and admired by the next generation. The dissonances of the past become the consonances of the future. Salvador Daniel also concludes therefore, that "It is in virtue of a habit acquired in some degree unknowingly, that we admire today the musical works which we rejected yesterday. In music the habit of hearing is the Law, and thru it, the exception of yesterday becomes the rule of today." (12).

As a French writer has recently pointed out the standard of aesthetic excellence in music as in other arts-the Beautiful in Music-is an evolutionary one. The failure to recognize a dynamic,

(9) Lane, E.W. -- Modern Egyptians. Ch.XVIII pp.324-5.

(10) Farmer--Notes to Salvador Daniel's Arab Music.pp.187-8.

(11) Munsterberg, H.-- Psychology General and Applied. p. 362.

(12) Salvador Daniel, J.-- Arab Music, etc. p.51.

principle of reference, the desire and belief in a fixed standard of beauty is responsible for much confusion in estimating aesthetic origins.(13).

Some biologists and psychologists, however, accept Spencer's theory of the origin of music from impassioned speech, a view apparently in conflict with the sexual selection theory. According to Spencer and his followers, the human voice is a kind of gesture. Music is originally vocal, and is derived from the inflexions of the human voice produced by emotions and sentiments. The elements which demarcate song from spoken language belong to the native language of emotion. Cadence is in general the commentary of the sentiments on the ideas expressed by the words. The subsequent evolution of elements determines the well-defined differences which separate music from ordinary language today, and make of the former a potent means of emotional expression.(14).

The differences between Spencer and Darwin are not, however, irreconcilable. Both admit that music develops from vocal noises, - from all vocal noises, according to Spencer; from vocal noises of an amatory class, according to Darwin.(15).

But the question at once arises as to the origin of the musical element in early speech, and this may well have been by sexual selection- all vocal expression thereby acquiring an

(13) Cf. Belot, G. --- Esquisse d'une genealogie des Categories esthetique
Journal de Psychologie XVIII, 1921. pp.498-500.

(14) Ingegnieros, J. --- Le Langage Musical. p.197.

(15) Spencer, H. --- The Origin of Music - Pop;Sci.Mo.Vol.38,p.1-8.

emotional accompaniment and musical expression. The two views merely differ as to what stage of a continuous developmental process is to be regarded as the origin of music. Marie(16) has remarked that one could reverse Spencer's hypothesis and see in musical modulation the primal origin of expression. Language before becoming articulate may have been at its origin merely expressive musical inflection of the voice. It is logical to suppose that song preceded speech as design antedated writing. Ludwig Noire(17) in his well-known essay on the synergistic origin of Language suggests that speech arose out of the melodious, rythmical noises emitted by primitive men, (homo alalus) working together at some common task. It is significant that several of the oldest and presumably most stable languages, viz- the monosyllabic tongues of China and Siam, rely largely on tonal accents in expressing thought. The language must, in a sense, be sung to be understood. Darwin citing similar views expressed by Lord Monboddo, points out that musical sounds may have afforded "one of the bases for the development of language"(18)an opinion shared by the explorer, Winwood Readeon, the basis of personal observations of African natives.(19) Finally Dr. Donovan in a significant article on the origin of articulate speech, concludes that "the origin of speech was only possible through the aid of the psychological machinery which belonged to musical pleasure".(20) Sound, above all other sensory stimuli, impresses man from infancy, and on festal occasions vocal-

(16) Marie, A.--L'Audition morbide. p.58.
(17) Cf. Noire, L.--The Logos Theory of Language.
(18) Darwin, Chas.--The Descent of Man. p.567.
(19) Reade, Winwood--The Martyrdom of Man pp.441-42.
(20) Donovan --The Festal Origin of Human Speech.Mind. Vol.16 p.499.

ization, evolved by collective emotion and suggestion, would secure the maximum of attention, the first prerequisite to the selection of vocal signs as standard carriers of meaning.

It may well be that the embryonic music of prelinguistic vocal utterance developed first into primitive speech, which in turn differentiated into developed music, as we understand it, and the ordinary language of daily life. Both Spencer and Darwin are right, the one stresses the proximate, the other the ultimate origin of music, or as has been said, they differ only as to what stage of a continuous process in the development of human expression shall be regarded as the origin of Music in its developed form.

Objections involving a more fundamental opposition of views have been offered by a number of writers, among whom are A. R. Wallace, a co-discoverer with Darwin of Natural Selection, W. McDowell, E. Dickinson, and Prof. William Knight.

Wallace's arguments need not detain us long, since they are based on the view that man represents psychologically a break in the continuity of evolution. Continuous biologically with the animal world, man's intelligence is a kind of influx or superposition from a higher order of reality. Music and Art in general as products of intelligence cannot therefore be brought into connection with animal origins. It is clear that such an assumption can contribute nothing towards solving our problem, and as the hypothesis is entirely unverifiable, we can afford to dismiss it in this connection. A Weissman, though free from animistic hypotheses, partially shares.

Wallace's views in his contention that music is primarily a product of culture, an invention of the progressive social intelligence of humanity.(22)

McDowell's rejection of Darwin's theory of sexual selection in favor of the view of Theophrastus, "in which the origin of music is attributed to the whole range of human emotion"(23) seems based on a failure to follow up the implications of the Darwinian standpoint. We may admit with Descartes, Kant, Fetis, Helmholtz, and other exponents of the view, that music is a special language of the feelings,- a medium of emotional expression,- but the emotions themselves seem to be closely correlated with the instincts, of which the sexual instinct is one of the most powerful. It may even be regarded as the primary one from which all other instincts and their emotional correlates differentiate, if we cared to assume the position of the psycho-analysist. In brief, admitting that music is the expression of the emotions, the question arises; How did it come to be such? The theory of sexual selection furnishes a plausible answer. The emotions themselves must have evolved with their expression as adaptive mechanisms in recurrent situations having survival significance. Indeed, it is precisely in courtship situations, taken in a large sense, that the whole range of human emotions appear and assume definite expression.

Mr. E. Dickinson(24) offers no original criticism of his own, but categorically rejects Darwin's view, and declares that few hold

(22) Weissmann, A.-- Thoughts upon the musical sense in animals and men. Essays upon Heredity. Vol.2. pp.33-70.
(23) McDowell, W.-- Critical and Historical Essays. p.1.
(24) Dickinson, E.-- History of Music. Ch.I.

it today. His principal authority seems to be Prof. Wm. Knight who presents several unconvincing arguments against the sexual selection theory; for example, although he admits that "In the love call of birds, the note of the male is sweeter and more musical than in the female", yet it is not so with the voice of male and female in the human race⁽²⁵⁾. This is highly questionable, as we have seen that what is musically beautiful is relative, depending upon habituation and associations. The habitual association of the female voice with visual beauty and delicacy may be responsible for the common view that the female's voice is sweeter. It throws no light on the probable impression of a hypothetical anthropoid ancestor. The kindred objection, that in many primitive peoples, most barbarians and especially among cultured peoples, women are more musical than men loses force when we remember that it is not true in animal societies. In human society it may be explained by Tarde's Law of Imitation, according to which imitation proceeds from superior to inferior levels of Society. Women being treated as social inferiors until a comparatively recent period, would tend to this kind of imitation, while men would tend to lay less stress on the musical function when cheapened by the imitation of supposed inferiors. This would account for a complete reversal in time, of the practice of the musical function of the sexes. That music, vocal or otherwise, may have originally been regarded as a male prerogative is indicated by the fact that among some tribes, certain songs or musical instruments are taboo for women. Wallace found an Amazon tribe where women were forbidden to view a certain instrument on pain of death. Marriageable girls may not touch a certain drum among the Finnish Laps;⁽²⁶⁾ bull roarers

(25) Knight, Wm.-- Philosophy of the Beautiful, Part 2. p.164.

(26) Wallaschek, R.-- Primitive Music. pp/73-74.

are almost universally taboo for women.

In the second place, Knight says that the songs of savages are not love themes, but songs of war, exploit, or lamentation, and that if love gave rise to song, there ought to be some record of the dominant passion in the earliest surviving songs. But this does not follow since contemporary savages are probably both imperfect and sophisticated specimens of earliest man, while the earliest surviving songs are very recent indeed compared with the long history of primitive humanity. The absence of love songs and prominence of war songs, is conditioned by the nature of the instincts they subserve. The original love song, expressing individual sex emotion is essentially private and adapted to individual ends. No communal service would result from its preservation. The war song, or song of achievement is connected with the herd instinct, and expresses collective emotion. It is essentially public, falls readily into the frame of ritual, and is therefore preserved.

Moreover, erotic art including erotic music has been frequently neglected by ethnological writers through prudish motives, while in many savage tribes, sexual matters are hedged in by taboo, and are especially concealed from white visitors.(27) Thus savage reticence based on instinctive or magical motives, along with civilized prudishness combines to limit our insight into the degree of erotic motivation of primitive music, and a closer intimacy with primitive men may reveal many more illustrations of erotic music that we now possess. It is not true, however, that we are utterly lacking in material of this nature. In most primitive tribes "dances often of a decidedly erotic

(27) Hirn, Y.-- Origins of Art. Ch.XVII. p.244.

character are performed either by both sexes together, or by one sex before the other", (28) and dancing implies the presence of music.

"There have been translated some exquisite samples of love songs composed by the Malay tribes of Java and Sumatra", and in some instances it is quite evident that these songs have been used in winning the favor of the women---love occupies an important place in the poetry which has been collected in Malaysia, not only among the Malays proper, but also among the Tagols, Alfieras, Battalis, Ets. (29), and primitive poetry is not only generally sung, but partakes of the nature of magical incantations or Machtsprüche, designed to actively influence objects.

Primitive Australian poets describe the charms of their sweet-hearts in dancing songs, and the Maori possessed several classes of love songs. Among the Aborigines of Hindustan, courtship is pervaded by Art and aesthetic activities, several collections of native love songs (Khyounga love songs, Chukina songs) having been made by Lewin in his Wild Races.

Still better examples of music for erotic purposes can be cited from America. The Iroquois assign great importance to dancing festivals in which both sexes participate, and made use of serenades, too, when they wished to lure a girl from her wigwam to a meeting. (30) The Yuma Indians of California win the affections of maidens by flute playing (31), while among the Shawnees of Tennessee, the young men

(28) Wallaschek -- Primitive Music. pp.210-213.

(29) Hirn, Y.-- Origin of Art. p.235.

(30) Morgan, L.-- The League of the Iroquois. pp.284-287.

(31) Bancroft, H.H.-- Native Races. Vol.1. p.516.

practiced flute playing in the evening "to decoy the women from the villages so that they could obtain opportunities for declaring their love in the quiet woods or on the banks of the murmuring streams".(32) Finally, Miss Alice Fletcher in a paper on the Love Songs of the Omaha Indians, directly refutes the statements of Spencer and others, that there is no evidence "of a love song spontaneously commenced by a man to charm a woman". That such were not observed at first, is due to the fact that the students meet great difficulties in any attempt to "penetrate into the mysteries of secret societies and ceremonials", "and these obstacles increase as he approaches the Indian's personal habits and experiences".(p.153) As a matter of fact, love songs, called by the Omahas "Bethaewa'an" are numerous, and are generally sung in the early morning "when the lover is keeping his tryst and watching for the maiden to emerge from the tent and go to the spring. They belong to the secret courtships and are sometimes called Me-the-g'thun wa an--*Courting songs." Me-the-g'thun, means the act of courting or wooing. They were sung without drum, bell, or rattle to accent the rythm which is subordinated to tonality and is felt only in the musical phrases. "Few unprejudiced observers", concludes Miss Fletcher "will fail to recognize in these Bethaewa'an or love songs, the emotion and the sentiment that prompts a man to woo the woman of his choice".(33) All these examples tend in favor of the Sexual Selection theory of musical origins and closer investigation of primitives may demonstrate that music, dance, and songs, subserve erotic purposes to a greater extent than travelers report or the opponents of the view

(32) Walleschek, R. -- Primitive Music. p.48.

(33) Fletcher, Alice C.-- Love Songs among the Omaha Indians, The International Congress of Anthropology, 1894. pp.153-57.

suppose. Prof. Knight's final objection, that the doctrine, that the human voice was primitively used and perfected in the practice of a love call "is a hysteron proteron" and that a voice would surely be pretty well perfected before it could be used, seems founded on an inability to conceive of an evolving function conditioned and directed in its further evolution by its results, but possessing some measure of effectiveness at every stage.(34)

Jules Combarieu in his Evolution of Music, urges some of the same objections against Darwin, but he does not regard them as destructive of the theory. He does not think the theory exhausts all musical origins, and believes that the Sex impulse involved should be understood in a somewhat wider sense as something perhaps equivalent to the Libido of the Psycho-analyst or the vital urge of certain philosophers. With a few modifications, which do not alter the essence of the theory, it can be made entirely acceptable.(35) Such a modification we shall see has been made by Prof. Y. Hirn.

Indeed, to summarise at this point; Most criticisms of the theory seem to be founded on misconceptions among which the following may be noted:

1) A confusion of developed modern music and standards of taste with, the essence of music which in its simplest definition is merely "ordered noise".(36)

Developed music, either civilized or savage, did not exist in pre-human periods for sexual selection to work upon, but ordered

(34) Knight, Wm. -- Philosophy of the Beautiful. Part 2. p.164.

(35) Combarieu, Jules -- La Musique. p.169.

(36) Smith, H. -- The World's Earliest Music. p.229.

noise, in the voices of animals and even in inanimate nature, certainly did exist and could have attracted the attention of animate beings. Skilled musicians, such as Prof. F.B. Weber and Gardner, agree upon this point. Weber assures us that "the sounds of nature are mostly melodious and harmonious, or in some harmonious connection, and form exact intervals and chords", and that all animals have characteristic calls and voices in distinct intervals, giving examples.(37) It has even been suggested that this music of nature, the sound of animal and bird voices, rain, wind, and waters, may have "awakened the innate powers of human mimicry and had something to do with human song", a view that conflicts in no way with the sex selection theory, since the sounds of nature simply provided models for expression of emotion, as physical stimuli afford material for emotionally directed dreams. Conscious recognition that musical stimuli are arranged according to a determined musical system, is not essential to musical sensation, and reaction. All that is necessary is that such arrangement and analysis should be possible. The possibility of the existence of a prehuman musical material for the purposes of sexual selection is therefore indisputable.

2) The assumption that man represents, psychologically, a break in the continuity of the evolutionary process, and that human music, therefore, is a purely intellectual achievement or collective invention, depending upon the new factor of intelligence, and unconnected with animal origins.

3) A third line of objections results from the attempt to preserve an imaginary aesthetic distinction, the conception of the autotelic nature

(37) Pole, Wm. -- Music in Nature. Nature Vo. 35: 1887. pp.343-4.

of Art, the disinterestedness of aesthetic attitudes, etc. Hence, we find naturalists themselves, such as Darwin and Weissmann, blinded by the prevalent aesthetic theory, asserting the biological uselessness(38) of music when its supreme utility was just what they were demonstrating. Indeed, Weissmann, stressing utility as the principal consideration in questions of development, and maintaining the non-utility of music, decides that the musical sense is "a merely incidental production", and the development of music due to accumulation of social tradition and technique(39). The non-utility of music is, of course, questionable, since the inability to define its utility is no proof of its absence. As Wm. Wallace says: "No one has a right to quarrel with Nature and say roughly, 'This is useless', its existence proclaims its utility."(40)

But the dogma that the aesthetic is of no life value is an academic distinction, an abstraction from concrete aesthetic experience involved in the existence of the Arts, and it is interesting that the latest attempt to define the aesthetic categories, bases them upon the whole repertoire of human instincts, and thus acknowledges the intimate connection between the arts, and the vital processes of man. "Our aesthetic experience", says Chandler, "becomes a precious supplement and reinforcement to the other activities of Life".(41)

4) Another group of objections is based on a rigid adherence to the letter of the initial statement of Darwin's sexual selection theory.

(38) Cf. Darwin, Chas. -- Descent of Man. p.569.

(39) Weissmann, A. -- Thoughts upon the Musical Sense in Animals and Man in Essays in Heridity. Vol.2, p.37-54.

(40) Wallace, Wm. -- The Threshold of Music. p.13.

(41) Chandler, Albert -- The Aesthetic Categories--Monist. Vol.31, 1921 p.-419.

The critics apparently do not perceive that the theory could be materially modified without sacrificing the principles involved, and that a refutation of incidental statements is not a general refutation.

5) Finally, the retention of the theory does not as some believe, force us to assume aesthetic judgments on the part of the animals, since all that is required is that certain sound and color stimuli, which we, but not necessarily the animals, judge as aesthetic, should produce certain definite changes in behavior. This has been satisfactorily worked out by Hirn to whose reconstruction of the sexual selection theory we will now turn: No treatise, according to Hirn, is so important for aesthetics as the chapters on sexual selection in the "Descent of Man". Altho much of Darwin's language is theoretically inappropriate, "the aesthetical terms in the "Descent of Man" could easily be exchanged for more psychological ones without any important alteration in the main thesis of the book".(42) Indeed, Darwin's language often suggests that by aesthetic appreciation, he means merely physiological stimulation of the animals by what WE call aesthetic stimuli. The theory of primordial aesthetic appreciation on the part of female animals is untenable since aesthetic judgment involves intellectual qualities and moral restraints. Attention to beauty involves voluntary attention which is not possessed by any animal, and the presence of aesthetic appreciation is still less probable in view of the excited emotional state of the female during the supposed aesthetic displays of the male.(p.189) Nevertheless, an influence of such displays, plumage, dance, or song on the female

(42) Hirn, Y. -- Origins of Art. p. 186 p.200.

can not be argued away. In the absence of intellectual activity, aesthetic judgment, or conscious choice of any kind, there may still be a profound influence on the emotional and instinctive life. The involuntary attention of the female is attracted and retained. If this is true, we can understand the effect of a prolonged exhibition of dancing and singing or brilliant plumage. This effect is a kind of hypnosis, a passive state which leaves the female a prey to the emotions and images of the situation.... an enhanced inclination to pairing results. The whole thing is a purely physiological phenomenon, and Darwin's terms, "charming" and "fascination" are strictly appropriate. As concerns the topic of music, songs are physiological suggestions to activity, not aesthetic incentives. Animal music then has real biological value in overcoming the instinctive coyness of the female, and arises as an overflow or exhibition activity due to increased nervous energy in the males during courtship. (43)

Stated in this form, the theory loses most of its difficulties, and its thesis far from being rejected by most authorities, as the historian Dickinson states, is widely accepted, and the author of a recent work which purports to be a "Revaluation of Psychological Principles as Foundation of All Thought" declares that "all our aesthetics, our poetic, musical, pictorial arts, are as is commonly recognized, derivative transformations of male love-struttings and displays" (44)

Without assuming this extreme position, it is clear that sexual selection is a very important factor in the development of musical Response, both the production of musical stimuli and the reactions

(43) Cf. Hirn, Y. -- Origins of Art. pp.185-202.

(44) Briffault, Robert -- Psyche's Lamp. p.201.

which they evoke. We have seen, however, that in the view of some psychologists, the repertoire of instincts may be derived from three primary basic instincts, drives or primary expressions of the organism's energy, viz., Sex, Ego, and Herd instincts. It is possible that a special type of selection may have centered around the latter, and have been responsible for the development of those forms of song which seem unconnected with courtship, viz., Work and War songs. These were said in a previous section to represent collective effort, and they may have arisen from what, for want of a better word, may be called herd selection. Many animals and presumably primitive man, are social, forming flocks, herds, or packs. Now, M. Espinas, believes that the males, when collecting in great numbers during the pairing season, are led by an unconscious desire to stimulate their feelings by the view of the other equally excited males.(45) Excitement, mutually enhanced by mimesis, culminates in vocal expression. Such may also occur upon any occasion when many animals are assembled in a herd or pack, apart from questions of courtship, though such would usually be present. It is possible that such vocalization had survival value in warning fellows, deterring aggressors against the herd, or terrifying and stupefying the victims of the pack. Those herds or packs that possessed the greatest number of highly vocal males would then tend to have a slight advantage over less vocal groups in the struggle for existence or in another sense, the principle of mutual aid would be more effective among them. Here then, may have originated the rudiments of the war and work songs which are so valued by primitives. They are by origin and nature public and not subject to taboos, so

(45) Espinas, A. -- Des Societes Animals. p.328.

that they are the first evidence of primitive music which attracts the traveler's attention. But, even, the war songs may come to play a part in sex selection, just as attractive military features still do today among supposedly cultured individuals. Thus, the development of the capacity of producing and responding to rudimentary musical stimuli - the raw materials of music - is intimately connected with the great primary impulses of man, the Reproductive and herd instincts. These, perhaps, suffice to explain the evolution of the musical function at prehuman levels, since it is hard to see how the third great primary impulse, the Ego Urge, could in itself have evolved musical expression; for the Ego Urge is in itself undirected, and its energy expands in all directions. Only in so far as the expression of its energy is directed or ~~or~~channeled by other impulses, could it give rise to a definite development of expression. However, from this standpoint, the Ego Urge, may be said in its superabundant activity to have contributed part of its energy for elaboration on the part of the other impulses. Vocalization, only a part of its total activities, may have been utilized and developed by sexual and herd selections. Thus, those theorists who maintain that music or Art in general sprang from the natural rhythm inherent in the organism or from play activities conceived as an evolution of surplus energy, bring a real contribution toward a theory of musical origins though they cannot offer an explanation. Vocalization, the most primitive material, will be conditioned by organismic structure, and, therefore necessarily rhythmical. It will also be one of many means of expending surplus energy. But to admit this, explains only the production of the first crude stimuli, and not 1) the improvement in means of producing such stimuli or 2) responses to such stimuli on the part of other organisms of the same

species. The latter seems to depend upon phylogenetic association with the two great primary impulses (principally sex) which we have discussed above.

On the basis of the theory sketched, we can readily incorporate the views of Bücher, Spencer, Wallaschek, etc., to explain later stages in musical evolution, and assume that the movements of the body in the toil of the limbs in the orgiastic dance, the sounds of women's implements at the loom, grinding corn, or beating skins, the stroke of the hammer on the anvil, the twang of the bow string, etc., suggest definite sequences of measure and rhythm, which become conventionalized in sound patterns, varying in different parts of the world according to the scales imposed by varying auditory discrimination and magical interpretation.(46)

II.

If musical stimuli have really played such a role in ~~the~~ biological evolution as our analysis suggests, the general influence of music on the organism is a deductive fact requiring no further proof. It is, however, of interest chiefly as a background to studies of specific musical effects, the presence of which, if found by experiment on a few individuals, would still be a doubtful basis for a generalization in the absence of some such general conditions for the appearance of musical effects.

When we inquire into the specific nature of musical influences on the individual organism, we find indeed a considerable mass of data,

(46) Cf. Bücher, K. -- Arbeit und Rythmus. Ch.I, II.

but very little of positive scientific value in itself. Our data on the subject vary in reliability according to the methods by which they were obtained, the standards of observation and expression of the age in which they were made, and the temperament, training, and object of the individual investigator. There is no reason, however, for rejecting a large part of this data, since much of it could not be reduplicated under modern conditions. What is needed is a critical comparison and evaluation of all available data - however secured, supplemented by experimental work in the field, culminating in an effort to correlate the results in a unified whole. By organizing all available series of data on musical influences, from ethnology, sociology, and Culture History, as well as from experiment, we may derive a convergent proof of the influence of music on the organism, which will be more satisfactory than one based on any single series of data with its inherent limitations.

Our purpose then is to study the influence of music on the organism. We approach music from the practical rather than the aesthetic standpoint, regarding it as a necessity, a possible means of re-education and human reconstruction for all, rather than a mere subject of unproductive pleasure, or an object for criticism for the learned few.

Even musicians sometimes confess that "the numerous expositions of a composer's philosophy, the inner meaning of his works, the appreciations, the analytical discourses on this masterpiece or that, leave us in a nebulous state of mind," and that "the most obvious procedure in music too often is attributed to some remote occurrence, to some banal idea, without a scintilla of evidence."⁴⁷ On the other hand, scientific investigators have either approached the problem of the

47. Wallace, Wm. The Threshold of Music. P. 1-2.

effect of music in the wrong way or have neglected it because of its failure to contribute to traditional aesthetic theories of the disinterested appreciation and the biological uselessness of the arts. A little study indicates, however, that as it appeared in history, Music was always associated with social life, or rather the functioning of the organs of society. It was never "an end in itself", but subordinate to important public acts, magic, ritual, ceremony, or labor.(48) Incidentally, even a study from an avowedly practical standpoint, may contribute to the purely aesthetic field, where nearly all past experiments could be profitably repeated "in the light of developing theories of aesthetic experience".(49)

Our general method will be genetic as well as experimental. We shall take account of:

1. The social phenomena connected with the development of music, such as are observable in myth, ritual, magic, medicine, and the evolution of Work. None of these phenomena can be explained aside from sociological considerations, yet their essence is probably physiological, so that we cannot afford to neglect them. The sociological method is also objective in a sense, and therefore a supplement to psychological study from a behavioristic standpoint. Myths, ritual, and magical ceremonies, whatever else they are, are verbal or muscular reactions to complex social situations, usually involving musical components. Further as a part of the sociological method we may include responses to questionnaires on the influence of Music on human beings or even animals.

(48) Cf. Combarieu, Jules -- La Musique. p.14.

(49) Cf. Bullough, Edward -- Recent Work in Experimental Aesthetics, Brit. Journal of Psych. Vol.12, 1921,p.77.

2. The results of experiments on individuals, including:
 - 1) A summary of the experimental work of other investigators.
 - 2) Original experiments for the purpose of securing new experimental results.

Our method of observation will neither be purely behavioristic nor purely introspective. The former is indeed in the strict sense impossible, since even the behaviorist begs to be allowed to use consciousness as a tool, just as the physiologist does. In other words, where the behaviorist relies on verbal responses, as he often must, discrimination between sensory stimuli, certainly a conscious process is involved, and we have what Woodworth calls simple introspection(50), a process which we shall employ when necessary. Complex introspection in which the mental operations and not sensory stimuli must be observed will be usually unnecessary in our work, and wherever possible, observations will be confined to objective behavior.

In our choice of materials, we shall make use of actual musical selections in spite of the difficulties involved, for greater ones seem to result from the use of mere isolated tones, chords, intervals, etc; as was customary with many earlier investigators. Such investigators encounter the same difficulties in applying their results to music as attend the efforts of color students to explain a painting on the basis of experimental results with isolated colors or very simple color combinations. The results in both cases are of theoretical interest, but have no bearing on actual music or painting where no pure tones and few pure colors occur. Indeed, some of them seem to confuse the work

(50) Woodworth, R.S. -- Dynamic Psychology. pp.32 ff.

of art - musical selection or picture - with a mere summation of stimuli, under which conditions, a response would be fairly predictable. But the relations between the elementary stimuli, tones, or colors, which are built up in the constitution of the art work, must themselves be stimuli, which must be considered as factors in responses to the complex situations constituted by the completed art work, and since the permutations and combinations of reciprocal modifications of the total series of elementary stimuli involved are so numerous, the course of inhibition and of facilitation seems incalculable, and the only safe method of determining responses to experiment with actual music or pictures, whatever the difficulties involved. In short, the method of isolated elements, particularly in the study of Music:

- 1) is highly artificial.
- 2) We are not practically interested in responses to isolated tones, intervals, chords, etc.
- 3) Such reactions do not correspond to the genuine musical situations in which we are interested.
- 4) These simple elements are no more music, than the letters of the alphabet are literature, a miscellaneous medley of words, poetry, or an accumulation of building materials, architecture.(51).
- 5) For this reason, material for the experimental investigation of musical effects on organisms should always be organized material, ~~it~~z. actual musical selections.

(51) Cf. Combarieu, Jules -- La Musique. p.18.
Nathan and Dupre -- Le Langage Musical. p.18.

THE REACTIONS OF ANIMALS TO MUSIC.

The close relationship of man to the animal world, intuitively recognized in the Totemism of primitives and demonstrated by the Evolutionary biology of today, suggests that animal psychology may be able to throw some light on the influence of music on the human organism.

Accepting as we do the account of the human organism and its functions as offered in the general theory of evolution, it is clear that "man's claim to a superior place among animals depends less upon different reactions than upon a greater number of reactions as compared with the reactions of lower animals".(1) Perhaps we should modify this statement slightly and say that man differs from the animal in the greater number and complexity of his reactions, altho the physiological reflex elements are identical. Inference based on Behavior would suggest a similar statement with respect to conscious states in men and animals, altho such inference can neither give us data on the exact point on the animal scale at which conscious states arise, nor inform us as to their quality, except in the case of man where introspection and standardized verbal response is possible. It is evident that we cannot study the conscious musical response of animals (assuming such to exist), and that accounts of animal response to music must be critically analyzed with the object of separating relevant descriptions of behavior from the subjective interpretations of the observer.

(1) Crile, G. -- Man and Adaptive Mechanism. p.38.

In so far as he confines himself to observable behavior, the greater simplicity of his materials enables the animal psychologist to study fundamental reactions under more favorable conditions than the student of human psychology, and many of the latter's problems have been illuminated by studies of animal behavior. In particular, the solution of problems connected with the learning process has been promoted by the work of Thorndike, Yerkes, Watson, Carr, and a host of other students of the animal mind.

Any overt form of response may be profitably studied under such simplified conditions, and since response to musical stimuli is predominantly overt in primitive human beings, children, and uncultivated adults, and among cultivated adults, the musically uneducated, it follows that a study of the behavior of animals in the presence of music may be as useful here as elsewhere.

Indeed a considerably tho scattered mass of data on animal response to music does actually exist. We shall see that well controlled experiments in this field are relatively rare, and what few exist will be summarized later. At present we may note that observations began very early; Plato tells us that song and melody can tame savage animals and even reptile(2), and Aelian reports a number of specific instances of music affecting animals.(3) That even earlier observations of the kind is evidenced by the widely diffused myths concerning the power of music. Indeed some have supposed that "the influence of modulated sounds upon animals must have been more studied formerly than today; the experiments were more varied, and their results more

(2) Cf. Plato. -- Republic, Book II.

(3) Aelian, De Nat. -- Animal Books, V,II,VC,XII.

extended".(4) Such study was possibly dictated by the search for what could be palmed off as miracles by the priests of pagan religion. If so, no precise reports of such experiments, but only distorted conclusions of scarcely more than historical interest have come down to us. Observations have also been made, frequently by travelers, many of them eminent scholars in their field, such as Chateaubriand and Sir William Jones. Observations on animal response to music exist also in the works of the older zoologists such as Buffon and Lacepede. Many of these have been incorporated in the accounts of animal mind offered by the so-called anecdotal school of animal psychology. Within this school we find such great names as Darwin, Romanes, Lubbock, and Büchner; and altho modern students of behavior are inclined to discount their work in animal psychology on the ground of anthromorphism, probably no one would dispute the capacity of the great naturalists to observe accurately, and give an honest report of what they saw.

Anthropomorphism, or the doctrine which attributes to animals mental functions of the same or similar nature to those of men, is a matter of analogical interpretation. It is of course unwarranted by scientific evidence. In one sense, however, anth^{ro}morphism cannot be avoided since animal experiences must be interpreted in terms of human experience, in order to be thought of at all. The animal's reactions must be ultimately described in terms of the consciousness of the observer, if any description is to be given at all. This kind of anthropomorphism is, however, confused with the first named type, and since it is inevitable, leads to an unwarranted contempt for the work

(4) Salverte, E. -- The Philosophy of Magic. Vol.II, pp.333 ff.

of the older naturalists.(5)

Anthropomorphism is only dangerous where it leads to an actual distortion of the facts observed. In so far as it consists of interpretation of responses correctly observed, it is harmless and attention may be given entirely to the responses. The many reports as to animal response to music given by older observers are therefore as useful as any other behavior studies, and may easily be separated from their deductions as to animal intelligence, aesthetic motives, etc.

It may still be urged, however, that these are mere reports of observations and not controlled experiments. Experiment, however, is nothing but observation in which conditions are arranged or controlled by the observer to facilitate the discovery of facts. But, "in psychology, as in every science, facts are often observed under quite informal and uncontrolled conditions. Their discovery is frequently unpremeditated by the observer. But they are nevertheless valuable." Such observation may be genuinely scientific, if it is careful and critical and the natural circumstances are favorable.

Only a few experimental studies of the effect of music on animals exist, and of these, the majority consist of observations made by naturalists on caged animals, subjected to the influence of selected pieces of music. Here at least, the type of music employed was deliberately varied, the effect of different kinds of instruments noted, and the effects of time of day and varying physiological condition (hunger, etc.) observed. The experiments were also repeated and the conditions controlled so that repetition by other observers is possible at any

(5) Cf. Watson, J. -- Behavior. p.5 (for attack on anthropomorphism)

time. Observations of behavior under such conditions are evidently valuable.(6) Several laboratory experiments on the response of animals to music have been made in Italy, while American Behaviorists in a few cases have studied the responses to isolated musical stimuli - chords, etc. - with the object of discovering whether animals actually hear such stimuli.

The latter question is, of course, extremely important. It is, indeed, quite possible that many animals do not perceive tones; that they are not responding to musical stimuli when they seem to do so, but are really responding to some kind of concomitant stimuli of a different nature. The real facts can only be discovered by careful experiments; and the results based on the study of auditory response in a number of animal species are so far conflicting. Kalischer concludes for example that dogs possess a fine sensitivity to absolute pitch. Rothman found no difference in reaction to noises and tones. Johnson repeating these experiments concludes that the dogs reacted to accidental stimuli under such conditions, but his work does not prove that dogs are unsensitive to pitch. Pfungst finds no auditory sensitivity in horses, and Yerkes denies auditory sensitivity to the dancing mouse, but finds that tonal stimuli, though producing no direct response, reinforce the reflexes of the frog, an animal much lower in the scale than the dog, horse, or mouse. Selionyi and Shepherd found cats sensitive to pitch and the latter also noted auditory sensitivity to tones in monkeys.(7) It is clear that many more and infinitely varied experiments must be carried out before we can decide on this basis just which animals are capable of responding to musical stimuli.

(6) Yerkes, R. -- Introduction to Psychology. p.46.

(7) Cf. Watson, J. -- Behavior. pp.374-389.

Meanwhile, several lines of indirect evidence indicate the wide-spread diffusion of such a capacity in the animal world.

In the first place, if we accept the sexual selection theory of the origin of music, it follows necessarily that animals are sensitive to musical stimuli, since an important phase of evolution would depend upon such sensitivity.

In the second place, even if we do not accept the Darwinian view, the fact remains that a wide range of animals from certain insects with stridulating apparatus to the singing gibbon (*Hylobates*) produce musical sounds. Weissmann has noted this fact, while at the same time denying the utility of this animal music and rejecting sexual selection.(8) That the sounds produced are really musical is vouched for by distinguished musicians, as well as by savants who have taken the trouble to record in musical notation the voices of animals and birds. Thus Father Athanasius Kircher (p.16) in his "Musurgia" has arranged in notes the songs of the cuckoo, quail, cock, and hen; Yersin, the song of the cricket; while Charles Butler recorded the murmur of bees - in a manner approved by Reaumur.(9) Weber claims that all animals have characteristic calls and voices giving examples,(10) and Gardiner(11) cites others in an attempt to prove that "whatever is passionate in the art of singing, speaking, and performing upon musical instruments, is derived from the sounds of the animated world". It would be difficult to account for the presence of all this animal music unless some kind of response to it on the part of its possessors is assumed.

- Vol. (p.34, Essays/II
- (8) Weissmann, A. -- Thoughts Upon the Musical Sense in Animals and Man.
 - (9) Radau, R. -- Wonders of Acoustics. pp. 13, 14, 19.
 - (10) Weber, F.B. -- On Melody in Speech. Longman's Magazine, Feb. 1877.
 - (11) Gardiner, Wm. -- The Music of Nature. Ch.X pp.199-204. Ch.XIV p.247-253.

Finally we have the argument from anatomy that the structure of the brain and organ of audition are so similar, at least in the higher vertebrates, that there is no reason why sensations of tone should not be experienced by all, and evoke characteristic responses, provided such exist. No one disputes that animals react to noises, and Darwin takes this as proof of sensitivity to tones. "A noise", he says, "is the sensation resulting from the coexistence of several aerial 'simple vibrations' of various periods, each of which intermits so frequently that its separate existence cannot be perceived. It is only in the want of continuity in such vibrations, and in their want of harmony inter se., that a noise differs from a musical note." An ear capable of discriminating noises, the importance of which is acknowledged by all, must be sensitive to musical notes. Darwin, therefore concludes, that "as far as mere perception of musical notes is concerned, there seems no difficulty in the case of man or of any other animals".(12)

Weissmann also observes that in man "the auditory organ proper is, so far as we know, not much higher in organization than that of many mammals, and it does not possess any peculiarity of construction which would justify us in the assumption that the power of hearing music is greater than in animals".(13) He shows that it has been useful to animals in the struggle for existence to hear distinctly a very large number of notes, a fact which must render the hearing of music a possibility. Moreover, it follows that if -- the mammalian auditory organ must attain so high in pitch of perfection lest it should be inadequate in the struggle for life, it is clear that the part of the brain by which notes are perceived, the auditory center, must possess

(12) Darwin, Chas. -- Descent of Man. p.563.

(13) Weissmann, Aug. -- Thoughts Upon the Musical Sense. p.55.

a corresponding degree of organization".(14)

On the whole, the indications are that the higher animals are capable of reacting to musical stimuli, though the attendant consciousness is hypothetical. Weissmann thinks that it is confined to a simple awareness of the agreeableness or disagreeableness of music,(15) If this is the case, we should expect more definite reactions from animals than from human beings, since no conflicting contents of consciousness would then interfere with the native responses to affective states.

Accepting this as a provisional view, we may now survey the evidence at our disposal. In doing so, we shall

1) Interpret music rather broadly so as to include

- a) Sounds not musical per se, but occurring in simple rhythmic order, eg, the beating of drums, etc.
- b) Musical sounds in harmonious sequence.
- c) The same in different keys, of varying complexity, but combined in accordance with harmony.(16)

2) We shall consider the effects of music thus interpreted on as wide a variety of animals as possible, proceeding from the lower to the higher forms. Inferences based on such data will naturally be proportional in value to the nearness of the animal in question to man, upon the phylogenetic scale.

3) For psychological purposes, a classification of animals similar to that suggested by Yerkes will be adapted. Viz:

- (14) " Idem Thoughts Upon the Musical Sense. p.59.
- (15) " Idem Thoughts Upon the Musical Sense. p.66.
- (16) " Stearns, R.E. -- Instances of the Effects of Musical Sounds on Animals. Am. Naturalist.V.24,1890,p.24.

- I. Animals which lack a nervous system: the unicellular organisms.
- II. Multicellular organisms which, although possessing a nervous system, are simple in structure and behavior as compared with all other animals except those of the first group.
- III. The Arthropoda, crustacea, spiders, and insects - invertebrate animals with complicated structure.
- IV. Inferior vertebrates - fishes, amphibians, reptiles, and birds.
- V. Superior vertebrates, including all the mammalia except the primates.
- VI. The primates with the exception of man.(17) Since the question of response to music can not arise, where organs of audition are absent or remain undiscovered, Classes I and II are at once excluded from consideration.

According to Darwin, however, evidence of the capacity to respond to musical tones appears at a very low stage in the animal scale. "Thus crustaceans are provided with auditory hairs of different lengths which have been seen to vibrate when the proper musical notes are struck..... Similar observations have been made on the hairs of the antennae of snats".(18) A lobster described as a lady's pet in Paris was said to be so fond of music, that it was always drawn to the piano whenever its mistress played,(19) and the ancient Greeks are said to have employed the flute to entice certain kinds of crabs from their hiding places.(20)

(17) Cf. Yerkes, R. -- Introduction to Psychology. p.233.

(18) Darwin, Chas. -- The Descent of Man.

(19) Lindsay, W.L. -- Mind in Animals. Vol. I. p.56.

(20) Fitzgibbon, H.M. -- The Story of the Flute. p.264.

"Bees", says Burton, "though they be flying away, when they hear any tingling sound, will tarry behind", (21) and Chomet claims that "bees that have escaped from their hive are easily brought back by the sound of cymbals, or of pans and kettles". (22) According to Lubbock, however, bees seem to be insensible to sounds (23), while Galton's experiments on the auditory sensitivity of insects were without results (24) Darwin and Büchner agree that it has been positively asserted by good observers that spiders are attracted by music, and Romanes declares that the evidence on this matter is so abundant and varied that we can scarcely doubt the facts. (Animal Intelligence). Prof. Beaunis has recently made a like statement. Büchner writes: "Spiders living in a room are attracted out by the playing of a piano, guitar, or violin, especially when the music is tender and not too loud. They approach as close as possible to the instrument and to the player, and seem so bewitched by it that they pay no attention to anything else. They are often seen to let themselves down by a thread from the ceiling of a room so as to get as near as possible to the player. As soon as the music becomes noisy, however, they run back to their nest". (25)

An incident of this kind was described by Professor Reclam. At a Leipzig concert, a spider came down and suspended itself from a chandelier during a violin solo, but withdrew to its hiding place when the orchestra joined in. (26) Similar incidents are given by E von Hartmann in his Philosophy of the Unconscious, and by Michelet, Wier, and others.

- (21) Burton, I. -- Anatomy of Melancholy. p.335
- (22) Chomet, H. -- The Influence of Music. p.180
- (23) Lubbock, J. -- Ants, Bees, and Wasps. p.290
- (24) Galton, F. -- Inquiry into Human Faculty. pp.39-40
- (25) Büchner, L. -- Mind in Animals. p.320
- (26) Reclam, C. -- Body and Mind. p.275

The responses so far described are, however, probably of a purely mechanical nature. E. Rabaud has noted especially with respect to spiders that reactions formerly ascribed to curiosity, interest, foresight, etc., are due to varying intensities of vibrations imparted to their webs, -gentle vibrations inducing movements of approach to the source, violent vibrations, movements of flight.(27) The different responses of the spider to the violin solo and to the music of the entire orchestra may, therefore, be due to the different intensities of vibration imparted to the web by the two kinds of music.

No reliable observations seem to have been made on whether fish respond to musical stimuli, though Aelian reports that music facilitates their capture.(28) Professor G.H. Parker and his students, however, have carried out experiments on the responses of fish to vibrating strings, bells, and tuning forks. The killifish (*Fundulus heteroclitus*) responded to the sound of the vibrating string with movements of pectoral fins, increased respiratory movements, movement of caudal fin, or a spurt forward, according to the intensity of the stimulus.(29) Bigelow worked with goldfish (*Carassius auratus* L.) using an electrically driven tuning fork of 100 vibrations per second. Normal fish responded in various ways, such as tail jerks followed by swimming forward; tail jerks without locomotion; tail and trunk jerks, with turns to the side, etc. (30)

Zanneck, working with an electro-magnetically driven bell, noted

- (27) Rabaud, E. -- *Journal de Psychologie*. Vol. 1921.
- (28) Aelian -- *De Nat. Animal lib. VI. Cap XXXI and XXXII*.
- (29) Parker, G.H. -- *The Sense of Hearing in Fishes*. *Amer. Nat.* 1903, Vol. 37, p. 185.
- (30) Bigelow, H.B. -- *The Sense of Hearing in the Goldfish*. *Amer. Nat.* 1904, Vol. 38, p. 275.

-12- .

that a fresh water fish (*Lucisoma dobula*, L. *rutitus* and *Alburnis lucidus*) responded to a bell by swimming away.(31) Other experimenters, however, deny these results in toto. Aside from these experiments, made simply to determine whether fish hear tones or not, no data exist as to the response of fish to music in the proper sense of the word. The same statement applies to Batrachians, among which Professor Yerkes has determined auditory sensitivity to tones in the green frog. Tones from an electric bell produced no response by themselves, but given shortly before an adequate tactual stimulus (interval of 35") produced a reinforcement of leg reflexes. For intervals of from 4 to 9", partial inhibition resulted.(32)

Large Lizards and Iguanos, however, are said to be very susceptible to the influence of music. A song or even soft and measured whistling induces quiet and attention, and enables the hunter to capture them.(33)

Wier relates a number of incidents relative to the attraction exercised by music on lizards. A lady in Italy when singing one moonlight night near the Campanile noted "several little lizards lying about on the stones, their heads held alertly in the air as if entranced by the sound of her voice". He also claims that "Tree lizards will listen completely entranced to the music of a good whistler, and will allow themselves to be captured while thus enthralled..... The sound of the piccolo is very pleasing to these little creatures, and I have frequently collected about me as many as ten or a dozen by sounding this instrument in the still depths of a wood which I knew

- (31) Zanneck, J.--Reagieren die Fische auf Tone-Arch.für gesamte physiologie -1903 XCV p.346. p.627
 (32) Yerkes, R. -- Auditory Reactions of Frogs.Harvard Psych.Studies1913
 (33) Lacepede -- Histoire Naturelle des Quadrupedes ovipares.Art.19. Iguane.

these salamanders frequented".(34)

Among the most ancient traditions of the Orient are those of snake charming by means of music. Thus Hindu snake charmers, while handling the cobra de capello, play continuously on flagellets, fifes, and other musical instruments; and Sir Wm. Jones was informed by a learned native "that he had frequently seen the most venomous and malignant snakes leave their holes, upon hearing tones on a flute, which as he supposed gave them peculiar delight".(35) Weir observed a southern negro charm a serpent from beneath a house in order to kill it, and was informed many times by negroes "that they could charm snakes from their holes with music".(36) The same claim is made by various American Indians from the borders of Mexico to the Canadian plains. Chateaubriand writes of seeing rattlesnakes fascinated by the tones of a flute. One day in 1896 a rattlesnake appeared and a Canadian flute player who wished to exhibit his power undertook to charm it. "At his approach the reptile raised itself in a spiral, flattened its head, inflated its cheeks, and drawing back its lips, displayed its poisonous fangs and its cruel jaws: its forked tongue glanced like a flame, its eyes shone like coals, its body swollen with rage rose and fell like the bellows of a furnace, its skin became stiff and horny, and its tail moved with such rapidity as to look like a vapour, making the while a horrid sound." Then the Canadian begins to play on his flute. The serpent draws back his head--its eyes lose their glitter, the vibration of the tail lessens, and the noise ceases. The coils of the snake relax, and the brilliant colors reappear on

(34) Weir, James -- The Dawn of Reason. pp.119-120.

(35) Jones, Wm. -- Works. Vol. IV. p.170.

(36) Weir, J. -- Dawn of Reason. p.121.

the skin. Turning its head, the snake rests motionless in an attitude of attention. As the musician moves away while continuing to play, the serpent follows in his footsteps and is led out of the camp.(37)

Dixon describes a similar experiment of his own carried out recently in a zoological garden. Accompanied by a violinist, he visited the snake house where the musician played chords of various types, "delicate and swift, then sad, then gay, slow, or tremulous". A large cobra, as soon as the music began, raised himself in a listening attitude--spread his hood, "and slowly began to shake his head from side to side, as if he were trying to keep time to the music. As soon as the music would change, his attitude changed accordingly. Only after the music had ceased, did he resume his normal position".(38) Experiments of the writer with a small black snake, though showing less varied response, indicated a tendency toward quiescence with certain types of music, while other types provoked a restlessness, and an effort to crawl away from the source of sound.

The abundance of the material even though most of it is anecdotal, seems to show that music produces striking responses in reptiles.

The elaborate development of song among birds would lead us to expect them to be very responsive to music, and numerous observations show this to be the case. An "intelligent Persian" informed Sir Wm. Jones that "he had more than once been present when a celebrated lutanist Mirza Mohammed, surnamed Bulbul, was playing to a large company in a grove near Shiraz where he distinctly saw the nightingales

(37) Chateaubriand -- Autobiography. Vol. II, p.9.

(38) Dixon, Royal -- The Human Side of Animals. p.30

trying to vie with the musician, sometimes warbling on the trees, sometimes fluttering from branch to branch, as if they wished to approach the instrument whence the melody proceeded, and at length dropping on the ground in a kind of ecstasy, from which they were soon raised, he assured me, by a change of the mode".(39) A friend tells me that he has noticed that birds approach and perch near windows when a phonograph is played.

Stearns describes a pet pigeon, which became greatly excited over a particular tune (Rule Britannia) played upon the flute. The pigeon would circle round and round "in a space six feet or more in diameter, crouching low, spreading out her wings, and cooing in the most intense tones." Excitement increased with the loudness of music, and the bird would desert her corn and appear at the sound of the music.(40) Romanes also declares that pigeons and parrots respond to musical sounds, mentioning a pigeon which would always descend from the dovecote to a window and listen when a particular air was played on the piano, the "Spere Se" from Handel's Admetus, afterwards flying back to the dovecote.

A pet female canary is also mentioned, which chirped upon hearing flute music, and if the cage door was opened, would fly to the performer and even perch upon his fingers while playing a church organ. Dr. Weir mentions a pair of tame quails which seemed to be attracted by singing and whistling, guitar and violin music. Even late at night they would desert their roosts and fly to the source of music.(41)

(39) Jones, Wm. -- Works. Vol. IV. p.170.

(40) Stearns, R.E.C. -- loc cit.

(41) Weir, James -- Dawn of Reason. pp.111-112.

Baker, in his experiments at the New York Zoo, noted that brown and white pelicans (*Pelicanus fuscus* and *P. Erythrorhynous*) in the presence of music "began to jump about, flap their wings, and snap their huge beaks" at the violinist as he drew near. Other birds, however, paid little attention, possibly because the experiment was in the evening.(42) The owl is said to have an aversion for music.(43)

Turning now to the mammals, we find an even greater abundance of observations on response to music, so that most of the material can only be briefly summarized, and its sources indicated.

"Seals apparently appreciate music, and their fondness for it was well known to the ancients, and is often taken advantage of by the hunters at the present day".(44) Laing, in his account of a voyage to Spitzbergen, says that a violinist on board always had a numerous audience in seas frequented by seals, and "that they have been seen to follow a ship for miles when any person was playing on deck".(45) During Hall's expedition in search of Franklin, a sailor wishing to harpoon some porpoises, endeavored to attract them by whistling, claiming that whales and porpoises can never resist the charms of music.(46)

Certain rodents are traditionally reported to be attracted by music, as is evidenced from the variants of the Pied Piper legend found all over the world. Weir gives a number of instances. A celebrated violinist noticed that mice and rats were "peculiarly suscep-

(42) Baker, F.C. -- On the Effect of Music on Caged Animals.
Amer. Naturalist 1897, Vol. 31, p.463.

(43) Lindsay, W.L. -- Mind in Animals. p.226.

(44) Brown, R. -- In Proc. Zool. Soc. 1868, p.410. Quoted by Darwin,
Descent of Man. p.563.

(45) Stearns, R.E.C. -- loc. cit.

(46) Hall, Chas. F. -- Arctic Researches and Life among the Eskimo.
pp.32-33.

tible to minor chords, or to compositions played in minors, and that quick lively music would bring them forth from their lurking places in great numbers", while discords sent them back to their holes. Two other violinists informed Weir that, mice appeared to listen intently to Andante movements, but would scamper away when allegros were played.(47) Stearns cites an instance of a mouse appearing before a violinist while the latter was playing a plaintive tune. The animal made all kinds of violent gestures and movements, shaking its head, and leaping about the table. "It was observed that in proportion to the tones of the soft point the ecstasy of the animal appeared to be increased and vice versa". Hares are said to approach a source of music. While gray squirrels (*sciurus carolinensis lencotis*) according to Meriam, are fascinated by whistling or the tones of a guitar or music box, so that they may be readily approached and even stroked by the musician. While listening to music, they always behaved in a uniform manner. "They always sat bolt upright, inclining a little forward (and if eating a nut were sure to drop it) letting the forepaws hang listlessly over the breast, and turning the head to one side in a bewildered sort of way, assumed a more idiotic expression".(48)

Sir Wm. Jones speaks of antelopes being lured from the Indian forests by the sound of music(49); and cattle and pigs have been observed to approach and attentively listen to music.(50) From remote times, shepherds have piped to their sheep in order to promote digestion and docility; and the composer Haydn tells of an incident in Lombardy, where goats and sheep broke away from their shepherd and flocked round a flute player, listening with motionless attention to

(47) Weir, J. -- Dawn of Reason. pp.116-119.

(48) Meriam, C.H. -- The Mammals of the Adirondack Region. p.130.

(49) Jones, Wm. -- Works. Vol.IV. p.172.

(50) Stearns, R.E.C. -- loc cit. pp.125-127.

an opera air.

According to Buffon, the elephant loves music and learns to move in time to it. To test this view, a concert was given to a pair of elephants in the Jardin des Plantes. At the first notes, the attention of the elephants was aroused and they approached the musicians seated above in a gallery above the cages. Dance music from Gluck's *Iphigenia in Tauris* (wild in character) impressed its rhythm on the gait of the animals. "From their movements and their gait, now accelerated, now slackened, one would have said they were following the undulations of the song and the beats of the measure." They bit the bars of the cages, grasped them with the trunk, pressed against them with occasional piercing cries and hisses .. Calmness attended the performance of *O Ma tendre Musette* in C minor on the bassoon. No sounds and only slow movements occurred.

The lively tones of "Ca Ira" in D by whole orchestra induced excitement, expressed by rapid movements and cries of varying intensity and intonation. An adagio from the opera *Dardanus* allayed their excitement, and "Ca Ira" repeated in the F key was received with indifference. The overture to *Le devin du Village* proved exciting, while *La Charmante Gabrielle* played upon the cornet evoked languor. *Ca Ira* repeated in the D key proved as exciting as in the first instance.(51) Low tones and simple slow music seemed most attractive.. Lindsay says madness may occur in elephants from zoo concerts where shrill music is employed. E. Tenant mentions that a flute called the Bansee is used in Ceylon to tame wild elephants.(52)

(51) Chomet, H. -- *The Influence of Music.* pp.182-187.

(52) Tenant, Emerson -- *The Wild Elephant.* p.141.

Another member of the Pachydermata, the hypopotamus, is also evidently affected by musical sounds, for the African explorer Clapperton noted with surprise that "these cumbrous animals followed the drums of a war march the whole length of the river.(53)

Mr. F.C.Baker carried out a number of musical experiments on animals - mostly carnivorous - in the Zoological Gardens at Lincoln Park, N.Y. Experiments were made at 6 P.M.. two hours after feeding, and soft music and jig music played on a violin were alternately employed. A resume of results follows: the puma panther (*Felis concolor*) started up at once..when the player approached the cage, the pumas lay down at full length, placing their heads between their paws. This was the reaction to "Home Sweet Home" and "Annie Laurie", but a sudden change to "The Irish Washerwoman" and other jigs caused twitching of tail and ears, until the animals arose and began pacing up and down the cage. Soft strains retranquilized them. The jaguar (*Felis onca*) grew nervous under the influence of jigs, leaping from a shelf to the floor of the cage and back. Soft music quieted him. He extended the paw with claws retracted toward player. Leopards paid no attention to the music. A lioness (*Felis leo*) with three cubs was next tested. At the approach of the violinist the cubs scampered back of the parent who hissed. At a lively jig, the cubs stood up on their hind legs, apparently curious and puzzled. As the violinist retired still playing the family came to the front of the cage. Upon his return, they remained motionless and attentive during the playing of "Home Sweet Home", while a rapid jig made the cubs prance about.

(53) Stearns, R.E.C. -- loc cit. p.238
Salverte, E. -- Philosophy of Magic. pp.331-2.

Of a pair of bengal tigers, the male paid no attention, but the female responded by leaping upon a shelf and shoving paws and nose through the bars.(54) These results may be compared with John Wesley's statement that when the flute was played near the lions' den in the tower of London, one of the lions rose up, came to the front of the den, and seemed all attention. Meanwhile, a tiger in the same den started up, leaped over the lion's back, turned, and ran under its belly, leaped over him again, and so to and fro for a long time.(55) According to Dixon, professional animal trainers declare that lions and tigers when tamed "will not do their stunts without the accompaniment of music."(56)

Returning to Mr. Baker's experiments, we find that the hyenas retired and attempted to escape from the music. Jigs evoked violent manifestations of fear, results which corroborate a traveler's report to the same effect.

Coyotes (*Canis latrans*) were remarkably responsive to the tones of the violin which were tried in a den. At the first note, all came running out, rushing about until they located the sounds. They then squatted in a semicircle about the violinist and listened in silence. At the cessation of the music, they pawed at the bars, only to resume their position and silence, when the music was renewed. This was repeated many times and no howling occurred. Finally experiments were made with *Quadrumana*. Monkeys (*genus cynocephalus*) did not respond definitely to music, with the exception of a South American "Sooty

(54) Baker, F.C. -- On the Effect of Music on Caged Animals. Amer. NAT. Vol.31,1897.p.461.

(55) Wesley, John -- Journal (Dec. 1764)

(56) Dixon, Royal -- The Human Side of Animals. p.22.

"Mangabey" which reacted to jigs. This monkey followed the violinist as far as he could when the latter retired. The monkeys in another cage formed a group, sitting in a broken semicircle about that part of the cage nearest the violinist; rising and following as he withdrew.

Mr. Baker's conclusions were that "slow and soft music was received as a rule with more signs of pleasure than the lively jigs. The female also seemed to pay more attention to the music and to be more pleased with it than were the males. Noise on the part of the animals was very rare. Experiments varying as to hour and physiological condition of the animals should be repeated.(57)

A few statements respecting the musical response of those domestic animals most closely associated with man - horses, cats, and dogs - will close our account of the purely observational data on Animal Behavior in the presence of music. It has long been asserted that horses are especially sensitive to music, particularly the sound of brasses.

According to Athenaeus, the Sybarites employed musicians to train their horses to dance to the sound of flutes, a practice which ended in disaster when a flute player went over to the hostile Crotonites, and playing familiar airs from the Crotonite ranks, threw the cavalry of the Sybarites into confusion.(58) Circus horses are said to decline to do their stunts in the absence of certain familiar tunes, and cavalry horses are thought to possess a rare sense of pitch by the fact that they will obey the calls of the bugle for cavalry evolutions without the slightest hesitation and without apparent suggestion from other sources. Lindsay says that the old familiar drum or trumpet call

(57) Baker, F.C. -- On the Effect of Music on Caged Animals. Amer Nat. Vol.31;1897. pp.460-463.

(58) Athenaeus -- Deipnosophists. Vol.III.

stimulates and revives the spirit of the old military horse, and the effect of the fire gong on old horses of fire companies has similarly excited remark. Pfungst, however, as we have seen, denies auditory sensitivity to the horse. Tests on cavalry horses failed to indicate ability to respond to bugle calls when not directed involuntarily by the rider.(59) Certain observers(60) assert that cats ignore music, a view supported by crude experiments carried out by the writer. Others mention a fear response. Professor Sully, for example, says that when he took a young cat of about eight weeks in his lap and struck some chords not loudly on the piano, the cat got up, moved uneasily from side to side, then bolted to the corner of the room, and seemed to try to get up the walls of the room.(61) Galton notes that cats are particularly sensitive to tones of high pitch, a capacity that is evidently of biological value to an animal preying on small rodents. Still others note positive responses suggestive of pleasure. Weissmann mentions the behavior of his cat which approached whenever the piano was played and sat quietly near the performer, "sometimes jumping into his lap or even upon the keyboard of the instrument".(62) Dixon and Stearns cite a large number of similar instances. A cat mentioned by the former loves to touch the strings of a guitar, "and springs with delight as the notes are produced". The cats described by Stearns sought the source of music, followed or fondled the performer, purred, mewed or leaped upon the instrument.

An entire chapter might be devoted to the responses of dogs to music, so abundant are the observations. The musical dog has even

(59) Pfungst, O. -- Clever Hans.

(60) Timbs, J. -- Doctors and Patents.

(61) Sully, James -- Studies of Childhood. p.195.

(62) Weissmann, A. -- Thoughts Upon the Musical Sense in Animals and Man
Essays. Vol. II. p.55.

entered into fiction in Jack London's story of Batard, an Alaskan wolf hound, tortured by the violin music of a brutal master. The howling of dogs in response to certain notes is universally admitted and has received all kinds of explanations from that of Oerstedt(63), who supposes the dog to have been trained by whipping, to that of J. Loeb, who seems to regard such howling as a forced movement or muscular resonance of the stimulus.(64) Groos, however, finds playful imitation in the howling of dogs under such circumstances"; for the dog which, for instance, accompanies the piano with mournful wails is often not compelled to listen to the music, but comes into the room voluntarily".(65) Descriptions of Behavior, however, rather than explanations are our object at present. And we may pass on to some of the classical observations of the musical behavior of dogs. Scheitlin, mentions a dog which accompanied his master's falsetto voice with howls that adapted themselves to the pitch of the notes.(66)

Alix describes two dogs that had been taught to sing, and a poodle that could run the scale in tune.(67)

Weissmann speaks of a "dog which always approached when music was played, often coming from distant rooms and opening the doors with his paw", and of another which followed the Frankfort Street bands from morning till night.(68) Romanes "heard a terrier, which used to accompany a song by howling, follow the prolonged notes of the human voice with some approximation to unison".(69) He also cites other examples of

(The Beautiful in Music.p.110)

- {63} Oerstedt, J.--Der Geistinder Nature.Vol.III,p.9-quoted by Hanslick.
- {64} Loeb, Jacques -- Physiology and Psychology of the Brain.
- {65} Groos, K. -- The Play of Animals. p.188.
- {66} Scheitlin, P. -- Thierseelenkunde. Vol. II. p.254.
- {67} Alix, Eugene -- L'Esprit de nos betes. p.364.
- {68} Weissmann, A. -- Essays. Vol. II. p.55.
- {69} Romanes, J.G.-- Mental Evolution in Animals. p.93.

similar behavior. Stearns, in the articles we have so often quoted, gives many anecdotes of the apparent effect of music on many varieties of dogs,(70) Great individual differences seem to occur in the responses of these animals, indeed of all the higher animals.

The writer has made personal investigations of the musical responses of several dogs belonging to friends. The most striking case is that of a Scotch Terrier, "Jerry", belonging to Mr. P. Bittenwieser of Cincinnati. In this case, the writer, as well as others, has repeatedly observed very interesting reactions to musical stimuli. When Schumann's "Novelette" is played, the dog, wherever he may be, comes into the room. At first there is no sound. The dog's whole body trembles; he seems nervous and ill at ease. Then there is a violent heaving and squirming of the body, followed by whimpering and short barks or cries. Finally he throws back his head, with nose straight in the air, and howls or rather cries in tones resembling those of a young child. He becomes vocal particularly upon hearing high notes of the scale. Besides Schumann, he responds readily to Chopin. Even when he does not howl or cry, the dog seems nervous, scratches himself, lies with his nose to the ground raising and lowering it in an almost rythmical way, or retires under a table or sofa, or to some place inaccessible to observation.// The data we have offered are of varying degrees of value, depending upon whether the observer was a trained naturalist or merely an interested spectator. Certain statements were probably distorted by the natural love of the marvelous inherent in man. In many cases, statements are from an anthropomorphic view point, but it is generally easy to separate such anthromorphic coloring from the actual behavior

(70) Stearns, R.E.C.--Effects of Musical Sounds on Animals. Amer. Nat. Vol.24.pp.26-29.

of the animals in question in the presence of music. Thus, while many of the observations reviewed are doubtless more entertaining than important, as a totality, they do indicate that a large number of animals react definitely to musical stimuli. Moreover, they show that an interesting field of inquiry is open to us, that experiments in this field are worth making, and that only by carefully controlled experiments, can satisfactory data be secured. Experiments on the musical responses of caged animals must be repeated under all sorts of conditions, and laboratory studies of the physiological coefficients must be made. We shall close this account with a brief resume of three experimental studies of this type.

The first is by Dogiel who made an experimental study of the circulation of the blood in animals. He found that music affects blood pressure, increasing or diminishing it, according to the type of music. The rate of pulsation increased and there was concordance between the reactions of circulation and respiration. Intensity and timbre of notes affect the reactions, while habituation tended to diminish the reactions to musical stimuli(71).

Professor Tarchanoff made a careful study of the influence of music on dogs and guinea pigs. By means of special apparatus, he was enabled to measure muscular work and physiological changes. When the animals mentioned were subjected to the influence of music, nutritive changes were accelerated and the oxydation of tissue increased. This was demonstrated by analysing the exhaled air, whereby an increase in the consumption of oxygen as well as an increased production of carbonic acid gas were determined, thus justifying the Arab tradition that

(71) Dogiel, J.--Ueber den Einfluss der Musik auf den Blutkreislauf - Arch fur Psys.1880.pp.416-28.

the music of the shepherds does more to fatten their flocks than good pasture.(72)

Finally Dr. Dutto, working in the Laboratory of Physiology at Rome, has published experiments on the influence of musical stimuli on animal thermogenesis. In order to extend the investigations of Dogiel and Tarchonoff, he subjected various animals to the influence of organ music, during periods of from an hour to an hour and a half. He found that under such conditions thermogenesis was increased in pigeons and birds, while it was decreased in hares, guinea pigs, and chickens. This is explained as due to a state of attention to the music, determining a flow of blood from the periphery to the internal organs, resulting in increased metabolism, but diminished irradiation of heat from the surface of the body.

It is clear that studies of this kind should be multiplied with parallel studies of animal behavior in the presence of music. In a work, written forty years ago, W. Lander Lindsay gives a summary of the effects of music on animals. His conclusions based on the study of 1250 animal species, representing all zoological classes and orders from Protozoa to Omadrumana are still of great interest.

According to Lindsay, music both vocal and instrumental acts on animals:

1. As a gentle calmative in states of irritation or excitement
2. As a mild excitant in conditions of depression.
3. As a dangerous irritant in certain morbid states of mind or body, including the part it plays occasionally in the development of insanity.

(72) Tarchanoff, J. -- Influence de la Musique sur l'homme et sur les animaux. Arch. Italiens de Biologie. Vol.21. p.313-17.

4. As a stimulant to work of an uncongenial kind - to endurance, perseverance, strength, and energy in ordinary domestic life, of courage, and ardor in the war-horse or elephant.

5. As a means of refinement in animals whom man thinks it worth his while to subject methodically to its power.

In other words, music is to be considered in other animals than man one of the fine (or refining) arts, one of which man might well make much better and more extended use in his training of them."(74)

These conclusions may still be regarded as substantially correct.

They do not imply any aesthetic judgment on the part of animals, but merely a high degree of sensitivity to tonal stimuli, and a tendency to overt reaction. The numerous examples which we have given seem to bring out clearly this fact of marked differential behavior in the presence of music, while anyone may easily confirm them in the case of domestic animals, especially the dog. In brief, the reactions of animals to music agree very well with the responses of human beings, particularly the primitive or uncultivated, as we shall see in the subsequent sections of this paper.

- (73) Dutto, U. -- *Influenza della musica sulla termogenese animale.* Rendiconto della R. Accademia dei Lincei. Vol.5. 15 Marzo, 1896.
 (74) Lindsay, W.L. -- *Mind in the Lower Animals.* Vol.II. p.308.

MUSIC IN MYTH.

Before examining musical myths as a source of data concerning the influence of music on behavior, a few remarks must be made upon the general nature and meaning of Myth, in order that it may be clear that it does afford a possible source of useful data.

Many explanations of Myth have been offered. For Aristophanes and medieval theologians, Myths were dangerous or ridiculous fables, while they were allegories for Theogenes of Rhegium (4th Cent. B. C.), Francis Bacon, and Creutzer.

According to Euhemerus, Myths are idealized distortions of historical events - history disguised - an explanation widely held, and accepted in a modified form by Herbert Spencer, whose theory of myths is founded on the view that myths owe their origin to a confusion in the minds of primitive people who worshipped their ancestors under the names of plants and animals or inanimate objects, whose name the ancestor bore on account of real or fancied resemblance. After a lapse of generations, the ancestors are confounded with the objects for which they were named, resulting in the growth
1
of an elaborate mythology.

For Max Muller and other students of the philological school of Mythology, Myths are diseases of language; inevitable products of the rapid linguistic changes in the unstandardized dialects of primitives - - culminating in the personification of natural forces; principally the Sun, according to Muller; meteorological phenomena, according to other exponents of this method.

1. Spencer, H. Principles of Sociology Vol. 1. Data of Soc. Chap. 21, 22.

Mythologists of the anthropological school, regard most of these as partial explanations, or explanations of particular classes of Myth, but on the basis of comparative studies assume a more ultimate foundation in the universality of certain psychological laws, which tend to result in similar mental structures all over the world. ² Among special hypotheses proposed by members of this school are those of Robertson Smith, who regards Myth as an explanation of traditional practice - a derivative of ritual, and Andrew Lang who thinks that Myths arose out of the mind's playful and exoteric fantasy. (p68)

Lang's view is thus allied to the psycho-analytic theory of Myth, according to which "a Myth is a waking dream or fantasy. Both dreams and myths are symbols of wishes rooted in the unconscious. In the individual this unconscious symbolism leads to dreams; in the race and society, to myths, legends and fairy tales. The Myth is therefore a fragment of the repressed life of the race." ³

Abraham (Traum and Mythus) has briefly formulated the psycho-analytic view in the statement that "Myth is the dream of a people, and a dream is the Myth of the individual." Rank (Inzest - Motiv in Dichtung und Sage) conceives the Myth as a series of images intermediate between collective dreams and collective poems. ⁴

⁵ Jung, Spence, Gomme, Lang, and Tylor ⁶ call attention to the fact that later Myths are an attempt to explain primitive scientific notions; to apply or state relations of cause and effect in phenomena. "Where savages ask themselves, as they certainly do ask themselves, whence the sky, when the winds,

- | | | |
|----------------|-------------------------------------|----------|
| 2. Tylor E. B. | Primitive Culture | p. 282 |
| 3. Coriat I | The Meaning of Dreams | p. 136-7 |
| 4. Silberer H | Problems of Mysticism and Symbolism | p. 36-7 |
| 5. Jung C. G. | Psychology of the Unconscious | |
| 6. Tylor | Ibid | p. 369 |

the sun, the moon, stars, sea, rivers, mountains, and other natural objects, they reply in terms of good logic applied to deficient knowledge; ⁷ and again "primitive science was primitive belief." According to Lang "they frame their stories generally in harmony with their general theory of things, by what may be called the Savage Metaphysics." In short, Mythology may be regarded as the science of primitive man, his manner of explaining the phenomena which surrounded him.

It is clear, therefore, as Spencer says that "there is no universal solvent for myths, no single philosopher's stone by which it can be made to yield its secrets, no royal road to its elucidation." ⁸ Nevertheless several principles emerge which justify our attempt to use musical myths as psychological data.

In the first place, many Myths as primitive science, are attempts to explain observed phenomena. Of course, if a Myth is isolated or sporadic, or if its recurrence can be traced to borrowing during tribal intercourse, it would have little value as resting upon a single and possibly mistaken observation. If the same Myths arise independently in different parts of the world, a coincidence of observation and explanation has genuine scientific value. An authentic Myth, according to Tylor is known by the Law of Recurrence, i. e. "if we discover a tale possessing the same elements in several different parts of the world, "we " cannot set down the coincidence to chance or fraud."

Now in many cases we also cannot explain the coincidence by borrowing - the Myth is too widespread. That resemblances between Myths are no criterion of a common origin, is proved by widespread examples in which ⁹ circumstances of time and geography forbid all possibility of borrowing.

- | | | |
|--------------|----------------------------------|--------|
| 7. Gomme G L | Folklore as a Historical Science | p. 132 |
| 8. Spence L | Introduction to Mythology | p. 21 |
| 9. Spence | Ibid. | p. 37 |

as the drumming of the snipe's tail, the tapping of the wood-pecker's beak, the harsh trumpet-like cry of certain water fowl, the cooings of the turtle dove and the song of the nightingale, should all be pleasing to the female of the several species."(p.375). But, he goes on to say that "we should not judge of the tastes of distinct species by a uniform standard; nor must we judge by the standard of man's taste. Even with man we should remember what discordant noises the beating of tomtoms, and the shrill notes of reeds please the ear of savages."(6).

The warning of the naturalist is confirmed by the observations of professional musicians of note. Thus J. Salvador Daniel who made a thorough investigation of Arab music says: "Where I heard nothing but noise, the Arabs found a pleasing melody, in which they would often join their voices; and where I could distinguish no measure, I was compelled to admit of one by the dance."(p.45) (7). The incomprehensible complexity of the measure and rythm of Malay music has been experimentally investigated by Myers who found real, though very complex rythms perceptible to native, but imperceptible to European ears.(8). Salvador Daniel calls this an interesting problem in the difference of musical sensations, and tells how he finally came to revel in Arab music, not as a mere technical conquest, but as a genuine enjoyment. He concludes that musical taste is always relative, being based on the "habit of hearing". Lane

(6) Darwin, Chas. --- Descent of Man p. 375.

(7) Salvador Daniel, J. --Arab Music and Musical Instruments. p. 45.

(8) Myers, Charles --- A Study of Rythm in Primitive Music
Brit. J. of Psych. Vol. 1, pp.397-406.

Art was communicated to our species of Brahma himself, or by his active power Sereswati, the Goddess of Speech, and their mythological son Nared, who was in truth an ancient lawgiver and astronomer, invented the "Vina", also called "Cach'hapi or testudo;" a fact connecting the Indian Myth with that of Hermes which follows. In Hindu Myth, a special class of divine musicians, the Gandhargas are enumerated among the mythical inhabitants of Indra's heaven. In Egypt; Hermes Trismegistus constructs the lyre from a tortoise shell to which the sinews still adhere.¹¹ Similarly the Irish hero Cool devises his harp after hearing the wind singing thru the skeleton of a dead sea monster on the seashore. Odin, the war god and chief of the Scandinavian pantheon, was regarded as the inventor of magic songs. Apollo, Odin, and Angus are Gods of Music among the Greeks, and Northmen and Gaels, respectively. Music is the invention of the culture hero Fo-Hi in China, while among the Polynesians Maui has the credit. In America, the Aztecs regarded their principle deity Texcatlipoca, as the donor of Music, while the South American Indians of Guiana, ascribe the origin of music to the culture hero Amalivaca, the divine minstrel.¹² Myths of this type are a general reflection of primitive conceptions of the power inherent of Music. Among primitives, whatever exhibits power or influence, especially powers of a mysterious nature, is ascribed at first to animistic agencies and later on to the Gods.

More relevant to our purpose, however, are those myths which describe in detail the alleged effects of music on man, animals, and even inanimate objects. It must be remembered that primitive man did not make any sharp distinction between these three classes. All objects were animated in some sense, and observations made on animals or human beings would be thought to

11. Jones Sir William On the musical modes of Hindus Complete Works
v. 4. p. 184
12. Rowbotham R. F. Musical Myths, Chambers J. Vol. 68 '91 p. 449-450

apply to what we call inanimate objects as well. Such a transfer would be quite in accord with primitive logic, but the fact that it was made indicates a basis in actual observation. Moreover, Levy-Bruhl has pointed out that an actual identity is often thought to exist between human beings, animals, and objects, so that the names of men, animals, and objects may be interchangeable

13

in Mythical Narrative. A Myth relating the influence of music on inanimate objects may therefore be equally referable to the observed effects on living beings.

Among Myths of this type we shall quote at length a few of the most striking, selecting our examples from as many distinct mythologies as possible.

Greek myths as most generally familiar, may claim our attention first of all. Among the oldest is the Homeric myth of the Sirens. These mythical beings were singing sea maidens, who lived on the southwest coast of Sicily, and their song was so sweet that sailors cruising by, ceased work and listened to the music till they died of hunger, or according to another variant, the singing of the Sirens caused the mariners to steer for the rocks where they sat and thus perished in shipwreck. The Siren myth appears in the Teutonic legend of the Lorelei.

14

Another famous myth, which finds its analogue all over the world, is that of Orpheus. "The song of Orpheus subdued wild beasts, arrested the course of the waves, and made the trees and rocks dance," and when his beloved Eurydice was snatched away by death, he descended into hades, charming the infernal powers so that Pluto, granted him the return of his wife.

Wm. Sharpe, found a similar legend among the Gaelic speaking populations on the Island north of Scotland and Skinner in his "Myths and Legends on our Borders," describes a Hawaiian Orpheus.

15

- 13. Levy-Bruhl L Les Fonctions Mentales dans les Societes Inferieures
- 14. Rowbotham Ibid p. 449 p. 77-8, 135-9
- 15. Sharpe W. The Winged Destiny Studies in the Spiritual Oisin and Orpheus.
history of the gael

Several Greek legends refer to the miraculous power of the flute.

Thus Tyrtæus is reported to have aroused an entire army to action; and Terpander restored a rebellious people to allegiance by means of this instrument, or according to some, by singing with the accompaniment of the harp. The flute of Telapheus of Samos, is said to have had equal power over man and brute. According to a quasi-historical account, Antigonus, a flute player, so transported Alexander the Great by his playing of a martial air at a banquet that the Monarch seized his weapons and almost attacked his guests. Arion, seized by pirates and cast into the sea, was rescued by Dolphins, which had assembled about the galley, charmed by the notes of his lyre, as he strummed the parting song. The story has been beautifully poetized by A. Tieck and especially by A. Schlegel; beginning with the paraphrase of Homer in which Arion is described as follows:

Arion war der Tone Meister,
Die Zither lebt in seiner Hand.
Damit beglückt er alle Geister,
Und gern empfangt ihm Jedes Land.

The less fortunate Ibycus was followed by a flock of cranes attracted by the sound of his lyre.

But the most remarkable of these early Greek musicians was Amphion whose divine music raised the walls of Thebes. At the sound of his music, the stones came and placed themselves in order, one upon the other.

Agitatque saxa per Artem
Sponte sua in Muri membra coisse ferunt.
He seems to have exercised a remarkable influence on the vegetable

world, so that according to Tennyson:

'Tis said he had a tuneful tongue
Such happy intonation
Wherever he sat down and sung
He left a small plantation.
Wherever in a lonely grove
He set up his forlorn pipes
The gouty oaks began to move
And flounder into horn pipes."

- 16. Fitzgibbon H. M. The Story of the Flute
- 17. Tennyson A. Poe, s

ization, evolved by collective emotion and suggestion, would secure the maximum of attention, the first prerequisite to the selection of vocal signs as standard carriers of meaning.

It may well be that the embryonic music of prelinguistic vocal utterance developed first into primitive speech, which in turn differentiated into developed music, as we understand it, and the ordinary language of daily life. Both Spencer and Darwin are right, the one stresses the proximate, the other the ultimate origin of music, or as has been said, they differ only as to what stage of a continuous process in the development of human expression shall be regarded as the origin of Music in its developed form.

Objections involving a more fundamental opposition of views have been offered by a number of writers, among whom are A. R. Wallace, a co-discoverer with Darwin of Natural Selection, W. McDowell, E. Dickinson, and Prof. William Knight.

Wallace's arguments need not detain us long, since they are based on the view that man represents psychologically a break in the continuity of evolution. Continuous biologically with the animal world, man's intelligence is a kind of influx or superposition from a higher order of reality. Music and Art in general as products of intelligence cannot therefore be brought into connection with animal origins. It is clear that such an assumption can contribute nothing towards solving our problem, and as the hypothesis is entirely unverifiable, we can afford to dismiss it in this connection. A Weisaman, though free from animistic hypotheses, partially shares.

21. Wallace A. R. Darwinism C. H. xv p. 444-478

Orpheus is depicted playing upon a Vina instead of a Lute, and surrounded by gazelles attracted by the power of the music. Mrs. Frere also related an interesting Hindu fairy tale concerning the powers of flute music. Seventee Vai, a Rajah's daughter assumes the costume of a boy and sets out in search of adventure. She meets the enchantress Hera, who supposing her to be a man falls in love with her. Seventee claims that she must perform an important mission before marrying Hera, and the latter gives her a golden flute, bidding her to play it when in need of assistance, and promising to appear before the sound of it ceases. Thereafter Seventee plays on the flute when in difficulties, and the enchantress at once appears, swinging in a silver tree.

22

The mythologies of the Celts and Teutons yield fewer striking music myths than the foregoing. Nevertheless references to the supposed powers of music are numerous.

The Irish harp we have seen was invented by the hero Cool and the first use he made of its tones was to affect a reconciliation with his wife Canola, who had fled after a quarrel. The variant of the Orpheus myth among the Northern Kelts has already been mentioned. Irish folktales moreover refer to magic whistles or horns, which attract the birds of the air from every quarter, and the irresistible power of music to induce sleep in frequently mentioned.

In one of the stories about Fin MacCumhail, the Great Irish hero a particularly striking account is given. Two sons of Fin, who are set to watch a dangerous ford, are told "there will be music at the ford, and if you hear music you will fall asleep." Accordingly after reaching the ford,

- 22. Frere M Old Deccan Days - or Hindu Fairy Legends
- 23. Curtin J Myths and Folklore of Ireland p. 301

they remarked to one another that they were falling asleep from the music. The two sons of Fin struck, kicked and even wounded one another with spears in order to keep awake, but all to no purpose. The music irresistibly put them to sleep. Other Keltic legends tell of the magic songs of the mermaids luring men to come and dwell amid the sea-folk.²⁴ A later Irish legend dating from Christian times, related how a vision directed the founders of the Franciscan Friary of Armagh to Carraig on Chuil, the "Rock of Music," whence supernatural strains proceeded as a miraculous sign of a divinely favored locality.²⁵

Anster Fair, a long poem descriptive of Scottish life and manners of a century ago, contains a vivid account of the marvelous effects of the Boglin Puck's Bagpipe. Animate and inanimate objects dance to the tones of the pipe: the heroine of the poem is irresistibly driven to dance until exhaustion.

"Had Midas heard a tune so exquisite²⁶
By Heaven, his long ears had quivered with delight."

Teutonic mythology proper, presents a few stories relevant to our purpose, although it is said in the Edda, that Heimdalls trumpet awakened the seven sons of Mimer²⁷ and Odin is described as inventing and employing songs of magical power. Teutonic folklore based on the old mythology, however, affords many interesting sidelights on the belief in the powers of music. The mermaids of Teutonic mythology are all musical, and one of them has become famous for her irresistible song, in the Lorelei legend, a variant of the Hellenic myth of the Sirens. The Necks or nixies of Scandinavian folklore are supposed to teach music to their worshippers in return for animals sacrifices. It is significant

- | | | |
|--------------|---------------------------|------------------------|
| 24. Engel C | Musical Myths and Facts | p. 70 |
| 25. Hood H G | A History of Irish Music | ~~p. 70~~ p. 70 |
| 26. Conant W | Anster Fair Canto 1 | p. 17-19 |
| 27. Rohmer | Sax Music of Magic, Forum | Vol. 58 '17 p. 736 |

in the aboriginal legend of the distant Maoris, existant before the arrival of the first European, relates how "a chief Kanawa learned a song of the fairies 28 which is still preserved in New Zealand poetry." In the Shetland Island, the Norse inhabitants say "that the trows (trolls) were great powers and great lovers of music and the fiddlers of olden times could discuss lightsome lilt 29 known as fairy reels, that had been learned from the hill folk."

A Danish legend recalls the story of Antigenida's flute and its effect on Alexander the Great. King Eric the Good hearing a musician boast that he could at will arouse his listener's joy, sorrow, or rage, tested the assertion with the result that the king became in turn melancholy, joyous, and infuriated. In the latter state he slew four of his retainers and could only be subsided with difficulty.

Grimm's collection of German Fairy stories, described wonderful violins 30 which irresistibly attract wild animals and men, or set them dancing madly. Similarly in Frankish legends, the Horn of the paladin Roland, is endowed with magical powers, while the horn of Huon of Bordeaux, given him by Oberon, king of the Fairies, if blown mildly causes listeners to dance; if loudly, the King 31 of the Fairies appears with assistance. The resemblance to the Hindu folktale of Seventee and the enchantress Hera quoted above is striking. The troubador Pierre de Chateauneuf (13th cent.) robbed and threatened with death by brigands asked permission to play and sing, and so worked upon the feelings of his 32 auditors that they restored his property.

Prussian legends based on a mingling of Teutonic and Slavonic (Wendish) mythology, tell of marvelous things, done by pipers, Most famous of

28. Wallaschek R	Primitive Music	p. 43
29. Spence J	Shetland Folklore	p 151-2
30. Wieland C. M.	Oberon Gesange	11
31. Grimm J.	Fairy Tales - The Wonderful Fiddler V. 1. p. 37	
	The Magic Fiddle, etc.	V. 11. p. 54
32. Kadan, R.	Wonders of Acoustics	p. 29

all was the Pied Piper of Hamelin, immortalized in the poetry of R. Browning, and Julius Wolf. This man, the possessor of a magic flute, came to Hamelin in Saxony in the year 1460, offering to rid the town of the rats which swarmed there. Upon the promise of a reward by the corporation, he began playing a tune which attracted the rats from every quarter. He drew them into the River Weser by the enchanting music, but his reward was withheld; he returned with another flute which so charmed the children of the town that they followed him into a mountain cavern to vanish forever. Another musical wizard, the Piper of the Hartz Mountains, also a Wend, was accustomed to appear so many days every year, when he played unearthly tunes and whoever listened immediately fell into a frenzy from which there was no escape.

33

Weir remarks that the legend of the Pied Piper of Hamelin is by no means recent nor is it confined to European peoples alone; in one form or another, it exists among Asiatic, Indian, and Indo-Malayan races. In the legends, the rats and mice are drawn together by sounds emanating from some kind of musical instrument.

34

Turning from Indo-Germanic myths to those of Semitic origin we find a few references to the power of music in the Old Testament and Talmud. At the trumpet blasts of the Hebrew priests, the walls of Jericho fell down. David cured Saul of his illness by the tones of the harp, and Solomon was driven to folly by the songs of his numerous wives.

35

Arabian folklore is richer in this respect, in spite of the fact that Mohammed taught that music was an expedient of the Evil One to ruin mankind.

36

- 33. Howbotham K. F. Musical Myths, Chambers J. V. 68 '91 p. 450
- 34. Weir J Dawn of Reason p. 116
- 35. Isaacs Stories of Rabbis

The following legend, however, would seem to indicate a different attitude. It is related that "Mohammed once entrusted to his son-in-law Ali certain holy mysteries, commanding him to reveal them to none but the initiated. For forty days Ali kept silent but in doing so was troubled so that he felt ill. Fleeing to the wilderness, he came to a well, and unable to contain the mysteries any longer, he whispered them to the well. With the excitement of pronouncing the words his mouth filled with the foam which he spat into the well, and at once found relief. After some days a reed shot up at the well, and was cut by a shepherd boy, who made a flute of it, which he played to his flocks. Presently the wind carried the music abroad, and the desert tribes came to listen, bringing their flocks. Wherever the shepherd played, even the camels and sheep stopped grazing, charmed by the notes of the flute, and when word was brought to Mohammed of the young desert musician he declared that in the notes of the flute lay the interpretation of the divine secrets confided to Ali, and that thereafter the flute should be the companion and comforter of man. "

37

The best known Arabian legend of music is that about Alfarabi, the celebrated alchemist, philosopher, and savant of Cordova. Ordered to appear before the Sultan of the East Fekr ed Douk to demonstrate his musical abilities, and fearing that his return to Spain might be prevented, he paid a visit incognito, appearing at the Sultan's court in tattered costume. Admitted as an ordinary musician he was asked to play and sing. "Scarcely had he begun when all the court were seized with a fit of laughter which not even the Sultan's presence could check. Alfarabi then changed his mode and immediately sadness and groans took the place of the noise of laughter. Suddenly the singer once again altered his melody and rhythm which evoked in his audience such a fury of madness, that they would have hurled themselves upon him if a new change of mode

had not appeased them, and while they were thus plunged in deep slumber, Alfarabi had time to get out of the palace and even out of the town before any one could attempt to follow." ³⁸ The Arabs also have their myths of music influencing vegetation, for there is a Moorish legend that the flowers of Mullein and Mothwort fall from their stalks at the playing of the Mizmoune, a celebrated mode.

Turning to the races of Mongolian affinities, we find old Finnish songs; river sands change into diamonds; haycocks, hasten to stow themselves away in barns; turbulent seas are calmed; and savage animals tamed by the magic lyre of the epic hero Wainamoine while the bard himself intoxicated with his own music, sheds pearls in place of tears. ³⁹

In distant China a legend affirms that supernatural music accompanied the birth of Confucious, while later on the sage himself was so enraptured by the tones of a Chinese violin (kin) that he could neither eat nor drink; love-sick with the melody, he lived for a week shut up in his room listening to the music that had a voice for him alone, and spoke only under his fingers. ⁴⁰

The neighboring Japanese have a legend of a famous flute player who concealed himself in a cavern to avoid the consequences of a crime. An enormous serpent advancing upon him, the flute-player began to play, whereupon the serpent halted, appeared to listen with pleasure, and withdrew after a tune leaving the performer unharmed. ⁴¹ Dr. Shiro Tashiro informs me that the traditional test of a master of music is the ability to go out into the fields and forests and charm the wild animals by his musical performance.

- | | | | |
|-----|----------------|----------------------------|--------|
| 38. | Salvador D. F. | Arab Music and Instruments | p. 146 |
| 39. | Drawford C. F. | Kalevala | |
| 40. | Smith H | The World's earliest Music | p. 256 |
| 41. | Fitzgibbon | Ibid | p. 264 |

If now we cross the Ocean, we discover musical myths in both Americas, Amalivaca, the divine minstrel of the Guina Indians, the best drummer in the world rescues despairing mankind from the deluge by the magic of his snakeskin drum; beating upon it in time and measure so symmetrically that the waters gradually sank, delighted, to the sea, and the rocks arose to listen.

According to certain North American Indian tribes, the Great Spirit divided the earth from the waters and restored order to the flooded globe by beating upon a drum which was henceforth sacred. Other tribes called the drum the instrument of angels, or of the celestial maidens.

Among the Cherokees, the fabulous horned snake was supposed to be lured from its dwelling in the waters of the songs of the old men who thereby were enabled to secure the horns for use in "War Physic."

A tribe of Southern Indians dwelling on the banks of the River Passagoula is said to have worshipped a mermaid and when she appeared singing, the whole tribe irresistibly impelled by the music plunged into the water and vanished; a story reminding one of the legend of the Pied Piper.

In the preceding examples, we have generally confined ourselves to Myths, or legends of an older type, but contemporary folklore also yields its quota of stories concerning the marvelous properties of music. In an interesting chapter on "Phantom Music," Mr. W. C. T. Thistleton-Dyer informs us that most countries have their stories and traditions of mysterious properties. In various forms the belief in phantom music prevailed throughout Europe. It is the favorite recreation of the Nature Spirits and has many strange qualities. Sometimes it is a presage of evil. The harp playing of the Welsh fairies has the peculiar quality that no one can ever learn the tune. The Music of the Sea spirits lures men into the waters.

42. Rowbotham

Ibid

p. 450-1

43. Spence

Ibid

44. Thistleton-Dyer T. The Ghost World

p. 411-25

Many more relevant musical myths and folktales could be offered, but the selection presented suffices to prove the universal recognition that music is capable of producing striking effects. According to mythology, music influences the growth of vegetables, subjugates and tames wild animals, arouses irresistible impulses in man or just as irresistibly lulls him to sleep. Our selections show that similar stories exist all over the globe, in many cases where communication was impossible, so that the phenomena on which they were founded must be genuine, while the primitive conclusions embodied in such myths derive a certain value from their uniform tendencies.

MUSIC IN MAGIC.

The world's earliest music developed in the service of magic and a large part of the music of primitive peoples of to-day is devoted to that purpose. As we have already seen, myths from mutually independent sources depict the great musicians of primitive times as potent magicians, fascinating savage men, subduing and taming wild beasts, promoting or delaying the growth of vegetation, and even influencing the course of physical phenomena solely by the power of music. Philology demonstrates that many of the terms used to designate musical performances were synonyms for magical formulae, and in some cases, the identity is still quite clear. The Sanskrit mantra, means both magical invocation and a hymn of praise. The Norse rune is at once a Zauberspruch and a mystic song. The Latin carmen and incantatio, plainly indicate this early identity between magical and musical, so that according to Cyril Scott, the well known quotation "Music hath charms to soothe the savage beast," may be taken quite literally, "the word charm meaning magic pure and simple." Indeed among primitives, including the most ancient historical peoples, as well as contemporary savages, we shall find that music is not only an art but a form of magic, and that the magical function far transcends the aesthetic in the importance ascribed to it. In fact, the first musicians were not artists appealing to the imagination of the elite, as is the case to-day, but experts in magic, invoked by the group or the individual, in difficult situations. The primitive called upon them in the same spirit, that we have recourse to engineer, electrician, surgeon, or physician, in short, the technical expert. Magic was primitive technique.

1. Scott, Cyril. The Philosophy of Modernism p. 104-5.

The primitive man made use of musical magic usually in the form of songs, to procure rain or dissipate the clouds, to secure the love of a desired woman, or overcome an enemy, to bring abundance or famine; to cure, or induce disease in men or animals. In all cases, the purpose was practical and the situation often one in which the cultivated modern would try to secure the services of a scientific expert. In short, as Combarieu points out "the belief in the efficacy of musical magic is one of the most important facts in the history of civilization, and the most important offensive and defensive weapon of magic has been the song. The same author shows moreover that the opinions of the greatest modern German metaphysicians strangely coincide with the primitive view point in maintaining that music introduces us to "an intelligible world of ideas, (Novalis and Krause) gives an impression of "the creation of a new world" (Nietzsche); unveils the essence of things (Wagner), puts us en rapport with the divine (Schelling), or lies at the heart of things, lives upon their essence, and influences all. (Schopenhauer).²

We may add that several modern composers, Scott and Scriabin, for example, seem to identify music with magic, and even compose according to magical principles, while many occult and theosophical works discuss the occult properties of musical tones and modes.³

It is our purpose to discuss the psychological significance of these facts, illustrating the general statements which we have made, with suitable concrete examples from ethnological investigations; but before attempting this, we must consider at some length the nature and foundations of magic.

2. Combarieu J. La Musique p. 96-99, 111.
3. Vide: Hartmann, Franz. Magic White and Black. p. 91
Fletcher, E. A. Doctrine of the Rhythmic Breath
Blavatsky H. P. Secret Doctrine
Hayman, K. Relation of Ultra-modern to Archaic Music.

Human behavior may be classified either in terms of complexity and inheritance, or it may be classified according to the psychological attitude which accompanies it. The first method is that of text books and treatises on individual psychology, in which behavior is analyzed and classified as inherited and acquired reactions of varying degrees of complexity. The second method is a convenient manner of describing the behavior of individuals as members of groups. From the latter standpoint, behavior may be described as:

(1). Magical: in which the psychological attitude is one of command, striving

to effect actions, thru the possession of mystic knowledge, or by mere force of indomitable will, assumed to be unlimited in its powers:

(2). Religious: in which the attitude is the reverse of the magical and man with a sense of his own helplessness, prays to superior powers:

(3). Scientific or Mechanistic: in which the casual connections of things are defined and utilized in the pursuit of ends.⁴

In general ways, these three forms of behavior characterize successive stages of mental evolution; magical behavior appearing first, only to give way to religion when the failure of magic becomes manifest, while religious behavior in turn gradually recedes into an ideal or value factor, with the acquisition of fuller knowledge and the development of scientific technique, based on recognized causal connections. The distinction in time is however by no means complete. In every historic period and probably in pre-historic periods, behavior of all three types existed, but one form will always be predominant. According to their complexity, we can say that magical behavior is the most primitive, religious behavior is intermediate, and scientific behavior is the most advanced.

Thus primitive man recognized the causal relation between the tension of a bow, and the flight of an arrow and always constructed his bow so as to secure a maximum tension; but he added feathers to the shaft of the arrow in

4. cf. Leuba, H. Psychology of Religions.

order to make it fly like a bird, fortunately also in accordance with mechanical principles. Causal and magical behavior were thus mingled in the construction of a perfect weapon. Similarly the people of Borneo show a nice appreciation of the mechanical principles involved in the construction of houses, boats, weapons traps, etc., yet believe that they can retard an enemy's boat by hanging a quartz pebble under one of its benches. The Fijians, also excellent boatbuilders, think that a basket of bitter oranges placed on board a canoe reduces its speed.

Thus among primitives magical behavior predominates, except among the few, skeptic or positivist by nature, who are found in all grades of society. Among peoples further advanced such as the ancient Egyptians, Babylonians, Hebrews, and Medieval Europeans, religious behavior with many survivals of magic is the rule; while the behavior of modern civilized peoples is characteristically scientific or positive, governed by the laws of causation. Yet numerous undesirable survivals of former magical and religious attitudes persist in the form of sensational religious revivals, sects, etc., spiritualism, mysticism, and anti-scientific movements of all kinds.

Behavior, however, classified, is a response to stimuli, which in a precise sense are forces effecting a change in the organism. In a more general sense, however, all phenomena which affect the attitude of man either directly thru his sense organs or indirectly thru reflection or by modifying direct stimulation and response constitute stimuli. In short, stimuli are physical, social, and cultural according to their complexity, and all of these must be considered in accounting for the responses of social human beings. Among the primitives

5. McDougall, W. and Hosi C. The Pagan Tribes of Borneo, Vol. 2. p. 124.
6. Williams, T. Fiji and the Fijians p. 74
7. cf. Dunlap, K. Mysticism, Freudianism and Sci. Method in Psychology.

in particular, social and cultural stimuli are closely blended with physical, through the mimetic and dramatic processes, which are the primitive man's principal means of acquiring or conveying information, whether in the initiation of ceremonies of youth, the description of war and hunting scenes, or the ceremonies of religious or political life. Thus the responses of the primitive are chiefly conditioned responses in which the substituted stimulus is of a dramatic nature involving emotional elements. The result is that the primitive perception tends to differ from that of a modern individual by being suffused with emotion. The primitive perception is surrounded by an emotional aura. Thus the whole cognitive life of the primitive, his perceptions, images, and reflective processes, take on an emotional vividness, which we can scarcely appreciate to-day, and which determined a system of logic, as well as a type of overt response or adaptation which is hardly conceivable by us. Objects of cognition tended also to be objects of emotion, and the primitive was led irresistibly to that over-valuation of the physical, and the animistic theory of the world which form the basis of the magical attitude and its technique-magic.

In his Development of Moral Ideas (11 p. 47) Prof. Westermarck notes that primitives distinguish two classes of phenomena or stimuli as we shall call them. (1) The Natural or familiar, and (2) the supernatural or mysterious; while the latter are divided into mechanical and volitional. The knowledge of the primitives is of course very meager, so that mysterious phenomena greatly predominated. Now since the savage perception is shot thru with the intimately personal emotional element, it seems quite reasonable that he should interpret such phenomena in terms of his own experiences as forces (animism) and later as spirits (animism). Emotions are forces which the savage feels,

S. Read, Carveth The -Origin of Man p. 109-110.

hence objects identified with the emotions are also forces. The conclusion is not a conscious inference, but an assumption based on apparent identity.

This view at least seems more plausible than the more intellectualistic view first proposed by Hume and elaborated by the English Anthropological School. According to Hume, "There is a universal tendency among mankind to conceive all beings like themselves and to transfer to every object those qualities with which they are familiarly acquainted and of which they are intimately conscious." Thus according to this theory "everything is necessarily conceived of by every body as a center of forces." In the movements of external objects, man reads such tension and effort as he experiences in dealing with them. Moreover, the movements and noises which objects such as trees, wind, water, thunder and lightning make, excite sympathy or empathy so that ultimately the world becomes a group of forces or spirits essentially like man himself.

This view, however, presupposes an act of inference on the part of the primitive. The resulting animistic world is a conceptual one, while our view assumes that animatism or animism is solely the result of emotionally suffused perception. Phenomena are simply perceived as forces or spirits in virtue of the nature of the perceptive act conditioned as it is by constant dramatic stimuli of social origin. There is no distinction made between objective and subject forces.

In any event the result is that the objects of the external world become a system of mysterious forces more or less identical with the forces which man experiences in his mental processes. At this stage magic proper arises, the relations existing between mental contents and processes are as a matter of course assumed for forces in general. Now the two most general

9. Hume D. Natural History of Religion

Section 111

10. Read. O. Ibid

p. 119

and obvious relations of mental contents are those of association by contiguity and similarity. Objects which have been perceived together and objects that resemble one another tend to be revived at the same time, whenever one of the series appears in perception. These habits of mind, for such they are to the primitive, are simply universalized as forces analogous to mental ones.

The habits of mind are assumed to be habits of nature since no distinction between subjective and objective phenomena yet exists. As a result (1) contagious and (2) homeopathic or imitative magic arise, the former striving to effect its ends by creating conditions of contiguity between objects, the latter by preparing conditions of similarity, which permit of active interference in the course of events. In short, as Frazer says, "Men mistook the order of their ideas for the order of nature, and hence imagined that the control which they have or seemed to have over their thoughts, permitted them to have a corresponding control over things."¹¹

Since in thought any object may succeed any other object, provided both objects fall within the experience of the thinker, the possible connections of objects and events in the external world, on this theory far exceed the possible causal connections, and the magician can imagine himself possessed of almost unlimited power to alter events in the world of forces provided he has the knowledge.

For this reason Reinach calls magic and sorcery the "Strategy of Animism,"¹² while Hubert and Mauss refer to them as the "Technique of Animism." On our view however, the world of early magic is not yet animistic. It is a world of mysterious forces better called animatism, a term of Prof. Marett's. Magic proper is the technique of animatism, and Sorcery is the particular kind

11. Frazer J. G.	The Magic Art	p. 201-203
12. Freud, S.	Totemism and Taboo	p 129

of magic which appears when animatism gives away to animism or the belief in a world of spirits. In time the mysterious forces of early belief become personalized and the man "imagines that all other physical entities in nature are like himself gifted with powers of speech volition and thought." ¹³ This is animism in the true sense, i. e., the ascription of a soul or personality to all objects. Sorcery is the strategy or technique of dealing with this new world of spirits. It is what is usually termed magic among contemporary savages, as well as among ancient civilized peoples, and pure magic in the sense we have defined it has probably been non-existent for ages. Its methods are the same as those of magic proper but it is accompanied by a conscious attitude of will which was only implicit in the older magic. It is this attitude which we believe will explain the widespread use of music in magic and thus contribute to a theory of the effects of music on behavior.

In the pre-animistic stage "Magic may be defined as a connection of events imagined to be constant and to depend upon the agency of some thing or activity possessing an efficacious quality or force (in fact unreal) ¹⁴ and not to depend (as a connection) upon the will of any particular person. The technic of this older magic dealing with its world of mysterious forces consisted simply in a supposed knowledge of what to do at the right time. Magical power inheres in implements, fetiches, charms, rites, and spells, irrespective of the person who uses them. They may be sold, taught, or transferred and then serve their new possessor. A magical formula is equally potent in the hands of Faust or Wagner, Master Wizard or the Zauberlehrling. The magician attempts to control phenomena by a supposed knowledge of the hidden connections of things but he does not ascribe his results to individual force of will. Of course, as Freud points out, a wish is the ultimate

13. Spence, Lewis

Introduction to Mythology

p. 17

14. Head C.

Ibid

p. 110

basis of the attempt to use magic, but this is a different matter from making the wish the supposed agency. The latter however happens when spirits displace forces in the world of primitive imagination. The sorcerer's control of personalities at the animistic stage is a conscious and deliberate act of will. A mere wish or volition provided it be powerful enough, is regarded as efficacious. Evidence of this attitude is abundant thruout the later history of magic. Thus Dr. Hadden tells us that "the Omaha believe that a man's own will can act directly on his fellows by singing certain songs; this act is called Wazhin dhedhe, that is, "directive energy to send"; the Omaha term signifies to send forth one's thought and will power toward another in order to supplement his strength and thereby affect his action, or as we should term it, "telepathy." Prof. Brinton writing of the American

15

Indians in general, describes contests of strength between rival medicine men, the outcome of which was supposed to depend on which had the stronger will. "Sometimes one gathering his medicine" as it was termed, feeling within himself that strength of will which makes itself acknowledged even without word, would rise in his might, and in a loud and severe voice command his opponent to die." The rival magician would frequently drop dead or retire in terror to his tent, to perish later.

16

Inspection of magical grimoires show that all over the world, spells, incantations, and invocations of spirits are in the imperative. (p.74) Thus Freud has good grounds for his statement that "primitive man had great confidence in the power of his wishes," and that magic or as we should say, sorcery, is due to the extension of the psychic valuation of the will to all phenomena. Magic then rests upon what Freud calls the principle of

17

15. Hadden A. C.	Magic and Fetichism	p. 60
16. Brinton, D.	The Myths of the New World	p. 295-6
17. Freud, S	Ibic	p. 138

omnipotence of thought, a principle common to savages, children and paranoiacs, i. e., wherever primitive mind or a reversion to that state exists. The basis, of course, is unfamiliarity with, or withdrawal from the conditions of reality accompanied by hallucinatory or ideal satisfaction of desires.

The feeling of the omnipotence of thought or of will, will naturally fluctuate in strength, and probably varies directly with the dynamic condition of the organism. Whatever tends to evoke powerful movements of the organism, or arouse emotions with the consequent liberation of adrenalin and sugar in the blood will tend to bring the feeling to its maximum. Hence, whatever promotes this result will be incorporated in the technique of magic whether personal or communal, and the extent to which such an agent is incorporated will indicate the efficiency which it possessed, in evoking the favorable psycho-physiological attitude. Thus if we find a widespread employment of music in magic it will be one more proof of the influence of music on the organism. Musical magic will constitute so to speak, a natural sociological experiment on the physiological effects of music.

That the enhancement of bodily energy and the increased sense of power attendant upon this dynamic state, is a prime object in magical practice, is shown by the persistent use of drugs and stimulants by medicine men and their disciples. Hashish, Candia, henbane, hellebore, and draughts of tobacco juice have been used in various parts of the world to bring on the dynamic states thought necessary for prophecy or magical achievement. The effect of these drugs in altering physiological activities and inducing heightened mental activity is well known.

18. Freud S.
19. cf. Maury A.
20. Hirn,

Ibid
La Magic, also Livet L.
The Progress of Art

p. 140-1

Art, too, insofar as it can enhance bodily and mental energy enters into magical practice. Hirn shows how poetry and particularly dramatic performances enter into the technique of magic. e. g., Primitive man "draws the rain from heaven by representing in dance and drama the appropriate meteorological phenomena," and regulates the movements of the sun and changes of the seasons in the same way. Even the sick are cured by imitating in dramatic pantomime the symptoms of the disease. ²⁰ It may be granted that dancing and drama play an important role in primitive magic, and that the function of these arts of motion is the enhancement of mental processes, particularly the feeling of power or will. Hirn, however, neglects to mention the most important factor of all, i. e., music which not only uniformly accompanies magical dancing and pantomime, but also forms the essential element of all vocal incantations, charms, etc. Hirn claims that "in the more artistic forms of poetic magic the suggestive power of the words replaces the brute force of their sound." ²¹ But that this is rarely the case, is clear from the fact that most primitive songs, e. g. those of the Australians and Mincopies ²² whether magical or otherwise, are quite meaningless to all but the singers. In some of Boas' Eskimo songs the text is merely a repetition of meaningless interjections. Primitive poetry has primarily a musical character. Tylor also notes that a common character of primitive songs is a "refrain of generally meaningless syllables." ²³ Magical formulae likewise are very frequently in a tongue unknown to any but the magician and often not even to the latter. In the magic of the Middle Ages, and the debased sorcery of the superstitious to-day, Hebrew words and phrases, of-

20. Hirn	The Progress of Art	p. 283-4
21. Hirn	Ibid	p. 296
22. Grosse E.	The Beginnings of Art	p. 249-50
23. Tylor	Anthropology	p. 288

ten greatly corrupted, are widely employed in incantations and the same practice exists among modern savages where the medicine men often seem to speak a different language although it is usually found that the so-called secret language consists of archaic or borrowed foreign words along with stereotyped grammatical mannerisms. It may be recollected that certain forms of religious ritual which are allied to magic, and which often involve the magical attitude in the spectators at least, make use of a sacred language unknown to the masses. Thus the chanting of the Catholic priest is in Latin; the cantilation of the Synagogue in Hebrew, both languages unfamiliar to the majority of devotees. Verbal meaning being thus excluded it is clear that the musical element of magic song, incantation, and ritual is relied upon as the really effective element in the situation. It is the human voice in its musical aspect which is of chief importance to the magician. Maspero commenting on the importance of the voice in the magic of the Orient, says that "the human voice is the instrument par excellence, of the priest and the enchanter. C'est elle qui va chercher au loin les invisibles qu'on appelle; c'est elle qui realise les objets necessaires; et chacun des sons qu'elle emit a une puissance particuliere qui echappe au commun des mortels, mais que les adeptes connaissent et dont ils se servent. A note irritates, appeases or attracts spirits; another acts on bodies.

In combining the two, the melodies are composed which magicians intone in the course of their evocations. But since each of them (the tones) has its particular power, one must be careful not to alter the order or substitute one for another, lest great disasters ensue."

24. e. g. Consult formulae in the 7th Book of Moses, a popular manual of the lower occultism.

25. Maspero, Etudes de Mythologie et d'Archeologie, Egyptiennes T. 1. p. 106 (quoted by Combarieu p. 102.)

Of course as Combarieu points out, the incantations found on ancient papyri are not accompanied by music, and the same thing is true of the magic formulae in the Chaldean and Assyrian tablets. This is natural since no system of written musical notation had been worked out, but an examination of the sounds and their arrangement which constitute such formulae, reveal elements suggestive of musical composition, viz., repetition of sounds, imitation, onomatopoeia, parallelism, inversion, development of vocal motifs, rhapsody, etc. In fact, these ancient grimoires clearly constitute a residue of ancient music, a kind of music congealed in writing. Hence certain modern Romanticists have even seen in magic the origin of music and verse as we know it to-day. Says Yeats "Have not poetry and music arisen as it seems out of the sounds the enchanters made to help their imagination to enchant, to charm, to bind, with a spell the passersby? These very words, a chief part of all praise of music or poetry still cry to us
26
their origin."

We have seen that the mimetic and dramatic practices of homeopathic magic are accompanied by music, while the incantations of contagious magic are in a sense identical with music. An exhaustive study of magical practices would probably reveal music of some kind as a constant concomitant. Space forbids any such complete survey, but a certain number of examples may be given here to illustrate the actual extent of musical magic.

The sculptured monuments of Egyptians, Chaldeans, Babylonians and Assyrians, exhibit music in constant associations with magic and ritual, while the Greeks had characteristic songs for every task; songs for harvesting, wine-making, grinding the wheat, etc., etc., and these songs aside from
27
their function of facilitating collective work by imposing a common rhythm.

26. Yeats W. B. Ideas of Good and Evil, Essay on Magic.

p. 54

27. cf. Bucher, K. Arbeit and Rhythms

Chap. 2.

doubtless had their ritual or magical significance, since they seem to have been strictly appropriated to the particular work in hand, and untransferable to other tasks. Indeed, as Hirn points out, the whole class of songs sung in order to facilitate the labor of works everywhere are a form of poetic or as we should prefer to say, musical magic. Ancient love songs are incantations and are often accompanied by symbolic acts partaking of the nature of magic in one of its forms, and the songs the shaman uses in his medical practise belong to the same category since primitive medicine is essentially a branch of magic. Preceding to concrete illustrations, Maury shows that most of the savages or barbarous people of Central Asia, use music in their attempts to conjure or exorcise the demons in which they all believe. At Lhasa, at a certain time each year, the Thibetan Shamans drive away the demons supposed to desolate the country and occasion maladies and the conjuration is made to the sound of trumpets, drums, bells, and conch shells. (p. 280). Kalmuck priests exorcise with the aid of the tambourine, as do most central Asiatic tribes. The Malay medicine men of the Kingdom of Djohore, exorcise to the sound of an instrument called the Gilondar and the Dayaks of Borneo observe similar practices. (p. 286)

Hadden gives many instances of musical magic among the very primitive Australians aborigines. In the Intichiuma ceremony, the Arunta, the headman and his associates sing songs inviting the witchetty grub to lay eggs. Men of the cockatoo totem, sing the cockatoo in order to promote its increase, and in the Wara tribe, a man of the rain group bends over a pool and sings the water to bring rain. (p. 49) In North Australia any one can sing magic, though medicine men do it best and magic is often sung into what are called "death-bones" which are regarded as potent weapons against

28. cf. Hadden A.

Magic and Fetichism

p. 26

29. Maury A.

La Magie, Partie II. Chap. II.

p. 250-338.

enemies. A. W. Howitt in his study of "Australian medicine men" gives numerous examples of musical magic. Certain wizards chant songs to close wounds, while the rain makers or Bunjil Willung of the Kurnai use songs accompanied by expressive pantomime to secure rain. An old woman is described as having "a great reputation for calming the storms by her songs which speak of the furious winds blowing the leaves of the trees. Charms are sung to cure people, to drive away pain, and inspire love." In connection with the latter, the Yenjin, an elopement song is sung by a special class of enchanters called Bunjil Yenjin among the Kurnai. It is a potent love spell according ³¹ to the natives and a Kurnai said "Yenkin made the women run in all directions when they heard it." This example clearly contradicts the frequent assertion that no songs connected with love are found among the most primitive peoples. Many more examples of singing magic among the Australians could be given, and M. Maus, shows that an entire class of songs used in funeral ceremonies are really magical in nature, consisting of imprecations against the ³² magicians held responsible for the death, and denial of group responsibility. These peculiar songs are then really a form of defensive magic.

In the two Americas, from Patagonia to Greenland, music is associated with magical practices. The Patagonians according to Maury exorcise spirits to the sound of a tambourine, and the Juripari or Devil music of the Orinoco Indians, is played on instruments reputed to be so full of magic that no woman ³⁴ may behold them on pain of death. Training in music was part of the education of the priestly magicians of Anahmac. In the magical rituals of the North American tribes, music is a constant feature. The exciting "ghost dance" songs of the Arapaho, Cheyenne, Comanches, Paiuts, Sioux, Kiowa, and Caddo Indians of the West, were produced in trance, the trance subject embodying

30. cf. ~~Maury~~ Hadden A. Magic and Fetishism p. 42, 44, 45, 49

31. Howitt, A. W. On Australian Medicine Men. Journal Anthropological Institute, Vol. 16. 1886-7 p. 25-58

32. Maus M. L. L'Expression obligatoire des Sentiments. (Rituels oraux funéraires Australiens) Journal de Psychologie 18:1921 p. 433

33. Wallace A. R. Travels on the Amazon p. 348

his experiences in the spiritual world in the form of a song which was sung at the next dance. Other songs, the opening and closing ones, formed a permanent part of the ceremonies which were of a magical or semi-magical character.³⁴ The Ojibways exorcise evil spirits by means of a drum (Maury p. 19) and among the same people magic songs play an important part in the technique of the sorcerers of the Midewiwan Secret Societies. They are used in the initiation of new members, the cure of disease, or to influence the course of nature. In a certain class of Mnemonic songs, exact reproduction of the songs taught by preceptors is required, since otherwise the formulae would be impaired or destroyed.³⁵ This requirement common among medicine men of many lands has led to the statement that the magician is really a prisoner to his song.

Among the Central Eskimos studied by Dr. Boas, the Angakoq in attempting a magical cure invokes his tornaq (or guardian spirit) by singing and shouting alternately, the listeners at the bedside joining in the chorus. The Angakoq even thinks he can lure Sedna, mistress of the underworld, from the sea by means of magic songs. (p. 604.) and magic songs are frequent at the festivals about the time of Christmas. In late Autumn, when storms abound and the seas are rough and disordered by broken ice, evil spirits are supposed to be abroad and in every hut wizards may be heard singing and praying.³⁶ "Conjuration of the spirits is going on in every house." (p. 604).

But further illustrations are superfluous, and it remains for us to try to explain at greater length this prevalence of musical magic. We have suggested that it is due to the dynamogenic effect of music on the human organism, which culminated in a feeling of superior power or Omnipotence

34. cf. Mooney J. The Ghost Dance Religion. Bureau of Eth. 1892-3 p. 953 ff.

35. Hoffman W. J. The Midewiwan of the Ojibwa

36. Boas, Franz. The Central Eskimo, Bureau of Eth. 1884-5 p. 592-604

of Will. We must, however, consider an alternative explanation suggested by Prof. Combarieu. In primitive animism, as we have seen, every phenomenon represented a person or an affective state. Sounds, particularly musical tones, share in this general personalization of phenomena, and since music has precisely the character of translating that which is most general and profound in emotion, it follows upon the animistic theory, that music has not only the power of expressing nature but also of acting upon it. ³⁷

Musical magic is an expression of the doctrine that there is a living soul in nature and that music can affect it directly, a view clearly formulated in the Chinese Book of Rites. This seems however to assume more theory, and a closer logic on the part of primitive man than facts warrant. It seems more probable that the primitive man simply reacted to their feelings apart from any theory, and that they used musical magic because it produced an affective attitude favorable toward action, or a sense of capacity to act. ³⁸ Aboulia or lack of will seems a special weakness of the primitive and whatever overcomes this native inertia is adopted wherever there is an incentive to action.

Now we shall find in our survey of experimental literature that music may have a dynamogenic effect on the human organism, neutralise the effects of fatigue, accelerate or retard circulation and respiration, and alter the volume of bodily members, while certain tones magnify or reinforce reflexes and shorten reaction times. ³⁹ In short, musical stimuli, while evoking no specific emotion, provide the organic foundation for emotions of every kind so that the dynamogenic tendency of ideas is increased. Thus a temporary impulsiveness of will supervenes, and plans can readily be transformed into action. The situation is aptly expressed by Tolstoi in the Kreutzer

37. Combarieu J. La Musique p. 100.-1

38. cf. Bucher Arbeit und Rhythmus

39. cf. Weld H. P. Study of Musical Enjoyment, Amer. Jour. of Psych. Vol. 23: 1912. p. 245-308.

Sonata, where he maintains that music makes one feel that he can achieve things of which he would be normally incapable. In brief, music tends to induce that state of Omnipotence of will which is essential to the magician in his work.

The fact then that music is universally employed in magical ceremonies is a confirmation of the results of experimental research on a limited number of subjects, tending to prove that the experimental data are not a consequence of non-musical factors involved in the highly artificial situations of the laboratory.

Such an enhancement of physical energy and impulsiveness of will is naturally greatest in neurotic individuals of unstable nervous systems such as Shamans medicine men and magicians are described as being. Frenzy is uniformly stated to be the state aimed at by the shaman who produces it in himself "by rhythmic drumming and dancing or by drugs" or by voluntary control of a "disciplined temperament." ⁴⁰ A Hindu order of Brahmans has even been described in which no candidate was admitted who did not respond in this way to music.

The success of the magicians depends first, upon his own feeling of power, and secondly, upon the suggestibility of his clientele. Now a suggestion, as Munsterberg has briefly defined it "is a proposition towards action," and the same factors that promote a feeling of power in the magician, increase the impulsiveness and therefore the suggestibility of his clients. Hence we find the Shaman often consciously utilizing the effect of rhythmic movements, and noises in inducing what must be regarded as a hypnotic state. Music renders the Shaman's client, or the whole group in case of communal magic, more inclined to respond uncritically to the vivid

87

images presented in the magical situation. In the case of group magic or ritual, the image already potent, as the object of group attention, is especially facilitated in its passage over into overt action by the state of exaltation or dissociation induced by the monotonous music of primitive instruments. It will be recalled that Mesmer employed slow soft music for similar purposes in his magnetic seances at Paris. In many cases the exaltation thus produced must amount to a true hypnosis, both in the Shaman and his fellow tribesmen. It will be remembered that De Rochas discovered very curious mimetic ability in his hypnotized subject, Lina; abilities amounting almost to a power of absolute motor expression of music so that appropriate movements for unknown folk-dances were reproduced. 41 It may well be that the original folk dances as well as primitive dances generally were produced in a state of musical hypnotism, and that to this is due the machine-like precision and regularity of even the most difficult movements, which travelers among primitives comment upon. These dances would therefore represent natural physiological responses to music and their re-duplication by others in a hypnotic state would be natural, while their physiological appropriateness would account for the surprising uniformity which is observed in their communal performances among primitives.

The effectiveness of music in the magical ceremonies of primitives is furthered by the probability that its influence on physiological functions and behavior in general, is probably greater than in the case of civilized individuals. Among the latter it has been observed that the overt effects are greater in children than in adults; in the ignorant than in the cultured, and among the latter in those who are not musically educated. The primitive is usually assimilated to the childhood stage of the race, and his education, musical or otherwise, is wanting. As we understand the term, the education

41. De. Rochas A. *Les Sentiments La Musique and Le Geste*
Nouvelle Revue Vol. 114. p. 587-602.

of the civilized man consists largely of information, partly of adaptive habits of response, and acquired in a relatively unemotional way; at least the affective tones of the acquisitive process is not commonly very intense. It is largely a matter of intellectual association of almost neutral tone.

On the other hand, the education of the primitive consists mostly of habits and action, acquired in the emotional situations of war or the chase, or imparted by personages of tremendous prestige in the still more emotional, often awe-inspiring initiations of youth. The primitive learns by acting. The process is usually communal, evoking the powerful instincts with their attendant emotions. Ideas and reactions all acquire a permanent affective tone, so that the entire mental life of the primitive probably consists of feelings, and sentiments rather than of ideas.

The result is that the mental functions of inferior races differ materially from our own, and imply a logic often/comprehensible to us. A different scale of psychic values exists, and where we attend to the causal, the orderly and predictable, in phenomena, it is precisely these elements which the primitive neglects, while he attends to the rare or mysterious phenomena, assigning to them a superior value and reality. Thus tone phantoms, vivid musical imagery, the apparently varying voluminousness of tones, chromesthesias, and the apparent enhancement of color by associated tonal stimuli, like the phenomena of dream and trance, are precisely what the primitive observes, values, and is unable to explain except upon a magical basis. The constant employment of music in magical rites, public ceremonies, and as an accompaniment of work at all times, moreover yields ample opportunity for the observation of such phenomena. Thus, the primary physiological phenomena, involved in hearing music are reinforced by the affective associations of the selections so that the primitive is permanently susceptible,

42. cf. King, Irving. Social Aspects of Education for a survey of primitive education. Ch. 1.

43. cf. Levy-Bruhl L. Les Fonctions Mentales dans les societes inferieures p.57

and in a constant way to his crude melodies, in contrast with the civilized individual whose initial reactions to music probably tend to alter somewhat,
44
with habituation.

The principal effect of music which led to its application in magic was undoubtedly the direct dynamogenic influence but certain other secondary phenomena, to some of which we have briefly alluded, probably influence behavior less directly yet effectively.

Music evokes imagery which is sometimes fairly vivid even among ourselves. The musical imagery of primitives, is probably both more frequent and more vivid, since ethnologists report that primitive imagery in general is more vivid and detailed. This musical imagery, we now know, is non-specific, varying in richness and character from individual to individual.
45

It seems to appear under conditions of bodily fatigue though in some persons, music normally arouses "phantoms of color and form, light and shade,
46
colored clouds, streams, waves, etc." which may be a special and freer development of colored hearing. The musical images of primitives are moreover more distinct and the phenomena of music phantoms more frequent among primitives just as they are among the uncultivated, according to Galton. That such musical imagery is non-specific, was only finally established on the basis of experiment and statistical treatment of reports, and the primitive lacking all test methods must have regarded the images as objective realities, tending to demonstrate his views of magical connections. Where images of men or animals appeared they were probably regarded as embodied tones, or as spirits evoked by music. This view is rendered plausible by the statement of a clairvoyant, that while listening to a German professor perform on an organ "he noticed a host of appearances moving about the keyboard - veritable
44. cf. Lehmann A. Die korporlichen aussagerungen psychischer Zustände.
Th. 1. Leipzig 1899
45. MacDougal, H. V. Music Imagery, a Confession of Experience.
Psych. Review Vol. 5. 1898 p. 463-476.
46. Ellis, Havelock The World of Dreams p. 77.

44. cf. Lehmann A. Die korporlichen aussagerungen psychischer Zustände.

Th. 1. Leipzig 1899

45. MacDougal, H. V. Music Imagery, a Confession of Experience.

Psych. Review Vol. 5. 1898

p. 463-476.

46. Ellis, Havelock The World of Dreams

p. 77.

Lilliputian sprites, fairies and gnomes astonishingly minute in size, yet as perfect in form and features as any of the larger people in the room." In form, appearance, and movement, they were in perfect accord with the theme. The substitution of funeral music for quick measures brought black-robed scowling figures. New music called in plumed knights, and at every change of the music, a new set of sprites appeared. Their faces expressed the sentiment of the music, and discords evoked strange misshapen creatures, usually humpbacked dwarfs of disagreeable movement and expression. Here we have musical imagery become hallucination and it is fair to assume that this was quite frequent among primitives naturally endowed with vivid imagery, particularly among the medicine men, whose unstable nervous system placed them on a par with the modern clairvoyant. The latter, indeed, is an atavistic throwback to the Shaman type. It is possible that hallucinatory musical imagery may even now be more frequent than is commonly supposed, and this may underlie the common use of music at modern spiritualistic seances and may partially account for the materialization phenomena observed by the highly imaginative on such occasions.

The influence of music on the imagery of dreams, hallucinations and hypnotic states, has been dealt with in our chapter on musical Therapeutics. It suffices to recall that imagery under such conditions is profoundly influenced by musical stimuli and since dreams or trance visions are a common source of divination among primitives, this branch of magic also would be led to the use of music to promote its practices.

Another group of phenomena known as synaesthesias probably influenced primitive magical practices to no small extent, while it may have also contributed considerably to the formulation of the Animistic doctrine in

47. Hartmann, Franz Magic White and Black

p. 59-60

48. See Chapter 5.

general as well as of certain peculiarities to be mentioned. Of the synaesthesias, or fixed associations between sensations of different modes, colored hearing appears to be by far the most prevalent. Colored hearing is a condition in which sounds (vowels or musical tones) produce a simultaneous sensation of a definite color. For example, in nine cases studied by Claparede, colors were attributed to all or almost all the notes of the scale. A number of persons ascribed colors to musical intervals and represented sharps or flats by slight changes of tint. Entire musical selections or the work of particular composers may induce particular colors, which may also vary with the mood of the music, or the type of instruments played upon.

Flournoy speaks of the music of Gounod evoking sensations of violet in one individual and sensations of blue in another, while Beethoven aroused the sensation of black in a third. In a case studied by A. Marinesco, the music of Wagner was gray and yellow, while that of Chopin was designated as luminous. Coriat mentions an artist in whom "harsh and loud music produced instantaneously a sensation of red and yellow, while soft music caused a violet and blue sensation. A clash of cymbals produced a red-yellow sensation, a harp, a blue-violet sensation. The colors were intense and persistent during the entire duration of the music." Cases of this kind would be multiplied, but the above suffice for purposes of concrete definition. The conclusions of a large number of special students of colored hearing may be summarized in the following propositions as to the association of tone and color:

- (1) It is of very early origin, less than 25% of the subjects being able to state when it first appeared.

49. Flournoy, Th. Des Phenomenes de Synopsie-Photismes Musicaux p. 99-108
50. Coriat, I. Abnormal Psychology p. 408
51. Parish E. Hallucinations and Illusions p. 228

- (2) It is invariable - the colors associated with clangs are constant in
52
the same individual.
- (3) The relation is purely individual and not referable to any general law.
"No two people" says Galton," agree or hardly ever do, as to the color
53
they associate with the same sound. Statistical studies, however,
shows that deep tones and vowels are usually associated with darker
54
colors; high tones and sharp vowels with lighter colors.
- (4) The relation of tone and color is irreversible, tone stimuli producing
55
colors, while color stimuli do not evoke tones.
- (5) The tone and color sensations involved are strictly synchronous, i. e.
56
possess the same duration.
- (6) Colored hearing is generally hereditary. 57
- (7) The subjects of colored hearing like those possessing number forms
regard the phenomena as strictly normal and common to everyone, expressing
58
surprise on discovering that their experiences are exceptional.
- (8) The phenomena of colored hearing are more frequent than commonly supposed.
Lemaitre found it in 30% of children examined; Phillippe, in 12%; while
59
Bleuler and Lehmann found a frequency of 12.5% in adults; 43% of the
individuals responding to Chapard's questionnaire on the subject possessed
60
colored hearing.

52. Parish E. Ibid p. 223 and Galton p. 107
53. Galton Ft. Inquiries into Human Faculty p. 107
54. Parish E. Ibid p. 223-4
55. Coriat, I. Abnormal Psychology p. 405
56. Ibid p. 412
57. Galton Fr. Inquiries, p. 107 and Coriat 1. - Ibid p. 403
58. Binet A. Le Probleme de L'Audition Colores. Revue des deux Mondes
1892 p. 585-614
59. Marie, C. l'Audition Mobbide p. 102
60. Binet. Ibid.

1. The Embryological Hypothesis, according to which there is incomplete anatomical differentiation between the senses of audition and vision, or rather of their cortical centers. Colored hearing is therefore an atavism going back to a time when discrimination of sensory centers did not exist, but all was implicit in protoplasm.
2. The Anatomical Hypothesis: Anastomoses are supposed to exist between the cerebral centers of vision and audition, whereby simultaneous excitation by a single stimulus is possible. It is therefore frequent among the less evolved peoples.
3. The physiological or nervous irradiation hypothesis: The stimulation of one center passes over to the others, varying with the individual and with the intensity of the sensation evoked. (Fechner.)
4. The psychological hypothesis, in which the association of two representations is not the result of frequency but of emotional character. (Flournoy, Hugg-
61
Helmuth, Pfister, etc.)

Recent investigations incline toward the third hypothesis and explain colored hearing as due to "incomplete differentiation of the cortical projection fields corresponding to the peripheral auditory and visual neurons." The result is irradiation of peripheral impulses into non-corresponding centers, a phenomenon demonstrated by Sherrington. "Thus it seems that the theory of nerve irradiation, arising from a congenital defect of the nervous system in which the stimulation of one center passes over into another, varying with the individual and with the intensity of the provoked sensation, appears at present the
62
most satisfactory explanation of the various synaesthesias." Colored hearing is therefore a physiological effect and its consideration belongs properly in a survey of the influence of music on behavior. But it may be

61. Flournoy, Th. Ibid p. 99-108
62. Coriat I. Abnormal Psychology p. 406

asked how such unusual phenomena could influence the reactions of primitives to musical stimuli, and what bearing they could have on primitive theories.

In the first place, the phenomena of colored hearing are fairly frequent even among ourselves, estimates ranging from 12% to 43%. Children, according to Le Maitre, exhibit it more frequently than adults; and on the basis of the analogy between children and primitives, we should expect to find it more frequent in the latter than in civilized individuals. This would also be the case according to any one of the first three theories proposed, since the primitive is presumably less completely and less perfectly differentiated. Finally it may be noted that colored hearing appears most often in those of unstable nervous systems. This is illustrated by its prevalence in the French literary men such as Rimbaud, Baudelaire, etc. who participated in the symbolist movement and laid great stress on colored hearing as a superior type of experience.⁶³ The primitive magician was also of an unstable nervous type, making it probable that colored hearing would be a frequent experience of his class. On the whole, it seems probable that colored synaesthetic phenomena were much more common and possibly more elaborate among primitives, just as were dreams. Such phenomena as those of colored hearing were equally inexplicable to the primitive mind, and when it is recalled that primitives attend to, and value most the mysterious and inexplicable, we may readily believe that colored hearing, as well as dream and trance phenomena, played a part in the evolution of animistic philosophy.

The English Anthropologists traced the genesis of the primitive soul concept to the experiences of trance and dream. Surrounded as he constantly was, by an atmosphere of crude musical stimuli, the synaesthetic experiences of primitive man must also have been sufficiently frequent to secure attention and wonder. The fact that in such cases, tones, intervals, or

63. Binet, A. Ibid

selections, inevitably and invariably evoke colors, or even tastes, and smells, in certain very rare auditory synaesthesias, while the reverse relation does not hold, must have seemed special proofs of the magical power of tones, already emphasized by their dynamic influence on the organism. Tones then constituted a particular and superior domain of forces, which the magician must master in order to control nature. Moreover, the synchronism of tones and their synaesthetic concomitants, may have contributed to that primitive theory of the essential identity of diverse objects, which seems to run counter to the primary laws of logical thought and which persuades certain modern students to assume a different type of mental function in primitive minds.

Prof. Levy-Bruhl, gives numerous instances of this primitive view in his great work on "The Mental Functions of Inferior Societies." "The Trumai (a North Brazilian tribe) say that they are aquatic animals. The Bororo (a neighboring tribe) boast of being red araras (perroquets)." As Von den Steinen learned, they mean this in a quite literal sense. They declare they actually are araras, exactly as if a caterpillar said it was a moth. In short, they assert essential identity. In the same way the Huichols of Mexico assert the identity of the stag, what, a sacred plant called Hikuli, and feathers. Similar facts abound among primitives and it is conceivable that such views might originate in the experience of medicine men for whom the tones of the ceremonial drum or trumpet were colours, tastes, odors or even complex objects and persons, in case the colored hearing was of the elaborate type presented in the phenomena of music phantoms.

This possible explanation of primitive belief becomes even more plausible in the light of certain theosophical doctrines respecting music, which are accepted in certain circles to-day. A number of occultists, inclu-

64. Ellis Havelock

Ibid

p. 79-80

65. Scott Cyril The Philosophy of Modernism

p. 107-117.

ding several musical composers of great merit, base a complete theory of music on the phenomena of colored hearing and affirm precisely the identity of tones, colores and forms which we suppose the primitive to have accepted. "Every musical composition," says Cyril Scott, "produces a thought and color form in the astral space, and according to that form and color, is to be judged the spiritual value of the composition under review." Vivid luminous colors characterise spiritual values, muddy or faded colors, works of a lower order. The disagreements of individuals as to the correlation of tones and colors which psychologists have determined, are brushed aside as cases of mere imaginative assertions, different in kind from the experiences of clairvoyants, who have determined the following scale of tones colors and potencies.

STONE	COLOR	ESSENCE	VOWEL
C	red	power	O
D	orange	energy	L
E	yellow	intellect	e
F	green	sympathy	oo
G	blue	devotion	u
A	indigo	selfless love	ee
B	violet	psychism	a

66

Here we have a complete scheme of identities of different things in which vowels, musical tones, colors, and abstract concepts are equated, and may presumably replace one another, in the musicians' or the magicians' operations.

Thus the ancient musical magic survives in the doctrines of the Theosophists, as well as the practice of certain composers, and the uniformity of human nature in similar situations, makes it probable that the explicit doctrines of the new magic are nothing more than the implicit principles upon which the primitive medicine man acted.

66. Wundt W. Elements of Folk Psychology: regards the "Totemistic Age" as a distinct period of Social Evolution.

The influence exercised by music over primitive magical behavior probably does not end here. Less direct results could doubtless be traced if we desired. For example, the observed effect of music on animals, particularly the serpent, must have convinced totem worshippers of its magical powers. When we reflect that most peoples have passed thru a totemistic period⁶⁷ and that even serpent worship according to some students of comparative religion was once world wide, we can readily understand that the influence of music on animals may have been a substantial factor in convincing primitives of the efficacy of musical magic. This conclusion moreover agrees with the results of our study of musical myths. A psycho-analyst might perhaps find it significant that Apollo, at once the God of music and medicine (which is originally magic) has a serpent for his emblem. But speculation of this kind need only be touched upon at present. Our object has been to trace the more direct influences of music on behavior as illustrated by primitive magical practice.

To sum up, we may note that :

1. Magic requires a peculiar condition of enhanced physical energy and mental exaltation on the part of the exponents, culminating in the sense of omnipotent will.
2. Music is a constant accompaniment of magical practices, and so must have contributed to the organic condition favorable to such pursuits.
3. Secondary phenomena connected with audition, such as imagery, colored hearing, etc., contributed toward the animistic theory which was built up to rationalise magical procedure.
4. The use of music in magic, therefore, confirms the data of experimental research on musical effects, indicating that similar effects are experienced by individuals in all stages of social development, and with musical systems of diverse types.

⁶⁷. cf. Works of Dean, Ferguson and Wake, on Serpent worship.

THE INFLUENCE OF MUSIC ON THE SICK.

(Musical Therapeutics)

Any study of the influence of music on the organism must include the data of Musical Therapeutics. Whether or not a practicable system of melo-therapy exists, or is even possible; has nothing to do with the psychological value of the observations of its exponents, in their attempt to work out and apply such a system. The mere fact that people, including many reputable physicians, in every epoch of history have believed that Music was able to effect changes in the disordered human organism and have applied Music to that end, is interesting psychologically. Still more interesting are the large number of narrations or even clinical descriptions of the Behavior of the diseased, abnormal, or subnormal when subjected to musical treatment. Such accounts supplement the psychologists' experiments on the influence of music on the normal, besides suggesting new experiments. In evaluating data, we must, of course, carefully discriminate between opinions based on theories of melo-therapy, and actual descriptions of the reactions of the sick to musical stimuli.

Mere opinions based on several theories to be discussed briefly later on, however interesting as evidence of belief in the influence of Music, are on a par with the Music myths related in a former section. The farther back we go the more akin to myth do such opinions seem, and we often find magical elements of a non-musical nature associated with music ~~prescribed~~, so that it is not clear whether the alleged beneficent influence is ascribed to the music or the general magical situation.

The relation of Music to Magic has been discussed in detail in another chapter but to illustrate our point we may cite the opinion of Baptista Porta (1540-1615) according to whom a flute of hellebore cured dropsy; a flute of poplar wood sciatica; while a pipe of cinnamon weed was a sovereign remedy for fits of fainting.¹

(1). Radau R. The Wonders of Acoustics

p. 31

+ In India certain modes were only to be sung at stated times of the day, and in the same spirit a comparatively modern writer, R. P. Kircher, thinks that every composition has its own peculiar time, place, and most favorable season.³ Similar limitations on the employment of music are sometimes found in the uses of music in the ritual of inferior races. It is clear that in such cases music is regarded as but one part of a total effective magical situation; the really effective element being indiscriminated in judgments of this type. It is evident that descriptions of behavior or observable changes of any kind in the disordered when subjected to music are of most importance to us. Nevertheless, the statements of greater ancient physicians of reputation, though generally categorical rather than descriptive, were probably founded on actual observation and are therefore of value to the psychologist. In all cases we must bear in mind the qualification of the observer, his attitude, and the inherent probability of his report.

With these general principles in mind, we may now turn to a brief review of the opinions of classical authorities, ethnological data, and the objections of those who do not think musical therapeutics possible.

The conception of music-therapy dates from the remotest antiquity and is current among practically every primitive or semi-primitive people of to-day. The ancient Egyptians called music, physic for the soul and had faith in its specific remedial virtues. } Maspero in his "Dawn of Civilization" says that the disciples of Thoth had control over words and sounds which, when emitted at the favorable moment and with the correct voice "had power over the gods to make them do and undo at their special will." We may presume that the incantations presented in the medical papyri were likewise to be emitted with the proper voice, "and therefore contain an element of music."⁴

2. Chomet, H. The Influence of Music p. 237
3. Davison, James T. R. Music in Medicine, The Lancet, Oct. 28, 1899
4. p. 1159.

The Persians regarded music as an expression of the good principle Ahura-
Mazda and are said to have cured various maladies by the sound of the lute. 5

The therapeutic effects of music so impressed the Greeks that they made Apollo at once the god of music and healing. Aesculapius, the mythical son of Apollo, god of music, remains to-day the traditional patron of medicine. The greatest Greek philosophers ascribed, the most important medical virtues to music, and many astounding cures are reported by classical writers.

Thales (600 B. C.) called from Crete to Sparta, is said to have cured a plague by means of music and we find Pythagoras directing certain mental disorders to be treated by this means. Empedocles (490 B. C.) cured the desperately melancholy and the mad, and Democritus (470 B. C.) recommended music as a remedy for the bites of serpents and other venomous reptiles as well as against the plague. Xenocrates cured maniacs by melodies, and Asclepiades (c. 50 B. C.) overcame deafness with a trumpet. 6

Hippocrates mentions a certain Nicanor, who fainted on hearing the sound of a flute. Theophrastus asserts that music can heal diseases in his treatise in Enthusiasm, where he says that men "with diseases in the loins become free from pain, if any one plays a Phrygian air opposite the part affected." 7

Aulus Gellius (2d. c. A. D.) speaks of a traditional belief that sciatica was relieved by the music of a flute. 8 Celsus (45-50 A. D.) prescribes music for the insane. To quote his words, "we must quiet their demonical laughter by reprimands and threats and soothe their sadness by harmony, the sound of cymbals or other noisy instruments." 9

5. Cf. Lawrence, R. M. Primitive Psychotherapy p. 173.
6. Timbs, J. Doctors and Patients. p. 314-15.
7. Athenaeus. The Deipno-Sophists Book XLV C 19.
8. Aulus Gellius - Attic nights Books IV C14.
9. See other page.

Arataeus (31-90 A. D.) prescribed music as a cure for Coryban-
tism, a disease of the imagination, similar to the dancing mania of medie-
val Europe. ^{9 a} Galen recommended the employment of music as an antidote to
the bite of vipers and scorpions, a prescription followed by later medieval
physicians in treating tarantism. The remarks of Coelius Auralianus show
that music was in general usage as a remedy for mental disorders, and he
lays down rules for the use of different Greek modes in treating madness.
The Phrygian mode, full of sweetness and vivacity, is adapted to those who
are alternately overwhelmed with grief and transported with rage, while the
martial Dorian mode suits the maudlin or delirious type. The same author
mentions a flutist who by playing in the Phrygian mode, charmed as it was ¹⁰
the diseased part causing it to palpitate and tremble. This seemingly
improbably statement receives support from the comparatively modern obser-
vation of Haller who saw the blood spurt more violently from an open artery ¹¹
as a result of increased blood pressure caused by the rolling of a drum.
Before dismissing the ancients, we may remark that a number of other writers,
notably Martianus Capella, who prescribed for fevers, and the Greek Patristic ¹²
father, Origen, allude to the use of music as a therapeutic agent.

Medieval writers, whenever they speak of melo-therapy generally
repeat the views of the ancients or simply add new marvelous examples. A
passage in Burton, who warmly praises the therapeutic virtues of music with
quotations from many authors, (some well-known, others obscure,) illustrates
the general tendency.

"(Rhasis cont 9 Tract 15, Altomarus Cap 17) Aeliamus Montaltus.

Cap 26 Picinus Bened. Victor. Feventinus are almost immoderate in the commen-
9a. Arataus - De signis Chronicorum Morborum Book I C 6.
9. Calsus - De Medecina Book III.
10. Chomet H. The Influence of Music p. 206, 207.
11. Haller, A. - Elementa Physiologiae Vol. 5. Lib. 15.
12. Maury A. La Magie p. 273.

dation of it; a most forcible medicine Jachinus calls it; Jason Pratensis, "a most admirable thing and worthy of consideration, that can so mollify the mind and stay those tempestuous affections of it." "Musica est mentis medicinae maestae, a roaring-meg against melancholy, to rear and revive the languishing soul; affecting not only the ears but the very arteries, the vital and animal spirits, it erects the mind and makes it nimble, etc."

13

Bartholomew Anglicanus in his Encyclopedia entitled "The properties of things" devotes a section to medicine in which he says that the insane "must be gladdened with instruments of music."

13b

A writer in the New York Medical Record,

remarks that when the Arabs dominated a large part of Europe in the 13th century, they founded numerous great hospitals and that a striking feature of some of these institutions was a music room where musicians played constantly for the sick. "The Arabian physicians of that day believed that

13c

music had a very positive healing effect." Indeed there was a universal belief during the Middle Ages among physicians as well as laymen, that music exercised a potent influence on psychopathological phenomena, whether individual or collective. The best illustration of this belief is the employment of music as a means of hastening crises in the dancing epidemics that swept over central and west Europe from the 13th to the 17th centuries.

The dancing mania, variously known as St. John's, St. Guy's, or St. Vitus's Dance, or Tarantism was characterized by screaming, foaming at the mouth, convulsions, violent contortions and leaping about in a menadic fury. It persisted for hours until complete exhaustion, returning again and again after intervals of quiescence.

13. Burton T.	Anatomy of Melancholy	Part 11 Sec 11	
		Subsec. 111	p. 334
13 b.	Medieval Lore. Ed. by R. Steele		p. 58
13 c. Mays T.J.I.	A Study of Drug Action, Music and Medicines.	N. Y. Med. Rec. Vol 105; 1917	p. 835.

13

It attacked entire groups at a time, was contagious and was popularly ascribed to malevolent demons; but in Italy to the bite of the Tarantula. The principal therapeutic agent was music. At Strassburg in 1418, swarms of dancers "were seen night and day passing through the streets accompanied by musicians playing on bagpipes."¹⁴ It is said that these musicians were hired by the German Magistrates for the purpose of carrying the St. Vitus dancers, more quickly through the attacks. In all these cases the dancing fit was probably excited by music "from the effects of which patients were thrown into convulsions." "Concurrent testimonies" says Hecker, "serve to show that music generally contributed much to the continuance of St. Vitus dance, originated and increased its paroxysms and was sometimes the cause of their mitigation. . . . " "It may readily be supposed that by the performance of lively melodies, and stimulating effects, which the shrill tones of pipe and trumpets would produce, a paroxysm that was perhaps but slight in itself, might in many cases be increased to the most outrageous fury, such as in later times was purposely induced in order that the force of the disease might be exhausted by the violence of the attack."¹⁵ Soft music now lost but containing transitions from quick to slow measure and passing gradually from a high to a low key was employed to calm the excitement of the dancers after it had reached a crisis.

In Italy the cure of Tarantism was undertaken on a grand scale by traveling bands of musicians. The music was adapted to the nature of the malady, and survives in the modern Tarentella, which still produces remarkable excitement among the Italian peasantry even under normal conditions. Sir George Henschel graphically describes the wild Tarentello of the Moun-

14. Hecker J. F. C. The Dancing Mania of the Middle Ages

p. 4.

15. Ibid

p. 14.

tainers of Saricinesco. The young dancers shouting at intervals short musical phrases, "accompanied certain accents of the rhythm with shrieks of joy, the wildness of which would make a Scottish reel seem funereal in comparison." The effects of native gypsy and Hungarian music is described as a kind of intoxication.

16

Jorsen in his notes to the Arabic version of the Arabian Nights comments on the powerful effect of music on Orientals. "When under no restraint, they give way to the excitement of the moment and vent their feelings in exclamations and cries." He also speaks of "men completely overcome falling senseless and fainting under the influence of music."

17

Salvador Daniel says, "I have seen a musician of great reputation fall into quite an ecstasy when playing his Kemendjah, those diabolical songs in the Asbein mode." He states further that the effect was not due to religious enthusiasm since the musician was a Jew.

18

The Bamboula dance of the Hayti Negroes in their Voodoo rites, which is performed to the monotonous roll of a primitive drum, culminates in the wildest frenzy.. In the light of these modern examples the profound effect of the medieval tarentella music on abnormal pathological individuals is not surprising. At least six varieties of Tarantella adapted to various states of mind were employed, most famous of which were the Panno rosso " a lively impassioned style of music, to which wild dithyrambic songs were adapted, and the Panno verde suited to the milder excitement of the senses," and which was used to calm the crises provoked by the former. Individual differences in patients were noted. Some showed a predilection for certain tunes in preference to others, as well as partialities for particular instruments. "Thus some longed for the shrill notes of the trumpet, others for the softest

19

music produced by the vibrations of strings."

16.	Henschel George	Musings and Memories of a Musician	p. 394
17.	Farmer H.	Notes to Salvador Daniel	p. 244-6
18.	Salvador, Daniel J.	Arab Music	p. 149
19.	Spencer H.	The Origin of Music	Pop. Sci. Vol. 38 p. 17-8

153
 The dancing ^{music} afforded the middle ages a strenuous test of its faith in musico-therapy; a test which evidently was successful since we find confidence in the medical virtues of music unshaken in those Renaissance and early modern writers who refer to the subject. We have noted Baptista Porta's prescription of a flute of Hellebore for sciatica. According to Descartes, music relieves catalepsy, and father Kärcher under the title, "Phonurgia Iatrica" devotes a chapter to musico-therapy. According to Nathan and Dupre however the positive history of musico-therapy dates from the essays of Allbrecht published in 1743, and since this time a fairly extensive, though scattered literature, on the physiological effect of music and its therapeutic application has arisen.

U. Fr. Bruckman (1728-1812) and Ch. W. Hufeland (1762-1836) relate cases of St. Vitus dance cured by music while other physicians asserted its favorable influence in hysteric and hypochondriac affections and Lichtenthal went so far as to prescribe music for the cure of gout, sciatica, epilepsy, the plague, catalepsy, delirium, convulsions, typhus, and stupidity. References to much of this material may be found in the records of the Paris Academy of Science and in the Columns of the London Lancet. Authenticated cases of music cures increase, the most famous instances being those of Philip V of Spain, Ludwig of Bavaria, and George III of England, all of whom suffered from extreme mental depression.

Philip V of Spain was so despondent from ill-health that he refused to be shaved or to appear in public, but listening daily to Farinelli's songs soon effected a complete cure. King Ludwig's depression and recurrent head-

- | | | |
|-------------------------|-------------------------|------------|
| 20. Descartes, R. | Oeuvres. | |
| 21. Radau, R. | Wonders of Acoustics | p. 32 |
| 22. Dupre A et Nathan M | Le Langage Musical | p. 177 |
| 23. Lichtenthal. P. | Der Musicalische Artzt. | passis 11. |

aches were relieved by Masanello and "Stradella's Prayer," and "George III when suffering from his terrible fits of melancholy received much solace from music." "Indeed Musico-therapy seems to have achieved its greatest triumph in the field of mental pathology, and a long line of physicians have declared their belief in the usefulness of music in diseases of the mind."

Celsus as we have seen thought that "the melancholy insane may be relieved by symphonies, cymbals and music." Jean Bodin, (1606) a celebrated political philosopher and general savant, notes that melancholy madness was common in Germany and was invariably cured by music. Thomas Willis (1670) considered music useful in cases of insanity, unattended by lesions but due to abnormal sequences in physiological activities, and hence removable by sudden stimuli. Richard Brown (1729) employed music in the treatment of mania, melancholias, and hypochondrias, ascribing special virtues to the music of particular

25

instruments. Richard Brocklesby (1749) described the curative effects of music "in delirium melancholia, lunacy, and even frantic madness." Dr.

26

Bourdelot of Paris and David Campbell of Edinburgh (1772) advocated music for nervous and cerebral diseases "as it helps to calm and also accelerate the

27

circulation of the blood, thus removing any over pressure on the brain."

Brown prescribes adagios for states of excitement and certain forms of madness, allegros for hysteria, spasms, and lethargic states. Campbell advises smooth pieces, dolce, piano et pianissimo for delirium, and quick variegated tunes for morbid conditions.

- 24. Hadden J C Music as Medicine Music Vol 9 p 367-8
- 25. Brown R Medicina Musica (quoted by G. C. Rothary -
Music and the Healing art.)
- 26. Brocklesby R Reflections on ancient and modern music
with application to the cure of diseases.
- 27. Disquisitio inauguralis de musicis effectu in doloribus leniendis
aut fugandis.

Dr. H. Chomat summarizes the application of musico-therapy to mental disturbances in a few sentences. "Calm the irritable with sweet and soothing melodies; charm the biliously inclined individuals with short, airy ballads full of amiable gayety; enliven the desponding; electrify the monomaniac."

Among recent authorities the Russian physiologist, Tarchanoff, and Dr. Farrand strongly recommended music for nervous disorders but offer no formulae;

while Dupre and Nathan consider it effective in mild psychic disorders; in short, only where the attention of the patient can be secured.

Dr. S. L. Katzoff recommends musical programs as part of the schedule of sanitoriums, hospitals, etc. as a material aid to the early recovery of patients, and gives certain musical prescriptions, e. g., Tschaikevsky's "The Tempes Overture," or "Mendelsohn's Fingal's Cave," for hazy states of thought, and the "Volga Boat Song," "My heart at thy Sweet Voice," "Mappari tutt Amor," and similar selections for nervous exhaustion and insomnia.

Altho such precise prescriptions as the foregoing have been deprecated by Farrand, they are interesting as presumably based on observations of behavior. Before leaving the subject of music in its relation to psychic disorders it may be noted that considerable success has attended the musical treatment of shell-shock.

Miss Margaret Anderson, who conducted a course in musico-therapy in Columbia University in 1919, prescribed music for any form of War neuroses. Instrumental music is better than vocal, and timbre is the effective element. Memories have been restored to aphasics; acute temporary insanity banished, and paralyzed muscles restored by musico-therapy.

J. W. Harting also declares that in cases of

28. Chomat H	Influence of Music	p. 235-237
29. Farrand J	Essais Physiologiques sur la musique	p. 288
30. Dupre etc Nathan	Ibid. Chap. LX Melotherapie	p. 179-81
31. Katzoff, SL	Music as an Aid to Health.	The National Electric Medical Association Quarterly, Dec. 1921 Vol 13 p. 134
32. Literary Digest	March 1, 1919	p. 59-62.

nervous disorders brought about through horrors witnessed, or from shell shock,
music is often the only medium through which the patient can be reached.

A considerably number of clinical cases of music cures are given by Chomet, as well as by J. T. R. Davison in works already cited and others appear in articles by Eva Vascelius and the recent work of Harriet Seymour.

A noted composer attacked by fever and lapsing into violent and continuous delirium was cured by ten days of music treatment starting with the singing of Berner's cantata. The fever and delirium always subsided during the concert, to return when it was over.

A middle aged man, stricken with apoplexy, with one-half of his body paralysed, and reduced to a lethargic condition, convalesced rapidly under the influence of cheerful music. This personal observation of Chomat's is paralleled by one given by the Prof. Malherbe, whose music master, a very old man, failed rapidly after a severe accident, was revived under the influence of his pupil's music.

Quarin describes a cure of Epilepsy by music. The patient by chance was listening to music when she felt the epileptic fit approaching. Only the symptoms appeared, however, and afterwards by providing music whenever she felt the approach of a paroxysm, a complete cure was effected.

In 1896 Dr. Baschinsky, a Russian physician reported the cure of a three year old child of sleeplessness and night terrors by recourse to Chopins' Waltzes, at first played nightly, afterwards at intervals of two, four nights, etc. and Dr. Fournier Pescay employed flute music for the insomnia of his own son with good results. Dr. Bourdois de la Mothe, attended a young woman who had a fever for 18 days. Her pulse was weak and the extremities cold. After

33. Harting J W Music takes first place in Reconstruction Work
 The Modern Hospital Vol. 12 1919 p 404-406.
34. Seymour Harriet What Music can do for you. p 146-154.

40 minutes of harp music breathing improved, the feet grew warmer, the pulse stronger, and after a nose hemorrhage, speech returned and convalescence set in. ³⁵ Still more striking are the clinical experiments of Dr. J. E. Hunter on the therapeutic effects of music in patients at Hallsburgh Hospital in 1892. In a letter to the British Medical Record he stated that "the cessation or at least diminution of pain has been marked in many cases!" In a later statement he noted "that seven out of ten cases studied were benefited insofar as a reduction of temperature was recorded."

Up to this point our data has largely consisted of opinions on musico-therapy, or isolated instances of cures. This has led many to declare that a practicable system of musico-therapy is impossible. "Every cure," says Hanslick, effected by the aid of music must be regarded in the light of an exception, and the success can never be put down to the music alone, being due partly to special causes and often merely to the patient's idiosyncrasy. ³⁶

Whether this verdict of 70 years ago is valid, depends upon further investigation, and seems less probable in the light of experimental data. In any case, Hanslick does not deny profound physiological effects to music, but only that these effects can be controlled, a problem which as we shall see does not present insurmountable difficulties.

A criticism of a more serious nature - one that would explain the therapeutic effects of music as a mere matter of mental associations has been advanced in the light of modern ethnological data on the medical use of music by primitives. To this evidence and the criticism based upon it, we must turn for a moment. The studies of ethnologists disclose the fact that savages make use of music wherever a powerful emotion effect is intended, and particularly in the treatment of diseases. The primitive physician in all parts of the world

35. Davison J T R Music in Medicine Lancet Oct 28 1899 p 1160

36. Hanslick ed. The Beautiful in Music p 114.

invariably performs his functions with musical accompaniment. Herndon and Gibbons observed the use of music in the medical incantations of the Brazilian Indians, while Dr. Wallaschek gives numerous examples from among the Africans, Australians, and North American Indians. In Africa, musicians accompany the doctor, surround the patient, and play on instruments day and night. The Wambara Doctor rings a bell and sings to his patient. Each tribe has its musical physician. In Australia and Borneo native doctors sing away diseases, as is also the case among many American Indians. Native Chilean, Patagonian, and Aracanian doctors attempt to cure patients by singing, beating a drum, and shaking a rattle. "In British Columbia the doctor sings, when he visits the patient, while a chorus of other people intones a song outside the house." The medicine man of the Argentine Indians used a sort of drum in his musical invocations with which he hoped to expel the evil spirit.

Miss Frances Densmore in a recent work on Teton Sioux music gives an elaborate description of songs intended for the treatment of the sick. These songs are used in connection with medicinal herbs, and each disease; e. g. headache, consumption, heart trouble, etc. has its appropriate songs. The songs were sung during the administration of the herbs, usually a fixed number of times, varying with the disease. Graphical plots of these medical songs often show a peculiar recurrence and dwelling on the keynote suggesting the confidence which the medicine-man felt in his own power, and which he wished to impress on the mind of his patient.

Similar practices are current among barbarous and semi-civilized peoples, such as the Arabs of Egypt and the Abyssinians. Brown gives a graphic description of the medical use of music in Abyssinia, in which magic

37. Herndon W L and Gibbons L	Exploration of the Valley of the Amazon	Part 1	p 232
38. Wallaschek R	Primitive Music		p 167-9
39. Densmore Frances	Teton Sioux Music		p 244-83
40. Rohmer Sax	Music of Magic; Forum	Vol 38	p 737-8

Religion and medicine are confused. A nervous disease called Tigröter is particularly common to women, and is ascribed to evil spirits. The patient is siezed with a fever, which culminates in lingering sickness, great weakmass, and loss of articulate speech. The cure consists in hiring an orchestra of trumpeters, drummers, and fifers, who gradually arouse the patient to action until finally she dances and leaps about as if impelled by unnatural strength. The patients express displeasure at cessation of the music and seem almost unfatigable. Several days are devoted to the cure; the patients making the wildest contortions and exerting themselves to the utmost with the constant accompaniment of noisy music. 41 The resemblance to the Chorea and Tarantism of Europe is obvious.

Thus we have abundant historical evidence of the use of music in the attempt to cure diseases. We find however that the primitive theory of disease is that the sufferer is a prey to evil spirits and that music can cure the disease because it influences these spirits. Hence music therapy according to Combarieu is really founded on a superstition altogether opposed to the phsio-logical thesis of observable bodily effects due to music. In other words the theory back of the original application of music is metaphysical or transcen-dental and the observed influence may be the result of purely mental associa-tion. 42

Many students take this position and formulate a purely psychological theory of music-therapy which we shall outline later; but before assuming that the influence of music is entirely secondary to the complex intellectual states, images, associations, etc., built up by reflection, and transmitted by social heredity, certain facts suggesting other possibilities must be considered. Primitive man, savages, and even civilized people until quite recently are animists, and ascribe disease wholly or in part to spiritual agencies. Mediaeval remedies of any kind whatever are intended to expel these spirits. Drugs

41. Brown Robert	The Races of Mankind	Vol 11.	p. 186-7
42. Combarieu J.	L ₃ Musique		p. 221-2

no less than music, were supposed to work in this way. The primitive is an absolute empiric and tries all sorts of possible remedies, many of which seem ridiculous. Some of these work and presumably survive, because they produce real effects, but this has nothing to do with the theory which the savage holds. If certain remedies prove successful, they are retained and explained in terms of the animistic theory; if not, they are perforce probably dropped in time and their disuse or impotence can also be explained in terms of the theory. The point is that in spite of all these theories, it is probably only that which is successful which is retained. | Improbable as the assertion may seem in the light of a superficial examination of the materials found in primitive pharmacopaeias and the recipes of folk medicine, it is perhaps supported by a closer study of these same things. The new science of Endocrinology, shows that numerous diseases are connected with deficiencies in the glandular secretions of the ductless gland system. Just how many substances of this kind are produced is unknown at present, but the bad effects of a deficient supply of certain of these secretions; e. g. those of the adrenal, pituitary, and thyroid glands, has been fully ascertained. It has also been demonstrated that such substances may be supplied from without in the form of extracts from animals, with the result of restoring and maintaining normal conditions. Now it is probable that many of the strange animal remedies of primitive medicine contained just these missing secretions (hormones, etc.) and that their efficiency was discovered by chance by the medicine man in his practice. Thus we may understand why the tutor of Achilles fed him lion's marrow and why the Malays believe that eating the flesh of the tiger will make them courageous. A real basis of fact lies behind all these strange remedies. Those which worked in some degree survived, and the historical persistence of any particular form of therapy is perhaps an indication that it actually produces favorable changes in the organism.

Thus the long persistence of musical therapy not only as a belief, but as a constant practice is almost proof that music produces direct physiological reactions in the organism, which are responsible for the widespread belief, rather than explanation for the practice.

In addition to the primitive animistic view of musical therapy which we have been discussing, three other theories exist which may be designated; the metaphysical, psychological, and physiological theories of musical therapy. The first, based upon the peculiar mathematical philosophy of Pythagoras according to which all good things are expressions of numerical harmonies, assumes that the healing qualities of musical tones are due to their regular periodic vibrations. The tone acts by substituting its own state of harmony for the mental or physical discord in which the malady consists. Music raises consciousness to a higher level, placing it in rapport with the Universal Mind and its harmony. Health is equivalent to harmony and is hence a channel for music, while disease is disharmony, - a channel for noise. Music is thus the health, noise the disease of sound and each tends to create its appropriate channel in the mind.

44

According to the psychological theory music arouses emotions and passions which violently agitate the nervous system, producing a healthy reaction in the diseased organisms. Thus according to Hanslick, but more recently, the emotions have been ascribed to images and associations aroused in the mind by music, the connection between emotion and music being indirect. In case the cognitive elements evoked are pleasant, the emotions aroused will be exhilarating, and the effects upon the organism evidently favorable in the light of the researches of Cannon, Dearborn, etc.

45

The physiological theory of musico-therapy has assumed various forms. Its earliest expression seems to be due to Dr. P. J. Burwette, editor

44. cf Stratton H C Keynote in Musical Therapy Arena V 30 p 288
 45. cf Cannon Walter Bodily Changes in Pain Hunger Fear and Rage.

of the Journal des Savants (Paris 1723), who from intensive study of ancient music and personal experiments concluded that music through repeated shocks given to the nervous system by atmospheric vibration, was of use in the cure of disease. He thought that music worked on the organism by (1) arousing pleasure (2) distracting attention from symptoms (3) agitating the nerves whereby a beneficial movement of "animal spirits and humours" occurred. This theory could be readily renovated in terms of the modern theory of internal secretions, which is a partial return to the humoral view. Music arouses the emotions, which in turn result in the release of the adrenalin, etc. as W. Cannon has shown. M. de Maeran (1737) advocated a similar theory ascribing the cure of spasmodic disorders and fevers, attended with delirium and convulsions to the vibrations of the auditory organ in response to musical stimuli.

46

Albertus Haller, (1769) quotes several curious examples of similar views. He writes "subtiliter olim brevis vitae juvenis C l. Roger haec explicare tentavit per particulas heterogeneas, nostris admistas spiritibus, eos putabat densare, sic fieri unisonos cum sonis cum quibus alioquin nihil haberent harmoniae, excitatis ergo sonis oriri in spiritibus motum, quo adtemperantur." Haller adds "Sed oportebat de phenomeno prius constitesse, cujus resolutionem quaerit, Paulo aliter Georgius Cheyne a musica docuit in fibris nervis hominum oriri vibrationes, uti tremores sympathici Chordarum se mutuo excitant. Per eas vero oscillationes possis credere, aliter et aliter systema nervorum affici.

47

J. L. Desessarts (1803) Dean of the Faculty of Medicine of Paris, in a work on the Curative Power of Music assumed a mechanical action of music on nervous tissue, whereby the fluidity of humours was increased so as to lead to a favorable crisis. Music by imparting to the nerves their life which in certain maladies is suspended or choked restores the function of vitality to vessels and tissues. It can, therefore, have a powerful influence on the secretions and ex-

46. Rothery C D Music and the Healing Art p 12, 47, 121.

47. Haller Albertus Elementa Physiologiae Tomus V Lib XV p.305.

cretions, and become a constant means of healing maladies that are called "h-
48
moral, gastric, putrid, of malignant. " J. E. D. Esquirol (1772-1841), the noted
authority on insanity, believed that music acts upon the physique by determining
49 nervous vibrations, and stimulation of the circulation. Thus older represen-
tatives of the physiological theory postulate a direct action of the sound waves
which they claim are transmitted by the auditory nerve to the whole nervous sys-
tem and the general shock exercises a salutary influence on the diseased part
of the organism. To use the phrase of a more modern writer of the same opinion,
50 "Music affords a kind of neurotic massage."

The feelings and emotions involved are the effect of the nervous
shocks, a position somewhat similar to that of the James-Lange theory of the
emotions. In the extreme form this theory assumes that music operates on the
sick, just as the peals of an organ do on glass windows, doors, the church pews,
etc. which tremble under the influence of the air waves of sound. Even recently
physicians have expressed somewhat the same view. Richard La Prade notes that
music is the only art to which animals, the feeble-minded, and idiots are sen-
sible, and that it, therefore, has in it an entirely physical element, a kind of
51 electricity which affects the nerves, independently of any action on intelligence.
Davison tells us "that music undoubtedly exercises its influence over the body
without the influence of the highest nervous centers," and that the "Human or-
ganism participates in the tendency to vibrate synchronously with music, which
52 sometimes obtains in the animal world." This view was reaffirmed by H. Dixon
53

in a paper before the Birkenhead Medical Society. Ribot also declares that "music
acts physically as a kind of vibratory medicine," the proofs being furnished by
the researches of Boudet de Paris, Mortimer Granville, Buccola, Morselli, and
54 Vigouroux.

In a recent article Ribot points out that the deaf mutes, notably

48. Rothary	Ibid	p. 60
49. Lawrence R M	Primitive Psychotherapy	190-191
50. Pastnor P	Music as Medicine	Music Vol 1 p. 652-3
51. Richard de La Prade	Contre la Musique	
52. Davison J T R	Lancet Oct '99	p. 1159-62
53. Dixon H	" Dec '99	1815
54. Ribot H	PSYCHOLOGY OF THE EMOTIONS CH 7	p. 106

Haken Keller, and Laura Bridgman respond to musical sounds. They distinguish several different musical instruments according to the nature of the vibrations. They are also able to appreciate pitch, rhythm, measure and make a comparison of measures and the values of notes.

55

For similar reasons, and also on the theoretical grounds, Dr. Beaunis, in a recent essay on musical emotion, concludes that "on peut avec just raison considerer notre organisme un system susceptible de vibrer, quand les ondes sonore viennent le frapper et a coté de l'excitation auditive proprement dite, admettre une excitation sensitive generale independante de la premier." Certain parts of the organism, bones, teeth, etc. are admittedly capable of vibrations but Dr. Beaunis thinks that the other tissues, when living are in a state of tension which renders them capable of sympathetic vibration to sound stimuli. The various organs and systems of tissue are like so many resonators each responding most effectively to some particular tone. Hence the apparent localization of deep tones in the abdomen, and the high tones in the head, which may be established by introspection. The very adjectives "high" and "low" as applied to tones of great and small frequency points to a common experience and is reflected in the vocabularies of seemingly unrelated languages. This localization based apparently on mere analogy may therefore have a physiological basis in the varying vibratory rates of the tissues. These vibrations of the tissues swell the volume of organic sensations and contribute an important element to musical emotion.

56

An alternative explanation may be offered in the light of J. Loeb's researches on forced movements. Phonotropisms, independent of the action of higher brain centers would seem to be possible, and it is even suggested that the howling of dogs on hearing certain tones is a laryngeal muscular resonance effect;

55. Ribot Th.	La Conscience Tactile Motrice Pure.	Revue Philosophique
		V 84 1916 p 26-42 Especially 41.
56. Beaunis H	L'emotion musicale	Rev Phil V 86 '18 p 363.

Sentiments for Cabanis are, of course, simply physiological reactions like other mental processes so that the quotation is appropriate as an anticipation of modern experimental results. For a long time, however, no definite statement could be made, and Lotze, another great physiological psychologist says that "a careful study of melodies would force us to admit that we know nothing whatever about the conditions under which the change from one kind of nerve excitation to another becomes the physical substratum of the powerful aesthetic feelings, which vary with the music." 61 If such were the case, control in the interests of musico-therapy is impossible. The results of the modern experimental study of musical effects which will be stated in a succeeding chapter show, however, that such knowledge and control may be possible after all, though not yet achieved. At this point, we may anticipate by quoting the conclusions of Dr. Ingegneros based on a thorough study of the entire literature of the Experimental Psychology of Music up to 1907. According to Dr. Ingegneros three conclusions follow from the experimental work; viz.,

- (1) Musical stimuli, like all sensorial excitations, determine an increase of the general physiological activities of the organism. The influence of music is a fact experimentally demonstrated.
- (2) Musical stimuli in certain well-known conditions determine in the organism the transitory functional reactions which characterize an emotion.
- (3) Physiologically there do not exist functional reactions which are specific of the musical emotion. It is a matter of reactions common to emotions in general determined by music under certain conditions. 62

A thorough investigation of the particular conditions under which music is employed is then all that is necessary to make the production of a desirable emotion, with its attendant physiological changes, possible at the will

61.	Lotze H.	Medizinische Psychologie	p. 237
62.	Ingegneros J	Le Langage Musicale	p. 50

Sentiments for Cabanis are, of course, simply physiological reactions like other mental processes so that the quotation is appropriate as an anticipation of modern experimental results. For a long time, however, no definite statement could be made, and Lotze, another great physiological psychologist says that "a careful study of melodies would force us to admit that we know nothing whatever about the conditions under which the change from one kind of nerve excitation to another becomes the physical substratum of the powerful aesthetic feelings, which vary with the music." 61 If such were the case, control in the interests of musico-therapy is impossible. The results of the modern experimental study of musical effects which will be stated in a succeeding chapter show, however, that such knowledge and control may be possible after all, though not yet achieved. At this point, we may anticipate by quoting the conclusions of Dr. Ingegnieros based on a thorough study of the entire literature of the Experimental Psychology of Music up to 1907. According to Dr. Ingegnieros three conclusions follow from the experimental work; viz.,

- (1) Musical stimuli, like all sensorial excitations, determine an increase of the general physiological activities of the organism. The influence of music is a fact experimentally demonstrated.
- (2) Musical stimuli in certain well-known conditions determine in the organism the transitory functional reactions which characterize an emotion.
- (3) Physiologically there do not exist functional reactions which are specific of the musical emotion. It is a matter of reactions common to emotions in general determined by music under certain conditions. 62

A thorough investigation of the particular conditions under which music is employed is then all that is necessary to make the production of a desirable emotion, with its attendant physiological changes, possible at the will

61. Lotze H. Medizinische Psychologie

p. 237

62. Ingegnieros J Le Langage Musicale

p. 50

of the experimenter, and this is the final aim of the musico-therapist.

63

Thomas Edison's "mood tests" worked out by Dr. Bingham and his assistants is therefore one of the most important steps toward a real musical therapeutics. It would seem that the compilation of a sufficient number of mood change charts taken from all known kinds of listeners to the Edison phonograph would result in statistics indicating the probability of the appearance of any specific kind of emotion, in connection with various pieces of music. If the conditions under which the tests are given could be standardized and repeated in cases of therapeutic application the certainty of the effect would be increased. The physician who applies music as a therapeutic agent must moreover be acquainted with the patient's manner of life, character, temperament, passions, habits, and musical aptitudes in order to predict and control response to music. In the absence of such control undesirable physiological changes may be induced as was doubtless the case in the classic instances of Mozart fainting at the sound of a trumpet, and the lady, who according to Rousseau, was thrown into a convulsive fit of laughter upon hearing certain forms of music. It would seem that with such a careful control of conditions, almost any type of disease would be benefited by suitable music, and not merely the milder forms of mental and nervous diseases mentioned by Nathan and Dupré.

64

Before closing the chapter on musical therapy, it seems fitting to introduce an account of certain experimental or semi-experimental studies of the effects of music on special phases of behavior usually neglected in summaries of experimental literature. We refer to the influence of music in the hypnotic state, sleep, and dreams, in connection with certain functions involved in reproduction and as an aid or a substitute for anaesthesia.

63. Bingham W V Mood Music

64. Dupré E & Nathan M Ibid

p. 179-181.

120

The influence of music in hypnotic states was probably known to the ancients and the early students of animal magnetism employed it as part of their technique. In Mesmer's famous Paris seances the apartment where the hypnotic experiments were conducted were dimly lighted and silent except for the soft strains of music which floated through the room. ⁶⁵ Dr. Braid says that hypnotized subjects move to music with a grace which they do not show when in the normal state, ⁶⁶ and De Rochas carried out an elaborate series of experiments with a hypnotized girl in which he found that the audition of isolated sounds arouses trembling, varying with the pitch and intensity, while successive notes occasioned gestures mounting from the feet upwards, as the tones ascended the gamut, and vice versa. In the case of a succession of rhythmic and melodic sounds, gestures of the lower part of the body expressed rhythm while those of the upper part expressed melody. The hypnotized subject ⁶⁷ gave appropriate movements to dance music previously unheard of or unknown. The music of Gounod was very effective in evoking expression while that of Wagner produced few results.

Dr. Warthin of Vienna hypnotized five men and two women and treated them to music, with the suggestion that they retain their impressions. The playing of the Walkurenritt to a patient aged 40 resulted in augmented strength and rate of pulse, the latter rising 120 per minute. Respiration increased from 18 to 30 per minute. The subject's face was agitated and there was profuse perspiration. When roused from the trance, he said he was not sensible to the sound, but to a general stimulus like flight through space. The motif of the Valhalla, slowed pulse and increased tension, then the reverse and evoked a sensation of grandeur. Another patient responded only to the Pilg-

65. Wells D W Psychology Applied to Medicine
66. Braid J Neurhypnology

p. 69
p. 56.

68

grim's chorus of Tannhauser. Moss/remarks that "by means of music during hypnosis all sorts of different moods and feelings can be aroused corresponding to the kind of music."

69

The effect of music on sleep and dreams has been noted by several investigators. Persons listening to music just before retiring tend to have vivid auditory dreams which are most common in musicians. Music also induces vivid dreams in those already asleep and Stepanow has made an interesting experimental study of such dreams. Arrangements were made whereby the experimenter would play music to his subject sleeping in a room near-by. Musical selections were played on a piano until the sleeping subject awakened and reported her dream experiences through a speaking tube. The dreams induced were particularly vivid and varied with the type, familiarity, and associations of the selections played. "The ease," says Ellis with which musical sounds can be applied during sleep have suggested their therapeutic use." and Leonard Corning advocated the use of musical vibrations before and after sleep as a remedial agent.

70

71

72

73

It is evident that the psycho-analyst may take advantage of this oneirogenic property of music to induce in a pleasant way the dreams which he utilizes in his analysis in cases where such dreams are otherwise too fragmentary for analysis.

Respecting the influences of music on functions connected with reproduction, many statements, but few observations, have been made. The following observations of Lahy and Vaschide are important enough to be quoted, since they bear directly on the question of sex hygiene in the broad sense of the word. Prof. Lahy noted the reactions of a "femme enceinte,"

68.	Warthin A S	Some Physiological Effects of Music on Hypnotized subjects.	Vol 65 1894
		The Medical News	p. 89-94
69.	Moll A	Hypnotism	p. 66
70.	Walsh W. S.	The Psychology of Dreams	p. 47
71.	Stepanow G	I Suogni Indotti	
72.	Ellis H	The World of Dreams	p. 79
73.	Corning L.		

122

under the influence of two types of music. A musician played on the piano two pieces which he had composed. On hearing one of these works a female auditor "enceinte" for 8 months felt her child make movements that obliged her to leave the hall. Even in an adjoining room, the mother felt these movements, and only after the music ceased did they stop. During the hearing of the second selection, the foetus remained at rest, at least the mother felt no movement. When the experiment was repeated several times the results were the same. "Having identical reactions under identical conditions I endeavored," says Lahy," to learn the character of the excitement." The composer said that the first selection which the foetus reacted to was essentially emotional, while the second which produced no reaction was essentially descriptive. Mother and foetus were two distinct beings, the emotions produced by the music were felt by the mother who transmitted them to the foetus, through the vaso-motor disturbances which the emotion determined in her.

N. Vaschide reports a morbid genesico-musical association in the case of music student form of Grieg, Chopin, and Schumann. The simplest symphony afforded a sexual stimulus and influenced the duration of the menstrual period. "X avait remarque d'une maniere constante que chaque fois, qu'elle entendit de la musique pendant ses menstruations l'ecoulement sanguin augmentait dans des proportions notables." and a prolonged study of the case showed that "chaque fois qu'elle etait intoxique pour ainsi dire par des morceaux de musique la periode catemeniale augmentait." Ingegnieros further reports cases of fixed association between certain pieces of music and erotic reactions amounting in some cases to what he declares might be "onanisme musical." The bearing of such data on the hygiene of the sex life needs no comment.

74. Lahy Case Report Bul. Inst. Gen. Psych. '04.

75. Ingegnieros J Ibid

123
Finally reference may be made to the relation between music and anaesthesia. It will be remembered that Hunter noted diminution of pain as an effect of music in his experiments on a group of patients at Hellenburgh Hospital. Dr. Mays obtained a notable reduction of pain by music played in
76
minor moods in a patient afflicted with neuritis, and Miss Seymour declares that in War Hospitals music was played with good results when patients were
77
entering or emerging from the anaesthetic state. Drs. Burdick and O'Neil of Kane, Pa. Hospital perform surgical operations to a musical accompaniment, maintaining that cheerful music on the phonograph selected in the light of the patient's nationality, interests, and tastes, reduced suffering, and
78
improves the attitude of the patient. Recently a young man rejected an anaesthetic in place of music played on a harmonica by himself while surgeons probed for a bullet in his thigh. Evidently, music rightly selected, may promote the effects of anaesthetics or even replace them at times and the subject deserves further careful study. That music should reduce pain, however, seems probably from a priori grounds.

Music as experiments amply demonstrate, evokes or tends to evoke motor reactions. In any case incipient motor reactions probably result even where imagery is alone detected. These in turn arouse a large number of proprioceptive sensations, which may possibly be very faint, but when added to the intense auditory sensations greatly increase the total sensations mass, in which the pain sensations tend to be lost or are crowded into a marginal position.

We shall close our study of musico-therapy with a quotation and a resume, the former from one who was at once a celebrated singer and a successful nurse; the latter from the essays of a well-known French physician.

- 76. Mays T J Music and Medicine N Y Med Rec. V 105 p. 735
- 77. Seymour H What music can do for you p. 153.
- 78. Surgery to Music Lit. Dig. Dec. 18 '15.

12-7

Miss Florence Nightingale, writing of the effect of music on the sick declares, "that wind instruments capable of continuous sound have generally a beneficial effect on the sick, while the piano forte with such instruments as have no continuity of sound has just the reverse; the piano-forte playing will damage sick, while an air" like "Home Sweet Home," or "Assisa a pie d'un salice" on the most ordinary grinding organ will sensibly sooth them and this quite independent of association." ⁷⁹ Dr. Farrand, whose views fairly express the present possibilities of the field declares that music in varying its moods, rhythms, melody, and harmonic complexes, seems able to respond to the different modes of physiological action and to fill the role of an anti-spasmodic. It is clear that medicine should not limit itself to advising patients to listen to any kind of music whatever but that a choice should be made according to the necessities of the case. Music should not be considered as a rare distraction in which form and subject do not matter. It is in some way comparable to those substances which constitute in certain doses a hygienic agent, in larger doses dangerous toxins, capable of exhausting and producing organic exhaustion. A careful choice must be made of the amount of musical exercise and the subject matter of the music which the patient plays or hears. At present we cannot be more precise and say that Mozart is best for Neurasthenia, Beethoven for hyper-excitability, Wagner for depression, etc., but we may positively assert the presence of profound physiological and psychological effects. In any event, music is important to medicine and we may yet determine more precisely the therapeutic services which it can render, ⁸⁰ as well as the dangers which attend its use.

We have noted the Bingham's mood test promises more precise data on therapeutic applications. Dr. George Stratton's prediction that music

79. Nightingale F.

Notes on Nursing.

Essais Phy. sur la Musique

Bul Acad. Med. 18

p. 288-9

80. Farrand, A.

Would be a vital factor in treating the sick in the future may yet be realized and as he added, a training in music may become an essential part of the nurse's professional equipment.

In conclusion, we may offer as an appendix a questionnaire on music-therapy directed to a class of nurses in the German Deaconess Hospital, Cincinnati, Ohio. An analysis of replies and several quotations are appended.

126

QUESTIONNAIRE ON MUSICAL THERAPEUTICS.

1. In what classes of maladies, if any, does music have therapeutic (curative) value? e. g. Nervous diseases, fevers, special diseases such as Grave's disease?

2. Does music ever exercise an unfavorable influence on the sick? When?

3. What kind of music has the most therapeutic value?

Answer in terms of the following classification -

1. Martial, devotional (religious), lyric (love), dance (jazz or waltz), minor (funeral or philosophic).

2. Rapid or slow.

3. Simple or complex (melodious or harmonious).

4. What influence has the patient's musical training or lack of musical training on the therapeutic value of musical effects?

5. What is the relation or degree of general education of patient to the therapeutic effect of music?

6. Is familiar or unfamiliar music more effective therapeutically?

1. e., music the patient recognizes, or music that is new to him.

7. What emotional type or temperament is susceptible to the influence of music in sickness? e. g., excitable or apathetic individuals?

8. Do age or sex of patient determine his response to the music?

9. Does music of a particular instrument have superior therapeutic value?

e. g., violin, flute, piano?

10. What elements of music, if any, seem most effective?

1. Rhythm

2. Tone

3. Melody (succession of tones)

4. Harmony (simultaneity of tones)

127

Note: do not attempt to answer if unfamiliar with music or if questions appear impossible to answer.

11. Describe in detail patient's response to music in cases coming under your actual observation. e. g., note such things as

1. Effect on rate of pulse

2. Effect on rate of respiration

Where possible.

3. Temperature

4. Frequency and type of movements.

12. Secure retrospective report of patient. How does he feel, think, with respect to music?

13. Supplement the above questions with any relevant information not called for in the above.

14. Always state source of information if not the result of your own observation. (Note: please make written reports)

C M D November 3, 1921.

128

About fifteen replies were received, eight from nurses, the remainder from patients. In only a few cases were all the questions answered, and since the amount of material does not warrant statistical treatment, we will merely give the general tenor of the replies.

All agree that music if well selected, is beneficial in nervous diseases, an unfavorable influence only appearing in cases where the music arouses unpleasant associations; where "despondency, restlessness, morbidity may result?" "The Tales of Hoffman," and "To a Wild Rose" were found particularly effective in equilibrating patients, afflicted with hysteria, neurasthenia, insomnia, etc. Several nurses also state that music exerts a favorable influence on tubercular cases. Simple religious music is declared to be the most effective, while musical education appears to play a sub-role, except that it opens up a wider range of pleasurable effects, and that the patient is more critical, so that greater care must be exercised in the choice of selections. General education increases the ability of the patient to yield to musical therapy.

Familiar music, provided that it arouses no disagreeable associations, is more effective than unfamiliar music, the latter producing irritability. Excitable temperaments are in general more susceptible to musical therapy but one nurse adds "when apathetic patients show a reaction, it is more remarkable." Sex, seems to play very little part in the responses of the sick to music, but age has some influence. The very old and the very young prefer simple, lively music. Opinions differ as to the most effective musical element, though the majority agree that it is rhythm. Others say that harmony is the effective element for educated patients, and rhythm for the uneducated. As far as physiological responses are concerned, pulse respiration, and movements become more normal according to two nurses. Another has observed a slight increase in pulse, respiration, and temperature, while another notes a reduction

of 2.8 degrees in one instance. Several also note that patients become more manageable under the influence of music and that music promotes sleep.

The most desirable musical instrument seems to be the violin which exercises a soothing effect.

Introspective accounts with two exceptions favor the use of music as an aid to therapy. One patient does not like music when sick or weak, and shows an acceleration of the pulse and respiration under its influence. A "dope" fiend said that the abnormal cutaneous sensations like worms crawling over and under the skin "worked to the time of music," which he was compelled to hear. One nurse, however, says she could quote hundreds of introspections in favor of music. Several patients urge the necessity of musical direction and a staff in hospitals in order to create energy and enthusiasm. A neuresthenic says "I never feel tired when I can listen to music." Another patient says that Rachmaninoff's Prelude causes him to lose all sense of pain and become oblivious of all things but the music. He also finds that certain airs infallibly promote sleep. A third writes that "music composes her main idea of Paradise." She has noted the calming influence of music on subnormal children, and that in hospitals music kindles and renews the desire to get well.

Only a few out of many similar introspections can be quoted here. But taken in connection with the nurses' accounts of behavior, they form an eloquent body of facts in favor of musical therapeutics, and indicate how music can influence the human organism.

THE INFLUENCE OF MUSIC ON WORK.

The influence of music on work is of obvious importance on account of the possible industrial applications, but before such applications can be made successfully, the nature of musical influence must be more precisely determined. Although an influence of the kind is generally acknowledged, it is not quite clear that it is favorable, or which elements of the musical accompaniment effect most profoundly the reactions involved in work. Before any serious attempt can be made to apply music in this direction, types of work, as well as types of music, must be carefully established and their correlations determined. In the light of what evidence we already possess, work consisting largely of stereotyped series of reactions - systems of habits - appears to be improved, when music is a factor in the sensory environment of the worker. Even original mental work is said, by some observers, to proceed more accurately and rapidly under such circumstances, but the latter statement does not seem to have been subjected to experimental study. At present we only know that music does influence the reactions belonging to work, but we cannot as yet control such effects with such certainty as to warrant general industrial use.

The problem of the control of musical influence on work however belongs to Applied Psychology. At present we are interested in the facts already known, as evidence of the general influence of music on Behavior. The available evidence as to the influence of music on work is roughly Ethnological, experimental, and industrial.

We have to consider:

1. The customs of primitives, who universally work to the accompaniment of crude music, usually vocal, and seem to be unable to labor persistently or successfully without its aid.
2. Experimental studies conducted in the Psychological laboratories, in which effects of tones, chords, or musical selections on the fatigue curve are determined.
3. Industrial experiments in which music has been introduced into the routine of factories and business offices, shops, laundries, etc., and statistical accounts of the effects on the efficiency of the workers were tabulated. Under this head also belongs the data as to the effect of music on the efficiency of athletes, on achievement in physical exercise, military drill, and the acquisition of graphic and manual habits, such as penmanship and typewriting. Unfortunately, not many accounts of work done of this kind have been published, and we have the mere fact that music is widely used for this purpose.
4. Finally, we have the statements of reputable individuals as to the effects of music on their mental activities and although the evidence is here subjective and not objective as are the preceding data, we must take some account of it in a complete survey of the subject.

We shall consider the various kinds of evidence in the order named which also indicates the relative abundance of the material. Reports on the applications of music to work by primitives are so nu-

merous that Prof. Bucher devotes half of a large volume to their description, and additional instances can easily be found in the most recent publications of travelers and ethnologists. Published laboratory and industrial experiments are on the contrary rather meager in point of numbers and will be summerized after the discussion of the ethnological data.

Travelers and ethnologists, unite in ascribing mental and physical inertness to primitive men as an almost universal characteristic. Of the ancient Germans Tacitus says, "During the intervals of war, they pass their time less in hunting, than in a sluggish repose divided between sleep and the table".... and that they "stupefy themselves into inaction."¹ In this circumstance American and African savages, if we can trust the reports of travelers and missionaries, exactly agree with the ancient Teutons. "Paresse et sauvagerie sont synonymes," according to Prof. Ferrero, and other authorities. They declare that the greatest happiness of the savage is idleness,² and that they dislike every kind of work. Moreover savages, and indeed, all human beings of inferior mental development, are incapable, of the power of instantaneous muscular exertion, possessed by educated men.³ Thus Féré tells that the naturalist Peron in 1800-1804 found that the aborigines of New Holland, and the Malays in Timor showed much less power of muscular effort than the French sailors with whom they were compared.

- | | | | | |
|------|----------|--------------------|------|---------|
| {1}. | Tacitus | Germania | C 15 | |
| {2}. | Bucher K | Arbeit and Rythmus | | P. 3. |
| {3}. | Hirn Y | The Origins of Art | | p. 252. |

The Anthropological authority Manouvrier, observed the same fact in regard to most of the savages exhibited at the Zoological Garden in Paris, while Feré's own dynamometric experiments on negroes showed them to be inferior in muscular strength to the average European. Broca's comparison of the dynamometric measurements of manual and intellectual workers was distinctly in favor of the latter. In both sexes, power of momentary effort varies directly with intelligence.⁴

In spite of all this, however, a very large amount of work must be done in primitive societies, and owing to the absence of proper tools as well as efficient working technique, the expenditure of physical energy, is much greater than the same amount of work would require among ourselves. The primitive lacks beasts of burden, tools machines, and technique, and must rely almost entirely on the muscular energy of human beings. It may therefore be unfair to accuse him of love of idleness, since, under the conditions in which he works, rest pauses may be absolutely necessary, while production is no index of the quantity of energy expended.

Under the conditions, it is clear that any concomitant activities, or sensory features, which primitive man constantly and deliberately introduces as a feature of his necessary work, must have value, presumably in facilitating the achievement of his tasks. This may happen by:

- (4) Feré Chas. Sensations ^{and} of Movement P. 4-5.

1. The removal or reduction of Subjective Fatigue, or Fatigue of the Will, which industrial psychologists are beginning to recognize as an important factor in efficiency.
2. By increasing the amount of physiological energy at the disposal of the individual, or by enabling him to make a more economic use of this energy.
3. By increasing the production, or as applied Psychologists would say, by reducing the amount of objective fatigue.

Primitive man, aware of these effects in only a general way, could only entertain beliefs as to the second and third of these points, since strict methods of testing are impossible at a primitive stage of culture and would doubtless appear superfluous. Even in the case of feeling of fatigue, the primitive probably forms no implicit judgment, that such and such a method of work, or concomitant factor, reduces such feelings. Instead, he tacitly and unconsciously adopts and retains whatever tends to reduce the mass of feelings of unpleasant affective tone which arise in connection with hard or prolonged labor, and which we to-day, define as fatigue of the Will. Nevertheless, such naive and spontaneous adjustments are valuable, evidence as to the psychological meaning of the factors involved.

Now it is an empirical fact that all over the world, work is accomplished with the accompaniment of music of some kind, particularly by song. Prof. Karl Bucher has treated this subject exhaustively in his treatise on "Arbeit ^u and Rythmus" but since this book is unavailable in English as well as complicated by an enormous mass

- (5). Watts Frank An Introduction to the Psychological Problems
of Industry . pp. 40-43.

13
of detail, and the attempt to reduce everything to a special theory, we shall present a certain number of examples exhibiting the varied application of the practise. Aside from the meagerness of existing accounts in English such concrete examples are necessary in determining what element of music is responsible for the observable effects. Here we shall find reason to dissent in part from the views of Bucher and all those who like him ascribe the influence of music almost entirely to rhythm.

Classic writers make allusions to music as an accompaniment to work among the peoples of Greece and southern Italy, and seem to regard it as a common and beneficial practise. Thus according to Athenaeus, the Tyrrhenians, (Etruscans) regulated everything by music and even "made bread, boxed, and flogged people to the sound of the flute." ⁶ Pausanias relates that Epaminondas had the walls of Messina built to the sound of Bactrian flutes ⁷ and Ovid says "even the miser while clanking his chains sings ^{and} as lightens his labor with untaught music. He too sings while bending low on the oozy sand, dragging the slow barge against the stream." ⁸

Quintilian (40-119 AD) says somewhere that "every man when at work even by himself has his own song, however rude, which may soften his labor."

Thus music as an accompaniment to ^{common} the individual labor as well as communal labor was well known and the statement of writers is confirmed by specimens of ancient art portraying workmen at their tasks, while musicians sit playing nearby. Bucher says the old Greeks had special songs for harvesting, threshing, grinding grain, winemaking, spinning, weaving, drawing of water, dyeing, and indeed daily labor of every kind." ⁹ A survey of the work-

- (6). Athenaeus The Deipnosophists Book XII C 16 p. 830. tr. C. D. Young
- (7). Ibid.
- (8). Ovid Tristia Book IV l. 5.
- (9). Bucher, K. Arbeit and Rythm.

ing methods of contemporary savages reveals an almost inexhaustible number of similar facts. African explorers and missionaries in particular refer uniformly to the employment of music by natives wherever any work is on hand.

Burton and Speke relate of the East Africans that they delight in harmony. The fisherman sings as he rows, the porter as he drags his load, the woman as she grinds grain, etc. Winwood Reade observed that his negroes when ordered to row always began to sing as an aid to overcoming their natural

laziness. ¹⁰ James Grant says that when his negroes were cleaning rice they were always supported by singers, who accompanied the words of the song by clapping their hands and stamping their feet, continuing the process until the

rice was almost ground to powder. ¹¹ At Zleatum, North Africa, Mr. Lyon heard the negro woman singing a national song in a chorus while pounding wheat, al-

ways in time with the music. ¹² In the southwest of Congo, porters of the Bambala tribes always sing songs when they arrive carrying loads, ¹³ and ac-

cording to Miss Kingsley, West African boatmen usually sing abusive songs directed at their employers; the boatswain leading and the crew joining in on the chorus. ¹⁴

It is well known that the negro stevedores, and cotton pickers of North America sing continuously while at work, and a recent writer says

of the negroes of Guiana and of the East Indian Creoles, also descendants of slaves, that " his chanties on the boats when paddling are not very different

from white sailor's songs at the windlass. ¹⁵

(10).	Reade, Winwood	African Sketch Book.	Vol. III	p. 313.
(11).	Grant, James	A Walk across Africa.	p. 62.	
(12).	Wallaschek, R.	Primitive Music.	p. 220.	
(13).	Hillon, Simpson,	My Land and the People of Kurmai		p. 254.
(14).	Kingsley, Mary	West African Studies.		p. 66.
(15).	Rodway, James	Guiana		p. 277.

137

The use of song as an accompaniment of work is less common among the North American Indians, though Wallaschek mentions an Alaskan Indian boating song, "which was performed in chorus by boatmen usually in unison"; While the Keres of New Mexico used a bagpipe while at work keeping time to the music and the Caribs of Central America often accompany work by songs.

The inhabitants of the islands of the Pacific, however, make constant use of music while working. The people of Molucca accompany every communal work with song. Porters sing constantly while Forest heard boating songs, "which the weary rowers uttered each time with renewed vigor." The inhabitants of Timor sing incessantly while they are working, especially when the task requires co-operation of several individuals and synchronous action, as in rowing or stamping rice. The people of Tahiti have a song for every type of work, as do also the Maori. The Hervey Islanders have boat building songs of a semi-magical nature, analagous to those of the ancient Finns. An early traveler in Borneo says in describing one of his trips that "the boatmen enlivened the way with their songs, some of which were wild and musical. They all joined in the chorus....keeping time with their paddles. The song was cheerful and inspiring and seemed to help them along. Hirn gives an interesting narrative of the revival and return to work of exhausted Australian aborigines under the influence of a cheerful song. The semi-civilized workmen and peasants of Oriental nations, make an equal use of music as an accompaniment to their labors.

- | | | | |
|-------|----------------|------------------|-------------------------|
| (16). | Wallaschek, R. | Ibid | p. 47 |
| (17). | Finck, H. | Utility of Music | Forum '98 V 25. p. 301. |
| (18). | Gucher | Ibid | p. 49-52. |
| (19). | Hirn, Y. | Ibid | p. 255. |
| (20). | Ibid | Finck, H. | p. 300. |
| (21). | Hirn, Y. | Ibid. | p. 253-4. |

Of Japan, Mr. Ito Sangoro says that "the national dance with great variations of songs, developed on the basis of peasant songs sung as the men 22 trudged over the mountains with pack horses bringing tribute to the Emperor" Japanese work songs are very numerous; porters, fishermen, boatmen, jinrikisha, 23 men, and artisans having each their characteristic song.

According to Mr. Dean, Chinese workmen sing on every occasion. "The Chinese sing to win favor, to save their faces, to express their sense of fun, to increase their courage. They sing because they love their work, and because they have learned that even drudgery has its proper cadence and grows less dull if timed to music. They sing because they have inherited old tunes and chanties from their venerable guilds..." Dean heard Chinese workmen singing at such various tasks as mending streets, fighting fires, bearing burdens, building, masonry, and working metals in the shop or the foundry. He adds that "the habit of singing remains even in surroundings where its utility may seem questionable yet I doubt, whether a Chinese workman can ever do himself 24 credit, when put to any kind of work, unless he sings." Bucher mentions the songs of the Chinese silk packers, rivermen, and sailors. An observer noted that during the calms the sailors on the heavy junks are obliged to work at the two huge oars at the stern of the vessels. "The rowers then sing to the sound of a gong-like instrument. The song awakens feeling of home and involuntarily 25 they row more powerfully and rapidly." Siamese and Koreans engage in similar practices.

The working classes of Hindustan are equally accustomed to sing while engaged in labor. Indian coolies, for example, usually work in gangs.

(22).	Sangoro, Ito	A comparison of the Japanese Folk-song and the Occidental. U. of Cal. Pub. Psy. VII. #5. p.277
(23).	Bucher, K.	Ibid. p. 199, 201, 213, 251.
(24).	Dean, S.	Singing craftsmen of Peking. Asia, V. 21, '21, v. #8. p. 669.
(25).	Bucher.	Ibid p. 252.

and while one leads in song, the rest join in the chorus, each member in turn assuming the function of leader in a new song. Hand mill songs are sung by the Hindu women of all classes. (26- p. 74) and singing accompanied the daily work of artisans, such as potters and weavers.

The Arabs sing while shearing their flocks, tending camels, threshing, grinding grain, and building masonry. In Alexandria, says Billroth, "opposite the balcony of my hotel chamber the foundations of a house were being laid. Egyptian and Arabian women clad in black, and veiled according to the custom of the land, were bringing up stones upon their heads. In the hot sun they came up in regular order singing monotonously in recurrent rhythm.

When we turn to the civilized races, we still find a widespread use of song as an accompaniment of work among the peasantry and working classes. Bucher analyses a long list of such European working songs, giving words and music. There are hand mill songs, songs accompanying the preparation of textile material, weaving songs, water drawing songs, and songs that accompany agricultural operations, ploughing, planting, mowing, harvesting, fruit picking, etc. Trade songs are characteristic of whole classes of artisans, while communal songs are used to lighten the labor of gangs, engaged in such tasks as handling of building materials, excavation, loading vehicles or vessels, and the operations involved in managing ships. Certain classes of work songs; e. g. chanties, which are sung by sailors when weighing anchor or hoisting sails, raising masts or pumping water are spread all over the world, and are essentially similar among widely divergent races. Additional examples are unnecessary to show the wide diffusion of the working song. Moreover, an analysis of working methods yields indications that much work now done in silence was formerly accompanied by song or rhythmic music of some kind; for

(26).	Bucher, K.	Ibid	p. 194
(27).	Billroth, Th.	Wer ist musikalisch?	D. Rundschau B 81 '94 p. 84
(28).	Bucher, K.	Ibid	p. 237

140
example, the blacksmith when he strikes the anvil with his hammer in the interval of shaping the shoe which he is holding between the tongs, does not do so because it is necessary. The blows are needless and he gives them because all other fellow-craftsmen do. Once perhaps he thought they rounded off the music his hammer was making on the hot iron he was shaping, or perhaps they filled in the lapses of a song. 29 One may often observe a barber working his shears even while he pauses for a moment at his task. The audible clicks are possibly a survival of the rhythmic work methods of musical barber surgeons of the past.

Work songs according to Bucher represent certain common characteristics; viz.,

1. Through rhythm they facilitate the synchronous expenditure of energy by individuals engaged in common task, and thus economize energy.
2. As far as content goes -
They spur the worker^K on through jest, abuse, or reference in the songs to the spectator's opinions.
3. They state the opinion of the co-operating workmen concerning the work and its progress, the tools employed, incidental pleasures, and vexations and the difficulties and rewards involved.
4. Finally they inform the employers, foremen, and task masters, as well as the general public of the wishes and aspirations of the worker.

The verbal contents of such songs are therefore suggestions which influence the efficiency with which work is performed, but since the physiological effect is here indirect; i. e. excited by the emotional responses to conceptual images, it does not fall properly under a consideration of the physiological influence of music.

(29). Spence, L. Introduction to Mythology p. 239.

Moreover, as Hirn remarks "Many of the songs which are sung during the manufacture of weapons and utensils during boat building and such like are magical in their intention. ³⁰ This is true among primitives, but as we have shown elsewhere the conception of musical magic is based on a psychological experience of the feeling of bodily energy derived from music. Besides we find almost as extensive a use of music by civilized workmen ^{for} in whom the magical attribute has vanished. In by far the greater number of cases music appears to be used either for:

1. The regulation of rhythm as Bucher maintains, or
2. For the energizing influence of tonal elements.

But before discussing the relative influence of these two factors we must briefly allude to the use of music as an accompaniment to a number of activities not usually classified as work. Work is usually distinguished from ³¹ play activities as involving the functioning of habits rather than instincts, ³² voluntary attention, ³³ a more or less unpleasant affective tone, and a purpose beyond the mere activity in question. ³⁴ None of these distinctions are really valid, except the last one, and work and play agree as far as physiological mechanism is concerned. Both involve movements and expenditure of energy; i. e., may be reduced to a series of reflexes of varying force.

Many military activities, such as marching, drill, gymnastics, etc. clearly fall under the category of work. Acquiring habits of work, such as

30. Hirn Y. Ibid p. 255.
31. Johnson, G. E. - Education by Plays and Games. Ped. Sem. V. 3. p. 25.
32. Patrick, G.T.W.- The Psychology of Play. Ped. Sem. V. 21 p. 476
33. Hall, G. S. Youth p. 116
34. Patrick, G. T. W. Ibid.

typewriting, penmanship, etc., are also work although as in the case of drill and gymnastics, the purpose is as much the activity itself, as its future use.

Finally we have purely play activities such as dancing, but in all these cases, we are dealing simply with combinations of reflexes. Many of these activities are commonly accompanied by music and in some it is regarded as an essential concomitant.

Military music of a rhythmic nature, promotes co-operation in drilling, marching and fighting, but its principal function is probably that of stimulating the individual warrior to greater energy and effort. In primitive fighting, singers often went before the army as did the Norman minstrel Taillifer at the battle of Hastings. Hirn says that "in Ashante and New Zealand, in short, amongst all the warlike tribes, the military singers are able to bring themselves up to a pitch of frenzy which is almost equal to that produced by the dances." ³⁵ Marco Polo states that music preceded the onset of the huge Tartar

³⁶ armies which he observed in battle. The effect of the bagpipe's music on Scotch Highlanders is proverbial and it is said that a retreat was checked at the Battle of Quebec by resorting to the bagpipes, the playing of which had been forbidden. According to Cannon, "there is a tradition that the Hungarian troops are the worse in Europe, until their bands begin to play, then they are the best." General Linevitch is quoted as saying that "Music is one of the most vital ammunitions of the Russian Army.... without music a Russian soldier would be dull, cowardly, brutal, and inefficient....from the music he absorbs a magic power of endurance and forgets his sufferings and mortality. It is a divine dynamite." Napoleon also testified to the efficiency of the "wield and barbaric tunes of the Cossacks." Cannon suggests that martial music pro- ³⁷ bably reinforces the bodily changes that attend the belligerent emotions.

- | | | |
|------------------|--|---------|
| (35). Hirn, Y. | Origins of Art. | p. 267 |
| (36). Marco Polo | Travels Murray's Edition Part I. Sec. IV | p. 97 |
| (37). Cannon, W. | Bodily changes in Pain, Hunger, Fear and Rage. | p. 228. |

143

It has been known for a long time that physical exercises are carried out most successfully when accompanied by music. Plato recommended such a practise in his Republic, and the German as contrasted with the Swedish system of calisthenics makes extensive use of music. Miss Martha Johnson, director of physical education in the public schools of Salt Lake City states that the chief purposes of physical education are;

- (1). The stimulation of the nutritive processes of the body; e. g. the circulation, respiration, and digestion, and
- (2). The correction of poor posture.

The stronger the muscular contraction, the greater are the blood supply, nutrition and muscle tone. Hence music is excellent so far as concerns the first purpose of physical education since;

- (1). The strength of contraction increases with the intensity of the sound,
- (2). The effect of music upon muscular contraction is greatly increased by any sound made simultaneously with the movement.
- (3). The strength of contraction increases with the pitch.
- (4). The point of fatigue is greatly postponed, but
- (5). the steadiness of contraction varies.

We are not told whether these statements are based on original observations, or are theoretical generalizations founded on the experimental work of Pere', Tarchanoff, Yerkes, etc. On the strength of such data, Miss Johnson concludes that music should accompany the first stage of physical training, where the purpose is to build up the body, while the tendency of music to reduce steadiness, makes it inadvisable at the second stage when the object is that of good form. Finally, when the correct movements and attitudes are acquired, music may be reintroduced as a stimulus to maximum achievement.

38

Not only the normal but also the subnormal profit by musical accompaniment of physical exercise, as was shown by the experiments of Jonkhoeere,

- (38). Johnson, M. J. The relation of music to Physical Education, Nat. Ed. Ass'n '07; 45, p. 940

who introduced musical gymnastics into the institution for the feeble-minded
39
at Brussels. In modern business schools, the music of the phonograph or
piano is used to control or accelerate the speed of the learners of typewriting
and penmanship.

The influence of music on competing athletes is strikingly shown in
tests carried out during the six day bicycle race at Madison Square Garden,
New York City, December 4-10, 1911. The tests covered 46 miles separately timed
on three different evenings. One half of the miles were ridden while the band
played, the other half in silence. The average time per mile with music was
3 minutes and 24 seconds, or a rate of 17.6 miles per hour. Without music the
average time per mile was 3 minutes and 21 seconds, or a rate of 17.9 miles
per hour. The average difference was thus 1.7 miles per hour in favor of a
musical accompaniment. The fastest mile was covered in 2 minutes and 28 sec-
onds, the slowest mile in 4 minutes and 11 seconds, the band playing in both
cases. The following tables of the two days riding presents full details of
the essential facts.

1. Time for 20 miles, December 8, in minutes and seconds.

NO MUSIC		WITH MUSIC.	
Mile	Time	Mile	Time
1	3' 48"	2	3' 01"
3	3' 52"	4	3' 34"
5	4' 05"	6	4' 11"
7	3' 29"	8	3' 46"
9	2' 50"	10	2' 45"
11	3' 17"	12	3' 06"
13	2' 56"	14	3' 25"
15	2' 57"	16	3' 32"
17	3' 26"	18	3' 03"
19	3' 59"	20	3' 39"
Av. Time 3' 35"		Av. Time 3' 24"	
Rate, 16.7 miles per hour.		Rate 17.6 miles per hour.	

39. Jonkheere, T. Ueber den Einfluss der Musik auf die
Bewegungen bei schwachsinniger Kindern
Abst. Zeitschrift fur Psych. 1902, B. 27 p. 302.

11. TIMES IN MINUTES AND SECONDS FOR 20 MILES, Dec. 6, 1911.

NO MUSIC			WITH MUSIC.		
Mile	Time		Mile	Time.	
1	2	49 "	2	2	46 "
3	2	41 "	4	2	44 "
5	2	49 "	6	2	36 "
7	3	17 "	8	2	28 "
9	3	27 "	10	3	01 "
11	3	13 "	12	3	25 "
13	3	37 "	14	2	42 "
15	3	51 "	16	3	06 "
17	3	09 "	18	3	03 "
19	3	05 "	20	2	46 "
Av. Time	3	12"	Av. Time	2	51" 40.
Rate 18.8 miles per hour			Rate 21 miles per hour.		

Calculating the average deviations we find;

Table	No Music	With music
1	19.1"	22.8"
11	17.2"	13.5"

Thus in the race of December 8th the average deviation in each series of times exceed the difference of their averages (11 seconds) but in the race of December 2, the reverse relation holds true, neither average deviation approaching the difference in the average time per mile (in this case 61").

Allowing for the influence of occasional spurts and social demonstrations, etc., accompanying the musical periods, the results seem to indicate a distinct stimulation of the athlete by musical stimuli.

As noted before in many modern schools, the music of a phonograph or a piano is used to control the speed of the learners of typewriting and penmanship. A teacher of typewriting with the aid of the phonograph, declares that pupils learn faster, acquire better form through the exercise of all the fingers, and maintain a more favorable attitude when typewriting is taught to music. Mr. Cavens of the Illinois State Normal School teaches penmanship by

(40). Ayres, I. P. The influence of Music on Speed in the Six Day bicycle race. AM. PHYS. ED. REV. 16 p. 321-4.

146
the same method, employing simply² music off the 22-, 2-4 time type. His methods have been employed with success throughout the country in a number of high schools. Statistical studies of the relative merits of teaching typewriting or penmanship with or without music, are however, unavailable at present. For example Prof. Bingham states that "some artists paint to music finding that it helps them conjure up beautiful visions."⁴¹ Various other kinds of work are usually performed to a musical accompaniment with striking results. It is said⁴² that Da Vinci listened to the tones of a flute when he painted Mona Lisa. A well-known Cincinnati artist states that when he paints to music, the length of his brush strokes is increased, a phenomenon probably due to the re-inforcement of reflexes.

The influence of music on work and fatigue has been studied in the psychological laboratory by several investigators, particularly by Prof. Fere and Tarchanoff. Both of these investigators made use of Ergograph, whereby graphic records of the exact quantity of work done by a muscle in a given time with and without musical accompaniment could be determined. Fere confirmed his experiments to the effects of simple tones and intervals, alternation of tones and descending and ascending scales. Fere himself says that the results of the experiments cannot be summarized without disfiguring them. (p. 126) He formulated several principles however of which the most important seem to be:

- dynamometrie*
- (1). Isolated sounds produce changes in dynametric force and in the circulation of blood. The modifications being parallel to one another and directly proportional to the number and amplitude of the acoustic vibrations.
 - (2). This effect is transient and its maximum varies with the nature of the stimulus and the particular condition of the subject.

(41). Bingham, W. V. V. Research on Moods and Music p. 28.
(42). McDowell, Ed. Critical essays. p. 13.

- (3). Certain tones or series of tones produce marked increase of muscle tone and work, while others result in a decrease.
- (4) Distribution of the work varies with the nature of the relative position of the tones in the series of the stimuli.
- (5). Tonalties which are depressing to a subject who is rested, are exciting when the subject is in a state of fatigue. Thus in general, major tonalties are exciting in a states of rest; depressing in fatigue; while for minor tonalties the reverse is true.
- (6). Musical stimuli in the ascending scale, produce an exciting effect while descending scales are depressing.

43

Prof. Tarchnoff^a also measured the amount of muscular work by means of the ergograph but used musical selections as stimuli. He observed that music exercises a powerful influence on muscular activity, which increases or diminishes according to the character of the melodies employed. When music is sad, or of slow rhythm and in the minor key, the capacity for muscular work decreases to the point of ceasing entirely if the muscle has been

44

fatigued from previous work. The ergographic experiments of Binet and Courtier but partially confirm the data of Fere' and Tarchanoff and no other investigators seemed to have studied the problem experimentally.

Quite recently a number of what might be called industrial experiments on the influence of music on work have been made but very few published reports of this work have appeared. We have, however, a report of a dry cleaning establishment in the middle west which offers music at frequent intervals to its 300 workers as a stimulus to effort. A sufficient number of phonographs have been installed throughout the place to afford lively music most of the

(43). Fere, Chas. Le travail et le plaisir. Ch. 12 p. 127-159.
(44). Tarchanoff, J. Influence de la musique sur l'homme, et sur les animaux. Archives italiens de biologie XII 1894 p. 313-17

working day. Ragtime and popular music, selected by the employees and played at their pleasure, is used, and singing and humming on the part of the workers is permitted. According to the manager, "music while they work" is an idea that prevails throughout South America where most factories have musicians to play to the employes during business hours. The report states that the phonograph has solved the problem of "voluntary speeding up" but no records are given.

In another report, Mr. J. Vernes, a noted French financier and manufacturer, is quoted as saying that he intended to introduce music into all the industries with which he is connected. "In building roads and bridges among the Pyrenees Mountains the results were amazing. Gangs of workmen did better work, were in better humour and less fatigued on days when they sang, than on days when did not" Most of the railroads of the south were built to the rhythmic singing of negro workmen and the tobacco factories of Virginia, Kentucky, and the Carolinas are run by negro music. "It was said that negroes failed as operators in a North Carolina cotton mill some years ago, because they could not hear their voices above the roar of the machinery," Foremen encourage their negro workmen to sing while paving streets in southern cities. Combarieu also quotes a French official report that in constructing a railroad in Dahomey, the negroes required the sound of a flute to work. From German literature comes another example fortunately based on statistical inquiry, for according to Combarieu, an observer making a statistical comparison of the relative amounts of work done by groups of singing and silent workmen, discovered that the former produced more than the latter.

(45). A Ragtime Laundry	Illustrated World	25. pp. 599-600.
(46). The Value of Music in Factories.	Outlook	105: p. 9.
(47). Combarieu, J.	Ibid	p. 147

A recent group of experiments on sorting mail to music belongs in the same general category and yields a few interesting figures. Experiments with a phonograph in the Post Office at Minneapolis have shown that music will cause ordinary mail sorters to do more work and make fewer errors than usual. There are 55 clerks in the Post Office and Mr. Smith who installed the phonograph "required 65 records to produce proper efficiency." The first night's program included Dvorak's Humoresque, Labitsky's Dream of the Tyrolienne, and Rachmaninoff's Prelude in C Sharp minor. On subsequent nights the music varied from classic to "jazz." On two successive nights, one with music, one without, checks were made in handling mail for three stations. The test was made on the number of letters thrown into the wrong boxes. The records are as follows:

	Thursday Night No Music - Errors	Friday Night With music - errors
Station A	93	74
Station East Lake	172	152
Station West Lake	155	140
Total	420	366

Reduction in the number of errors 12.86%

The experimenter states that "in both nights 18 men were off duty and the same amount of mail was handled. On Thursday night without music 50 hours of substitute time and one hour of overtime for six men, was required while on Friday night with music, only 43 hours of substitute time was required, and the men got through threequarters of an hour earlier.

The preceding group of experiments on the relation of music to work, while rather crude, point the way to further studies in this line, and tend to confirm the results of Laboratory experiments as well as the spontaneous practice of primitive men and untutored laborers throughout the world. It remains to explain these results, or rather to try to discover the musical factor to which the principal efficacy is to be ascribed. As least four theories have been proposed.

(48). Sorting mail to music, Lit. Di. Mar. 4, '22 p. 22.

1. The theory of Bucher, Wallaschek, and Billroth, according to whom, the increase in productivity is due to the regulation of the movements involved in work, by the rhythms of the music employed. Bucher assumes with Aristotle that rhythm is natural to man and is based on the physiological and motor rhythms of circulation, respiration, walking, swinging the arms, etc. Work will naturally tend to be performed in a rhythmical way, and where this rhythm can be objectified, it will relieve the attention of workers otherwise obliged to concentrate on their task. This will reduce fatigue, and by regulating the intervals at which energy is expended tend to promote equal and adequate expenditure of muscular force. Particularly in communal labor, the saving of attention and the distribution, control, and co-ordination of effort by an objective regulating factor is desirable. In many forms of labor, the proper work rhythms are revealed in the tonal rhythms produced by the tools. As Bucher says, "each trade has its natural music." Where the natural tone rhythm is absent, or inadequate it may be strengthened artificially and the best means for this purpose is music, hence its universal use in primitive labor. The particular tonal elements, according to this theory are unimportant, and many examples of monotone singing are recorded. The rhythm of the music adopted to the rhythm of Work is the efficient element and it is suggested that Music arose out of the necessities of primitive laborers.

2. The theory of Forced Attention to Work in response to distractions: Here Music is regarded as a distraction to which the individual workman responds by very close voluntary attention to his task, with the possibility of greater production, though it is clear, that a greater expenditure of energy would be involved in this case, and that fatigue should set in more rapidly, a view that does not correspond with experiment. This view probably applies to

(49). Bucher, K. Ibid pp. 25-43.

certain kinds of work requiring non-stereotyped reactions, but not to primitive labor.

3. The theory of more rapid physiological repair under the influence of musical stimuli. We have noted Johnson's observations on the effect of music on the circulation, digestion, etc. Dr. Dutto's experiments on the organic processes of animals subjected to musical stimulation indicate increased metabolism. The consequences would naturally be a delay of the onset of Fatigue.
4. Finally, the theory of the direct stimulating value of music seems well grounded on the basis of experimental work. According to this theory the tonal elements are the really efficient causes of the effects observed. While rhythm is merely a contributing factor though an essential one, its function being to regulate work, synchronising tones and musical reflexes so that reinforcement of the latter occurs.

According to our own view, rhythm by lending regularity to muscular reaction, eliminates the strain of voluntary attention, and reduces fatigue. It is a conservative factor. Tone, on the other hand, lends force to muscular movements. Under certain conditions, where tones are arranged in rhythmic patterns corresponding to the rhythmic movements involved in work, they will synchronise with the elementary reflexes out of which even the most complex movements are built up. Now Yerkes experiments on the frog demonstrated that tonal stimuli reinforce the reflexes of the animal's legs, while Lombard showed that music increases the amplitude of the human knee jerk reflex, consequently the amount of energy expended in the movement.

50

Thus mere rhythm by itself would only insure regularity of movement while tonal stimulus is required to produce a maximum expenditure of energy. Wherever music is employed in work it is rarely confined to mere rhythm. If

(49).

(50). Lombard, W. P. The Variation of the Normal Knee-jerk and their relation to the Activity of the Central nervous system. Am. J. of Psych. Vol 1: 1887-8 pp. 58-61.

such alone were necessary, a rhythm of contacts of of visual stimuli ought to serve equally well, yet we find no such practice anywhere. The Rhythm employed to aid worders is always sound, containing tonal elements, and these rarely constitute a pure monotone. Man resorts mostly to the human voice, the best and most convenient source of tones that is available to men of a low level of culture. The chief function of rhythm is to synchronise these vocal tones with the work reflexes in order to produce reinforcement, and maximum effort. The fact that man universally resorts to music as an accompaniment of muscular activities is therefore at once an illustration on a very large scale, and a confirmation of the Experiments of the Laboratory.

THE HISTORY OF EXPERIMENTAL WORK ON REACTIONS TO MUSICAL STIMULI.

In preceding chapters we have confined ourselves to such effects of musical stimuli on man and animals as may be observed by the naturalist, or students of the objective phenomena of human society. Human and animal societies, when studied in relation to their responses to any particular type of stimuli, music for example, may be said to constitute a kind of sociological experiment, analogous to the psychological experiments of the laboratory. It is true that at first glance the essential mark of experimental procedure, viz., the control of conditions seems utterly lacking; yet this is only partially the case; Nature herself varies the conditions and the student of society need but apply the genetic comparative method and survey a sufficient number of groups, in order to find the wide variation of conditions, which the experimenter on the individual must actively bring about. Of course, it may be said, that the analogy breaks down since the laboratory experimentalist varies the conditions of the same individual or the same limited group while the social experimentalist must pass from group to group in order to secure the desired conditions. Essential psychological identity of groups is therefore presupposed, but it may be noted that this is also the pre-supposition of the experimental psychologist when he draws conclusions from the behavior of a controlled group. If he did not extend his conclusions by inference, standardized mental tests would be meaningless. Thus the genetic and comparative method in dealing with social facts has something in common with experiment, and the data amassed in this way are complementary to the data derived from the investigation of individual behavior. Less precise, they are equally objective, and far more extensive, so that they serve as a basis and check to the latter.

By this method, a considerable amount of data respecting response

to music has been brought to light, and we have only referred to laboratory experiments in order to point out their agreement with sociological data, or to explain certain musical effects.

At this point, however, we must attempt a survey of the experimental literature of Response to musical stimuli. We say musical stimuli instead of music, because certain of the experiments deal with reactions to simple musical elements, isolated tones, intervals, chords, etc. rather than complete selections. Such a historical survey is necessary as a guide to further experiment, and moreover, forms an excellent mode of transition from the Naturalistic to the Experimental method in the usual sense of the word.

✓ The first observation on the physiological effects of music which partake of the nature of experiment in the generally accepted sense seem to be due to the French musician, A. E. M. Gretry (1741-1813) who in his "Essais sur la musique" mentions the effect of music on the heart and the circulation of the blood. "I placed," said he, "three fingers of my right hand on the artery of my left arm, or on any other artery in my whole body, and sang to myself an air, the tempo of which was in accordance with the action of my pulse; some little time afterward, I sang with great ardor an air in a different tempo, when I distinctly felt my pulse quickening or slackening its action to accommodate itself by degrees to the tempo of the new air." A number of subsequent observers report a repetition of this crude experiment with similar results.

The earliest well controlled experiment on response to auditory stimuli were made in 1874 by Couty and Charpentier as a part of a general study of cardio-vascular reactions determined by stimulation of the various senses. The auditory stimuli employed were in part marches, but since whistling was also used, the results have some bearing on response to musical

elements. The experiments were carried out on dogs, usually under the influence of Choral, Strichmine, or Curare, and Kymographic records were taken of the cardio-vascular effects. Twelve experiments in all were made on the effects of sounds on the two dogs and the following are typical records.

Experiment 4.

Condition of Animal	Attachment of Kymograph -	Stimulus	Effects.
Curarised with artificial respiration	femoral artery	whistling	Heart rate reduced from 150 to 140 per second.
		continued whistling for 30 "	Pulse drop from 150 to 130 to return to 155 - no change of tension.
		Blow of shovel on stove	Tension increased 3 cms.
		"	Tension decreased irregular cardiac oscillations, becoming slower and of greater amplitude ending in sudden drop
		"	Little change.
		"	Pulse falls from 150 to 105 Tension lowered 1.5 cms. Unequal and more ample movements.

Experiment 5.

Curarised.	cardiograph	closing door	Pulse 180 (normal) to 170 per min; descending to 100 after 2-3 sec. to return to normal rhythm after 18-20 sec.
------------	-------------	--------------	---

Experiment 6.

Condition of Animal	Attachment	Stimulus	Effects.
curarised	cardiograph	noise of shovel	Pulse 140-210 per min. followed by progressive decrease to 70.
		repeated blows on stove	Pulse 80-160 per min Acceleration persisted during 25" of stimulation and 5" afterwards then descending quickly to 80.
		accidental noise	sudden acceleration of pulse.
		blows on stove after 3-4"	Pulse 80-120
		new blows	Brisk acceleration.

Interval of fifteen minutes.

curarised	cardiograph	noise of shovel	Quick acceleration 180 followed by retardation 80.
		"	Acceleration (145) retard 75.
		"	Acceleration (120)
		"	" hardly sensible
		"	no effect
		"	" "

Experiment 7.

Non-curarised	cardiograph	noise of shovel	Acceleration less than in experiment 5.
curarised	"	"	Acceleration followed by retardation
"	"	"	less acceleration
"	"	"	no reaction.

EXPERIMENT 10.

Condition of Animal	Attachment	Stimulus	Effects.
curarised and fasting during 4 days	cardiograph	noise of shovel	Pulse 200-220 tension increased 2 cm. slowly decreasing afterwards.
			Pulse descends to 160 per sec.
		"	same
		"	same less marked.

The principal fact brought out by the experiments was that of the diversity of cardio-vascular reactions in response to auditory stimuli. The diversity was exhibited not only in different individuals but in the same animal.

On the whole, however, the experiments showed that the amplitude of the Reactions correspond to the intensity of the auditory stimuli, and that if the excitations are continued, adaptation results; the Reactions diminishing or disappearing.

To Dogiel, however, belongs the credit of having carried out the first systematic experiments on the influence of music proper on the organism. In 1880 Dogiel executed two series of experiments on the influence of music on the circulation of the blood; the first on human circulation, the second on that of animals, chiefly dogs and rabbits.

The experiments on human beings were made by means of the plethysmograph; on animals by taking the cardiac pulse on the carotid artery. The sources of auditory stimuli were Königs Diapason with resonance boxes, the violino clarinet, flute and a metal whistle. The following experiments on animals are representative.

1. Couty L. et Charpentier A. Effets Cardio-vasculaires des excitations des Sons. Archives de Physiologie t. 4 1874 p. 525-83

1. Experiments on a small dog, stimulated by means of a whistle.

Observations. Number	Pulsations in 10 sec. Auditory Stimulation			Blood Pres. mm. Auditory Stimulation			Condition of animal.
	Before	During	After	Before	During	After	
1.	20	25	22	150	204	128	Animal was quiet without drug.
2.	35	40	37	178	222	210	
3.	32	39	204	204	214	214	Curare. Art. respira- tion with a little Strych nine.

2. Experiment on a small dog (same) with whistle.

1.	21	25		142	146	Quiet without curare move- ments during whistling Curarized Art respiration
2.	24	19		148	156	
3.	14	16	17	131	133	
4.	15	17		128	129	
5.	17	19		127	130	

3. Experiment on a white rabbit with whistle stimulation.

1.	46	50		114	150	Perfectly quiet without curare.
2.	48	49		112	146	
3.	36	40		132	140	Curarized with art respiration.

Thus the pulse rate increases under the influence of auditory stimuli, especially when the animal is under the influence of strychnine. In cases where pulse rate did not increase markedly, there was an increase of energy. The cardiac rhythm did not remain regular. From the other observations on dogs, cats, and rabbits, the author concludes that auditory stimulation is accompanied by oscillations in the circulation of the blood, and that the latter are dependent on the pitch, intensity, and timbre of the sound, a result in accord with

the observations of Gouty and Charpentier.

In the experiments on human beings, diapasons of varying pitch, Sol 3 Sol 4, Mi 4, etc., and a serenade of Schubert's in Mi 3 on the violin, clarinet and flute were employed as auditory stimuli. The general conclusions of Dogiel's study are as follows:

1. Music exhibits an influence on the circulation of the blood in Man as in animals.
2. Blood pressure sometimes rises and sometimes falls. These oscillations of pressure depend chiefly on the influence of the auditory stimulus on the medulla oblongata which is in relation with the auditory nerve.
3. The action of the musical sounds and of the whistles on animals and man expresses itself for the most part by the acceleration of the cardiac contractions. The automatic centers of the heart work more energetically.
4. The variations of the circulation as a result of musical influence agree with the respiratory changes, although they can be observed independently of the latter.
5. The variations of the circulation depend on the pitch, intensity, and timbre of the sound.
6. In the variations of the blood pressure, the idiosyncrasies of the individual, whether man or animal are plainly apparent and even the nationality in case of man has some effect.

No further work bearing on the subject appeared until 1885 when Féré and Londe investigated the effects of tones produced by vibrating tuning forks, on the dynamometric records of a single subject. In the first series of experiments a large number of forks ranging from 50 to 1000 vibrations per second were employed and large differences in dynamometric pressure, varying with the pitch of the tones were noted. In another series of experiments, electrically

2. Dogiel J Ueber den Einfluss der Musik auf den Blutkreislauf
Archiv für Physiologie (du Bois Raymond) 1880 p. 416-423.

driven forks were used, and the pressures increased with the intensity of the stimuli. With a tuning fork of 500 vibrations per second, the following results were obtained.

Distance of Tuning Fork in Meters.	Pressure in KG on Dynamometre ^{er} .
8	22
7	22
6	24
5	29
4	32
3	35
2	45
1	48
0	52

Approximately the same figures were obtained by placing the subject alternately in different positions in a different order. Feré says that auditory stimuli increase not only the intensity of sudden effort, but also the duration of sustained effort and the power of renewing it.

By means of a weighted tuning fork, yielding the range of the octave, the relative influence of different tones of the scale was ascertained. Two series of experiments were carried out, one involving ordinary transmission, through the air, and the other bone conduction of sound through direct contact with the skull. The records follow:

THROUGH THE AIR		THROUGH THE SKULL	
Stimulus	Dynamometer KG	Stimulus	Dynamometer KG
UT 2 do	26		50
RE 2	27		45
MI 2	28		45
FA 2	28		42
SOL 2	31		35
LA 2	35		30
SI 2	38		28
UT 2	45		25

The subject's normal dynamometric record was from 20 to 22 Kg.

The dynamometric results agreed with the Plethysmographic records under the

influence of auditory stimuli. The tone producing maximum reaction varies from subject to subject, the range being the interval of a fifth. The general conclusion is that sounds are dynamogenic; i. e., muscular energy increases with the intensity and pitch of auditory stimuli a result to be expected in the light of the previous experiments.

In 1887 Lombard observed the reinforcement of the knee jerk caused by music, while making a general experimental investigation of the variations of the knee jerk in their relation to the activity of the Central Nervous System. The apparatus consisted of :

1. a hammer suspended on its axis through the handle, falling like a pendulum so that the force of the blow could be regulated.
2. a rod connected with the foot, sliding in the groove of a wheel, and equipped with a needle which recorded the extent of movement on a blackened surface.

His observations may be summarized in the following tables.

CONDITIONS	KNEE JERKS	AVERAGE.
Silence	25 experiments	32 mm
Music of passing band - air not recorded.	60 71 74 70 60 55	65 mm
Another passing band playing "Maryland my Maryland"	62 76 76 74 71 66 59 64 59	67.4 mm
Drum creps	48 55 51 55 53 49 52	51.8 mm.

There was an increase and a decline in the extent of the knee jerks as music approached and receded. In a subsequent experiment to test the effect of music on the knee jerk, an air was played on the piano in an adjoining room. The average knee jerk at 7 P. M. was 32 mm; at 11 P. M. 29 mm; so that at 10:30 at the time of the experiment the knee jerk was probably about 30 mm.

Stimulus	Knee Jerks	Average.
Beethoven's	82, 104, 96, 105, 104, 99, 108, 95, 106,	
Funeral March	118, 117, 90, 115, 119, 98, 100, 124, 108, 112.	105 mm.
Interval of quiet 83, 90, 90, 66, 82, 59, 75, 50.		
Chopin's		
Raindrop Prelude		
Soft Music	52, 63, 47, 50, 55	53.4 mm
Deeper passage	66, 73, 58, 78, 70, 86, 77, 87	74. 3
Soft	66 , 43, 59, 62, 71, 68, 54	60.4
More thrilling	79, 86, 86	83.6
Varied and softer	58, 57, 79, 67, 47	61.6
Quiet 15 min. later	25 experiments	29 mm.

The amplitude of the knee jerks, therefore, seems to vary directly with the intensity of the auditory stimulus.⁴

During the same year, Urbantschitch investigated the influence of auditory stimuli on the sense impressions, particularly on normally minimal visual stimuli. He found that patches of color observed at a distance at which the color could scarcely be recognized were brought clearly into the sensory field, by sounding a tuning fork. In short, the threshold of color perception is lowered by tonal stimuli. Tuning forks of high pitch applied to both ears were most effective. The influence of the different colors is variable. Barely legible print was often read when a tone accompanied the effort. Tastes, odors, and touch are similarly effected by sound, and pain is increased by jarring noises. Sound perception is likewise affected by colors and brightness, the ticking of a watch, for example becoming more distinct under the influence of red and green; less distinct through blue and yellow. The influence of visual perceptions on musical tones varies with the pitch. Odors also exhibit a marked reinforcing power over sound. Finally Urbantschitch claims to have produced

4. Lombard W Variations of the normal Knee-jerk Am. J. Psy. VI 1887

photisms, or phenomena of colored audition, by having the subject observe a grey disk on white paper, or an undulating white surface, and describe the colors perceived while different tuning forks were sounded. The experiments, if valid, indicate that the subjects of audition coloree are merely striking examples of the normal psychological influence of one sense upon another.

Little further experimental investigation of reactions to music appeared until the end of the next decade. Eugenio Tanzi (1891), however, published an account of experiments on the reaction time for major and minor chords. The keys of a pianoforte, the reagent's key and a chronoscope were connected in a single circuit. The results are given in two tables, one for the simple reaction time, the other for the choice between reaction and no reaction. The conclusion is that minor chords produce more rapid reaction than the major chords, a fact that may have some relation to the prevalence of minor chords in primitive music.

Th. Billroth in a long theoretical paper on musical reactions presents some very interesting notes on the influence of music on the organism. Most of the paper is devoted to the physiological and motor effects of rhythm, but several observations on tonal effects on man and animals are recorded. The author reports an experiment of his own in which a violent pain appeared in an apparently sound tooth upon hearing a soprano sing a high note (B) at a concert a quarter tone too high. Examination of the tooth disclosed slight decay. The hyper-irritability of the nerve was thus excited by irradiation of an auditory stimulus. The observation accords with the conclusion of Urbantschitsch that auditory stimuli lower the sensory threshold. Billroth also mentions seeing a young "Great Dane" fall down as if in a faint when a village brass band struck up a "Schützenermarsch." "Es trat eine momentane Lähmung ein; er fiel mit ver-

5. Urbantschitsch J. Ueber den Einfluss einer Sinneserregung auf die übrigen Sinnesempfindungen
Pflügers Archiv f.d. ges. Physiologie XLII '88 p. 3-4

6. Tanzi E. Cenni ed esperimenti sulla psicologia dell' udito.
Rivista di Filosofia Scientifica Dec. 1891

warts and ruckwerts gestreckten Beinen hin."

G. Sergi in his work on Pain and Pleasure (Dolore e Piacere 1894) gives a critical resume of the experiments of Dogiel on reactions to music. Sergi interprets these results in terms of the James-Lange theory of emotion and concludes that musical emotions entirely lack intellectual character. A paragraph on the dynamometric influence of music appears in Scripture's "Thinking, Feeling, and Doing" published during the same year that Tarchanoff's researches appeared. "With the thumb-and-finger grip" says Scripture, "the greatest pressure I can exert during silence is 4 kg. When some one plays the Giants Motive from ^{the} Rheingold, my grip shows 4.5 kg." The slumber motive from the Walkure ^{reduces} the power to 3.24 kg.

8

9

Among those who have contributed most to our knowledge of reactions to musical stimuli is the Russian physiologist, Prof. Tarchanoff. As early as 1888 Tarchanoff noted variations in the electric conductivity of subjects, subjected to the stimulus of an electric bell. In later experiments he reported that decapitated animals respond to sound stimuli by violent struggling, though Prof. Henri Moun was unable to confirm these results in a similar experiment of his own. In an interesting communication to the International Congress of Rome in 1895, Prof. Tarchanoff presented results obtained by means of the Mosso ergograph which resembles those of Fere's experiments. He notes that music exercises a powerful influence on the muscular activity of man, increasing or diminishing it according to the nature of the melodic stimuli. When a subject is completely fatigued by working on the ergograph and can no longer raise the weight, gay music of rapid movement causes the fatigue to vanish for a variable time, and the subjects are able to raise the weight once more, i.e. do additional work. Sad, slow, music in the minor key produces the opposite effect.

10

11

7. Billroth, Th. Wer ist musikalisch? D. Rundschau XLIX 1894 p. 79-106
8. Sergi G. Dolore e Piacere p. 393-5
9. Scripture H W Thinking, feeling, and doing p. 85
10. Tarchanoff J Ueber den Galvanischen Erscheinungen in der Haut des Menschen bei Reizungen der Sinnesorgane und bei verschiedenen Formen der psychischen Taligheit Pfluger's Archiv Bd XLVI
11. Henri V. Sensations Auditive Annee psychologique 1894

A second series of experiments was made on dogs and guinea pigs in order to determine the quantity of oxygen consumed and the quantity of carbon dioxide gas eliminated in 24 hours under varying conditions of rest and auditory stimulation by means of an electric bell sounding every 5 seconds. In 24 hours the consumption of Oxygen and the elimination of carbon dioxide per kilogramme were as follows:-

	CONSUMPTION OF O		ELIMINATION OF CO ₂	
	Quiet	Auditory St. Bell	Quiet	Auditory St. Bell.
Dogs	16.66	20.01	18.66	21.78
Guinea pigs	35.54	38.79	38.20	42.23

A third series of experiments on human beings showed that the electric currents determined by the skin of the hand and registered by Wiedemann's Galvanometer are modified by the influence of music. Since these cutaneous currents are due to the increase of secretory activity, Tarchanoff concluded that music influences the activity of cutaneous glands.

Following the work of Tarchanoff, Dr. Uberto Dutto of the Laboratory of Physiology of Rome executed a series of tests to determine the influence of musical stimuli on thermogenesis of animals. For the purpose of extending the investigations of Dogiel and Tarchanoff, various animals were subjected to the influence of music by letting them hear an organ during an hour or an hour and one-half. Under these conditions he found that the thermogenesis increased in birds generally; hares, guinea pigs, and chickens, however, showed a diminution. The increase must be attributed to chemical changes in the tissues. Dutto thinks that music determines a state of special psychic tension during the afflux of blood to the peripheral circulatory system is diminished with a consequent decrease in the radiated heat. This result agrees with the experiments of Mosso, according to

12. Tarchanoff J. Influence de la Musique sur l'homme et les animaux.
Archives italiens de Biologie. XXI 1894 p. 313-17.

which every psychic process determines a peripheral circulatory constriction. If music, as Dutto contends, acts as a stimulus to organic metabolism, we have an explanation of the result of Tarchanoff who found that dogs and guinea pigs consume more oxygen and eliminate more carbon dioxide when subjected to the influence of music.

P. Ments (1895) conducted experiments on the influence of auditory stimuli on the movements of circulation and respiration under varying conditions of attention. The apparatus used was the Marey Sphygmograph and the pneumograph. He found that an auditory stimulus, noise as well as simple sounds produce a retardation of the pulse and a retardation or acceleration of the respiration, correlated with the duration of the stimulus and the presence or absence of voluntary attention. The intensity of the auditory sensation increases the duration of reactions up to a certain limit, beyond which reactions diminish.

The influence of a musical selection played on a harmonium differs according to the attitude of the listener. If he does not pay particular attention or attempt to analyze the selection, a retardation of the pulse ensued; if he analyses the music acceleration appears. In an examination of the pulse during the musical selection, Ments finds that a marked variation in intensity produces retardation. Disagreeable dissonances are accompanied by acceleration; agreeable consonance by retardation.

An excellent critical summary of the method and results of these experiments was published during the following year by Prof. Victor Henri.

The next important series of experiments on reactions to music are those of A. Binet and J. Courtier. In connection with the study of the capillary

- 13. Dutto Uberto *Influenza della musica sulla Termogenesi animale*
 Rendiconto della R. Accademia dei Lincei Vol 5 March 15, 1896
- 14. Ments P. *Die Wirkung akustischer Sinnesreize auf puls und Athmung*
 Philosophische Studien Vol 11 1895 pp. 61-75-391-394, 565-603
- 15. Henri V *Sensations Auditives - Année psychologique 1896 p. 390-401*

circulation of the hand, carried out on four subjects by means of the Marey sphygmograph and the plethysmograph, these authors found a diminution of the amplitude of the pulse in response to the sudden sound of a gong.

16

A subsequent study by the same investigators was devoted to the determination of the energy and rapidity of movements made by a pianist; i. e. the mechanical work of the fingers on the keys. The study bears most directly upon the influence of technical difficulties in performance, but the results are also of interest as reactions to musical stimuli; since the performer is obviously subjected to the stimulus of his own music. Two items of interest appear, viz, that in executing a series of notes, the final one is struck with most energy, and that in rapid playing there is always a diminution in the intensity of the movement.

17

Speed and force vary inversely. Binet and Courtier (1895) investigated the influence of musical stimuli on respiration and circulation. The former were studied by means of the pneumograph; the latter by the plethysmograph. The reactions of a single subject were studied. In one series of experiments, isolated tones, chords, and musical exercises possessing no intellectual or emotional association were used. These sensorial stimuli, as the authors term them, produced no respiratory modifications, except an acceleration of from .5 to 3.5 additional respirations per minute. The acceleration varies directly with the liveliness of the movements, and is greater for the minor mode and discordant sounds.

Musical selections, chiefly songs, arousing emotional associations according to the introspections of the subjects vary in their influence according to the affective tone evoked. Sad melodies accelerate respiration by 2.6 on the average, considerably diminish the amplitude, and produce irregularities in both acceleration and amplitude of Respiration. Gay music; e. g. military marches, pro-

16. Binet A et Courtier J Circulation Capillaire de la main
Année Psychologique 1895 p. 201-22
17. Binet A et Courtier J Recherches Graphiques sur la musique
Année Psychologique 1895 p. 201-22.

duced an acceleration of 3.6 and showed less tendency to reduce amplitude. A third class of melodies evoking complex and unclassifiable emotions, including fragments of "la Rencontre," *laisse moi contempler ton visage*; *Walkurenritt*, etc. produced an acceleration of 3.3 per minute with a tendency to reduced amplitude. With respect to circulation, purely sensorial excitations produce a slight lessening of the amplitude of pulsation. Dissonances produce a greater effect. Sad music has almost no influence, while gay music nearly always provokes a reduction.

The rate of the pulse remains constant or increases, in the case of simple musical elements, as much as 6. Melodies produce an acceleration ranging from 0 to 15. Finally, gay music produces an accentuation of microtism, sad music the reverse. A selection from the two series of tabular reports is embodied in the following combined table.

MUSIC	ACTION ON RESPIRATION R		ACTION ON PULSE R.	
	Before	After	Before	After.
March Eriomphale Tannhauser	9.6	13.5	84	84
March de Faust Gounod	9.	12.5	81	87
March Hongroise Berlioz	11.	14.5	86.5	91.5
L'Epee.chant Wagner	9.5	14.	69.	79
La Chevauchee.chant Wagner	9.	14.	68.	83
Printemps.chant Wagner	9.5	13.	69.	73.5
Le Rencontre.chant Faust	10.5	13	68	84
Laisse moi contempler.chant	11	12	73	83

Thanks to an interesting clinical accident Dr. Patrizi of the University of Modena was able to carry out important experiments on the influence of music on the cerebral circulation. Emmanuel Favre, a boy of 13 years of age,

18. Binet & Courtier: Influence de la vie emotionnelle sur le coeur
la respiration et la circulation capillaire
Année Psychologique 1896 pp. 104-125

was severely wounded in the head by an axe. The wound was 15 cm. in length cleaving the bones of the skull for the entire distance. Restored to health the boy presented a soft cicatrice, through which the pulsations of the brain were plainly visible, and changes of the cerebral circulation could be accurately determined. Two questions presented themselves.

1. Is the circulation of the blood in general influenced by music?
2. Is the circulation of the brain more or less influenced than that of the rest of the body?

Plethysmographs were used to determine changes in circulation; for registering the pulse of the brain a cup of gutta serena was made with an electric connection capable of showing the slightest modification in volume or pulsation. The results were recorded on a kymograph. In general it was found that pulsations

took a higher range after a musical note, or a very near repetition of the same note. High notes produced greater changes than tones of low pitch. For isolated tones three conditions were observed.

1. The volume of the pulse in the arm increased in the same proportion as that of the brain.
2. The two varied inversely.
3. The volume of peripheral circulation remained constant while that of the brain increased.

The same reactions accompanied melodic stimuli. Five tracings taken at considerable intervals showed, "that an increase of cerebral circulation occurs under the influence of simple music." This effect is more or less marked and persistent, according to the nature of the melody (pathetic or martial) and the movement (slow or fast.) Every increase in pulse was related to musical stimuli, and the different amplitudes of the variations observed seemed to depend on the relative intensity of the musical stimuli. Both cerebral and peri-

pheral circulation were increased by the singing of the Marseillaise, while a polka augmented the cerebral circulation and diminished that of the arm in the same proportion. A "galop" increased the cerebral circulation, while that of the arm remained unchanged, and great mental lucidity accompanied the music.

The depressing or exhilarating character of the music did not correspond to the deviations of the plethysmographic curve, and the circulatory effects were found to be independent of the respiratory. Patrizi is undecided whether the variations in cerebral volume are autonomic neuro-muscular functions, or passive reflections of general vaso-motor phenomena. He points out, however, that his results diverge from those of Pere and Tarchanoff, since the substitution of lively for melancholy music did not produce an increase of volume as these investigators assumed.

G. E. Ferrari repeated the experiments of Patrizi on normal, feeble minded, and idiotic individuals, devoting himself to the special study of the modifications of capillary circulation under the influence of music. He concludes that the vaso-motors are active after a musical emotion only when the individual is in a state of psychological inferiority; when the superior psychic functions have vanished; and when mental co-ordination ceases to inhibit emotion. In short, the effect appears when an organic disorder exists.

Dr. Guibaud followed by Binet and Courtier's study of the effect on respiration and circulation by very methodical investigations along the same lines at the University of Bordeaux.

His method and apparatus were similar to Binet's, but were not confined to the study of a single individual. His conclusions quoted "in extenso" in a review by Binet, include the following: All individuals do not

- 19. Patrizi M. L. Primi esperimenta intorno all'influenza della musica sulla circolazione de Sangue nel cervello umano Rivista musicale italiana 1896 Vol 3.
- 20. Ferrari G. Ricerche sperimentali sulla natura dell'emozione musicale Rivista musicale Italiana 1897 Vol 4 p. 2.

react in the same way to similar musical stimuli, whether simple or complex. Moreover, some subjects react to every kind of musical stimulus, while others react only to certain ones. In the first series of experiments, simple tones, chords, and gammes (scales) were used. It was found that reactions to dissonances were more marked and frequent in the majority of cases, although subjects habituated to modern music and its bold use of dissonances did not so react.

For isolated tones^S, the extent and frequency of reactions are functions of pitch, grave sounds being more affective than acute. Minor chords produce more effective and intense reactions than do majors. Reactions to gammes are in general less accentuated but minor provoked the greater number of responses. There is no uniform type of respiratory modifications for any of the types of musical stimuli named, but the Respiratory rhythm is now accelerated, now retarded, according to no apparent law. In the same individual, however, the variations are constant in direction for the same stimuli.

The amplitude of respiration may or may not be modified, but when it is, it usually becomes deeper. The total pulse determined by plethysmographic not sphygmographic tracings does not present perfectly definite changes. Where reaction appears it is vaso-constrictor. The amplitude of the pulse is diminished, the summit rounded, and details become less apparent. The cardiac rhythm is in general accelerated, but often by an amount only appreciable by comparing a dozen pulsations before and during the stimulus. Vaso-constriction varies in intensity with the nature of the stimulus and subject.

The fall of the plethysmographic curve occurs during emotion and varies directly with its intensity. A comparison of respiratory and circulatory modifications shows that the former always precedes the latter by 3 to 4 seconds.

When musical selections are used as stimuli, vascular and respiratory reactions become still more varied. Inconstant in direction, they follow the evolutions of the melody in a given individual. In the course of a musical selection, the respiratory reaction passes through diverse phases. Respiration is regular when the melody is calm, and becomes irregular, sometimes deep, sometimes shallow when rhythm or intensity is modified. The rhythm of respiration tends to adapt itself to the rhythm of the music especially when the latter grows slower. The intensity of peripheral vaso-constriction depends upon individual impressionability. With a constant uniform rhythm, the plethymographic curve rises gradually and the pulse which was reduced (in amplitude) during vaso-constriction resumes normal amplitude. Variations in rhythm occasion fresh phenomena of vaso-constriction; i.e. a fall of curve with diminished amplitude of pulse. Finally the vaso-motor phenomena agrees with the feelings experienced by the subjects during musical stimulation.

21

In 1898 also appeared the striking investigation of de Rochas on the influence of music during hypnosis. De Rochas' experiments have already been referred to in the chapter on Musical Magic and Therapy, but a more detailed account is now in order. The prior investigations of Dr. A. S. Warthin (1894) must also be reviewed. Dr. Warthin observing what he considered as a self-hypnotic condition in certain enthusiastic attendants at a concert of Wagner's music, determined experimentally the influence of Wagner's music on hypnotised subjects. The first subject was a physician of an emotional nature and easily hypnotised. When Wagner's "Ride of the Valkyries" was played on the piano, the pulse of the subject was accelerated, while the amplitude and the pressure

21. Buibaud M. Contribution a l'etude experimentale de l'influence de la musique sur la circulation et la respiration
Annee psychologique 1898 p. 645-49

increased. As the music continued, the pulse rose from 60 normal to 120 per minute, becoming quick, full, and of low tension. The rate of respiration increased from 18 to 30 per minute. The body and limbs showed excitement (agitation) and the countenance showed the effects of excitement, the whole body being bathed in perspiration. On being awakened the subject stated that he did not perceive the music as sound but as a falling; the latter being a sensation of wild excitement, induced by "riding furiously through the air."

The second subject, a young man of 22 years of age, was of average emotional development, and less readily hypnotized. The same music produced similar effects. The subject experienced a sensation of "riding through the air," while his pulsation rose from 70 to 120 per minute. The same experiment was repeated upon a number of subjects with similar results, although but one knew what the music was. Slow music (Walhalla motif) produced first an opposite effect on the pulse, afterwards almost doubling the rate and decreasing the pressure. It was accompanied by a feeling of lofty grandeur. The music of the scene in which Brunhilde appears to summon Sigmund to Walhalla produced irregularity of respiration, decrease of rapidity and amplitude of pulse. The respiration also became slower and cold perspiration appeared.

The experiments of Alfred Dr Rochas were carried out on a well known French model, while the latter was in the first phase of hypnotic condition. The author experimented very methodically, making successive use of isolated tones, intervals, chords, scales, phrases, and entire musical selections by different composers of contrasting types. According to de Rochas, isolated tones provoke a trembling extending to all parts of the body, the character of the reaction varying with the pitch and intensity of the notes. Very high tones evoked an expression of pain; very low tones, that of anguish or terror.

25. Dr Rochas A Les Sentiments, la musique et la gest.
Nouvelle Revue Vol 114 1898 pp. 584-589 and 587-602.

Chords excite the same reaction as simple tones, and dissonances at any part of the scale produce an expression of suffering. The ascending scale brings out a series of reactions mounting from foot to head, while descending scales produce reactions of the same type but in reverse order. These phenomenon occur in all tonalities. March and dance music involving both melody and rhythm produce very complex movements, the gestures of the upper part of the body corresponding to the melody, those of the lower part of the body corresponding to the rhythm. The music of different composers provokes varying effects. That of ^{Gounod} Gounod is most effective in producing appropriate expressive mimicry, physiognomical changes, gestures and attitudes. The music of Wagner and Beethoven is less effective in this respect. Verdi especially "le Miserere" exercised a remarkable influence, while the "Dernier pensee" of Weber and the "Berceuse" of Habert evoked appropriate attitudes. The author concludes that the phenomena observed are pur⁹ reflexes, set off by auditory stimuli without the²³ intervention of the will.

In 1899 Dr. Herbert Dixon reported the repetition of experiments similar to those of Dogiel with similar results; ie increased blood pressure and cardiac action, and variations in respiration. He does not state his method or the number and nature of his subjects, but mentions several physiological effects of music which are not reported by other experimenters. Among such effects are²⁴ "perspiration, desire to micturate lachrymation, and rarely laughter."

During the same year, Urbantschitsch described some rather indefinite experiments on the influence of tonal stimuli on handwriting. The subjects of

23. De Rochas A. Les Sentiments, la musique et le geste
Nouvelle Revue Vol 114 1898 p. 584-89 and 587-602.
24. Dixon H Music and Medicine considered from a Physiological,
Pathological and Therapeutic standpoint. Abstract of paper.
The Lancet Dec. 30, 1899.

the experiment were requested to write the same phrase three times in succession. The first test was conducted in silence. During the second, a low tone was produced; during the third, an acute tone by means of a harmonica.

The tones of low pitch produced in many subjects an enfeeblement of tonus in the scriptorial muscles, resulting in a tendency to uncertainty and increased size of handwriting. Tones of high pitch on the contrary, increased muscular tonus and the writing was more stiffened and smaller and the letters more angular. Dots of the i and accents were often omitted. One of the subjects showed a tendency to write above the line during high tones, while low tones caused his writing to descend. The number of subjects is not stated and the examples offered of changed handwriting are indefinite.

25

In 1902 Vashide and Lahy, published a critical synthesis of the work of preceding investigations as a preparation for subsequent work. In this work they analyze the value and significance of two important coefficients of organic response; viz., circulation and respiration. The results of preceding investigations are condensed into two tables. The first shows the influence of musical elements on organic reactions; the second exhibiting the variations of organic functions in relation to the general effects of music. The general conclusions are;

1. The repetition of musical stimulus diminishes and finally banishes peripheral reactions.
2. Musical rhythm produces by suggestion a mechanical action in respiration.

In general respiratory rhythm follows that of the music, increasing or diminishing with the latter, without going beyond the limits of extreme variations.

25. Ubrantschitsch V. Ueber den Einfluss von Schalleneempfindungen auf die Schrift.

3. Melody only produces variations in organic functions, insofar as one of its elements (rhythm, mode, timbre, intensity, changes.
4. Monotonous melody produces no peripheral changes. Scales provoke weak reactions, because they are the most simple and monotonous melodies.
5. The brain temporarily increases in volume in response to all musical stimuli.

26

The earlier experimental work of Prof. Féré has been treated in preceding sections while his later work, is partially summarized in the Chapter on Music and Work. Féré's contributions to the experimental study of response to music exceed in volume those of any other investigators. Appearing originally as communications to the "Société de Biologie" of Paris, they were assembled in two chapters of a very interesting book published by Féré in 1904. Féré confined his material and methods within severe limits. The auditory stimuli were never musical selections but always musical elements and the apparatus employed in all the later experiments was the Mosso ergograph. In short, Féré's experiments constitute an exhaustive study of the influence of elementary musical stimuli on muscular work and fatigue. The musical stimuli employed include simple, successive, and alternating intervals, dissonances; ascending and descending series of tones, and alternating tonalities and rhythms. The experiments were from a purely behavioristic standpoint; Féré stating that the consciousness of the subject is not relied on and that the fact of musical deafness raises the value of the results.

The subjects raised a weight of 5 kilograms with the middle finger in time with a metronome and the ergographs were separated by pauses of a second and grouped in series which series were in turn separated from each

26. Vassilide N et Lahy ^{8 M} Les coefficients respiratoire et circulatoire de la musique. Revista mus It. '02 Vol 9

other by 5 minute intervals; from 4 to 13 experiments were made on each element. As a result of these experiments certain intervals were classified as depressive, viz. la, so (flat). la-si, la-do, la-mi, (flat), la-sol; and others classified as exciting, viz. major third, fourth, fifth, minor sixth, major sixth, and the octave. After fatigue appearing gradually during the stimulation by exciting intervals the sudden change of interval to a depressing one resulted in a great accession of muscular energy. The alternation of intervals, e. g. octave and major seventh, major and minor seconds, etc. produced oscillations of energy, with progressively increasing muscular energy upon each recurrence of the exciting interval.

The alternation of sol (flat) and si seemed to indicate the first tone increased the exciting effect of the second, while it itself is decreasing. Two chords in alternation produce a very different effect if the 5th, the tonic or the dominant third of the initial chord form part of the second. The exciting value of alternating chords decreases with the distance between them. All minors are not depressing (do sharp) nor are all major chords exciting (re flat).

Féré not only experimented upon fresh subjects, but also on the fatigued. The musical elements are then found to change their role. Depressing tonalities or alternations, etc. become exciting and vice versa. Finally Féré found that the series of tones acts differently on work, according to the direction from grave to acute (ascending or from acute to grave (descending). The total work done in a set of experiments under the stimulus of ascending sounds is greater than for a descending series of sounds, in the ratio of two to one in the cases examined.

The work of Féré cannot be summarized conveniently as he himself declares and the above is nothing more than a selection of the salient points, in a work that deserves much attention and suggests many

problems. Since the appearance of Fere's work, the few experimental studies of reactions to music that have appeared, are due to American investigators. Miss Gamble (1905) in a study of attention and Thoracic Breathing devoted a group of experiments to the effect of music on respiratory activities. There were 20 subjects and organ music of three kinds were employed as stimuli, viz.

1. Hymns such as "Vox dilecti."
2. Two chorals from Mendelssohn
3. Elaborate compositions ranging from The "Torch Light Dance of Brides of Cashmere," by Rubenstein to the Dead March of "Saul."

The apparatus used was the Summer Belt Pneumograph, and the revolution time of the drum during the musical experiments was 3.33 minutes. The author says the results are of doubtful validity. Out of 155 stimulus tracings in which modifications of regularity were studied, the expiratory pause became less regular than the corresponding normal pause in 25.2% and more regular in 14.2% and the amplitude became less regular than the corresponding normal amplitude in 24.5% and more regular in 12%. The tendency was toward irregularity and the length of the pause seemed affected by variations in loudness. It is suggested that respiratory functions are influenced by musical rhythms.

In a subsequent study devoted solely to the influence of music on respiration, Miss Gamble seeks to determine the difference in the effect of (one) music in the major and minor keys, and (two) loud and soft music.

The subjects were 29 college women, and the apparatus used was the same as in the preceding experiments. Organ music was employed as stimulus. Four series of experiments were carried out and the results may be summarized as follows:

27. Fere' Chas.	Travail et Plaisir	Ch 11 Action Physiologique de sons musicaux	p. 127-150
28. Gamble E A	Attention and Thoracic Breathing	Amer J. Psychology	Vol XVI 1905 p. 270-80

SERIES	NUMBER	SUBJECTS MUSIC	Normal Breathing Rate	Average rate for Major passages	Average rate for minor passages.
I	8	4 hymns	16.7	18.9	17.8
II	12	2 Mendelsohn chorals in D Major and minor	16.9	18.2	16.8
III	6	9 elaborate compositions in fixed order	18.3	18.3	17.2
IV	10	18 elaborate compositions	18.7	21.3	21.5
			Loud	21.8	Loud 21.9
			Soft	20.8	Soft 21.2

A table showing the percentage of changes in the amount and regularity of amplitude and respiratory pause, under the influence of loud and soft major and minor music, fails to disclose any significant alterations.

The author concludes.

1. That listening to music loud or soft, major or minor, tends to shorten the expiratory pause, and to make the breathing faster and shallower.
2. "No remarkable difference appears in the effect either of loud or soft, or of major or minor music." (p. 411) Certain tendencies appear, however, viz.
 - a. loud music tends to decrease, and soft music tends to increase regularity.
 - b. loud music is more effective in shortening the respiratory pause, accelerating breathing, and making breathing shallower.
 - c. music in the major key had the greatest effect on the respiratory pause, and the major passages showed a greater tendency to produce acceleration. (p. 412)
3. Musical stimuli do not markedly affect the regularity of respiration.

29

29. Foster and Gamble Effect of Music on Thoracic Breathing
Am. J. of Psycho. Vol 17 1906 p. 406.

J. P. Shepard (1906) in an exhaustive study of organic changes and feeling carried on during three years used musical stimuli (chords and selections) in certain of his experiments. The apparatus employed were the pneumograph, and plethysmograph. In the preliminary series of experiments, there were six subjects, including the author, while another series of experiments were conducted upon an individual with a pulsating cerebral scar, similar to that of Patrizi's subject. Hundreds of tests were made and the following are from the preliminary tests cited.

EXPERIMENT	STIMULUS	RESULT	INTROSPECTION.
B 27	Major Triad (C-E-G)	Fall of volume and lower pulse	Pleasant
W 77	" "	" " "	Agreeable
B 6 S	Sousa's Band	" " "	Agreeable and stimulating
W 76	Major Triad	" " "	exciting.
W 96	" "	" " "	Exciting.

In the subject with the pulsating scar over the brain, a musical chord produced a decrease of volume of the hand and pulse, while the volume and pulse of brain increased. (p. 543) In the final series of experiments on the rate of the heart and breathing there were five subjects and seven trials of music which according to the subjects' introspections were agreeable and exciting. (p. 553) All resulted in a faster rate, with generally a marked increase. In four cases of agreeably depressing music, the pulse was shortened. In 16 out of 18 cases in which the stimulus was a loud unexpected whistle of a disagreeable exciting nature, showing was of an acceleration of the pulse. Agreeably exciting or depressing music also tended to eliminate the Traube-Hering blood pressure wave and the rate of breathing was almost always increased for all stimuli.

50. Shepard J P Organic changes and Feeling
Am J Psychology Vol 17 1906 p 521-594.

Dr. Ingegnaros (1907) presents an excellent critical review of the psycho-physiology of Music up to 1905. The bibliographical references to the experimental work of Italian scientists in this field is particularly valuable. The treatises of Patrizi and de Rochas based on the experimental studies referred to earlier in this chapter are analyzed and criticised in detail, and several rarely observed effects of musical stimuli are recorded. Such are the influence of music on the movements of a foetus, quoted from Vashide and Albertotti's report of a case of congenital blindness in which the subject saw phosphenas or hearing the sound of a siren, the result of involuntary contraction due to hypertonus of the ocular muscles.

W. V. Bingham (1910) devotes a chapter in his "Studies on Melody" to the effect of melodic stimuli upon muscular movements. The voluntary movements studied was the tapping movement of the index fingers of the right hand. This movement was recorded in all its detail by connecting the finger (by a silk thread running over a pulley) with a rubber thread bearing an aluminium writing point held against an electrically driven revolving drum by the torsion of the thread. Simple melodic stimuli-tones, intervals, and groups - were afforded the subject by a reed organ in electrical connection with a marker which recorded the instant of depressing and raising the keys. The duration of each stimulus was 3 seconds. There were 9 subjects and introspective accounts of affective tone were compared with objective achievement.

With simple auditory stimuli (tones and noises) alterations of the natural tapping rate usually retardation occurred. In the case of melodic stimuli, the results are different and difficult to summarize. The tables however show characteristic accelerations and retardations varying with the direction of the interval (ascending or descending), the extent, the relation

18
of consonance, and dissonance, and the mental states of the subject including expectation at the beginning and a sense of completeness or incompleteness at the end of a sequence.

32

Aullery's recent case of an artist who uniformly experiences a flash of white on hearing certain tones, may be a similar case to the one quoted by Albertotti's on the congenital blind subject. Aullery is inclined to classify it as a primitive form of synesthesia.

33

H. P. Weld (1912) presents interesting plethysmographic and pneumographic data on reactions to music in connection with a study of musical enjoyment. No tables are given since the object of the experiment was that of controlling introspections. The general results of the work are however indicated. Eight subjects took part in the experiments, which were carried out by means of the plethysmograph and two Sumner pneumographs for recording thoracic and abdominal respiration, the stimuli being a variety of selections on the phonograph. The author notes that the act of listening to music was attended by a decrease of the volume of the forearm in 90% of the cases, the decrease occurring almost immediately within two to five heartbeats after the music began. In auditors of an active temperament, the initial drop in the volumetric curve is abrupt; in those of a phlegmatic type, it was gradual. "The heart rate was usually accelerated, the acceleration beginning during the first few seconds and persisting throughout the music." There was in general no correlation between the tempo of the music and the change of heart rate, even the slowest musical tempos, which were much slower than the normal pulse produced an acceleration of the pulse and the most rapid tempos had no more accelerating effect per se than the slowest tempos." The author, therefore ascribes this effect to the

32. Bingham W V Studies in Melody Monograph Supplement Part III Vol XII
No. 3 1910

33. Ogden R Review of Auditory Sensations Vol. 1920 p. 238

Psych. Bul. Vol 7.

influence of expectation during the fore period. There is no correlation between heart beat and musical rhythm. The most striking changes in the respiration of the music period are acceleration of rate, and irregularity of amplitude, while in certain auditors respiration became more shallow. There is no correlation between musical tempo or phrasing and respiration. In certain auditors changes in respiration were the most striking physiological effects. The respiration of auditors characterized by active attention became more rapid and breathing was very irregular in rate and amplitude, respiration tending to follow the music. The results agree with those of previous investigators, except those of Ments, who made a statement that the pulse is retarded in passive attention, which Weld is unable to admit.

34

G. Stepanov (1915) studied experimentally the influence of an auditory stimulus on dreams. The experimenter and his subject occupied adjoining rooms and at intervals, during the night the former played musical selections (chiefly from Wagner) on the piano, awakening the subject who reported her dreams through a speaking tube. Interesting facts were brought out; the behavior of the subject demonstrating that there was subconscious recognition, although when awakened she could not name the selection. In some cases, in her knocking on the wall of the room to announce her presence at the speaking tube, the blows corresponded in time to the tempo of the music. In many cases dreams of a non-musical or even non-auditory character were evoked, indicating transformation of acoustic stimuli into visual images, (p. 38)

35

a phenomenon analagous to synesthesia. It would be interesting to experiment in this way on subjects of synesthesia to see if sensory stimuli evoked dreams in terms of the fixed sensory association.

34. Weld H P An experimental study of Musical Enjoyment
Amer J Psych. Vol 23 1912 p. 247-53.
35. Stepanov G Sogni Indotti Firenze 1915.

The most recent study of physiological responses to music is that of Hyde and Scalapino (1918) who investigated the influence of music upon electro-cardiograms and blood pressures. The reactions of one subject checked by the reports from two others are given in the preliminary experiments, so far as possible. The cardiograms were recorded with the ¹¹ Rithoven string galvanometer, while pulse and blood pressures were determined by a modified form of Erlangen's sphygmomanometer. The musical selections employed were Tschaiskowsky's "Death Symphony," the Toreador Song from "Carmen" and Sousa's "National Emblem March." The symphony produced a slight increase of blood pressure, pulse rate, and amplitude. The Toreador song accelerated pulse rate, and lessened amplitude. The after effects were increased, systolic pressure, pulse pressure, and pulse rate, with a decrease in the action current of the ventricular contraction. The March resulted in slower pulse rate, and increase of systolic pressure, pulse pressure, and action current. Minor tones increase pulse rate and action current and lower systolic and diastolic pressure, while stirring music increases systolic and pulse pressures. The data are arranged in tabular form exhibiting the changes indicated. Further experiments have not as yet appeared.

36

Our review of the experimental literature of Behavior in response to musical stimuli has been fairly complete, and all that remains is to determine the amount of agreement appearing in the results of the various experimental studies. The fact is, of course, evident that music profoundly influences physiological reactions. But the direction and reciprocal correlation of these reactions are still matters of dispute in many cases. The following points, seem generally agreed upon.

36. Hyde & Scalapino W Influence of Music on Electro-cardiograms and
blood pressure A J Psych : V 55 '18 p. 35-38

157
Music:

1. Increases bodily metabolism (Tarchanoff, Dutton)
2. increases or decreases muscular energy (Fere, Tarchanoff, Scripture)
3. accelerates respiration and decreases its regularity (Binet, Guibaud, Weld)
4. produces marked but variable effect on volume, pulse and blood pressure.
5. lowers the threshold for sensory stimuli of different modes.
6. It thus, affords the physiological bases for the genesis of emotions according to the James-Lange theory and consequently influences the internal secretions according to the researches of Cannon.
7. The precise influence of different modes and types of music has not been determined, and waits upon an adequate classification of musical selections, which must probably proceed at first by introspective and statistical methods.

AN EXPERIMENTAL STUDY OF THE INFLUENCE OF MUSIC ON BEHAVIOR.

The experiments reported in this chapter were begun in the Spring of 1921, and after the interval of the summer vacation were continued until May 1922. The object of the investigation was to determine the influence of music upon certain typical forms and aspects of behavior which are of importance in the ordinary activities of daily life.

The majority of investigators in this field, as our chapter on the history of the subject indicates, have been particularly interested in the affective processes in relation to music. They have therefore confined themselves in general to studying the reactions of the unstriated muscles or at least to reactions not normally under volitional control. The influence of music on voluntary responses, reactions of the striated muscles is, however, of equal interest and must be directly determined if music is to be applied successfully as a regulating and stimulating factor in industry. With this practical object in mind, the majority of the experiments concern the effect of music of various types on such features of response as endurance, speed, and accuracy, and on such forms of Behavior as Graphic reactions, Suggestion, and Illusion. The remaining experiments refer to the affective processes aroused by music. The complete list of experiments comprise studies of the influence of music on:

1. Fatigue and endurance by means of the ergograph and dynamometer.
2. Accuracy of movement, aiming being selected as the activity to be tested.
3. Speed of movement, as exemplified by handwriting and typewriting.
4. Graphic behavior including:
 - (1) A Study of the effect of music on speed, size, form, and character of handwriting.

(2). A study of the effect of single chords on the same element of handwriting.

(3). The effect of music on the drawing of lines.

5. The Müller Lyer Illusion.

6. Normal Suggestibility.

7. The Choice of Colors.

8. Reactions indicative of affective states including:

(1). The psychogalvanic reflex

(2). Respiration

(3). Involuntary movement.

In short, the experiments test:

1. Habitual voluntary reactions

2. Voluntary reactions involving attention and judgment.

3. Involuntary reactions.

This limited group of functions was selected for further study out of a much more extended list on which tentative experiments were made. Most of these tentative experiments yielded purely negative or doubtful results while the study of certain functions was impracticable at present, while offering possibilities which will be discussed later on.

The subjects of the present study were principally University students of both sexes, ranging from Sophomores to Graduate Students. Most of them ^{had} taken at least one course in elementary psychology. The majority possessed only an elementary knowledge of music. A few however were students of the Cincinnati Conservatory of Music. A number of young men from the Franklin Preparatory School also served as subjects in the experiments on Suggestion,

and Choice of Colors, while in one of the handwriting experiments, all of the subjects were men from the Franklin School.

A description of the particular apparatus, materials, and method used in each experiment is included in the corresponding sections, but certain general details may be given at this point, since they formed a constant part of the experimental situation.

The experiments were carried out in Rooms 44 and 45 on the fourth floor of McMicken Hall at the University of Cincinnati. Owing to this location, there were very few distracting noises and the subjects were enabled to give complete attention to the experiments. Room 44 in which the majority of the experiments were executed, is 22 by 25 feet. The subjects were seated during the experiments 10 to 25 feet from the source of music, usually with the back turned to the phonograph which was operated by an assistant. In the experiments on accuracy of movement, the psychogalvanic reflex, and involuntary movements, the phonograph was at a distance of from 40 to 45 feet, in another room from which the instrument could not be seen. However, when the phonograph was adjusted to give a maximum volume of tone, little difference in loudness was noted by the subjects. In all cases the music was plainly heard, and since the subject's attention was especially directed to the music during the experiments on the psychogalvanic reflex, and involuntary movements, the location of the phonograph in an adjoining room was favorable rather than otherwise, the illusion of an orchestral performance being thus increased, according to some of the introspections.

The experiments in general required from one to ten hours of work on the part of the subject according to whether the latter participated in but a few or in all tests. The experiments on the affect of chords on handwriting, however, required but a half hour's time from the participants.

The experiments took place in the afternoon from 1 to 5 P. M. and in the evening from 6 to 8 P. M. Those on graphic behavior and typewriting were mostly carried out during the evening hours, while the rest were in the afternoon. Within these limits, hours were arranged to suit the subjects' convenience. This was necessary since variation in the classroom schedule of subjects rendered it impossible to maintain constancy in the hour during which individuals were tested. The order of the experiments was not the same for all, and several different experiments were often worked at during the same day.

The experiments on Suggestion and the choice of colors were planned by the writer and performed with the assistance of Mr. C. O. Brown, a graduate student in the Department of Psychology. Other students frequently assisted in operating the phonograph or recording data, introspections, etc.

The music for the experiments was furnished by a large Edison Cabinet phonograph permitting of considerable variation in the volume or loudness as well as the tempo with which records could be played. The permanent diamond point and the driving mechanism, which moves the arm across the disc thus greatly reducing pressure, practically eliminated scratching so that none of the usual complaints on this score were offered. The phonographic records employed were selected out of a large number of tested records furnished by The Edison Company. The principle of selection was the effort to secure records free from imperfections, and representative of characteristic types of music as usually classified. In this group of records, a number are included which have already been classified according to the Edison mood tests of Dr. Bingham,

one object being to determine the correlation between this standard introspective account and Behavior observed.

The complete list of records employed included the following:

VOCAL .

- Toreador's Song
- Song of India
- I'll take you home again Kathleen
- Danny Deaver
- Carry me back to Old Virginia

INSTRUMENTAL

- Semper Fidelis March
- Vigoroso March
- Trumpeter's Carnival

MARCHES

Florida Waltz

Rose Mousse

DANCE MUSIC

Cataline Fox Trot

Dixie Melley

Praise Ye the Lord

The Sunshine of your Smile

Meditation

Simple Aven

MISCELLANEOUS.

Quanto io T'amo

Liebesfreud

Voici di primavera

The general method of our experiments was to make a detailed comparison between the subject's normal reactions, and the same subject's responses while listening to music. Ample intervals were permitted to elapse between the

observation of normal responses and responses under the influence of musical stimuli, and the order in which the two series were observed was alternately reversed in certain of the experiments; i. e., sometimes the normal record was taken first, at other times last. The actual forms of the experiments were determined according to the principle of simplicity, the object being to make the task, as well as the directions given to the subject as simple as possible without sacrificing the purpose of the experiment. This seemed desirable in order that comparable results might be obtained from all classes of subjects. In most of the experiments a minimum of introspection was required, the subject being merely required to state whether he was attending to the music or not, and whether the music was pleasant or unpleasant. In the experiments on respiration, involuntary movements, and the psychogalvanic reflex, however, the subject was requested to direct his attention to the music, and introspective records as complete as possible were afterward secured.

No information was given the subjects concerning the purpose, or results of the experiments, and every effort was made to guard against all suggestions which might influence the course of behavior.

THE INFLUENCE OF MUSIC ON FATIGUE AND ENDURANCE.

The object of the first series of experiments was to determine the effect of music on fatigue and endurance as measured by the expenditure of energy during a given time. Preliminary experiments were carried out by means of a Cattell thumb and finger ergograph, with a pointer recording the extent of muscular movement on a revolving drum. The force exerted could be read on a kilogram scale, and correlated with the depth of pull recorded on the Kymograph. The method of intermittent contractions was employed, the subject being told to exert maximum force every two seconds, following alternate strokes of a metronome beating seconds. There were eight subjects and two contrasted types of music were employed; viz., a stirring march, *Semper Fidelis*, (Sousa) and a song, "I'll take you home again, Kathleen," which the majority of a class of 150 students of psychology declared to be depressive. Ten minutes intervened between the several records of normal activity and the activity under the influence of music, and each record covered a period of two minutes involving sixty contractions of the muscles of the thumb and first finger. The records of responses to music were divided into four periods of thirty seconds each, in which the musical stimulus was alternately introduced and shut off.

These preliminary experiments were suspended on account of unsatisfactory results. Inspection of the graphic records failed to disclose any significant changes in the fatigue curve, due to the introduction of the musical stimulus. The decrease in the depth of the curve was very gradual, and although the depth was slightly increased sometimes during the music, the differences were too small to be accurately correlated with the readings on the kilogram scale.

The use of the time marker recording seconds on the Kymograph revealed the fact that the rhythm of music interfered with the subject's ability to follow the rhythm of the metronome in making muscular contractions. This was confirmed by the introspections of the subject, who generally declared that they wanted to "go faster" when rapid music was being played, and that the reverse was true for slow, depressive music. Mr. L. declared that the time seemed much less while rapid music was being played and that this feeling of fatigue during and after the experiment was less intense than under normal conditions. The depressive music on the other hand seemed to increase the sense of fatigue during the experiments as well as to lengthen its apparent duration.

The influence of music on muscular endurance and the course of the fatigue curve was next investigated by means of the dynamometer, using the method of continuous contractions. Ten subjects, all of whom were men served in these tests. The apparatus consisted of a Smedly dynamometer, metronome, phonograph, and two records, representative of stirring and depressive music. The selections employed were; "Semper Fidelis," March for rapid stirring music, and a song called, "Carry me Back to Old Virginia," as the contrasted type. In the case of one subject, however, the "Trumpeter's Carnival March" and Meditation from "Thais" were substituted for the above.

The dynamometer was adjusted to the subject's hand and the measurement recorded so as to maintain the same relation in subsequent tests. The subject was seated at a table with his back to the phonograph. The instrument was held in a vertical plane, with its edge resting on the table. The dial was within view of the subject, who was instructed to grip as strongly as possible, as soon as the music began, and to exert maximum effort until told to stop at the end of sixty seconds. The metronome was set at sixty, and readings were taken every four seconds directly from the dial. The right hand was tested, except upon

147

one or two instances which are noted. The first trial was always without music. The second trial with stirring music, the third with depressive music. A rest period of fifteen minutes intervened between the several trials. The introspections of the subjects were secured immediately after each trial.

The results of these tests appear in the following table, in which the readings, average, and index of fatigue are given for the individual and the entire group of subjects tested.

NORMAL RECORDS.

SUBJECTS.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Av.	Index
Broker L.		49	45	40	35	34	36	26	31	36	36	35	33	32	37	33	35.66	.201
Diserens	46	43	38	35	32	31	32	29	28	27	26	25	25	24	22	23	30.375	.419
DeZavellos	41	36	34	30	32	31	31	29	30	25	25	20	20	25	22	25	28.50	.350
Edwards	58	33	26	20	20	26	26	29	18	15	18	17	12	10	8	8	20.937	.700
Heleck	45	45	40	35	33	31	29	27	27	25	25	25	24	24	22	21	29.875	.455
Koch		37	35	36	36	35	33	32	30	27	26	24	23	24	22	21	29.40	.375
McMillan	33	29	24	25	28	25	33	30	25	23	21	20	22	19	16	19	24.50	.315
Reser	46	44	44	34	28	26	20	17	15	11	11	10	10	10	8	7	21.312	.787
Sample	35	31	30	28	26	25	24	23	21	20	20	19	17	17	16	15	22.937	.477
Walls	70	55	50	44	44	42	40	43	50	44	47	45	35	39	32	32	54.187	.369

11. DYNAMOMETER RECORDS WITH STIRRING MUSIC.

SUBJECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Av.	Index	Fat.
Brooker	43	45	40	31	30	29	34	30	27	24	24	25	25	20	21		29.866		.427
Diserens	47	47	41	38	35	34	34	31	31	31	29	27	29	30	30	28	33.875		.323
DeZavello	44	34	34	29	24	19	19	23	34	22	20	23	20	20	22	19	25.375		.425
Edwards	54	50	30	30	26	25	28	2	5	23	20	20	18	19	17	20	26.437		.555
Helak	48	48	41	33	30	35	31	26	25	31	25	27	27	26	32	30	32.187		.327
Koch		32	29	28	31	30	27	25	23	21	19	21	18	19	18	17	23.866		.400
McMillan	39	33	35	26	26	33	29	24	20	22	23	23	22	19	20	26	26.25		.346
Roser	44	42	37	36	32	29	25	23	21	18	18	17	17	16	17	16	25.75		.534
Sample	32	31	29	28	27	25	24	23	21	22	22	21	21	20	20	19	23.437		.333
Walls	69	58	58	56	55	53	51	54	50	46	42	39	35	30	35	30	47.562		.461

111. DYNAMOMETRIC RECORDS WITH SOOTHING MUSIC.

Broker	39	40	35	32	20	25	20	19	17	18	15	17	15	15	11	22.400	.617	
Diserens	50	46	42	37	36	35	33	32	30	30	28	27	27	26	25	24	32.0	.419
DeZavellos	40	30	29	27	31	24	23	22	23	20	21	15	21	19	19	18	23.875	.385
Edwards	55	40	40	36	30	25	23	26	21	25	20	18	16	17	28	27	27.75	.503
Helak	50	50	43	40	38	36	36	35	33	31	33	35	35	34	33	31	37.062	.290
Koch	34	30	38	26	24	25	21	20	19	18	18	17	16	16	15	21.80	.457	
McMillan	48	45	42	43	37	33	30	32	30	30	32	32	30	25	30	30	34.312	.354
Roser	45	37	36	32	31	31	37	34	25	35	23	22	25	30	22	30	29.062	.353
Sample	32	25	23	23	21	20	19	18	17	16	14	14	13	13	17	12	18.562	.498
Walls	70	69	70	69	69	69	67	64	60	55	50	46	37	36	33	32	56.000	.510

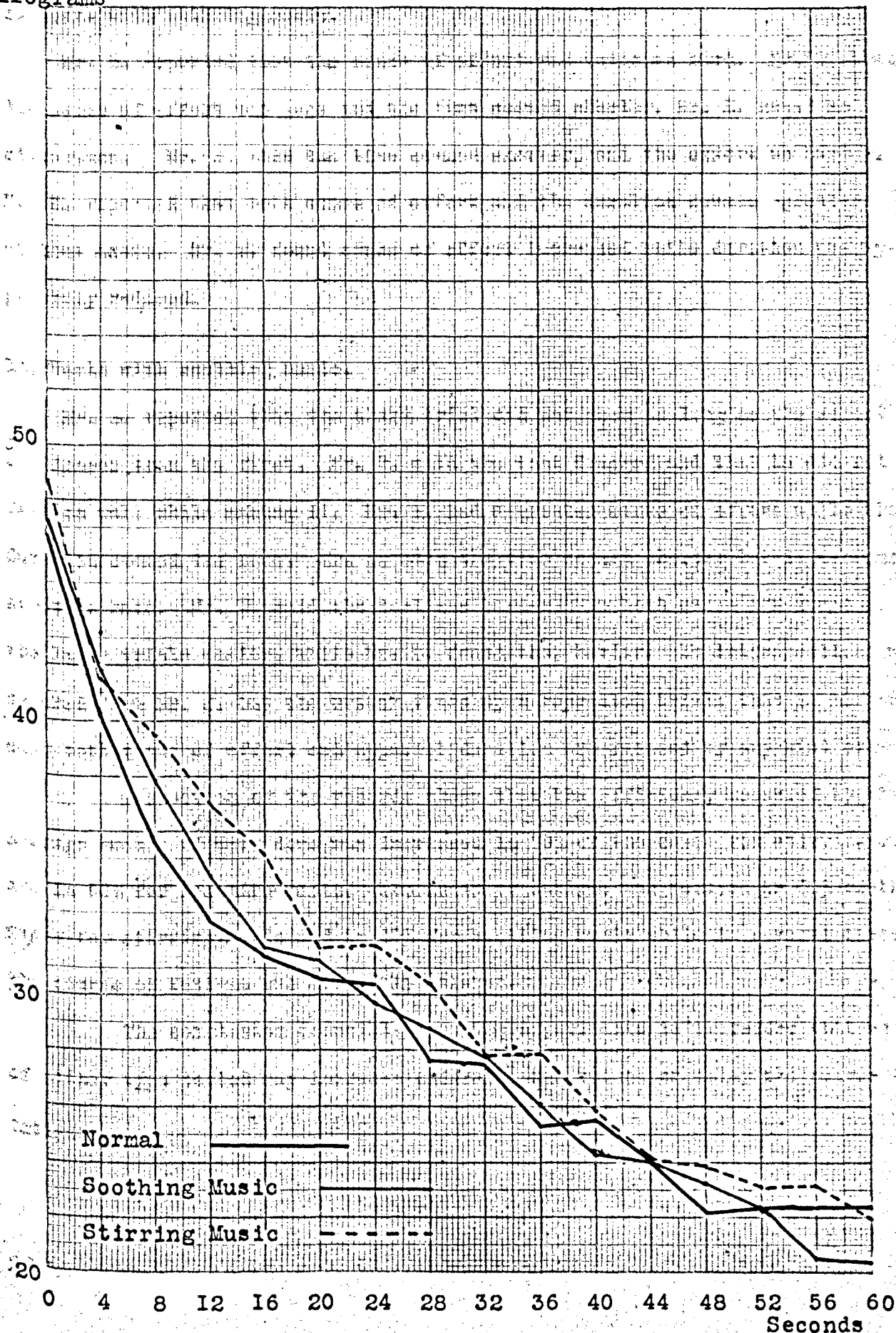
The index of Fatigue is calculated according to the formula given by Whipple (Manual of Mental and Physical Tests, Simpler Processes p. 119).

Fatigue Curves. Average for ten subjects.

190

Kilograms

Department of Criminal, College of Engineering



INTROSPECTION ACCOUNTS.

1. Tests with stirring music.

Mr. B. reported that the sense of effort was twice as hard. Mr. E. that the sense of effort was less and the time seemed shorter. Mr. R. noted no difference. Mr. H. said the time seemed shorter, and the effort no harder. Mr. K. reported that both sense of effort and the duration seemed greater without music. Mr. W. found sense of effort increased while duration was apparently reduced.

11. Tests with soothing music.

Mr. B. reported that the third trial did not seem as long as the second but longer than the first. Mr. E. said the test dragged and that he did not feel so well while making it. Mr. H. had a greater sense of effort while the duration seemed the same. Mr. K. said the time seemed shorter but it was just about as hard. Mr. W. said the test was harder. In both cases MCM found the later trials easier, while Mr. D. found the, harder. No introspections were secured from Mr. S. but the writer finds upon repeated trials that in his own case both sense of effort and apparent duration are reduced by any kind of music.

Inspection of the records shows that the efficiency measured by the average amount of work done was increased in 70% of the cases for stirring music, and in 60% for soothing music. The index of fatigue was reduced in 50% of the cases for stirring music and in 40% for soothing music while in several cases the course of fatigue was evidently delayed.

The conclusion deducible from the experiments is therefore that music of either type tested may increase endurance and reduce or delay the course of fatigue.

ACCURACY OF MOVEMENT.

The object of these experiments was to determine the influence of music on precision or accuracy of movement. Aiming was selected as the activity to be examined and the experiment consisted in a repetition of this test:

1. Under normal conditions.
2. With fast music.
3. With slow music.

19 subjects participated in these tests.

The materials were prepared blanks containing 10 crosses irregularly arranged, a metronome, the phonograph, and four records; viz. "Dixie Medley" (banjo solo), "Semper Fidelis March" (band) "Song of India" (vocal) and "Meditation" from Thais (violin). The only departure from the technique de-

2

scribed by Whipple was that in the second series of tests, the metronome was set at 60 instead of 138, the object being to discover the effects of music on more deliberate aiming. Two minutes were allowed to intervene between the tests, the order of which was varied from one subject to another. Only the right hand was tested.

The average errors and mean deviations for all subjects appear in the following tables.

2. Whipple G. M. Ibid Test 11 p. 147-151.

SERIES 1 METRONOME AT 128 BEATS PER MINUTE.

Subject	Normal		Fast Music		Slow Music		Change in Accur.
	Av. Error	A. D.	Av. Error	A. D.	Av. Error	A. D.	
Colwell	8.7	2.9			5.01	2.00	Positive
Diserens	6.00	2.12	6.10	2.65	6.77	2.88	Negative
DeZell.	9.33	3.50	5.43	3.14	3.70	2.12	Positive
Friedman	3.63	1.55	4.20	1.99	3.68	1.85	Negative
Kelok	4.03	1.74	4.53	2.18	3.43	1.88	Positive
Martin	7.53	2.59	6.03	2.39	7.02	2.68	"
McMillan	7.77	2.83	5.47	2.50	5.93	1.94	"
Morris	6.80	2.77	5.80	1.86	5.10	4.05	"
Oliver	5.85	1.18	4.58	2.56	3.85	2.25	"
Stiebel	4.65	1.96	3.90	1.39	4.50	1.74	"
General Av.	6.39		4.60		4.89		

11. METRONOME AT 60 BEATS PER MINUTE.

Brown	3.28	1.44	3.45	1.51	3.10	1.51	Pos-Neg.
Colson	3.78	1.50	4.08	1.73	4.32	1.96	Negative
Diserens	6.91	2.75	6.83	3.26	7.12	3.30	Pos-Neg.
Koch	2.58	1.14	3.57	1.06	2.38	1.58	Neg-Pos.
Nathan	6.20	3.33	6.02	2.51	4.45	2.20	Pos-Pos
Salkover	5.87	2.50	5.38	1.07	5.15	2.34	" "
Sample	2.88	1.21	3.73	1.62	3.75	1.08	Neg-Neg
Turpin	2.75	1.07	4.32	1.25	4.96	2.15	" "
Walls	2.71	2.33	4.38	2.34	4.31	2.06	Pos-Pos
Wills	3.96	1.89	3.93	2.06	3.91	2.07	" "
General Av.	4.29		4.57		4.34		

More than half of the subjects (nos. 4, 5, 8, and 9 in Series I and Nos. 2, 4, 5, 6, 7, 8, and 9 in series II) complained of finding difficulty in following the beats of the Metronome while music was playing. There was evidently a tendency to substitute the rhythm of the music for that of the metronome in making the aiming movements. Only one subject (no 1. of Series I) thought she could aim better while listening to slow music, an impression which happens to coincide with achievement. When the metronome was set at 60, there was not even the appearance of greater accuracy while listening to music, but with the metronome at 138 there seems at first sight to be a general improvement in precision since 8 out of ten subjects did somewhat better with music. An inspection of the mean deviation however reveals no significant differences, since in only two cases out of 10 are the differences greater than the average deviation. The conclusion from the records therefore is that music has little or no effect on precision of movement, while the reports of the subjects indicate that it may be a distracting factor.

L IV

SPEED AND ACCURACY IN TYPEWRITING.

The purpose of the tests was to determine the effect of music on the speed and accuracy of typewriting from copy. Ten subjects all of them fairly skilled typists using the touch system participated in the tests.

The apparatus used in the test was a Remington No. 10 machine, a stop watch, phonograph, and two records; viz

1. a rapid stirring march (Vigoreoso)
2. a slow soothing violin solo (Meditation from Thais.)

The material to be copied consisted of the following typewritten excerpts from H. G. Moulton's Principles of Money and Banking.

1. Every contract, combination in the form of trust or otherwise conspiracy in restraint of trade or commerce among the several states, or with foreign nations, is hereby declared to be illegal. Every person who shall make any such contract, or engage in any such combination, or conspiracy, shall be deemed guilty of misdemeanor, and on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishment, in the discretion of the courts.

2. Every person who shall monopolize, or attempt to monopolize or combine or conspire with any other person or persons, any part of the trade or commerce among several states, or the foreign nations, shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

3. Every contract, combination in form of trust, or otherwise, or conspiracy, in restraint of trade or commerce in any territory of the United States or in the District of Columbia, or in restraint of trade or commerce between any such territory or another, or between any such territory or territories and

20

and any states or states and District of Columbia, or with foreign nations, or between the District of Columbia and any state or states or foreign nations, is hereby declared illegal. Every person who shall make any such contract, or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by fine not exceeding five thousand dollars, or by imprisonment not exceeding one year, or by both said punishments in the discretion of the court.

4. The several circuit courts of the United States of America are hereby invested with jurisdiction to prevent and restrain violation of this act; and it shall be the duty of several District Attorneys in the United States in their respective Districts under the direction of the Attorney General, to institute proceedings in equity to prevent and restrain such violations. Such proceedings may be by way of petition, setting forth the case and praying that such violation shall be enjoined or otherwise prohibited. When the parties complained of shall have been duly notified of such petition, the court shall proceed, as soon as may be, to the hearing and determination of the case; and pending such petition and before final decree, the court may at any time make such temporary restraining order and prohibition as shall be deemed just in the premises."

This material was selected as affording a minimum of intrinsic interest, since it was desirable that the subject's attention be entirely directed to the task of typewriting. The subjects were first allowed to typewrite some miscellaneous material for several minutes in order to get used to the machine, as well as "warmed up" to the work. A normal typewriter record was then taken, the subject then being instructed to typewrite as rapidly as possible until told to stop at the end of two minutes. After a pause of two minutes, the test was repeated with a musical accompaniment.

The subject was instructed to begin typewriting the second paragraph of the material as soon as the music started and to continue typewriting as rapidly as possible until the music was shut off at the end of two minutes. After another pause of two minutes, the test was repeated with music of a different type, the third paragraph being employed as copy material. After the tests were all over the subject was asked to describe how they felt during the several trials. The records of the tests were analyzed for:

- 1. The total number of movements made by the typist and
- 2. The number (total) of errors.

Total movements include

- 1. numbers of letters written
- 2. number of punctuation marks,
- 3. number of spacing and shifting movements.

Errors include omissions or inversions of letters, substitution of wrong letters, omissions of punctuation marks and mistakes in spacing. The tabular result of this analysis appears below:

ANALYSIS OF SPEED AND ACCURACY IN TYPEWRITING DURING TWO MINUTES PERIOD.

Subjects	Normal		Fast Music		Slow Music.	
	Total Moves	Total Er.	Moves	Errors	Moves	Errors
Miss A	567	12	541	12	686	21
Miss B	549	2	601	4	676	0
Miss Bu	471	3	488	4	530	6
Mr. G	598	1	566	0	568	0
Miss L	276	0	260	1	267	4
Miss M	327	1	291	3	340	2
Miss P	525	3	493	8	515	4
Miss R	225	3	239	12	237	8
Miss S	222	8	233	6	230	4
Miss T	654	10	696	9	725	8
Average	439.4	4.3	440.8	5.9	477.4	4.9

A Certain number of introspections were obtained from the subjects but these as a rule did not correspond with actual performance. Miss A. was uncertain as to the influence of music of either type on the work. Miss B. found both types of music stimulating "especially the Meditation of Thais which is a favorite." She often typewrites at home while music is being played and thinks it aids her work.

Mr. G. said that the stirring music made him feel like working faster not because he must but quite voluntarily. Miss L. found music distracting in both cases, but the rapid March most distracting. Miss M writes that "the quiet music did not distract me nearly so much as did the fast and lively music. I found it very difficult to concentrate during the

fast music and made more errors, while I noticed the quiet music very little.

The fast music gave me the mental effect of trying to beat it, which caused nervousness. This was entirely basent with the quiet music. " Miss R. said that the Meditation from Thais made her work better. Miss S. said the "March makes you feel good," while the 2nd piece seems to "hold you back."

Miss P. found the music a distraction. She found herself stopping to listen, but believes that she could copy stereotyped material, e. g. addressing, etc., faster to music.

No introspections were secured from the others.

The changes seem to of slight to hazard any conclusions on the effect of music in typing, unless perhaps that agreeable music tends to increase speed in practiced typists. The slow music was pronounced most pleasant by all, while the rapid music was disliked by some and not especially attractive to the majority. It will be noted, that the average speed, as measured by number of movements made, remains practically the same for rapid music as for normal conditions, while it increases 8.8% for the slow music of Meditation. No striking difference appears in the number of errors made under the varying conditions of the experiment but a correlation of 84% is found to exist between speed and number of errors in the case of fast music.

INFLUENCE OF MUSIC ON HANDWRITING.

The purpose of the experiments was to determine the influence of music of contrasted types on such elements of graphic behavior as speed, size, pressure and accuracy. Ten subjects all of them women participated in the tests which were carried on from 6:30 to 7:30 P. M.

The apparatus consisted of a supply of unruled white paper, carbon paper, the typewritten excerpts from Moulton, the same as were used in the tests of typewriting, a stop-watch, phonograph, and two records; viz., "Semper Fidelis," (March) and "Meditation" from Thais, illustrating respectively rapid, stirring, and slow soothing music.

In carrying out the tests, the subject was seated at a table with her back to the machine. She was provided with paper, pencil, and a typewritten copy of the excerpts to be copied. The subject was told that she would be asked to write from copy for a few minutes and that music would be played during part of the time. The subject was told to begin writing at the signal "now" from the experimenter, to interpolate a vertical stroke when the music began and to cease writing at once when the music stopped. She was further told to write at whatever rate seemed most convenient or "felt best."

At the signal "now" the subject began writing and after two minutes the phonograph was started, and at the end of two minutes more the music was stopped. After an interval of five minutes the subject was requested to write once more on a lower section of the page, beginning and ending with the commencement and cessation of music of a different type. The subject began writing where she left off in the first part of the experiment. The usual order was (1) writing without music; (2) writing to rapid music; (3) writing to slow music, since a practice effect was improbable in the case of such thoroughly practiced activity as graphic behavior.

The results were analyzed by means of a key sheet of copy upon which the number of letters, punctuations marks, i's and t's were recorded per line, and cumulatively, at the side of the sheet. A record was made of

- (1) the total number of letters written under the varying conditions of the different two minute periods;
- (2) The number of i's dotted and t's correctly crossed.
- (3) The total length in millimeters of all the lines or parts of lines written during the two minute period.
- (4) An attempt was made to determine variations in pressure by inspecting carbon copies secured by placing several extra sheets alternating with carbon paper beneath the paper on which the subject wrote. The several sheets were held together by paper clamps and an inspection of the successively dimmer carbon copies of the handwriting gave some idea of the variation in pressure occurring during the experiments. The results are recorded in a special column; the plus sign indicating increased pressure, the minus sign - a decrease.

A rough measure of the increase in the size of the handwriting was obtained by dividing the total length in m. m. of lines written during a two minute period, by the number of letters written. This gives the average size or rather length per letter, and under given conditions and a comparison of these measures yields a rough index of change in size under the influence of music. A change in length would probably involve change in height of letters, so that the measure is probably a fair index of size. Of course, the change in the total length of lines during period may be due to both. In ^{relations.} In any case, some measure of the alteration in specialⁱⁿ graphic behavior is obtained in this way.

Finally, the total number of i's dotted, t's correctly crossed was noted in each test, and compared with the actual number in the portion of the typewritten excerpts actually copied. The results are expressed in percentages in a special table. The analytic results of the experiments are incorporated in the following tables.

INFLUENCE OF MUSIC ON HANDWRITING.

	Normal			Fast Music			Slow Music.		
Berg.	273	1363	5.00	242	1269	5.24	243	1319	5.42
Cald.	250	1176	4.70	243	1226	5.04	203	898	4.45
Ernst	210	1347	6.41	279	1408	5.05	225	1427	6.34
Foster	204	1166	5.71	199	1382	6.93	181	1202	6.64
Fulner	270	1248	4.62	158	1083	6.85	226	1150	5.00
Magrish	237	1104	4.64	247	1300	5.26	260	1119	4.30
Micelli	214	1169	5.46	194	1100	5.67	213	1182	5.55
Ryeburn	237	1188	5.05	203	1166	5.45	253	1292	5.11
Schwartz	189	1055	5.58	191	1155	6.04	224	1256	5.61
Stiebel	209	1076	5.15	246	1085	4.41	209	1141	5.46
Average	2293	11892	5.28	2202	12174	5.594	2237	11967	5.386

First column - subject
Second column - letters written
Third column - Total length in m. m.
Fourth Column - Size in m. m.
Fifth column - Pressure.

It will be noticed that in 8 out of 10 cases, there is an increase of size with fast music, in 7 cases there is an increase with slow music. In cases there is an increase in size for both kinds of music. In general there is no significant alteration in speed with music, but inspection shows that in those cases where there was no increase in size of writing there was a considerable increase in speed. This leads to a calculation of the correlation between size and speed, according to Spearman's method of rank differences; viz: $r = 1$

The results showed that size and speed are negatively correlated the correlation being as follows:

1. Under normal conditions 74
2. With fast music 79
3. With slow music 54

PERCENTAGE OF PERFECT i's and t's.

SUBJECTS	NORMAL		FAST MUSIC		SLOW MUSIC	
	i's	t's	i's	t's	i's	t's
B.	100	33-1/3	94	39	60	100
C	66-2/3	47	69	64	75	50
E	93	91	82	94	86	94
Fo	100	92	91	100	100	82
Fu	100	65	94	84	92	66-2/3
Ma	50	61	28	60	27	20
Mi	100	100	94	75	100	73
R	100	80	96	87	92	97
Sch	100	100	83	85	100	59
Average	98.9%	74.9%	83.1%	75.8%	83.2%	73.0%

210

It will be seen that both types of music have practically the same effect on omissions. Music tends to produce failure to dot i's but has little effect on t's. Music is a mild distracting factor.

The chief conclusions of the experiment are:

1. that music generally increases the size of handwriting and only occasionally the speed, and
2. That there exists a negative correlation between these two factors.

INFLUENCE OF HIGH AND LOW CHORDS ON HANDWRITING.

A short experiment was undertaken to test the assertion of Urbantschitsch that musical stimuli of high and low frequency produce characteristic changes in handwriting, such as alterations in size, position, and angularity of letters and lines, as well as omissions of i's and t's. Ten subjects, all of them pupils of the Franklin Preparatory School, took part in the experiment. A sentence "The capital of the United States is in Washington," was selected as containing a large number of i's and t's. The subject was required to write in pencil this sentence three times in silence. After an interval of five minutes, the subject was required to write the sentence again three times while the chord CEGD was sounded as low on the scale as possible. After another interval of five minutes the subjects were again required to write while the same chord as high on the scale as was possible with a piano was sounded. A piano was used to produce the chord which was sounded repeatedly during the writing. Ruled paper was used in every case in order that the tendency of writing to ascend might be detected. The total length of writing for the three conditions was then measured in millimetres, and the number of omissions in dotting i's and t's computed and the writing carefully studied for changes in angularity, slant and other graphic elements.

21

The average length of the sentence written, based on 30 samples was 162.7 mm. The average length with a low chord was 163.1 mm. The same figures held for a high chord. Thus the average of 60 samples written while a chord was sounded was 163.1 mm an increase of 4 m. m. which is probably negligible since the average deviation among samples was greater. No tendency to raise or lower the writing was observed, nor were there any consistent changes in graphic elements, although the writing seemed in general more carelessly done under the influence of the chord.

Since most of the subjects omitted to dot i's or cross t's in all cases, no useful data on the effect of the chords on omissions could be obtained from the papers. The results of the experiment are thus almost entirely negative, though a tendency to increased size of writing in the presence of musical stimuli may perhaps exist.

THE INFLUENCE OF MUSIC ON VOLUNTARY MOVEMENT.

The object of these experiments was to determine the influence of music on the extent and rapidity of simple voluntary movements. The investigation was suggested by the statement of an artist that when he painted to music, as he sometimes did - he noted that the strokes of his brush became longer. The drawing of straight lines in various directions - horizontal, vertical, and at angles was selected as an activity approximating the movements of a painter at work and it was at the same time a set of movements possessed by the average subject.

About thirty subjects in all took part in the tests, but as a number of records had to be discarded through failure of the subjects to comply with instructions, the results given are based on the work of but 21 individuals.

The apparatus consisted of

1. Edison phonograph and two records representing fast and slow music, viz. Semper Fidelis March, and Meditation from Thaïs.
2. Large sheets of white paper on which a thick black line, 50 mm. long was drawn at one end and numbered from 1 to 20.
3. A stop-watch.
4. Rectangles of cardboard.

Method: The subject was seated at a table with the white sheet and model line before him. He was asked to look at the line carefully and try to get a clear image of it as he would shortly be required to draw a series of lines from the image. The length of the line was not stated. The subject was told that he would be asked to draw three series of lines at intervals, each time from the mental image, and that during two of the tests music would be played. He was further told to select his own speed in drawing the lines. After this preliminary instruction, the subject was asked to

fixate the line for a few seconds and at a signal from the experimenter to cover the stimulus line and begin drawing lines as nearly like it in length as possible covering each line as soon as drawn and depending entirely on the mental image of the line. He was further told to stop after drawing twenty lines as indicated from a list of numbers along the margin of the sheet. The time taken by the subject was recorded by means of a stop-watch.

After an interval of several minutes the test was repeated, all of the conditions remaining the same, except that this time after fixating the model line, the subject was required to draw from the image while listening to music. The subject was told to start as soon as the music began, and the time consumed was recorded as before. Another interval after the test was repeated with music of a different type. The order of the tests varied with different subjects, the object being to avoid practice effects. No introspection was required.

The length of the lines drawn under the various conditions of the test were measured down to a half of a millimeter and the average for each individual together with the mean variation and the general averages appear in the following tabular analysis.

Subject	Condition	Mean	Mean Variation	General Average
1	Visual	1.25	0.10	1.25
1	Visual + Music	1.20	0.10	1.20
2	Visual	1.30	0.10	1.30
2	Visual + Music	1.25	0.10	1.25
3	Visual	1.35	0.10	1.35
3	Visual + Music	1.30	0.10	1.30
4	Visual	1.40	0.10	1.40
4	Visual + Music	1.35	0.10	1.35
5	Visual	1.45	0.10	1.45
5	Visual + Music	1.40	0.10	1.40
6	Visual	1.50	0.10	1.50
6	Visual + Music	1.45	0.10	1.45
7	Visual	1.55	0.10	1.55
7	Visual + Music	1.50	0.10	1.50
8	Visual	1.60	0.10	1.60
8	Visual + Music	1.55	0.10	1.55
9	Visual	1.65	0.10	1.65
9	Visual + Music	1.60	0.10	1.60
10	Visual	1.70	0.10	1.70
10	Visual + Music	1.65	0.10	1.65
11	Visual	1.75	0.10	1.75
11	Visual + Music	1.70	0.10	1.70
12	Visual	1.80	0.10	1.80
12	Visual + Music	1.75	0.10	1.75
13	Visual	1.85	0.10	1.85
13	Visual + Music	1.80	0.10	1.80
14	Visual	1.90	0.10	1.90
14	Visual + Music	1.85	0.10	1.85
15	Visual	1.95	0.10	1.95
15	Visual + Music	1.90	0.10	1.90
16	Visual	2.00	0.10	2.00
16	Visual + Music	1.95	0.10	1.95
17	Visual	2.05	0.10	2.05
17	Visual + Music	2.00	0.10	2.00
18	Visual	2.10	0.10	2.10
18	Visual + Music	2.05	0.10	2.05
19	Visual	2.15	0.10	2.15
19	Visual + Music	2.10	0.10	2.10
20	Visual	2.20	0.10	2.20
20	Visual + Music	2.15	0.10	2.15
21	Visual	2.25	0.10	2.25
21	Visual + Music	2.20	0.10	2.20
22	Visual	2.30	0.10	2.30
22	Visual + Music	2.25	0.10	2.25
23	Visual	2.35	0.10	2.35
23	Visual + Music	2.30	0.10	2.30
24	Visual	2.40	0.10	2.40
24	Visual + Music	2.35	0.10	2.35
25	Visual	2.45	0.10	2.45
25	Visual + Music	2.40	0.10	2.40
26	Visual	2.50	0.10	2.50
26	Visual + Music	2.45	0.10	2.45
27	Visual	2.55	0.10	2.55
27	Visual + Music	2.50	0.10	2.50
28	Visual	2.60	0.10	2.60
28	Visual + Music	2.55	0.10	2.55
29	Visual	2.65	0.10	2.65
29	Visual + Music	2.60	0.10	2.60
30	Visual	2.70	0.10	2.70
30	Visual + Music	2.65	0.10	2.65
31	Visual	2.75	0.10	2.75
31	Visual + Music	2.70	0.10	2.70
32	Visual	2.80	0.10	2.80
32	Visual + Music	2.75	0.10	2.75
33	Visual	2.85	0.10	2.85
33	Visual + Music	2.80	0.10	2.80
34	Visual	2.90	0.10	2.90
34	Visual + Music	2.85	0.10	2.85
35	Visual	2.95	0.10	2.95
35	Visual + Music	2.90	0.10	2.90
36	Visual	3.00	0.10	3.00
36	Visual + Music	2.95	0.10	2.95
37	Visual	3.05	0.10	3.05
37	Visual + Music	3.00	0.10	3.00
38	Visual	3.10	0.10	3.10
38	Visual + Music	3.05	0.10	3.05
39	Visual	3.15	0.10	3.15
39	Visual + Music	3.10	0.10	3.10
40	Visual	3.20	0.10	3.20
40	Visual + Music	3.15	0.10	3.15
41	Visual	3.25	0.10	3.25
41	Visual + Music	3.20	0.10	3.20
42	Visual	3.30	0.10	3.30
42	Visual + Music	3.25	0.10	3.25
43	Visual	3.35	0.10	3.35
43	Visual + Music	3.30	0.10	3.30
44	Visual	3.40	0.10	3.40
44	Visual + Music	3.35	0.10	3.35
45	Visual	3.45	0.10	3.45
45	Visual + Music	3.40	0.10	3.40
46	Visual	3.50	0.10	3.50
46	Visual + Music	3.45	0.10	3.45
47	Visual	3.55	0.10	3.55
47	Visual + Music	3.50	0.10	3.50
48	Visual	3.60	0.10	3.60
48	Visual + Music	3.55	0.10	3.55
49	Visual	3.65	0.10	3.65
49	Visual + Music	3.60	0.10	3.60
50	Visual	3.70	0.10	3.70
50	Visual + Music	3.65	0.10	3.65
51	Visual	3.75	0.10	3.75
51	Visual + Music	3.70	0.10	3.70
52	Visual	3.80	0.10	3.80
52	Visual + Music	3.75	0.10	3.75
53	Visual	3.85	0.10	3.85
53	Visual + Music	3.80	0.10	3.80
54	Visual	3.90	0.10	3.90
54	Visual + Music	3.85	0.10	3.85
55	Visual	3.95	0.10	3.95
55	Visual + Music	3.90	0.10	3.90
56	Visual	4.00	0.10	4.00
56	Visual + Music	3.95	0.10	3.95
57	Visual	4.05	0.10	4.05
57	Visual + Music	4.00	0.10	4.00
58	Visual	4.10	0.10	4.10
58	Visual + Music	4.05	0.10	4.05
59	Visual	4.15	0.10	4.15
59	Visual + Music	4.10	0.10	4.10
60	Visual	4.20	0.10	4.20
60	Visual + Music	4.15	0.10	4.15
61	Visual	4.25	0.10	4.25
61	Visual + Music	4.20	0.10	4.20
62	Visual	4.30	0.10	4.30
62	Visual + Music	4.25	0.10	4.25
63	Visual	4.35	0.10	4.35
63	Visual + Music	4.30	0.10	4.30
64	Visual	4.40	0.10	4.40
64	Visual + Music	4.35	0.10	4.35
65	Visual	4.45	0.10	4.45
65	Visual + Music	4.40	0.10	4.40
66	Visual	4.50	0.10	4.50
66	Visual + Music	4.45	0.10	4.45
67	Visual	4.55	0.10	4.55
67	Visual + Music	4.50	0.10	4.50
68	Visual	4.60	0.10	4.60
68	Visual + Music	4.55	0.10	4.55
69	Visual	4.65	0.10	4.65
69	Visual + Music	4.60	0.10	4.60
70	Visual	4.70	0.10	4.70
70	Visual + Music	4.65	0.10	4.65
71	Visual	4.75	0.10	4.75
71	Visual + Music	4.70	0.10	4.70
72	Visual	4.80	0.10	4.80
72	Visual + Music	4.75	0.10	4.75
73	Visual	4.85	0.10	4.85
73	Visual + Music	4.80	0.10	4.80
74	Visual	4.90	0.10	4.90
74	Visual + Music	4.85	0.10	4.85
75	Visual	4.95	0.10	4.95
75	Visual + Music	4.90	0.10	4.90
76	Visual	5.00	0.10	5.00
76	Visual + Music	4.95	0.10	4.95
77	Visual	5.05	0.10	5.05
77	Visual + Music	5.00	0.10	5.00
78	Visual	5.10	0.10	5.10
78	Visual + Music	5.05	0.10	5.05
79	Visual	5.15	0.10	5.15
79	Visual + Music	5.10	0.10	5.10
80	Visual	5.20	0.10	5.20
80	Visual + Music	5.15	0.10	5.15
81	Visual	5.25	0.10	5.25
81	Visual + Music	5.20	0.10	5.20
82	Visual	5.30	0.10	5.30
82	Visual + Music	5.25	0.10	5.25
83	Visual	5.35	0.10	5.35
83	Visual + Music	5.30	0.10	5.30
84	Visual	5.40	0.10	5.40
84	Visual + Music	5.35	0.10	5.35
85	Visual	5.45	0.10	5.45
85	Visual + Music	5.40	0.10	5.40
86	Visual	5.50	0.10	5.50
86	Visual + Music	5.45	0.10	5.45
87	Visual	5.55	0.10	5.55
87	Visual + Music	5.50	0.10	5.50
88	Visual	5.60	0.10	5.60
88	Visual + Music	5.55	0.10	5.55
89	Visual	5.65	0.10	5.65
89	Visual + Music	5.60	0.10	5.60
90	Visual	5.70	0.10	5.70
90	Visual + Music	5.65	0.10	5.65
91	Visual	5.75	0.10	5.75
91	Visual + Music	5.70	0.10	5.70
92	Visual	5.80	0.10	5.80
92	Visual + Music	5.75	0.10	5.75
93	Visual	5.85	0.10	5.85
93	Visual + Music	5.80	0.10	5.80
94	Visual	5.90	0.10	5.90
94	Visual + Music	5.85	0.10	5.85
95	Visual	5.95	0.10	5.95
95	Visual + Music	5.90	0.10	5.90
96	Visual	6.00	0.10	6.00
96	Visual + Music	5.95	0.10	5.95
97	Visual	6.05	0.10	6.05
97	Visual + Music	6.00	0.10	6.00
98	Visual	6.10	0.10	6.10
98	Visual + Music	6.05	0.10	6.05
99	Visual	6.15	0.10	6.15
99	Visual + Music	6.10	0.10	6.10
100	Visual	6.20	0.10	6.20
100	Visual + Music	6.15	0.10	6.15

DRAWING LINES NORMAL AND WITH MUSIC.

Subjects	Normal		Fast Music		Slow Music	
	Length mm	A. D.	Length	A. D.	Lengthmm	A. D.
HORIZONTAL LINES.						
Abel	42.85	218	80.20	2.66	50.90	2.40
Bergmayer	28.20	2106	49.80	2.42	50.85	1.08
Bromberg	48.70	3.45	80.20	2.65	53.35	4.25
Bush	41.40	1.70	54.88	2.45	48.45	1.45
Buttenweiser	47.05	1.05	47.65	1.21	49.95	1.05
Colson	55.05	2.05	56.65	2.08		
Diserens	47.45	2.80	53.30	2.50	54.30	2.27
Fulner	46.95	4.01	45.20	2.05	43.25	3.24
Laile	53.25	2.48	52.75	2.76	44.50	2.10
Micelli	55.35	7.10	39.45	4.72	58.51	4.00
Nathan	44.35	2.30	46.30	2.10	47.10	1.83
Stevens	45.70	3.32	56.10	1.51		
Wills	50.75	1.73	51.10	1.83	52.85	2.25
Withrow	52.05	1.15	55.90	1.00		
Vertical Lines.						
Appel	52.20	2.43	50.92	4.77	47.20	2.72
Schwartzenburg	52.85	2180	58.90	1.86	60.55	2.45
Lines Drawn at an angle of 45 degrees.						
Appel	39.55	2.55	46.05	2.60	44.70	2.83
Bergmayer	43.95	1.95	44.95	2.30	46.95	2.50
Fulner	37.66	1.40	48.60	1.70	38.20	2.00
Morris	45.05	3.55	47.40	2.60	53.15	3.55
Schwartzburg	41.75	2.15	51.25	1.90	63.40	2.70
Average for all	46.77		50.83		50.45	
horizontal lines	48.65		50.68		50.36	
Vertical lines	52.52		54.91		53.87	
Lines at angle	41.59		53.81		59.87	

TOTAL TIME REQUIRED IN DRAWING LINES.

	Normal Time in sec.	Fast music ¹ Horizontal Lines Time in Sec.	Slow music. Time in Sec.
Abel	80	52	56
Bergmeyer	85	72	63
Bromberg	37	39	38
Buttenweiser	58	56	47
Bush	59	54	52
Colson	78	64	
Diserens	45	48	54
Fulner	83	80	65
Laile	78	40	37
Micelli	65	46	53
Nathan	123	108	123
Stevens	85	85	
Wills	84	60	71
Withrow	95	91	

Vertical Lines

Appel	28	34	32
Schwartzburg	50	34	35

Lines Drawn at an Angle of 45 degrees.

Appel	25	25	29
Bergmeyer	47	35	35
Fulner	30	22	27
Morris	106	57	50
Schwartzburg	34	27	39
Average time for all lines	65.4	53.8	50.3
Horizontal	75.4	63.9	59.9
Vertical	39	34	33.5
Angular	48.4	33.2	34

A comparison of the average length of lines drawn with and without music shows that music either fast or slow almost invariably increases the length of the lines drawn. This occurred in 18 subjects out of 21 or 86% of the cases with rapid stirring music. In 16 subjects out of 18, or 89% of the cases with slow music. The average increase in length amounts to 8.7% for fast music and 7.9% for slow music. Comparing lines drawn without music with those drawn while listening to music - both kinds - the average increase in length is 8.33%. Inspection of the table of total reaction times also reveals, a considerable increase of speed under musical stimulus. This amounts to 21% for fast and 30% for slow music, and combination of the results gives 25.2% increase of speed for music of any kind.

This conclusion follows: that music of any kind increases the extent and rapidity of voluntary movements probably by reinforcing the elementary reflexes, which compose the movements.

THE INFLUENCE OF MUSIC ON SUGGESTIBILITY.

3

The object of this series of experiments was to determine the effect of different kinds of music upon the laws of normal suggestibility. The work is based on that of Sidis and consists essentially of (1) repetition of the latter's experiments with certain differences in method to be noted, and (2) a second repetition of the experiments while music of various types was being played. There were thirteen subjects including eight men and five women.

The apparatus consisted of:

1. fifty-four sheets of white paper (6 x 6 in.) upon which six one-inch squares of variously colored paper were pasted at equal distances across the paper. No color appeared twice on the same sheet. Apart from color, the following factors were present:
There were twelve sheets with one square slightly out of the regular position;
Twelve sheets with one square surrounded by a quarter inch fringe of gray paper.
Twelve sheets with one square of different shape (triangle circle or star)
Six sheets masked by paper of the color of one of the squares on the sheet.
2. Four inch squares of the color of various squares throughout the series.
The Bradley colored papers were used throughout.
3. A split second stop watch.
4. Edison Cabinet Phonograph.
5. The following musical records.

Carry Me Back to Old Virginia

Vocal

Danny Deever

Simple Aveu

Violin Solo

Samper Fidalis March

The Method and Conditions of the Experiments were as follows:

The subject was seated at a table on which a piece of white cardboard was placed to minimize the suggestibility of other colors about the room. The experimenter explained to the subject that an attempt was to be made to determine what factors affect suggestibility, without however, giving a clue as to what the factors were or their possible influence. A sheet on which no apparent factory of suggestibility was illustrated, was exhibited and the subject was instructed to select a square, but instead of pointing it out, merely to distinguish it by saying "one" "two", etc. always counting from the left of the horizontal row of color squares. He was also instructed to choose a square immediately upon the exhibition of a sheet, regardless of whether he liked or disliked any or all of the color squares presented, simply choosing that one to which he was most strongly attracted.

The experiment was then begun by two experimenters seating themselves, one on each side of the subject who was seated as comfortably as possible at a table and told not to move any more than was necessary during the experiment. The subject was seated with his back to the window, the light coming principally over his right shoulder. One of the experimenters placed before the subject a four-inch square of the same color as one of the squares occurring somewhere on the sheets. The subject was told to describe this color as accurately as possible. It was then removed and the fifty-four choice sheets placed before him. He was then told to begin making choices. The experimenter on the left having thoroughly mixed the choice sheets, removed the upper one as rapidly as the subject made his selections, while the experimenter at the right recorded the choices, and times as registered by a stop-watch. After the subject had gone thru the

whole series of sheets, the latter were again suffled and the subject told to choose once more, this time accompanied by either (1) sad, pensive music of slow tempo (selections 1, 2, 3) or stirring music of rapid tempo (selections 4 and 5.)

No subject was permitted to continue for more than ten or twelve minutes at a time, nor to make successive series of selections to different kinds of music. All other noises were excluded as far as possible and in order to eliminate a possible practice effect on the speed of reaction the series of choices, with music was sometimes first and at other times second.

The method employed departs from that of Sidis in that, except for the six sheets masked by colored paper corresponding to one of the color-squares, there was no sheet intervening between the choice sheets, and no fixation period was permitted between choices, while Sidis allowed a fixation period of five seconds. In other respects the method was substantially the same. Obviously, however, the ticking of a metronome could not be used to induce an atmosphere of monotony, because of its influence on the music.

The factors investigated, and the method of calculating results must now be briefly discussed before presenting our data. The factors of suggestibility employed were:

1. Abnormal position (of color elements)
2. Abnormal shape
3. Environment, i. e. conspicuous surroundings.
4. Colored cover, i. e. a sheet of the same color as one of the squares on the following sheet.
5. Color suggested verbally before the experiment was started.

If the square suggested either by colored cover or verbally suggested color was selected immediate suggestibility was assumed as the cause (x).

If a square next to the one suggested was chosen mediate suggestibility (Y) was said to be the cause. The element of pure chance, however, (P) enters into every choice, each square having $\frac{P}{6}$ chances of being selected or (p). But the total number of choices must be $x + Y + P$. The number of choices of the squares suggested (immediate) must be $x + \frac{P}{6} = x + p$ and the number of mediate choices is $Y + 2p$.

Consequently: $X + Y + 6p$ = total number of choices

$X + p$ = number of squares chosen by immediate suggestion
 $Y + 2p$ = number of squares chosen by mediate suggestion.
 $3p$ = number of squares neither immediately or mediate chosen.

Then p can easily be determined by dividing by three the number of experiments under each of the five factors, in which neither the square suggested nor that next to it was chosen. From this x and Y can be found by subtraction. The percentage of suggestibility is then found by dividing X and Y by the number of choices.

ANALYTIC TABLES OF THE RESULTS FOLLOW.

	immed normal	med %	immed. slow music	med. % changes	immed fast % change.	med. S.
1. Discrepancy position	50.0	50.0	-19.6	2.5	-38.9	-44.5
shape	50.0	50.0	-13.9	-69.4	31.8	-61.1
color	13.8	19.4	14.0	-30.5	14.0	-30.5
environment	41.7	8.3	-16.7	16.7	-13.9	-19.4
cover	77.7	-5.5	-16.7	27.7	-61.1	-11.1
2. Wills position	.88.8	-5.55	-63.0	-19.4	-30.5	-2.8
shape	80.5	2.8	-33.3	-16.0	-83.3	-16.7
color	19.4	11.1	-17.4	16.6	44.5	11.1
environ-	61.1	-5.5	16.7	-5.5	-61.1	5.5
cover	-27.6	-21.1	27.6	21.1	72.0	43.3

22

5. Miss Geoghagan						
position	-8.3	-25.0	-8.4	-8.3	-11.1	27.8
shape	225.0	-25.0	0.	0	5.6	27.8
color	36.1	-25.0	-25.0	-25.0	-25.0	-25.0
environment	-13.9	30.5	-2.8	-13.8	-11.1	-55.5
cover	-22.2	-11.1	61.1	8.3	11.1	55.5

6. Miss Winston:						
position	13.9	-30.5			-13.9	30.5
shape	33.3	33.3			-41.6	-8.3
color	-11.1	-5.5			30.5	22.7
environment	36.1	-19.4			-13.7	13.9
cover	0.0	0.0			16.7	-16.7

8. Charles De Zauellos:						
position	33.3	16.7	-22.2	-19.5		
shape	33.3	16.7	5.6	-22.2		
color	19.4	-2.8	13.9	19.5		
environment	8.3	-8.3	19.5	-2.8		
cover	38.9	-5.5	0.0	0.0		

4. Louise Stichel						
position	58.3	-8.3	-55.0	0.0	-14.4	42.8
shape	50.0	0.0	-72.2	-11.1	-2.8	-13.9
color	30.5	11.1	13.8	27.8	-25.0	-11.1
environment	38.9	22.2	25.0	25.0	-44.4	-22.2

9. Cliff Resore						
position	47.2	-1.39	-22.2	38.9		
shape	55.5	30.50	-44.4	-25.0		
color	2.8	13.90	5.5	-22.7		
environment	77.8	-11.1	-8.4	8.3		
cover	44.4	22.2	-49.9	55.6		

Analytical tables continued.

	Normal		Slow Music		Fast Music % of Change	
	Immed.	Med.	Immed.	Med.	Immed.	Med.
9. Cliff Resor						
position	47.2	-1.39	-22.2	38.9		
shape	55.5	30.50	-44.4	-25.0		
color	2.8	-13.90	5.5	-22.7		
environment	77.8	-11.1	-8.4	8.3		
cover	44.4	22.2	-49.9	55.6		
7. E. Laile						
position	2.8	-36.1	-16.7	16.7		
shape	-11.1	-5.5	19.4	-2.8		
color	-11.1	-5.5	27.8	-11.1		
environment	30.5	2.8	-19.4	2.8		
cover	16.7	-16.7	16.7	-16.7		
3. Brown						
position	33.3	16.7	-16.7	-33.3	30.6	2.7
shape	44.4	22.2	-16.6	5.5	-13.9	-19.4
color	19.4	47.2	8.4	-58.3	27.8	-61.1
environment	72.2	11.1	-22.2	-11.1	-8.3	8.3
cover	61.1	11.1	-16.7	16.7	-16.7	11.1
10. J. Malick						
position	-13.9	-19.4			-25.0	25.0
shape	16.7	-16.7			-33.3	-16.7
color	16.7	-16.7			-13.9	30.6
environment	33.3	0.0			-13.9	-13.9
cover	16.7	-16.7			-38.9	11.2
11. H. Steman						
position	16.7	-16.7	-19.5	-2.7		
shape	5.5	-22.2	2.8	13.9		
color	-22.2	-47.2	5.5	13.9		
environment	-5.5	22.2	33.3	-33.3		
cover	44.4	22.2	16.7	16.7		

Analytical tables continued

12. June Edwards	Normal		Slow Music		Fast Music		% of Change
	Immed.	Med	Immed.	Med.	Immed.	Med.	
position	61.1	11.1			-33.3	-22.2	
shape	80.5	2.8			-50.0	0.0	
environment	100.0	13.9			-58.3	8.3	
color	2.8	0.0			-16.7	-33.3	
cover	-5.5	55.5			5.5	-55.5	

13. Bert Halek

position	25.0	-25.0	-16.7	16.7
shape	33.3	-33.3	-25.0	75.0
color	25.0	-25.0	-80.5	52.8
environment	2.5	-22.2	19.7	41.6
cover	5.5	3.9	-11.1	-38.9

These results may be summarized in the three following tables. Table No. 1 is obtained by averaging columns one and two of the Normal individual results and comparing with Sidis. Table 11 is an average of individual results with slow and fast music. Table 111 is obtained by subtracting the values of Table 11 from the normal results of Table 1.

Thus:

Normal, Slow, Fast

1.0 1.0 1.0

1.0 1.0 1.0

1. Normal Results Compared with those of Sidis.

Investigator	Position			Shape			Color		
	Immed.	Med.	Total	Imme.	Med.	Total	Immed.	Med.	Total
Sidis	47.85	5.37	53.22	43.0	13.0	56	28.99	4.44	33.33
Diserens	32.2	-6.7	25.5	31.8	- .9	30.9	7.0	1.8	8.8
% Sidis			47.8			55.2			25.4

Investigator	Environment			Cover		
	Immed.	Med.	Total	Immed.	Med.	Total
Sidis	30.44	22.22	52.66	38.16	5.83	43.99
Diserens	37.2	2.7	39.9	22.7	7.8	30.0
			75.7			68.2

11. Suggestion Difference in percentage change from normal when music is used.

	POSITION			SHAPE			COLOR		
	Immed.	Med.	Total	Immed.	Med.	Total	Immed.	Med.	Total
Slow Music	-28.9	-.9	-29.8	-31.3	-5.8	-37.1	-.5	-2.1	-2.6
Fast Music	-11.4	-7.6	-19.0	-19.7	-13.5	-33.2	4.5	-14.2	-9.7
	Environment			Cover					
	Immed.	Med.	Total	Immed.	Med.	Total			
Show Music	-2.6	-4.6	-7.2	- .8	-6.2	-7.0			
Fast Music	-28.2	-10.4	-38.6	-6.9	1.9	-5.0			

111. Absolute Percentage of Absolute Suggestibility.

	Position			Shape			Color		
	Immed.	Med.	Total	Immed.	Med.	Total	Immed.	Med.	Total
Show Music	3.3	-7.8	-4.5	.5	-6.7	-6.2	6.5	-.3	5.2
Fast Music	2-.8	-14.3	6.5	12.1	-14.4	-3.3	11.5	-12.4	-.9

	Environment			Cover		
	Immed.	Med.	Total	Immed.	Med.	Total
Slow Music	34.6	-1.9	32.7	21.9	1.1	23.0
Fast Music	9.6	-7.7	1.3	15.8	9.2	25.0

The total reactions times in seconds were as follows:

Subject	Normal Condition.		Slow Music		Fast Music	
2	3'	55"			3'	10"
4	6	25			4	28
5	5	00	6'	10"	4	00
6	3	29			3	00
7	6	42			6	25
8	2	17	2	35		
9	2	25	2	25		
10	2	13			1	57
11	3	10	2	38		
12	2	43			2	10
13	2	50	4	00		
Average	3	44	3	33	3	48

Inspection of the tables reveals considerable differences in normal results from those of Sidis, - differences to be expected in view of the absence of a fixation period and a miscellaneous group of subjects. The effect of music on suggestibility is generally negative, although the difference is small in many cases. Only immediate suggestibility to verbally suggested colors and mediate suggestibility to cover increases. These are both instances of direct suggestion. The conclusion seems to be that music is in general a distracting factor though it may slightly increase direct suggestibility.

No significant changes in total reaction times occurred.

RELATIONS BETWEEN MUSIC AND COLOR PREFERENCE.

The object of this series of experiments was to determine

- (1) whether there was any relation between color preference and the moods evoked by music, and
- (2) what was the nature of this relation. Seven men and five women participated in the tests as subjects.

The apparatus consisted of the following:

1. Twenty-eight sheets of white paper upon each of which were mounted six one inch squares of Bradley colors, selected at random with the exception that the same shade or tint of color was never permitted to occur twice on the same sheet.
2. A scale containing the colors arranged chromatically and achromatically, numbers 1-13 in the chromatic series running from red to indigo, and numbers 1-8 in the achromatic series running from black to white. A color scale with the corresponding numerical key appears at the end of the experiments.
3. An Edison phonograph and the following records; Dixie Medley, (Banjo) Danny Deaver (Bass solo accompanied by orchestra), Song of India (Soprano solo accompanied by orchestra), Florida Waltz (orchestra) Semper Fidelis March (Band); Vigoroso March (Band); Simple Aveu (orchestra with violin lead), Catalina Fox Trot (orchestra); Meditation from Thais (violin accompanied by orchestra); Carry me back to Old Virginia (Soprano solo with Male Quartette), Quanto io t'amo (orchestra), The Sunshine of your Smile (orchestra), Praise ye the Lord (Soprano and Bass Duet) (with orchestral accompaniment), I'll take you home, Kathleen (tenor solo with orchestra), Liebesfreud (violin solo with accompaniment), Voici di Primavera (orchestra).

The Method: The subject to be tested was seated at a table on which were placed in rotation the twenty-eight test sheets. Two observers participated as in the experiments on suggestion; one placing the sheets before the subject, the other receiving the recorded preferences.

The subject called out a number of the preferred squares on each sheet, a selection being required in every case. Music was then played and the subject re-selected his preferred color on each sheet, the same being again recorded. This was repeated for several different types of music, eight selections sometimes being employed with a single subject at one sitting. In every case the preferences were recorded.

Tabulation and Treatment of Results.

The total choices for quality of color were added up and divided by the number of sheets chosen from grays and blacks being excluded from the chromatic average. The total choices for shade or tint, including grays and blacks were then added.

Or to state the procedure more precisely:

1. The sum of the numerical expressions of quality of color, as given in the color key was divided by the number of choices (in the case of a single subject) amounting to 28. Thus

$$n + n^2 + n^3 + \dots + n^x = X$$

$$\frac{X}{28} = Y = \text{average quality of color preferred.}$$

The average quality of color preferred under the influence of a given musical selection is found in the same way.

Thus:

$$n^1 + n^2 + n^3 + \dots + n^x = X$$

$$\frac{X}{28} = Y' = \text{Average quality of color preferred under the influence of music}$$

$$Y' - Y = \text{deviation in color preference.}$$

Where a number of persons have listened to the same musical selection,

average quality of color preferred will be found thus: Where S equals sum.

$$\frac{SX}{n} = Z \text{ normal preference average}$$

$$\text{and } \frac{SY}{n} = Z' \text{ Preference with music-average.}$$

and $Z - Z'$ = The absolute deviation in color preference.

Exactly similar operations give the average preference and deviation in the

achromatic series.

The average choice, needless to say, is not the person's favorite color, being nearer the red end of the spectrum, than the favorite color of those whose choice lies near the indigo, and vice versa. It does, however, furnish a standard by which to judge whether music causes a choice to incline toward one end of the spectrum or the other.

The results were not as well defined as could have been wished for, but indicated certain tendencies, at least. In only scattering cases was a choice in favor of a color, nearer the white end of the achromatic scale with any kind of music. These cases, moreover, were not as far away from the average as the choice of the darker color by the same person in the other experiments. Nevertheless, there seems to be a tendency to prefer slightly greater illumination with most kinds of music, 11 out of 17 pieces of music producing more or less shift toward the white end of the achromatic scale.

In the chromatic scale the results were also somewhat indefinite, but there seems to be a slight tendency to choose colors nearer the blue end of the spectrum, although the difference of choice within a single experiment seems insufficient to more than suggest that this may be the case. This holds good particularly in the case of music of a pronounced type, no matter what the type may be, as in the case of dance music; e. g. Florida Waltz, Meditation, Nanny Deaver. Music evoking unitary emotions of love or devotion; e. g. The Sunshine of your Smile, and Praise Ye the Lord, are particularly effective in this regard. Selections which admit of greater variety of mood on the other hand, seem not to cause any pronounced shift in color preference. A shift towards the blue end of the spectrum, however, would seem the natural thing to expect if the threshold of color perception is lowered by musical tones. For it is possible that the stimulus value of a color would then increase, and the

normal stimulus value would then belong to a color slightly different. Since red is biologically the most stimulating of colors, as measured by the energy changes in the retina as well as dynamogenic influence and the effect on plant growth, the shift would naturally be in the direction of the blue end of the spectrum in order that the normal stimulus value involved as a component of a given individual color preference might be retained.

Among the selections played which admitted of such a great variety of choices were, the Trumpeters Carnival, Dixie Medley, and the Song of India. These results seems to be more pronounced with persons of musical training, or feeling, and less for those of more limited musical experience. The average normal color preference for all subjects was a lemon yellow or in terms of the arbitrary-color-scale 7.69. The normal average preference in the achromatic scale was 4.6. The deviation from the normal color preference, under the influence of the various types of music are shown in the following tables, in which the plus sign indicates a deviation towards the blue end of the spectrum, or the black end of the achromatic scale, while the minus sign indicates a deviation towards the red end of the spectrum, or the white end of the achromatic series.

N. B. Absence of sign denotes plus sign.

TABLE OF ABSOLUTE DEVIATIONS UNDER THE INFLUENCE OF MUSIC.

Musical Selection	Chromatic series	Achromatic series.
Dixie Medley	- .09	- .18
Danny Deaver	.52	- .25
Florida Waltz	78.00	- .68
Song of India	40.00	- .22
Semper Fidelis March	42.50	- 1.75
Vigorouso March	5.00	- .35
Simple Aveu	-5.00	.10
Catalina Fox Trot	-5.00	.10
Trumpeter's Carnival March	-1.30	.05
Meditation	.90	- .25
Carry Me Back to Old Virginia	.30	.8
Quanto io t'amo	.29	.06
Sunshine of your Smile	1.60	- .28
Praise Ye the Lord	1.90	- .6
I'll take you home, Kathleen	.65	.2
Liebesfreund	-1 .80	- .1
Voci di Primavera	- .80	0 .0

The results do not seem to warrant any other conclusion than that a tendency probably exists for color preference to shift towards the blue end of the spectrum, under the influence of music. The key to the color chart, giving the arbitrary, number values of chromatic and achromatic qualities is given below. The first number expresses quality of color, the second degree of illumination. Thus .1 equals Red; 4, orange; 8, green, etc. intermediate numbers expressing transition. Again as the second number of a pair.

231
1. equals the lowest degree of illumination, while the increasing numbers express increasing degrees of brightness.

The Number Key to the color chart follows.

30 232

NUMERICAL KEY

Number of color square

No. of card	1	2	3	4	5	6	
1	8 -2	13-4	..	grey	11-4	7 -8	12-6 1
2	8 -4	5 -1	...	2 -black	12-4	2 -4	13-4 2
3	7 -6	2 -4	...	2 -8	7 -6	13-5	12-4 3
4	12-5	13-6	...	13-5	6 -3	11-7	9-4 4
5	4 -1	6 -4	...	2 -6	grey	8 -2	13-4 5
6	7 -6	1 -4	...	11-7	4 -1	4 -4	5 -6 6
7	9 -1	13-4	...	4 -1	2 -4	6 -4	10-4 7
8	7 -6	4 -1	...	2 -6	10-4	11-8	4 -4 8
9	11-7	6 -3	...	8 -2	6 -4	10-4	2 -4 9
10	6 -3	1 -4	...	2 -5	8 -4	13-6	2 -2 10
11	11-4	13-6	...	12 -6	6 -4	7 -6	12-2 11
12	grey-	12-4	...	9 -1	4 -4	12-6	7 -8 12
13	4 -4	2 -4	...	5 -4	10-4	2 -7	6 -4 13
14	4 -1	12-5	...	3 -4	2 -8	4 -4	9 -1 14
15	5 -1	7 -6	...	9 -1	5 -4	10-4	2 -6 15
16	9 -1	3 -4	...	5 -1	6 -4	10-4	13-5 16
17	7 -8	2 -2	...	12-5	6 -4	11-5	8 -2 17
18	8 -2	10-4	...	5 -4	4 -1	2 -4	black 18
19	2 -4	8 -2	...	13-5	5 -6	5 -4	11-8 19
20	12-2	2 -6	...	black	13-4	2 -7	8 -6 20
21	5 -4	2 -2	...	8 -2	2 -7	12-4	11-8 21
22	11-7	7 -4	...	grey	5 -4	2 -4	11-5 22
23	13-4	5 -6	...	4 -4	8 -2	3 -4	4 -1 23
24	13-4	7 -8	...	grey	2 -2	12-6	11-5 24
25	8 -2	4 -4	...	2 -7	13-4	5 -4	10-4 25
26	11-8	9 -1	...	8 -4	1 -4	12-2	6 -3 26
27	2 -8	12-2	...	7 -4	5 -4	black	11-5 27
28	11-4	5 -4	...	2 -8	2 -4	12-2	black 28

213

THE INFLUENCE OF MUSIC ON THE MILLER LYER ILLUSION.

The object of the experiments was to determine the influence of music of contrasted types on the extent of the well-known Muller Lyer Illusion. Thirteen subjects participated.

The apparatus consisted of

1. an instrument by which the relative length of the lines could be altered by sliding a part of the field like the lid of a box in and out of a framework, while the amount of the illusion in the case of each judgment could be read off a millimetre scale on the back of the instrument. The constant line was one foot (300 m. m.) in length and was to the right of the subject. The arrow lines were four inches in length and at an angle of 30 degrees, with the lines to be judged.
2. Edison phonograph and two records; viz,
 1. Vigoroso March representing rapid stirring music, and
 2. "Carry me back to Old Virginia," a song of a slow soothing type.

Method:

The apparatus was placed on a table, in a good light, and the subject seated about six feet away directly in front of it. The experimenter stood back of the apparatus, and alternately pushed the sliding section to the right and to the left, until the subject declared the lines were equal. Five observations were made by each procedure.

Records of the ten normal judgments without and with music of the two types, were made, giving 30 judgments in all. The order in which the tests were given varied from subject to subject and about five minutes intervened between tests.

The average error and the mean deviations of each series of ten judgments are given in the following tables.

Subjects	NORMAL RECORD		FAST MUSIC		SLOW MUSIC	
	Error in m. m.	A. D.	E. M. M.	A. D.	E. M. M.	A. D.
Colwell	55.3	6.04	39.7	3.04	35.9	3.1
Diserens	26.5	6.95	17.3	6.02	12.2	5.64
Friedman	41.2	13.36	32.4	6.68	34.00 25.0	14.00
Fushippel	45.4	8.44	26.9	6.10	29.7	7.2
Greenwald	36.4	3.48	32.7	4.36	66.5	5.08
Halck	91.0	7.80	70.4	6.60	56.0	4.90
Martin	80.8	9.32	47.6	8.00	17.5	5.40
Micelli	39.5	16.7	29.9	7.92	12.1	2.70
Nathan	37.7	2.88	22.7	3.84	25.7	2.12
Ryeburn	27.5	9.00	22.2	4.40	50.4	2.24
Salkover	66.9	6.32	58.7	2.36	38.9	1.90
Stiebel	50.8	10.06	43.9	8.65		
Zeligs	87.9	7.11	67.6	3.92	61.3	3.77

The results of this experiment are somewhat indefinite. In all cases a reduction in the amount of the illusion occurred when the judgments were made while the subject was listening to music. In five cases, however, the reductions are small, and are exceeded by the average deviation within the series of cases. In nine cases, however, or 64% the reduction is large and exceeds the average deviation so that on the whole, music seems to have a tendency to reduce the amount of illusion. Several possible explanations may be given.

- (1). The musical stimuli may reinforce ocular reflexes, so that the sense of effort in eye movement is altered. This would be equivalent to changing the proportions of the illusion, and it is well known that the average error varies somewhat according to the absolute length of the compared lines.
- (2). The difference may be due to the observed fact that the subject generally responded more quickly while music was being played. In short, judgments were speeded up. This would hardly account for any difference in average error since an equal number of judgments were made with the slide moving in opposite directions, and it would seem to involve larger mean deviations with music while just the reverse is the case.
- (3). Finally, music may distract the attention of the subject, and thus cause him to neglect the features responsible for the illusory effect. This seems probable, since some of the subjects showing small differences in the series of judgments, admitted making special efforts to concentrate on the illusion in order to avoid paying attention to the music which was unpleasant or boresome thru familiarity. This may also indicate why the familiar strains of the march were less effective in producing differences of judgment, than was the song with its numerous emotional associations.

INFLUENCE OF MUSIC ON THE PSYCHOGALVANIC REFLEX.

The object of the present series of experiments was to determine the influence of music of diverse types on emotion as manifested by the psychogalvanic reflex; i. e. the galvanometric deflection that follows sensory stimulation of a subject connected in series with a battery and galvanometer.

Fourteen subjects, including three men and eleven women, participated in the experiments which occupied the months of Dec. 1921 and Jan. 1922.

The apparatus consisted of a d'Arsonval Galvanometer with accessories, a fresh Columbia Dry Cell, a switch for turning current on and off, a rheostat for adjusting resistance, damper to bring galvanometer needle to rest after oscillations, and two copper terminals about one inch square covered with felt. A saturated solution of sodium chloride, Edison cabinet phonograph and records, and two stop watches. The arrangement of the apparatus is indicated in the diagram below.

The phonographic records employed were:

1. Meditation from Thais (violin)
2. Rosy Cheeks, Fox Trot (orchestra)
3. I'll take you Home Kathleen (song)
4. The Marseillaise (band.)

Method:

The experiments were conducted at about 40 feet distance from the phonograph which was in another room where it could not be seen by the subject but could be plainly heard through the open doors. The subject was seated as comfortably as possible about three feet from the Galvanometer, with his back to the source of music. The felted copper terminals which had been soaking in saturated sodium chloride solution were freed from superfluous liquid and then bound opposite one another on the back and front of the left wrist by means of tape. Care was taken not to bind the terminal on too tightly so that any unpleasantness might be experienced and the subject was then connected in series with the galvanometer and battery, and the switch being closed, the resistance was adjusted so that the deflection could be read about the middle of the reflected scale. A normal reading was then taken. In this as in all subsequent readings the amount of deflection was read every five seconds during a period of 90 seconds, the results appearing in the tables. After an interval of 2-3 minutes, a reading was taken while the subject was listening to music to which he was urged to attend. A preliminary reading of 30 seconds without music always preceded, the reading of deflections during music which lasted 60 seconds so that the first 30 seconds of each of our records illustrates normal conditions, the last 60 seconds, the effect of the music. In taking such readings, an assistant having a stop watch running parallel with that of the observer went to the phonograph as soon as a normal 30 second

reading began, and at the end of the 30 seconds started the music, stopping it again at the end of 90 seconds. After each musical selection, the subject was requested to introspect as fully as possible, concerning emotions, imagery, etc.

After this the experiment was repeated with music of a different type. Four musical selections were usually employed, so that 5 records in all were obtained from each subject. The records employed were the same for all, and the order in which they were played was invariable. The normal records were always taken first, after which were played in succession.

1. Meditation (slow)
2. Rosy Cheeks (Fast)
3. I'll Take you Home Kathleen (Slow)
4. Marseillaise (Fast.)

This fixed order renders it unnecessary to state the names of the selections in the tables of individual records. In these tables the first or normal record is indicated by N. while the Roman numerals 1-4 indicate the musical selections in the order stated.

The complete records of deflections for each individual is given, as this seemed more satisfactory than diagrammatic treatment. The complete introspections of each subject are also given after each record in order to facilitate comparison of mental conditions and objective results. The following reports in extenso permit of a complete inspection and analysis of data.

Miss E. B.

239

3

Time	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>	<u>45</u>
0									
17.5									
N. E. & %	.6	.9	.8	18.2	.3	.3	.2	.2	.0
1) 17.0	.5	.7	.6	.6	.5	.6	.6	.6	.6
2) 19.0	.5	.6	.5	.4	.3	.2	.6	.8	20.6
3)	22.0	.0	.0	21.9	.8	.6	.7	.6	.5
4) 22.5	.4	.2	.0	.0	.8	.8	.8	.7	.8

T	<u>50</u>	<u>55</u>	<u>60</u>	<u>65</u>	<u>70</u>	<u>75</u>	<u>80</u>	<u>85</u>	<u>90</u>
1)	18.	17.9	18.	.0	.1	.2	.2	.2	.2
2)	17.6	.4	.4	.4	.4	.4	.4	.3	.5
3)	20.7	.7	.8	.8	.8	.9	.7	.6	.6
4)	21.4	.4	.3	.3	.3	.2	.1	.1	.0
5)	21.8	.7	.7	.6	.6	.6	.6	.7	.6

Introspection

- 1) Music familiar. Did not like it. Picture of moonlight waltz in Gym
- 2) Well liked
- 3) Did not like, especially discord in middle
- 4) Did not like

MR. WILLS.

Time	0	5	10	15	20	25	30	35	40	45	50	55
N	27.5	.0	26.4	.0	25.5	.2	24.7	.2	.0	23.6	23.2	22.8
1.	18.0	17.5	.2	.0	16.5	.5	.4	.4	.4	.4	16.3	.2
2.	23.1	22.2	21.5	20.9	.2	.0	19.5	.8	.7	.4	19.1	18.7
3.	21.6	20.3	19.5	18.4	17.5	.0	16.5	.1	15.7	.5	15.2	.0
4.	26.7	25.3	24.5	23.5	.0	22.7	.5	.3	.2	.0	21.7	.4
	60	65	70	75	80	85	90.					
N	22.5	.2	.0	21.6	.3	.1	.0					
1.	.1	15.9	.6	.4	.3	.2	.2					
2.	.5	.3	.2	.1	17.9	.7	.5					
3.	14.8	.8	.6	.5	.4	.4	.3					
4.	.2	20.9	.6	.4	.3	.1	.0					

Miss M. Board.

Time	0	5	10	15	20	25	30	35	40	45	50
N	43.6	.6	54.0	55.0	52.0	55.0	.4	39.0	38.0	28.0	43.25
1.	43.0	42.8	.75	.6	.45	.4	.32	.2	.28	.134	42.1
2.	38.6	.5	.5	.48	.42	.4	.4	.4	.35	.22	38.2
3.	37.0	36.95	.9	.8	.71	.6	.6	.55	.5	.4	36.38
4.	35.3	.2	.1	34.9	.8	.76	.7	.6	.5	.49	34.4
	55	60	65	70	75	80	85	90			
N	43.28	.27	.25	.20	.22	.25	.20				
1.	.09	.05	.00	41.95	41.88	.8	.8				
2.	.112	.1	.08	.00	37.9	.9	.88				
3.	.3	.25	.22	.2	.15	.1	.05				
4.	.32	.35	.3	.32	.28	.2	.12				

Miss M. Bound Musically trained, Jan. 23, 1922.

Introspection.

1. Familiar, pleasant and relaxing. No association.
2. Familiar, but not liked, Association unpleasant because of hearing it too frequently during work.
3. Familiar very much liked. Many pleasant associations during childhood.
4. Music liked, but not the rendition. Did not give enough of life.

Miss Ryeburn - Musical training.

TIME	0	5	10	15	20	25	30	35	40	45	50
N	36.0	.3	.3	.32	.5	.55	.6	.8	.92	37.1	.4
1.	38.48	.5	.55	.61	.8	.8	.92	.87	31.1	.11	.2
2.	43.0	.1	.15	.25	.3	.45	.4	.5	.65	.7	.75
3.	45.3	.4	.1	.00	44.8	.7	.75	.6	.55	.6	.5
4.	48.00	47.5	.2	.00	46.7	.5	.4	.25	.1	46.00	45.18

Time	55	60	65	70	75	80	85
N	36.62	.7	.64	.68	.8	.9	
1.	31.3	.45	.55	.65	.85	.88	.9
2.	43.8	.85	.85	.85	.9	.9	.95
3.	44.17	.15	.15	.14	.17	.2	.2
4.	45.7	.55	.5	.42	.38	.3	.29

Introspection.

1. Familiar, pleasant, no special associations.
2. Liked as dance music.
3. Mingled feelings. Like some parts, don't like others. Associations: thought of Mary Rose, pathetic, sad in some places.
4. Fond of music. Disliked rendition. Should be played with more "pep"
Associated with appearance of French ambassador at Hughes High School. Picture of Roger de Lisle. Disagreeable behavior with a former French teacher.

C. O. B. Jan 19, 22.

6 2+2

T.	<u>0</u>	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>
N.	25.	24.5	.1	.8	.4	23.9	.5	22.7	2 .2
1)	27.	26.8	.3	.0	25.8	26.5	.4	.5	.4
2)	29.4	.3	.8	.7	.6	30.1	.2	.6	.5
3)	28	.7	29.0	28.8	29.0	28.8x	.5	.3	.2
4)	28.3	.8	29.6	.6	.0	28.	28.9	29.5	.4

T.	<u>45</u>	<u>50</u>	<u>55</u>	<u>60</u>	<u>65</u>	<u>70</u>	<u>75</u>	<u>80</u>	<u>85</u>	<u>90</u>
N.	21.6	.2	.0	.0	20.7	.5	.3	.3	21.7	
1)	26.0	25.9	26.8	.5	.4	.3	.1	27.5		
2)	30.7	.8	31.0	.7	32.0	.1	.4	.3	.2	
3)	28.2	27.9	.6	.5	.6	27.0	26.9	.9	.7	.7
4)	29.3	28.9	29.0	.0	.0	28.9	.6	.5	.4	.4

Mr. CM D Jan 19, 22.

T.	<u>0</u>	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>	<u>45</u>
N.	17.8	.5	.3	.1	.1	.2	.3	.3	.3	.2
1)	17.8	.8	.7	.9	18.3	.4	.5	.8	.7	.8
2)	17.9	.8	18.0	17.8	.8	.6	.5	.8	18.0	.2
3)	17.9	.9	18.0	.2	.3	.2	.1	.6	19.1	.8
4)	17.4	.3	.3	.4	.7	.7	18.0	.2	.4	.7

T.	<u>50</u>	<u>55</u>	<u>60</u>	<u>65</u>	<u>70</u>	<u>75</u>	<u>80</u>	<u>85</u>	<u>90</u>
N.	17.3	.3	.3	.3	.3	.3	.3	.4	.4
1)	18.8	.7	.5	.4	.5	.8	.8	.8	.8
2)	18.5	.6	.6	.6	.4	.3	.2	.3	.4
3)	20.1	.1	19.9	.6	.5	.3	.4	.4	.4
4)	18.9	19.0	.5	.7	.7	.8	.6	.6	.6

7

Mr C F D Musically trained.

T.	0	5	10	15	20	25	30	35	40	45
N.	24.3	.3	.3	.3	.3	.35	.3	.0	.4	.0
1)	25.8	.6	.15	.4	.4	.3	.3	.4	.45	.4
2)	25.5	26.7	27.6	.5	.4	.3	.1	.1	.15	27.0
3)	27.7	.65	.6	.7	.7	.7	.7	.65n		.4
4)	28.5	.1	.1	.1	.5	.1	.7	29.0	.0	.0

T	<u>50</u>	<u>55</u>	<u>60</u>	<u>65</u>	<u>70</u>	<u>75</u>	<u>80</u>	<u>85</u>	<u>90</u>	
N.	24.4	~~24~~	.45	.45	.45	.45	.5	.5	.5	.5
1)	25.4		.4	.45	.5	.55	.5	.5	.55	.55
2)	26.9		.9	.7	.65	.65	.65	.5	.5	.5
3)	27.8		.7	.6	.6	.5	.6	.6	.65	.65
4)	29.0		.0	.0	.1	.2	.2	.15	.3	.35

Introspections.

- 1) Familiar, good rendition. No associations Followed every tempo
- 2) Did not like it. Good for dancing
- 3) No introspections
- 4) " "

Miss S.											
T	0	5	10	15	20	25	30	35	40	45	50
2)	34.0	.2	.35	35.1	33.9	.7	.6	.5	34.5	35.6	36.
T.	55	60	65	70	75	80	85	90			
2)	36.0	36.7	37.	.8	.7	38.2	38.25	.2			

Tried to like it , but couldnt. Illusion of dancing.

Miss Geoh.

Time	0	5	10	15	20	25	30	35	40	45
N	20.	20.0	20.0	20.0	20.0	20.02	20.05	20.5	20.55	20.52
1	20.5	20.5	20.2	20.2	20.7	21.25	21.1	20.8		
	21.2	21.08	21.05	21.01	21.0	20.09	21.0	21.0	20.95	20.89
	20.85	20.82	20.8	20.78	20.75	20.7	20.69	20.68		
2	19.7	19.62	19.6	19.55	19.5	19.51	19.5	19.55	19.55	19.68
	19.7	19.72	19.78	19.8	19.81	19.88	19.9	19.98		
3	19.5	19.35	19.18	19.1	19.06	19.0	18.99	18.92	18.89	18.88
	18.8	18.8	18.75	18.72	18.7	18.69	18.65	18.7		
4	20.0	19.8	19.7	19.6	19.55	19.46	19.42	19.4	19.35	19.39
	19.4	19.38	19.35	19.32	19.3	19.29	19.25	19.25		

Introspections:

1. Familiar - liked pretty well - except some high notes were screechy, unpleasant, no associations.
2. Unfamiliar - rather pleasant - not strikingly so - no special association.
3. Did not like rendition - parts seemed like caricature, tendency to laugh - other parts dead - no association.
4. Familiar.

Mayy Kunz (musically trained) Jan. 28. 1922.

TIME	0	5	10	15	20	25	30	35	40	45	50
N	14.6	.6	.58	.59	.58	.55	.53	.51	.50	.49	.48
1.	14.5	.51	.51	.50	.49	.48	.48	.45	.45	.45	.43
2.	14.71	.6	.58	.59	.55	.52	.50	.51	.55	.55	.52
3.	14.85	.85	.80	.72	.70	.55	.52	.49	.48	.42	.39
4.	14.32	.30	.29	.30	.29	.28	.25	.24	.22	.22	.21
5.	14.55	.55	.53	.52	.51	.50	.48	.45	.42	.41	.41

Song of India.

TIME	55	60	65	70	75	80	85	90
N.	.45	14.42	.41	.40	.38	.38	.35	.32
1.	.44	14.44	.40	.40	.39	.38	.38	.38
2.	.52	14.51	.50	.50	.50	.49	.48	.48
3.	.38	14.38	.35	.35	.35	.32	.30	.30
4.	.22	14.22	.21	.21	.21	.21	.21	.21
5.	.41	14.29	.40	.40	.39	.37	.38	.38

1. Familiar, liked it, Pleasant, Caused to think of symphony, of which a picture appeared in mind.
2. Familiar. Liked it. Association, saw a dance which was attended last summer. Exceedingly pleasant experience.
3. Familiar - liked it. Liked first part particularly well. Thought of a story of a man calling people to arms. Second part made her think of buying a poor Frenchman. Association, images. First part made her think of people in cafe drinking, some one entering and playing, at which people stood up and saluted.
4. Unfamiliar didn't like particularly. No associations.
5. Familiar and liked. Didn't like singing. Picture of the Scheik.

MISS ELSIE LAILE Jan. 20. 1922.

TIME	0	5	10	15	20	25	30	35	40	45
N	42.80	.90	43.50	43.84	44.20	44.80	45.0	45.50	45.80	46.20
1.	32.61	.61	.65	.70	.71	.71	.78	.80	.80	.81
2.		35.90	.70	.40	.10	34.9	.60	.50	.30	.20
3.		35.40	.10	34.60	.30	.10	33.90	.70	.50	.40
4.		35.2	34.6	34.00	33.6	.50	.10	32.90	.80	.65

TIME	50	55	60	65	70	75	80	85	90
N	45.80		46.50	.80	.90	47.20	47.50		47.80
1.		32.80	.85	.89	.90	.91	.95	33.00	33.00
2.	34.00	33.90	.80	.75	.68	.60	.55	.50	31.10
3.	.25	33.1	.00	32.80	.70	.62	.55	.50	.50
4.		32.50	.32	.20	.15	.00	31.92	.90	.45
									.85

Introspections:

1. Familiar, and pleasant. No special associations. Seemed relaxing.
2. Familiar, and moderately pleasant. No associations.
3. Familiar, well-liked. No associations.
4. Familiar, and liked. Doesn't pay it as well as it should be played.

MISS MACMILLAN

Time	0	5	10	15	20	25	30	35	40	45
N	39.5	38.8	.6	.40	.00	37.70	37.40	37.00	36.85	36.50
1.	34.9	38.9	.5	.00	37.36	34.00	33.50	33.30	32.50	31.30
2.	38.6	.20	37.8	37.7	37.60	37.50	.75	.65	.80	.85
3.		38.2	.0	37.7	37.60	37.40	.30	.50	.85	37.60
4.	37.20	36.9	.9	.95	.85	.87	.37	.50	.60	.40

TIME	50	55	60	65	70	75	80	85	90	95
N	36.2	35.9	.80	.80	.60	.50	.20		.00	
1.	33.0	32.85	.80	33.10	.15	.10	.10	.05	.80	
2.	37.7	.6	.4	.5	.5	.48	.4	.3	.8	.1 .05
3.	37.2	.29	.3	.15	.10	.05	36.9	.9	.9	36.8
4.	37.2	.1	.0	36.9	.75	.7	.6	.42	2	.1 .00

Introspection.

- 1. Pleasant, but unfamiliar. Calming effect.
- 2. Unfamiliar, like Jazz. Didn't like music.
- 3. Rather familiar.
- 4. Pleasant and inspiring.

ED. MEYER Musically trained.

TIME	0	5	10	15	20	25	30	35	40	45
N.	24.50	.6	.5	.5	.55	.7	.7	.76	.95	25.00
1.	26.9	27.1	.4	.55	.68	.9	28.05	.2	.3	.45
2.		16.5	.6	.6	.62	.6	.62	.68	.62	.65
3.	16.3	.28	.3	.25	.28	.27	.29	.30	.28	.28
4.	18.2	.24	.25	.29	.30	.32	.32	.35	.39	.39
5.	16.15	.15	.17	.15	.15	.15	.12	.12	.17	.19

TIME	50	55	60	65	70	75	80	85	90
N	25.12	.35	.60	.82	.26	.40	.65		
1.	28.55	.65	.70	.80	.85	.99	29.00	29.10	
2.	16.89	.70	.71	.70	.70	.71	.72	.75	
3.	16.31	.32	.39	.40	.40	.40	.40	.41	
4.	16.40	.40	.40	.40	.40	.40	.40	.39	.32
5.	16.20	.21	.21	.28	.29	.29	.29	.30	

Introspection.

1. Faintly familiar. Didn't care much for interpretation, not well balanced.
No associations or images.
2. Not familiar and not well liked. Enlivening effect, but not really pleasant,
desire to beat time, and tensing of muscles.
3. Unfamiliar but well liked. Remembered playing in quartette. Image of
people who were playing.
4. Favorite national hymn. Rapidly changing imagery. Rendition pleasant
but not too good.
5. Familiar and well liked. But poor voice. Association of organ recital.
S. Song of India.

Miss Nell Mullikan.

TIME	0	5	10	15	20	25	30	35	40	45
N	20.6	.9	.9	.9	.5	.5	.5	.55	.55	.52
1.	21.5	.51	.50	.40	.20	.0	20.8	.80	.78	.72
2.	18.4	35.45	.42	42.43	47.49	.50	.50	.60	.61	.82
3.	24.4	.3	.15	.00	23.90	.85	.78	.70	.68	.60
4.	21.8	22.1	.15	.10	21.9	.89	.80	.75	.70	.65
5.	19.8	.7	.62	.58	.50	.45	.40	.35	.30	.25
6.	23.5	.40	.30	.20	.15	.10	.65	.00	22.09	.95

TIME	50	55	60	65	70	75	80	85	90
N	.45	.42	20.4	.55	.61	.62	.61	.60	
1.	.70	.69	20.67	.65	.65	.61	.69		
2.	.38	.72	18.80	.85	.85	.85	.85		
3.	.52	.45	23.40	.35	.30	.25	.20	.18	
4.	.60	.55	21.50	.48	.45	.40	.38	.35	
5.	.21	.20	19.16	.12	.10	.09	.05	.02	
6.	.90	.85	22.82	.80	.79	.79	.78	.75	

5. Song of India

6. Drink to me Only with Thine Eyes.

Introspection.

1. Familiar liked it. Thought of girl's quartette at a concert. Soothing rendition.

2. Unfamiliar, thought pleasant. Many associations. Dancing at home and elsewhere. Picture of playing with flute and victrola at home.

3. Soothing, and well-liked. Parlor at home played on Victrola. Auditorium in home town, with picture of audience.

Miss Nell Mallikan.

TIME	0	5	10	15	20	25	30	35	40	45
N	20.8	.9	.9	.9	.5	.5	.5	.55	.55	.52
1.	21.5	.51	.50	.40	.20	.0	20.8	.80	.78	.72
2.	18.4	35.45	.42	42.43	47.49	.50	.50	.60	.61	.82
3.	24.4	.5	.15	.00	23.90	.85	.78	.70	.68	.60
4.	21.8	22.1	.15	.10	21.9	.89	.80	.75	.70	.65
5.	19.8	.7	.62	.58	.50	.45	.40	.35	.30	.25
6.	23.5	.40	.30	.20	.15	.10	.65	.00	22.09	.95

TIME	50	55	60	65	70	75	80	85	90
N	.45	.42	20.4	.55	.61	.62	.61	.60	
1.	.70	.69	20.67	.65	.65	.61	.69		
2.	.38	.72	18.80	.85	.85	.85	.85		
3.	.52	.45	23.40	.35	.30	.25	.20	.10	
4.	.60	.55	21.50	.45	.45	.40	.38	.35	
5.	.21	.20	19.16	.12	.10	.09	.05	.02	
6.	.90	.85	22.82	.80	.79	.79	.78	.75	

5. Song of India

6. Drink to me Only with Thine Eyes.

Introspection.

1. Familiar liked it. Thought of girl's quartette at a concert. Soothing rendition.

2. Unfamiliar, thought pleasant. Many associations. Dancing at home and elsewhere. Picture of playing with flute and victrola at home.

3. Soothing, and well-liked. Parlor at home played on Victrola. Auditorium in home town, with picture of audience.

4. Emotional, liked it. During loud part, saw S. A. T. C. parade, with autos passing in sunshine. Soft part, saw huts in France with crying women. Again loud part, soldiers passing with flags.
5. Familiar and well liked. Picture of auditorium and audience. Something and causing sleepiness.
6. Familiar, but did not like playing. Piano part, saw room where she studied piano, but didn't like the lessons. A marble hall where the piano was. Violin part, picture of Methodist concert where she played.
- Can sing also.

MISS L. ORTNER Jan. 20. 1922.

TIME	0	5	10	15	20	25	30	35	40	45
N			50.0	48.0	46.10	45.20	44.20	43.8	.4	.1
1.		40.5	.4	.6	.5	.25	.30	.30	.28	.28
2.		40.2	.2	.19	.2	.18	.15	.15	.15	.12
3.		39.35	.25	.15	.10	.05	.00	38.95	.9	.88
4.		38.1	.15	.18	.15	.15	.16	.17	.19	.17

TIME	50	55	60	65	70	75	80	85	90
N	42.9	42.7	.5	.2	.05	41.9	.7	.6	46.4
1.	.25	40.25	.25	.24	.22	.23	.22	.22	.21
2.	.11	40.10	.09	.08	.05	.04	.02	.01	.00
3.	.80	38.79	.73	.70	.67	.62	.61	.60	.59
4.	.20	38.20	.19	.19	.20	.20	.21	.21	.22

Introspections.

1. Familiar suggests love scene. Agreeable.
2. Unfamiliar. First part not as agreeable as second. Tendency to dance.
3. Unfamiliar, didn't care for music. Tired of sitting in one place.
4. Familiar. Pleasant.

Subject has musical training.

MISS E. PFLEGER

Jan. 28, 1922.

TIME	0	5	10	15	20	25	30	35	40	45
N	16.7	.72	.72	.89	.90	.91	.92	.95	17.00	.00
1.	18.30	.12	.18	18.00	17.95	.90	.87	.85	.82	.82
2.	20.3	.88	.08	19.98	.85	.78	.72	.68	.62	.58
3.	19.85	.89	.75	.70	.68	.6	.57	.52	.51	.50
4.	19.60	.59	.58	.58	.58	.58	.58	.58	.59	.58
5.	20.72	.61	.60	.58	.55	.55	.52	.51	.51	.50

TIME	50	55	60	65	70	75	80	85	90
N	17.02	.08	.09	.10	.12	.15	.18	.18	.20
1.	17.82	.81	.80	.80	.81	.81	.81	.82	.82
2.	19.52	.50	.50	.42	.39	.35	.32	.30	.29
3.	19.49	.48	.48	.40	.40	.39	.38	.39	
4.	19.58	.57	.57	.54	.38	.39	.38	.55	.57
5.	20.49	.42	.42	.38	.36	.35	.36	.34	

Introspection.

1. Not especially pleasant. Not familiar, and no associations or images.
2. Not familiar. Didn't like it especially, inducive to sleeping. No Associations.
3. Not familiar, heard before but not remembered. No associations.
4. Familiar, but not liked. Lots of associations. A crowd of people in one part, and a group of soldiers in their midst.
5. Liked, but the rendition has been given much better before.
5. Drink to Me Only with Thine Eyes.

The fact that psychic states of all kinds occasion galvanic deflections has been known since the pioneer experiments of Tarchanoff in this field. His own explanation was that the deflections are due to secretory changes in the glands of the skin. Fere, however, ascribed the deflections to the lowering of bodily resistance under the influence of emotional states, an assumption followed by most investigators of the subject. This was the original assumption in the present experiments and the very large variations in the resistance reported by certain investigators, amounting in some cases to 300% or a reduction of one ¹ third, suggested that a dry cell might safely be used in the investigation, since little reduction of E. M. F. should follow short periods of closed circuit, where the resistance was always so high. This slight reduction, moreover, should not noticeably effect the results where the changes in resistance of the body are so high. In the light of Sidis's experiments, however, it seems probable that the galvanometric phenomenon is due to an electro-motive force ² which is muscular in origin. In this case it is not a question of altered resistance, and, the effect of even a slightly decreasing E. M. F. might appear in the records as a counteracting factor to the E. M. F. induced by muscular movements. As a matter of fact, a slight general decline in the amount of galvanometric deflection does actually occur in most of the records, but this is broken nearly always by upward fluctuations. Periods of equilibrium or of constant deflection also appear. These either mean:

1. That the E. M. F. is not decreasing noticeable or
2. that this decrease is compensated by decreased resistance due to emotional conditions (Fere) or that E. M. F. of muscular origin is added to the

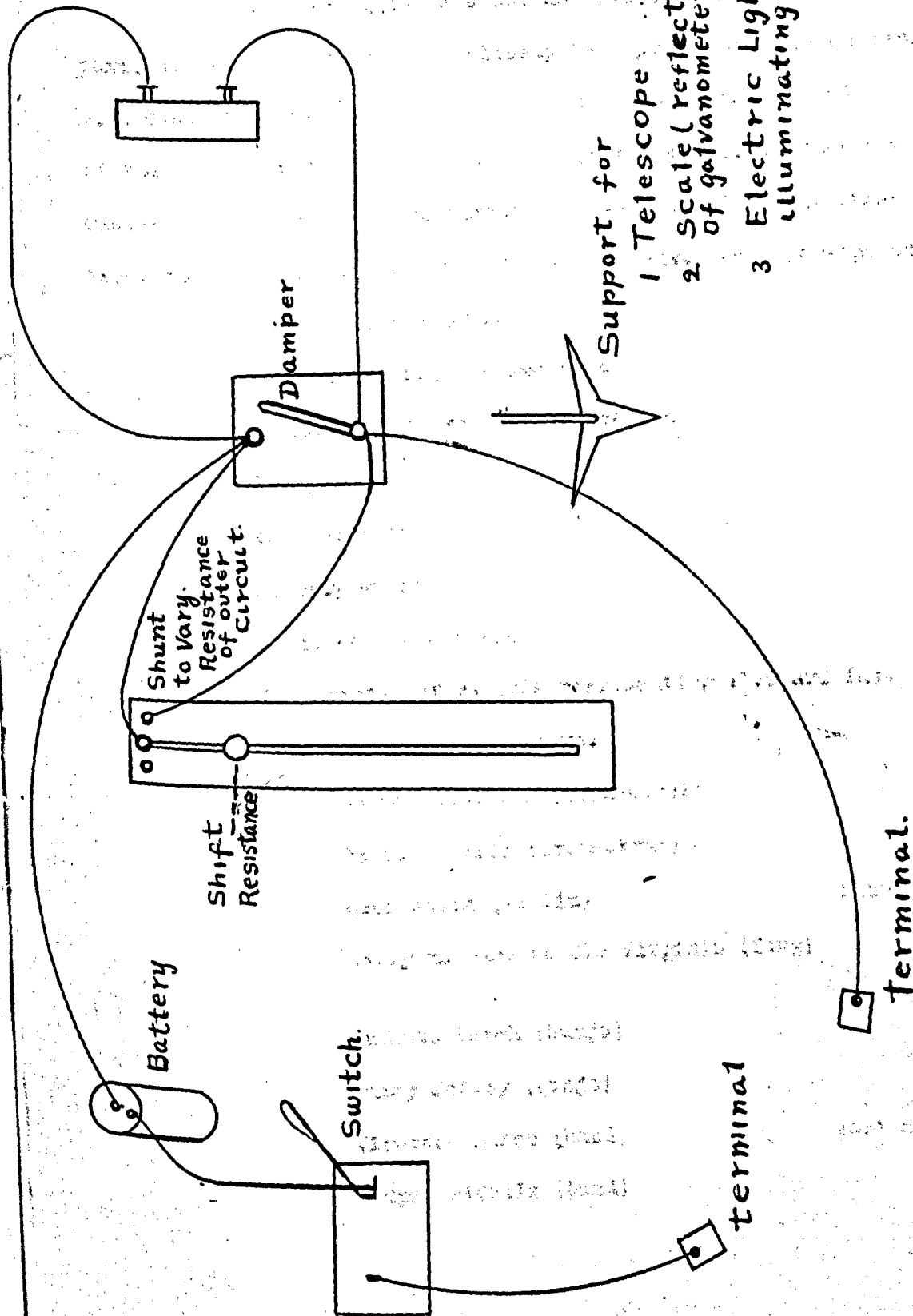
1. Waller W. W. Galvanometric Records of Conductivity Nature Vol 101 p.214
2. Sidis B. The Nature and Cause of the Galvanic Phenomenon
Studies in Abnormal Psychology Series.1
p. 74

203

to the decreasing E. M. F. of the battery thus compensating for the loss.

In the present experiments at least one fact stands out viz, that there are more changes in galvanometric deflection while the subject is listening to music.

To formulate the possibilities: If there is a loss of E. M. F. on the part of the battery, an increase in the deflection or constant deflection over a period of several seconds, indicates the presence of an emotion according to the theories of both Fere and Sidis. A decrease in the deflection if constant may indicate nothing whatever, but if sudden may point to a calming effect exercised by the music. If on the other hand the loss of E. M. F. by the dry cell is negligible under the circumstances, increased deflection alone indicates emotional conditions while a reduction certainly points to a calming influence due to the music. Since the deflections did actually tend to decrease in most cases in the present experiments, the conclusion would seem to be that music in general exercises a calming influence on the listener, tending on Sidis's theory to reduce the normal amount of muscular tensions, and relax the whole organism.



THE INFLUENCE OF MUSIC ON THORACIC BREATHING.

These experiments were not undertaken with the idea of securing new results, since the facts have already been pretty well established by the more elaborate studies of Binet, Guibaud, Shepherd, and Gamble. The object of the present series was rather to test the specific effects of some of the musical selections most frequently used as stimuli in our other series of experiments. Eleven subjects, six men and five women participated.

The apparatus included.

1. A Sumner belt Pneumograph
2. Marey Tambours and accessories
3. Kymograph
4. Time marker
5. Stop-watch
6. Edison phonograph
7. A number of records representing slow and fast music. The records were as follows:

Quanto io t'amo (orchestral)

Florida Waltz (orchestral)

Meditation (violin)

Slow music

Carry me Back to Old Virginia (Song)

Infanta March (banjo)

Dixey Medley (banjo)

Vigorous March (band)

Fast music.

Semper Fidelis (band)

METHOD;

The registering apparatus occupied a table about 15 feet distant from the phonograph. The recording pointer was astraw about eight inches long, with the upper part bent at an angle inward, and tangent to the drum of the kymograph. The time marker registered seconds above the pneumographic curve in every case, since a slight variation existed in the speed of the drum. The speed of the drum was adjusted so that one revolution required $3\frac{1}{2}$ minutes and from 6 to 8 records could be taken without changing the paper. A normal record of 60 seconds was always taken first, while normal records of 30 seconds preceded records taken while the subjects were listening to music.

The subject was seated with his back to the phonograph but in a position from which he could not see the tracing. The pneumograph was adjusted so as to give a tracing of medium depth, and a normal record of 60 seconds secured. After a rest of several minutes, a second tracing was begun, an assistant pressed a stop-watch when the time marker was started and at the end of 30 seconds started the phonograph. A 60 seconds was secured. The subject had previously been instructed to attend exclusively to the music. After a rest of 5 minutes a second musical selection was played. This procedure was repeated several times, records for from 4 to 6 musical selections often being obtained at one sitting. This was the general procedure but in certain instances shorter or longer records ranging from 45 to 180 seconds were secured. No elaborate introspective accounts were required but the subject was always asked to state whether the music was pleasant or unpleasant. The data secured from eight subjects are presented in the following tables. The plus sign indicates increased amplitude and irregularity, the minus sign a decrease in these aspects of the respiratory curve. The number of respirations per minute are averaged of all the records of each subject.

EFFECTS OF MUSIC ON BREATHING.

SUBJECT	NORMAL		FAST MUSIC		SLOW MUSIC.	
	R. per min.	A. R.	R. per min.	A. R.	R. per min.	A. R.
Mr. BB	8.33		8.0	- +	10.	- +
Mr. D.	19.00		20.5	+ -	15.33	+ -
Miss F.	14.50		21.75	- +	21.40	- +
Mr. H.	19.00		23.0	+ +	14.00	+ +
Mr. P.	11.50		13.5	+ +	14.00	+ +
Mr. R.	17.00		18.0	+ same	14.00	+ +
Miss S.	13.43		17.5	- -	14.00	- same
Mr. T.	19.80		24.0	- +	18.75	+ +

The introspections of the subjects show that most of the musical selections employed were agreeable. The slow music was in general more agreeable than the fast. The fast banjo pieces, however, were characterized as distracting by some subjects, and as unpleasant by Misses F and S, as well as by Mr. T. Inspection of the records show that music either fast or slow tends to make respiration more rapid. A conclusion agreeing with that of Miss Gamble and other investigators. The number of cases of reduced and increased amplitude are equal but where a reduction in amplitude occurred it was much greater than the increases which were usually slight. No constant tendency in respect to regularity appears with either type of music.

260

THE INFLUENCE OF MUSIC ON INVOLUNTARY MOVEMENT.

A few experiments were carried out on the effect of different kinds of music on involuntary movement. The purpose was to determine roughly the extent and direction of involuntary movements made while the subject was listening to music, and to observe the correlation between such movements and the affective tone revealed by introspection. Nine subjects participated in the test.

The apparatus consisted of an automatograph, phonograph, and a number of records including Kreisler's Liebesfreud, Vigoroso March, Rosy Cheek Fox-Trot, a Strauss Waltz, Rose Mousse Valse, Venetian Medley, Even Bravest Heart (Song from Faust) and Egyptia (an Oriental medley.)

Method: The automatograph was suspended from the ceiling of the Laboratory by a strong thin cord about ten feet in length. Immediately below it on a table was placed a thick glass plate on which blackened paper. The subject was seated comfortably with his back to the music which was played in an adjoining room.

The subject's arm was adjusted in the automatograph and the latter brought into a correct position over the blackened paper. Instructions were given to try to achieve an indifferent frame of mind and to avoid all movements. The record of the normal tremor was during a period, of from 20 to 60 seconds, was then taken. After an interval of a couple of minutes a record was taken while the subject was listening to music to which he was instructed to attend.

Several records with intervals of 2-3 minutes between them were taken in this way at a single sitting. After the experiments the subjects' introspections on the various musical selections were secured, in order to determine the general affective tone prevailing during each piece of music. Difficulty in adjusting the stylus properly spoiled some of the experiments, but the results of the majority may be summarized in tabular form as follows.

Thus plus sign indicating increased extent, the minus sign decreased extent of involuntary movement.

SUBJECT	MUSIC	EXTENT	DIRECTION	AFFECTIVE TONE
1B	1 Strauss Valse		Excentric or	
	2 Rosy Cheeks		expansive	
	3 Faust		"	
	4 Vigoroso		"	
2E	1 Strauss Valse		excentric	
	2 Rosy Cheeks		expansive	
	3 Faust		"	
	4 Vigoroso		"	
3F	1 Song of India		concentric	
	2 Liebesfreud		excentric	
4H	1 Liebesfreud		concentric	
	2 Vigoroso March		"	
5M	1 Rosy Cheeks		concentric	
	2 Venetian Medley		excentric	
6O	1 Liebesfreud (violin)		excentric	
8S	1 Egyptian		concentric	
	2 Simple Aveu		"	
	3 Rose Mousse		excentric	
9W	1 Strauss Valse		concentric	
	2 Song from Faust		"	
	3 Vigoroso March		"	
	4 Rosy Cheeks (fox-trot)		excentric	
7R	1 Simple Aveu (Violin)		excentric	

By excentric or expansive involuntary movements are meant those which are outward or away from the body as a center involving innervation of extensor muscles. By concentric are meant inward movements, or movements toward the body as a center involving flexor muscles. It will be noted that in the above experiments, excentric movements generally though not always corresponded to pleasant affective states as described in introspection. This was true in 12 out of 14 cases. Concentric movements on the other hand corresponded to unpleasant affective tone in 6 out of 10 cases. It will be noted that in 22 out of 23 cases, the extent of involuntary movement is increased

by listening to music.

The conclusion is that music of any kind tends to increase involuntary movements of striped muscles and to impart a characteristic direction to such movements, depending on the affective tone evoked.

GENERAL CONCLUSIONS.

Summarizing the conclusions arrived at in the various sections of our experimental work, we may state that:

1. Music tends to reduce or delay fatigue and consequently increases muscular endurance.
2. Music has no definite effect on precision or accuracy of movement, if the rhythm is not adapted to the rhythm of the work. It reduced accuracy in typewriting and handwriting, the result being shown in an increased number of errors.
3. Music speeds up such voluntary activities as typewriting and handwriting. It also accelerates respiration.
4. Music increases the extent of muscular reflexes employed in writing, drawing, etc.
5. Music reduces normal suggestibility, except in the case of direct suggestion involving color in which case suggestibility is increased.
6. Music seems to have a tendency to produce a shift in normal preference for chromatic and achromatic impressions, the change being toward the blue end of the spectrum and the white end of the achromatic series.
7. Music has a tendency to reduce the extent of illusions by acting as a distracting factor.
8. Music influences the electrical conductivity of the human body as manifested by increased fluctuations in the psychogalvanic reflex.

GENERAL SUMMARY AND CONCLUSIONS.

We have now completed our survey of data bearing on the question of the reactions of organisms to music. The treatment of the subject fell naturally into two parts; a descriptive account in which the probable origin of music and the observable effects on man and animals were stated; and an experimental part in which a detailed summary of experimental investigations was followed by the results of original experiments. At this point a constructive, general summary is necessary in order to connect the results of our various lines of study (as well as to justify the ^{point} results of our various lines of study) as well as to justify the mode of procedure employed. In many cases, the connections between our materials may not have seemed perfectly clear, and some of the discussion may seem extraneous to the object of research. This, however, is only apparent, since the complexity of the problem of response to musical stimuli clearly demands a breadth of treatment greater than that required by almost any other problem in Experimental Psychology. Music is not only a sensory stimulus, but a complex cultural stimulus, which has been gradually elaborated throughout the entire evolution of the race.

Whether music affects organisms, particularly man, what, or how great these specific effects are, are not questions susceptible of solution in the laboratory alone. The answer cannot be constructed from reflections on experiments with isolated elements of music, for these are no more music than bricks are architecture. Again, even where music is employed in laboratory experiments, the results at best refer to a limited number of experiments and can only be extended by inference. Such inference, however, is corroborated if we find independent evidence of an extensive nature, which agrees with experimental results. We have, therefore, resorted to the sociological method

which at its best seems analagous to experiment, since the observer, though he cannot vary the conditions of observation of individuals at will, can vary the field of observation of similar groups, thus securing almost any condition desired if his studies are sufficiently extended.

Finally, the data of both experimental investigation and ethnological research become more reliable if it can be shown that response to musical stimuli is in some manner connected with phylogenetic adaptation and survival in the continuous series of organisms culminating in man, and that therefore some kind of reaction to music can be looked for with absolute certainty.

Such a basis may be found by connecting the origin and development of musical response with the survival of the species, according to a modified form of the Darwinian Theory of Selection, in which aesthetic judgments on the part of animals or even very primitive man are not postulated, but the mere perception and reaction to elementary musical stimuli is developed and universalized in the successful operation of the courtship and herd instincts. The development in such way of musical response in man moreover, becomes more probable if musical reactions can be shown to exist in other organisms, and with this object the available material on the reactions of animals to music has been brought together in a critical summary.

If we turn from biological to sociological and ethnological evidence, we find the earliest data on response to music in myths and folk tales, which represent the scientific observations and reflections of the race in its infancy. Widespread musical myths constitute a residue of primitive observations which confirm or supplement that from other fields.

In discussing musical magic, it was necessary to show in some detail that the essential condition of the magical attitude, and the disposition to

263

practise magic, consisted in a sense of increased individual energy, and that such feeling of power was sought for in every conceivable way. When this was once shown, however, the dominating role of music in magic at once assumed meaning, as indicative of a connection between increased bodily energy and musical stimuli, such as experiments seem to show. Moreover, a possible connection between certain less obvious physiological effects of music and certain peculiarities in primitive theories of personality and causality is indicated, so that the presence of the beliefs and theories may even throw light on such a question as whether colored hearing is a vanishing or developing phenomenon in man, due to incomplete neural differentiation, as some maintain, or to highly imaginative association, as others suppose.

The survey of the beliefs and practices of musico-therapy was appropriate as yielding practically the only data on the reactions to music of individuals permanently or transiently in an abnormal state. It is acknowledged that the data of abnormal psychology solve many problems in normal psychology, and where experiments on the musical reactions of the abnormal are lacking, we can only turn to the beliefs, clinical evidence and semi-experimental studies of Exponents of Melotherapy. A review of the field yielded a large body of beliefs, as well as a considerable group of well-attested clinical cases and a number of little known but striking instances of the influence of music on the organism.

discussions

The relation of music to work is well-known, but previous/stress the predominance of the rhythmic over the tonal elements in producing the observed effects in speeding up and reinforcing reactions. Analysis of the data, however, seemed to point clearly to the view that the rhythmic elements are only a regulating or co-ordinating factor by which tonal stimuli are brought into sufficient temporal contiguity with stimuli initiating reflexes, to produce the reinforcement demonstrated by experiment.

Finally, a detailed review of existing experimental studies was made with a view to guiding the research of investigators as well as indicating points of common agreement on the nature of musical reactions.

Thus a number of increasingly coherent pictures of the nature of musical response have been sketched, and the agreement of the accounts from so many sources yields a convergent proof of the reality and nature of the phenomena. The historical account of previous experimental studies revealed the fact that most preceding investigations had dealt with various forms of involuntary reaction. They were dictated primarily by interest in affective processes. The fact that music seems to promote work suggested that its influence on voluntary reactions might also be profitably studied.

Our original experiments were therefore mainly planned to test voluntary activities, a few experiments on affective processes being introduced to determine the specific effects of the musical selections employed throughout the experiments. The results, while not especially striking, are fairly definite along certain lines. All activities tested are considerably accelerated by music, and an increase in the energy and extent of reflexes frequently occurs. The data on affective processes agree with those of other investigators.

Many repetitions of the experiments are, of course, desirable, and a wider range of activities should be investigated. A great many unsolved problems present themselves, particularly with respect to the reciprocal influence of musical and pictorial stimuli on aesthetic response. The application of such studies to a psychology of the drama is obvious. Finally, the problem of the influence of music on the emotions seems susceptible of a new experimental attack from the side of Endocrinology. The effects of musical stimuli on the internal secretions could be determined by suitably devised tests, and the known relations of these secretions to primary emotions would afford a guide to the analysis of the particular emotional state evoked by music.

267

BIBLIOGRAPHY.

- Aelian,** **Claudii Aeliani**
 De Natura Animalium,
 Libri XVII. t 11
 Lipsiae 1864 95 works
- Alix Eugene,**
 L'Esprit de nos Bêtes
 Paris 1880
- Aretaeus**
 De Signis chronicorum morborum
 English trans. (F. Adams)
 London 1856
- Athenaeus** -
 The Deipnosophists or the Banquet of the Learned
 English trans. Bohm's Ed.
 London 1854
- Anlus Gellius**
 Noctes Atticae
 Ed. Hertz
 Berlin 1886
- Ayres, L. P.**
 The Influence of Music on Speed in the six-day Bicycle Races.
 American Physical Education Review
 Vol. 16 pp. 321-4.
- Baker, Frank Collins,**
 On the Effect of Music on Caged Animals
 American Naturalist 1897
 Vol. 31.
- Bancroft, Hubert Howe**
 The Native Races of the Pacific States of North America
 New York 1874-6
- Beaunis, H.**
 L'emotion musicale
 Revue Philosophique
 Vol. 86, 1918.

Belot, G.

Esquisse d'une genealogie des categories esthetiques
Journal de Psychologie
XVIII 1921 pp 498-500.

Bigelow H. B.

The Sense of Hearing in the Goldfish
American Naturalist
1904 Vol. 38

Billroth, Theodor

Wer ist musikalisch?
Deutsche Rundschau
B 61. 1894. s. 84

Binet A et Courtier J.

Influence de la Vie emotionnelle sur le coeur la respiration
et la circulation capillaire
Annee Psychologique
tome III. 1896. pp. 104-125

Binet A et Courtier J.

Recherches graphiques sur la Musique
Annee Psychologique
tome II. 1895

Binet A et Courtier J.

Circulation capillaire de la Main
Annee Psychologique
tome II. 1895 pp. 201-22.

Binet Alfred

Les Problemes de l'audition cölöree
Revue des deux Mondes
1892

Bingham W. Van Dyke

Studies in Melody.
Monograph Supplement.
Vol. xII. No. 3. 1910

Bingham W. Van Dyke

Research on Moods and Music.

Boas, Frans

The Central Eskimo
6th Annual Report of the Bureau of Ethnology
1884-5

Braid, James

Neurypnology, or the rationale of Nervous sleep in relation
with animal magnetism.
London 1843

Briffault, Robert.

Psyche's Lamp, A Revaluation of Psychological Principles as
foundation of all thought.
London, 1921.

Brinton, Daniel G.

Myths of the New World.
A treatise on the symbolism and mythology of the red races of
America
New York 1868.

Brown, Robert;

The Races of Mankind
London, Paris, and New York.
(no date.)

Bucher, Karl

Arbeit und Rhythmus
5th Ed. Leipzig 1919.

Buchner Ludwig

Mind in Animals
Eng. trans.
London 1880.

Bullough, Edward.

Recent Work in Experimental Aesthetics
British Journal of Psychology
Vol XII, 1921. pp. 76-99

✓ Burton, T.

Anatomy of Melancholy.

Cabanis, Pierre Jean George

Rapports du Physique et du moral de l'homme
Paris 1844.

Carus, Paul

The Significance of Music
Monist, Vol. 5. 1895.

Celsus, Aulus Cornelius

De Medecina
Eng. trans. 1837

Chandler, Albert

The Aesthetic Categories
Monist, vol. 31, 1921.

Chomet, H.

The Influence of Music on Health and Life.
Eng. trans. New York, 1875.

Combarieu, Jules.

La Musique, Les Lois, Son Evolution.
Paris 1907.

Cariat, Isador

The Meaning of Dreams
New York, 1915.

Coriat, Isador

Abnormal Psychology,
New York, 1920.

Corning, Leonard,

The Use of Musical Vibrations before and during Sleep.
Medical Record. Jan. 21, 1899.

Couty, L. et Charpentier A.

Effets Cardio-vasculaires des excitations des sons
Archives de Physiologie
tome IV, 1874, pp. 525-583.

Curtin, Jeremiah

Myths and Folklore of Ireland
Boston, 1911.

Darwin, Charles

The descent of Man
2nd Edition London 1888

- Davison, J. T. R.
Music in Medicine.
London; Lancet; Oct, 28, 1899.
- Dean, Sam.
Singing Craftsmen of Peking.
Asia. Vol. 21, 1921.
- Densmore, Frances
Teton Sioux Music.
Washington, 1918.
- De Rochas, Alfred
Les Sentiments, la Musique et le Ceste.
Nouvelle Revue, Vol. 114; 1898
pp. 384-389, pp. 587-602.
- Dickinson, Edward.
Music in the History of the Western Church.
New York, 1902.
- Dickinson, Edward.
The Study of the History of Music.
New York, 1905/
- Dixon, Herbert
Music and Medicine considered from a Physiological,
Pathological and Therapeutic Standpoint
The Lancet, Dec. 30, 1899.
- Dixon, Royal
The Human Side of Animals.
New York, 1918.
- Dogiel J.
Ueber den Einfluss der Musik auf den Blutkreislauf
Archiv fur Physiologie
(Du Bois Raymond) 1880 pp. 416-428.
- Donovan J.
The Fetal Origin of Human Speech.
Mind. Vol 16, 1891. pp. 498-506.
- Dunlop, Knight.
Mysticism Freudianism and Scientific Method en Psychology
St. Louis, 1921.

Dupre Ernest et Nathan H
Le Langage Musical
Etude Medico-psychologique
Paris 1911

Dutto Uberto
Influenza della Musica sulla termogenesi animale
Accademia dei Lincei
Vol. 5. 1896.

Dyer, T. F. Thistleton
The Ghost World
London, 1893.

Ellis Havelock
The World of Dreams
Boston and New York, 1912.

Elson, Louis G
The Realm of Music
Boston, 1892

Encasse Gerard
La Magie Pratique
Paris 1893

Engel Carl
Musical Myths and Facts
London 1876

Espinas Alfred
Des Societes Animales
2nd Ed. Paris 1878

Pere Charles
Sensation et Mouvement
Paris 1900

Pere Charles
Travail et Plaisir
Paris 1904

Ferrand G. Essais Physiologiques sur la Musique
Bulletin Academie de Medecine 1895
tome xxxli

Ferrari, G.
Ricerche sperimentali sulla natura dell'emozione musicale
Rivista musicale Italiana
Vol. IV 1897

Finck Henry T.
The Utility of Music
Forum, Vol. 25, 1898.

Fitzgibbon, H. M.
The Story of the Flute
New York 1914.

Fletcher, Alice C.
Love Songs among the Omaha Indians
The International Congress of Anthropology, 1894.

Fletcher Ella Adelia
The Law of the Rhythmic Breath
New York 1908

Flood Wm. H. Gratton
A History of Irish Music
Dublin 1906

Flournoy, Theodore
Des Phenomenes de Synopsie
Paris 1895

Foster E and Gamble E. A.
Effect of Music on Thoracic Breathing
Am. J. of Psychology vol. 17, 1906, pp. 406-414.

Fraser J. G.
"The Magic Art in the Golden Bough.

Frere, Mary Elizabeth I.
Old Deccan Days
Philadelphia 1869

Fraud Sigmund
Totem and Taboo
Engl. trans. New York 1919

Golton Frances,
Inquiries into Human Faculty and its Development
London 1863.

- Gamble, E. A.
Attention and Thoracic Breathing
Am. J. of Psychology
Vol. 16, 1905 pp. 220-280
- Gardiner, William
The Music of Nature
London 1832.
- Gomme George Lawrence
Folklore as an Historical Science
London 1908
- Grant, James A.
A Walk Across Africa
London 1864
- Grimm, J.
Fairy Tales
- Groos, Karl
The Play of Animals,
A Study of Animal Life and Instinct.
Eng. trans.
London, 1898.
- Grosse, Ernst.
The Beginnings of Art.
Eng. trans. New York and London 1914.
- Guibaud, M.
Contribution a l'etude experimentale de l'influence de la
musique sur la circulation et la respiration
Annee psychologique
1898 pp. 645-649
- Gurney, Edmund
The Psychology of Music
Mind Vol 7, 1898
- Hadden G. Cuthbert
Music as Medicine
Music Vol 9. pp. 359-368.
- Hadden, Alfred
Magic and Fetishism
London 1910

Hall Charles Francois
Artic Researches and Life Among the Eskimo
New York 1865

Hall, G. Stanley
Youth, Its Education, Regimen and Hygiene
New York 1906

Haller Albertus
Elementa Physiologiae corporis Humani
Tomus V Lausannae 1763

Hanslick Edward
The Beautiful in Music
A Contribution to the Revision of Musical Aesthetics
Eng. trans.
London and New York 1891.

Harting, J. W.
Music takes first place in reconstruction work.
The Modern Hospital
Vol. 12, 1919.

Hartmann, Franz.
Magic, White and Black,
London 1886.

Hecker, J. F. C.
The Dancing Mania in the Middle Ages.
New York 1885

Henri, Victor
Sensations Auditives
Annee Psychologique
Tome 1, 1894.

Henri Victor
Sensations Auditives
Annee Psychologique
Tome III 1896, pp. 390-401.

Henschel George
Musings and Memories of a Musician
New York 1919.

Hericourt M.
Musical Sensations,
Popular Science Monthly 1882-3. vol. 22. pp. 225-30.

- Harndon, W. L. and Gibbon L.
Exploration of the Valley of the Amazon
Washington 1854
- Hayman Kate R W.
Relation of Ultra Modern to Archaic Music
Boston 1921.
- Hilton Simpson, M. W.
The Land and People of the Kurnai
London 1911
- Hirn Yrjo
The Origins of Art.
A Psychological and Sociological Inquiry
London 1900
- Hoffman W. J.
The Midewww or "Grand Medicine Society" of the Ojibwa.
7th Annual Report of the Bureau of Ethnology 1885-1886
- Howitt, A. W.
On Australian Medicine Men
Journal of the Anthropological Institute
Vol. 16: 1886-7.
- Hume, David
The Natural History of Religion
- Huet L. et Voivenel P.
Le Courage
Paris 1917
- Hyde E and Scalapino W
Influence of Music on Electro-cardiograms and Blood Pressure
American Journal of Physiology, Vol. 46. 1918. pp. 35-38
- Ingegnieros Joseph
Le Langage Musical et ses troubles hysteriques.
Etudes de Psychologie Clinique
Paris 1907
- Isaacs, Abram S.
Stories of the Rabbis
New York, 1916.

Johnson, G. E.

Education by Plays and Games
Ped. Sem. Vol. 3. pp. 97-135.

Johnson, Martha J.

The Relation of Music to Physical Education
National Educational Association
V 45. 1907

Jonckheere Tobie

Ueber den Einfluss der Musik auf die Bewegungen bei schwachemnigen
Kindern
Vol 27. 1902.

Jones, William

The Musical Modes of the Hindoos
Complete Workd Vol. 1V London 1807.

Jung, C. G. Psychology of the Unconscious
Eng. tr. New York 1916.

Katzoff S. L.

Music an aid to Health
The National Eclectic Medical Association Quarterly
Vol. 13; 1921.

King, Irving

Social Aspects of Education
New York 1912.

Kingsley, Mary

West African Studies
London 1897

Knight William

The Philosophy of the Beautiful
New York 1906

Lacepede B. G. E.

Histoire Naturelle des Quadrupedes ovipares
Paris 1788-89

Lane Edward

Modern Egyptians
London 1892

Lawrence, Robert Means
Primitive Psycho-Therapy and Quackery
Boston and New York 1910

Leuba, James H.
A psychological Study of Religion
Its Origin, Function and Future.
New York, 1912.

Levy, Bruhl, L.
Les fonctions mentales
dans les Societes inferieures
Paris 1918

Lindsay, William Lauder
Mind in the Lower Animals in Health and Disease
2 vols. London 1871.

Literary Digest.
Articles on Music.
Vols. 49, 51, 52, 60, 62.

Loeb, Jacques
Psychology and Physiology of the Brain
New York 1902

Lombard, Warren Plympton
The Variations of the Normal Knee-Jerk, and their relation to the
Activity of the central nervous system.
Am. Journal of Psychology. Vol. 1. 1887-8 pp. 2-71.

Lotze, Rudolph Hermann
Medizinische Psychologie
Leipzig 1852

Lubbock, John
Ants, Bees, and Wasps
New York 1894

Lukach, Harry Charles
The city of Dancing Dervishes and other Sketches from the
Far East
London 1914

MacDougall Robert
Music Imagery: A Confession of Experience
Psychological Review
Vol. 5, 1898. p. 463-476.

- McDougall W and Rose C
The Pagan Tribes of Borneo
2 vols. London 1912.
- McDowell, Edward
Critical and Historical Essays
New York 1912.
- Mach Ernst,
Contribution to the Analysis of the Sensations
Eng. trans. Chicago 1897
- Marco Polo
Travels
Eng. trans. Murray's Ed. New York 1895.
- Marie A.
L'audition morbide
Paris 1908
- Maury Alfred
La Magie et l'astrologie dans l'antiquite et au moyen age
Paris 1860
- Mausse M.
L'expression obligatoire des sentiments
(Rituels Oraux funeraires Australiens)
Journal de Psychologie
Vol. 18, 1921.
- Mays T. J. A.
A Study of Drug Action,
Music and Medicine
New York Medical Record Vol. 105, 1917.
- Mentz P
Die Wirkung akustischer Sinnesreize auf Puls und Atmung
Philosophische Studien XI, 1895
p. 61-124, 371-393, 563-602.
- Merriss C. Hart
The Mammals of the Adirondack Region 1882-4.
- Moll A.
Hypnotism Eng. trans. 4th ed.
London and New York 1899.

Mooney J.

The Ghost Dance Religion
Annual Report of Bureau of Ethnology
1892-3.

Morgan, Louis,

The League of the Iroquois
Rochester 1851.

Mott, Frederick

The Influence of Song on Mind and Body
The Journal of Mental Science Vol. 77, 1921.

Muensterberg, Hugo

Psychology, General and Applied
New York and London 1914.

Myers, Charles

A study of rythm in Primitive Music
British Journal of Psychology vol. 11. p. 397-406.

Myers Charles S.

An Introduction to Experimental Psychology,
Cambridge 1912.

Nathan M. et. Dupre E.

Le Langage Musical
Etude Medico-psychologique
Paris 1911.

Nightingale, Florence

Notes on Nursing
New York 1860

Noire L.

On the Origin of Language and the Logos Theory
Eng. trans. Chicago 1899

Ogden R. E.

Review of Auditory Sensation
Psychological Bulletin
Vol. 17, 1920
pp. 238. ff.

Ovid, Tristia

Eng. trans. Bohm's ed.
London 1851.

Outlook:

Articles on Music
Vol. 99. 105, 108.

Parish Edmund

Hallucinations and Illusions
London and New York 1897

Parker G. H.

The Sense of Hearing in Fishes
American Naturalist 1903, Vol. 37.

Pastner P.

Music as Medicine
Music Vol. 14

Patrick G. T. W.

The Psychology of Play
Ped. Sem. Vol. 21. p. 469-484

Patrizi M. L.

Music and the Cerebral Circulation of Man
First Experiments Music Vol. XI. 1896, pp. 232-42.

Patrizi M. L.

Primi Esperimenti intorno all'influenza della musica sulla
circolazione de Sangue nel cervello umano
Rivista Musicale Italiana Vol. III. 1896.

Peterson Frederick

The Galvanometer in Psychology
The Journal of Abnormal Psychology
Vol. 3. 1918-19. p. 43-45.

Pfungst O.

Clever Hans.
Eng. trans. New York 1911.

Plato

Republic Book 11 Jowetts trans.

Pole William

Music in Nature
35: 1897. p. 343-4.

Rabaud, Etienne

Contribution a l'etude de l'instinct: comportement de
quelques araignees
Journal de Psychologie xVlll 1921 p. 171-176.

Radau, Rodolphe

Wonders of Acoustics
Eng. trans. (Ball)
New York 1872.

Read Carveth

The Origin of Man and his Superstitions
Cambridge 1920

Reade Winwood

The Martyrdom of Man
London 1872

Reade Winwood

The African Sketch Book
1 11 London 1873

Reclam K H

Geist und Korper in ihren Wechselbeziehungen
Leipzig 1859

Resse Elizabeth Phelps

Some of the Uses of Unemotional Music
Inst. Journal of Ethics Vol. 5. 1895. p. 471-477

Ribot Th.

La Conscience Tactile-motrice pure
Revue Philosophique V. 84. 1916.

Ribot Th.

Psychology of the Emotions
Eng. trans. London and New York 1903.

Richard de la Prade

Contre la Musique
Paris 1884

Rodway James

Guiana
London 1912

Rohmer, Sax

The Music of Magic
Forum Vol. 58. 1917.

Romances George J.

Animal Intelligence
3d. Ed. London 1883.

Romanes G. J.

Mental Evolution in Animals
London 1880

Rothery G. D.

Music and the Healing Art.
London 1918

Rowbotham R. F.

Musical Myths
Chambers Journal 1891 Vol. 68.

Salvador Daniel, Francisco

Arab Music and Musical Instruments London (no date.)

Salverte Ensebe

The Philosophy of Magic
Eng. trans. London 1846

Sangoro Ito

A comparison of the Japanese fold-song and the Occidental
University of California Publications in Psychology VII

Scheitlin P.

Versuch einer vollständigen Thierseelenkunde
Stuttgart u. Tübingen 1840

Scott Cyril

The Philosophy of Modernism London 1917

Scripture E. W.

Thinking, Feeling and Doing
New York and London 1907

Sergi Giuseppe

Dolore e Piacere
Milano 1893

✓ Seymour, Harriet

What Music can do for you
New York 1920

Sharp William

The Winged Destiny
Studies in the Spiritual History of the gael
New York 1911

Shepard J. P.

Organic Changes and feeling
Am. J. of Psychology Vol. 17 1906, p. 521-84

Silberer H

Problems of Mysticism and Symbolism
Eng. trans. N. Y. 1917.

Sidis Boris

The Nature of the Psycho Galvanic Phenomenon
Studies in Abnormal Psychology

Sidis Boris

The Psychology of Suggestion
New York 1901

Smith Hermann

The Worlds Earliest Music
London (no date)

Spence, John

Shetland Folklore
Lerwick 1899

Spence Louis

Introduction to Mythology
New York 1921

Spencer Herbert

The Principles of Sociology
Vol. 1. 3d. Ed. London and Edinburgh 1885

Spencer Herbert

The Origin of Music
Popular Science Monthly 1890 Vol. 38, p. 1-18.

Stearns R. E. D.

Instances of the Effects of Musical Sounds on Animals
American Naturalist Vol. 24, 1980

Steele R.

Medieval Lore or gleanings from the Encyclopedia of Bartholomew
Anglicus on the Properties of Things London 1893.

Stepanow Giovanni

Sogni Indotti
Firenze 1915

✓ Stratton H C.

The Keynote in Musical Therapy
Arena Vol. 30

Sully James

Studies of Childhood
New York 1898

Tacitus Publius Cornelius

Germania
(Loeb Classical library)
New York 1914

Tanzi R

Cenni ed Esperimenti sulla psicologia dell'Udito
Rivista di Filosofia Scientifica 1891

Tarchanoff J

L'influence de la Musique sur l'homme et les Animaux
Archives Italiens de la Biologie ~~XXI~~ 1894 313-317

Tarchanoff J

Ueber den Galvanischen Erscheinungen in der Haut des Menschen bei
Reizungen der Sinnesorgane und bei verschiedenen Formen der
Psychischen Thätigkeit
Pflüger's Archiv Bd XLVI, p. 46-55.

Tennant Eneabson

The Wild Elephant in Ceylon 1867

Tennant Wm.

Anster Fair; A Poem in Six Cantos
Boston 1815

Tennyson, Alfred
Complete Works
Boston 1898

✓ Timbs John
Doctors and Patients
London 1876

Tylor Edward B.
Primitive Culture 1-11.
London 1891

Tyndall John
Sound
London 1867

Urbantschitsch J
Ueber den Einfluss einer Sinneserregung auf die Uebrigen
Sinnesempfindungen
Pfluger Archiv fue di die Gesamte Physiologie XLII 1888

Urbantschitsch Victor
Ueber den Einfluss von Schallempfindungen auf die Schrift
v Pflugers Archiv fur Physiologie LXLV 1899 p. 43-46.

Vaschide M and Lahy J M
Les coefficients respiratoire et circulatoire de la musique
Rivista musicale Italiana Vol. 19. 1902.

Wallace Alfred Russell
Travels on the Amazon
London 1889

Wallace, Alfred Russell Darwinism
An exposition of the theory of natural selection with some of its
applications
London 1899

Wallace William
The Threshold of Music
An Inquiry into the Development of the Musical Sense London 1908

Wallaschek Richard
Primitive Music, An Inquiry into the Origin and Development of
Music, Songs, Instruments, Dances, and Pantomimes of Savage Races
London 1893

Walsh, Wm. S.
The Psychology of Dreams
New York 1920

Warthin A. S.
Some Physiological Effects of Music in Hypnotized subjects
The Medical News
Vol. 65. 1894, p. 89-92

Watson, John
Behavior
An Introduction to Comparative Psychology
New York 1914

Watts, Frank
An Introduction to the Psychological Problems of Industry
New York 1921

Weaver, Edward R.
Mind and Health
New York 1913

Weber F. B.
On Melody in Speech
Longmans Mag. 1877.

Weir James
The Dawn of Reason
New York 1899

Weismann August
Thoughts upon the Musical Sense in Animals and Man in Essays
upon Heridity and kindred biological subjects
Eng. trans. Oxford 1892

Weld Harry Porter
An experimental study of musical enjoyment
Am. J. of Psychology
Vol. 23. 1912 p. 245-309

Wells D. W.
Psychology Applied to Medicine
Philadelphia 1907

Whipple Guy Montrose

Manual of Mental and Physical Tests
Part 1 2nd. Ed. Baltimore 1914.

Walland Chr. R.

Oberon
Eng. trans. London 1826

Williams T.

Fija and the Fijians
New York 1860

Woodworth R. S.

Dynamic Psychology
New York 1918

✓ Wundt Wilhelm

Elements of Folk Psychology
Outlines of a psychological History of the Development of Mankind
Eng. trans. London 1916

Yeats Wm. Butler

Ideas of Good and Evil
London 1903

Yerkes Robert M.

Introduction to Psychology
New York 1911

Zenneck J

Reagierende Fische auf Töne
Archiv für gesammte Physiologie 1903 XIV