

ON THE

SENSATIONS OF TONE

AS A PHYSIOLOGICAL BASIS FOR THE

THEORY OF MUSIC

HERMANN L. F. HELMHOLTZ

*The Second English Edition, Translated, thoroughly Revised and Corrected,
rendered conformal to the Fourth (and last) German Edition of 1877,
with numerous additional Notes and a New additional Appendix
bringing down information to 1885, and especially
adapted to the use of Music Students by
ALEXANDER J. ELLIS*

*With a New Introduction (1954) by
HENRY MARGENAU*

DOVER PUBLICATIONS, INC., NEW YORK



H. Helmholtz

larly Scales, Modes, and their Modulations have undergone multifarious alterations, not merely among uncultivated or savage people, but even in those periods of the world's history and among those nations where the noblest flowers of human culture have expanded.

Hence it follows,—and the proposition is not even now sufficiently present to the minds of our musical theoreticians and historians—that the *system of Scales, Modes, and Harmonic Tissues* does not rest solely upon *unalterable natural laws*, but is also, at least partly, the result of *esthetical principles, which have already changed, and will still further change, with the progressive development of humanity*. But it does not follow from this that the choice of those elements of musical art was perfectly arbitrary, and that they do not allow of being derived from some more general law. On the contrary the rules of any style of art form a well-connected system whenever that style has attained a full and perfect development. These rules of art were certainly never developed into a system by the artists themselves with conscious intention and consistency. They are rather the result of tentative exploration or the play of imagination, as the artists think out or execute their plans, and by trial gradually discover what kind or manner of performance best pleases them. Yet science can endeavour to discover the motors, whether psychological or technical, which have been at work in this artistic process. Scientific *esthetics* have to deal with the psychological motor; scientific *physics* with the technical. When the artist's aim in the style he has adopted, and its principal direction, have once been rightly conceived, it can be more or less correctly determined why he was forced to follow this or that rule, or employ this or that technical means. In musical theory, namely where the peculiar physiological functions of the ear, while not immediately present to conscious self-examination, play an important part, a large and rich field is thrown open for scientific investigation to shew the necessary character of the technical rules for each individual direction in the development of our art.

It does not rest with natural science to characterise the chief problem worked out by each school of art, and the elementary principle of its style. This must be gathered from the results of historical and esthetical inquiry. The relation we have to treat may be illustrated by a comparison with architecture, which, like music, has pursued essentially different directions at different times. The *Greeks*, in their stone temples, imitated the original wooden constructions; that was the principle of their architectural style. The whole division and arrangement of their decorations clearly shew that it was their intention to imitate wooden constructions. The verticality of the supporting columns, the general horizontality of the supported beam, forced them to divide all the subordinate parts for the great majority of cases into vertical and horizontal lines. The purposes of Grecian worship, which performed its principal functions in the open air, were satisfied by erections, of this kind, in which the internal spaces were necessarily narrowly limited by the length of the stone or wooden beams which could be employed. The old *Italians* (Etruscans), on the other hand, discovered the principle of the arch, composed of wedge-shaped stones. This discovery rendered it possible to cover in much more extensive buildings with arched roofs, than the Greeks could do with their wooden beams. Among these arched buildings the halls of justice (*basilicae*) became important, as is well known, for the subsequent development of architecture. The arched roof made the circular arch the chief principle in division and decoration for *Roman* (*Byzantine*) art. The columns, pressed by heavy weights, were transformed into pillars, on which, after the style was fully developed, columns merely appeared in diminished forms, half sunk in the mass of the pillar, as simply decorative articulations, and as the downward continuation of the ribs of the arches which radiated towards the ceiling from the upper end of the pillar.

In the arch the wedge-shaped stones press against each other, but as they all uniformly press inwards, each one prevents the other from falling. The most

PART III.

THE RELATIONSHIP OF MUSICAL TONES.

SCALES, AND TONALITY.

CHAPTER XIII.

GENERAL VIEW OF THE DIFFERENT PRINCIPLES OF MUSICAL STYLE IN THE DEVELOPMENT OF MUSIC.

Up to this point our investigation has been purely physical. We have analysed the sensations of hearing, and investigated the physical and physiological causes for the phenomena discovered,—partial tones, combinational tones, and beats. In the whole of this research we have dealt solely with natural phenomena, which present themselves mechanically, without any choice, to all living beings whose ears are constructed on the same anatomical plan as our own. In such a field, where necessity is paramount and nothing is arbitrary, science is rightfully called upon to establish constant laws of phenomena, and to demonstrate strictly a strict connection between cause and effect. As there is nothing arbitrary in the phenomena embraced by the theory, so also nothing arbitrary can be admitted into the laws which regulate the phenomena, or into the explanations given for their occurrence. As long as anything arbitrary remains in these laws and explanations, it is the duty of science (a duty which it is generally able to discharge) to exclude it, by continuing the investigations.

But in this third part of our inquiry into the theory of music we have to furnish a satisfactory foundation for the elementary rules of musical composition, and here we tread on new ground, which is no longer subject to physical laws alone, although the knowledge which we have gained of the nature of hearing, will still find numerous applications. We pass on to a problem which by its very nature belongs to the domain of esthetics. When we spoke previously, in the theory of consonance, of agreeable and disagreeable, we referred solely to the immediate impression made on the senses when an isolated combination of sounds strikes the ear, and paid no attention at all to artistic contrasts and means of expression; we thought only of sensuous pleasure, not of esthetic beauty. The two must be kept strictly apart, although the first is an important means for attaining the second.

The altered nature of the matters now to be treated betrays itself by a purely external characteristic. At every step we encounter historical and national differences of taste. Whether one combination is rougher or smoother than another, depends solely on the anatomical structure of the ear, and has nothing to do with psychological motives. But what degree of roughness a hearer is inclined to endure as a means of musical expression depends on taste and habit; hence the boundary between consonances and dissonances has been frequently changed. Simi-

powerful and most dangerous degree of pressure is exerted by the stones in the horizontal parts of the arch, where they have either no support or no obliquely placed support, and are prevented from falling solely by the greater thickness of their upper extremities. In very large arches the horizontal middle portion is consequently the most dangerous, and would be precipitated by the slightest yielding of the materials. As, then, medieval ecclesiastical structures assumed continually larger dimensions, the idea occurred of leaving out the middle horizontal part of the arch altogether, and of making the sides ascend with moderate obliquity until they met in a pointed arch. From thenceforward the pointed arch became the dominant principle. The building was divided into sections externally by the projecting buttresses. These, and the omnipresent pointed arch, made the outlines hard, and the churches became enormously high. But both characters suited the vigorous minds of the northern nations, and perhaps the very hardness of the forms, thoroughly subdued by that marvellous consistency which runs through the varied magnificence of form in a *gothic* cathedral, served to heighten the impression of immensity and power.

We see here, then, how the technical discoveries which were associated with the problems as they rose successively created three entirely distinct principles of style—the horizontal line, the circular arch, the pointed arch—and how at each new change in the main plan of construction, all the subordinate individualities, down to the smallest decorations, were altered accordingly; and hence how the individual rules of construction can only be comprehended from the general principle of construction. Although the gothic style has developed the richest, the most consistent, the mightiest and most imposing of architectural forms, just as modern music among other musical styles, no one would certainly for a moment think of asserting that the pointed arch is nature's original form of all architectural beauty, and must consequently be introduced everywhere. And at the present day it is well known that it is an artistic absurdity to put gothic windows in a Greek building. Conversely any one can unfortunately convince himself on visiting most of our gothic cathedrals how detestably unsuitable to the whole effect are those numerous little chapels of the *renaissance* period built in the Greek or Roman style. Just as little as the gothic pointed arch, should our diatonic major scale be regarded as a *natural product*. At least such an expression is quite inapplicable, except in so far as both are necessary and *natural* consequences of the principle of style selected. And just as little as we should use gothic ornamentation in a Greek temple, by providing their notes with marks of sharps and flats in accordance with the scheme of our major and minor harmonies. The feeling for historical artistic conception has certainly made little progress as yet among our musicians, even among those who are at the same time musical historians. They judge old music by the rules of modern harmony, and are inclined to consider every deviation from it as mere unskilfulness in the old composer, or even as barbarous want of taste.*

Hence before we proceed to the construction of scales and rules for a tissue of harmony, we must endeavour to characterise the principles of style, at least for the chief phases of the development of musical art. For present purposes we may divide these into three principal periods:—

1. The *Homophonic* or Unison Music of the ancients, to which also belongs the existing music of Oriental and Asiatic nations.
2. The *Polyphonic* Music of the middle ages, with several parts, but without regard to any independent musical significance of the harmonies, extending from the tenth to the seventeenth century, when it passes into
3. *Harmonic* or *Modern* Music, characterised by the independent significance

* Thus in R. G. Kiesewetter's historical-musical writings, which are otherwise so rich in facts industriously collected, there is evidently an exaggerated zeal to deny everything which will not fit into the modern major and minor modes.

attributed to the harmonies as such. Its sources date back from the sixteenth century.

I. HOMOPHONIC MUSIC.

One part music is the original form of music with all people. It still exists among the Chinese, Indians, Arabs, Turks, and modern Greeks, notwithstanding the greatly developed systems of music possessed by some of these nations.* That music in the time of highest Grecian culture, neglecting perhaps individual instrumental ornamentation, cadences, and interludes, was written in one part, or that the voices at most sang in Octaves, can now be considered as established. In the problems of Aristotle we find the question: 'Why is the consonance of the Octave alone sung? For this and no other consonance is played on the *magadis*.' This was a harp-shaped instrument [with a bridge dividing the strings at one-third their length]. In another place he remarks that the voices of boys and men form an Octave in singing.†

One part music, considered independently and unaccompanied by words, is too poor in forms and changes, to develop any of the greater and richer forms of art. Hence purely instrumental music at this stage is necessarily limited to short dances or marches. We really find no more among nations that have no harmonic music.‡ Performers on the flute§ have certainly repeatedly gained the prize in the Pythian games, but it is possible to perform feats of execution in instrumental music in concise forms of composition, as, for example, in the variations of a short melody. That the principle of varying (*μεταβολή*) a melody with reference to dramatical expression (*μήτρως*), was known to the Greeks, follows also from Aristotle. He describes the matter very plainly, and remarks that choruses must simply repeat the melodies in the antistrophes, because it is easier for one than for several to introduce variations. But public competitors (*ἀγωνισταί*) and actors (*ὑποκριταί*) are able to grapple with these difficulties.**

* [See App. XX. sect. K. for some of these scales.—*Translator*.]

† *Διδ. τὴν διὰ πᾶσαν συμφωνίαν ἄδεται μὲν: μαγὰδ' ὅσον, γὰρ τῶν, ἄλλαν δὲ οὐδένα.* *Prob. xix. 18.* [Translated in the text.] *Διδ. τὴν ἑστὴν τὸν ὀκτώων τοῦ διαφώνου: ἢ καὶ τὸ μὲν ἀντὶφώνον σὺμφωνον ἔστι διὰ πᾶσαν: ἐκ τῶν γὰρ νέον καὶ ἀνδρῶν γινεται τὸ ἀντὶφώνον ὁ διαφώνος τοῦ νέου, ὅς ἐστιν πρὸς τὴν ἑστάν.* *Prob. xix. 39.* [Why is a consonant union of voices pleasanter than a single voice? Is the singing of voice against voice, a consonant union of voices in Octaves? This singing of voice against voice occurs when young boys and men sing together, and their tones differ as the highest from the lowest of the scale.] Towards the end of the songs the instrumental accompaniment seems to have separated itself from the voice. Probably this is what is meant by the *krōusis* in the passage *τελευτώντας δ' εἰς τῶν, ἐν καὶ κούβη τοῦ ἔργου συμβαίνει γινεσθαι, κατέπερ τοῖς ἐν τῇ φῶν κροῦσι: καὶ γὰρ ὅσον τὰ ἄλλα οὐ προσαυδαίνουσιν, ἐν εἰς τῶν τὸν κατεστρόφον, εὐραύνουσιν ἄλλαν τῇ τῆς ἡ κρούσει τὰς πρὸ τοῦ τῆς διαφώνου, τῇ τὸ διαφώνον τὸ κούβη, ἥσττον ἐκ τοῦ διὰ πᾶσαν γινεσθαι.* *Arist. Prob. xix. 39.* [But when they end in the same, the matter is precisely similar to what occurs when they play an accompaniment to a song. For the accompanists do not follow the rest, but when the singers return to the same, they please more in the end, than they displease in the differences before the end, by which means the common part in what is generally different, pleases more than anything but the Octave.] See also *Plutarch, De Musica*, xix. xxviii. That the Greeks knew

the effect of consonances and did not like it, appears by the following passage from Aristotle. *De Audiibilibus*, ed. Bekker, p. 80: 'For this reason we understand a single speaker better than many who are saying the same things at the same time. And so with strings. And much less, when flute and lyre are played at the same time, because the voices are confused by the others. And this is very plain for the consonances. For both tones are concealed, one by the other.' *Διδ. καὶ ἄλλαν ἐνὸς ἀκούοντες συρίμεν, ἢ πολλῶν ἑκα τὰν ἀνδρῶν, κατέπερ καὶ ἐπὶ τῶν χορῶν, καὶ πολλὸ ἥττον, ὅταν προσ-αυλῇ τις ἑκα καὶ κιθάρῃ, διὰ τὸ συγχέεισθαι τὰς φωνὰς ἐν τῶν ἑτέρων. Οὐχ ἥκιστα δὲ τῶν ἐπὶ τῶν συμφωνίων φασερόν ἐστιν. Ἀναφορίους γὰρ ἀποκρίσασθαι συμβαίνει τοῖς ἥχους ἐν ἄλλῃων.* [In Java long pieces of music in non-harmonic scales occur to accompany actions and develop the feeling of a plot. Many instruments play together, but there is no harmony.—*Translator*.]

§ The *magadis* were perhaps more like our oboes. *ἐπισπύοντο· αἱ δὲ ἄλλαι φῶαι αἱ χορικά: ἢ ἐπὶ αἱ μὲν ἡμῶι ἀγωνιστικῶν ἦσαν, ὧν ἥδη μινεῖσθαι δυνάμενον καὶ διατρέσθαι, ἢ φῶν ἑτέρου μακρὰ καὶ πολυειδῆς: κατέπερ οὖν καὶ τὰ μέλη τῇ μινεῖσθαι ἡκολούθει ἀεὶ ἔτερα γινόμενα. Μᾶλλον γὰρ τῇ μέλει ἀντὶκη μινεῖσθαι, ἢ τοῖς ἥμασι. Δι' ἃ καὶ οἱ διδραμβοὶ, ἐπειδὴ μινεῖσθαι ἐθέλοντο, οὐκ ἔτι ἔχουσιν ἀντιστροφούς, πρὶν ποῦν δὲ εἶχον. Ἀφ' οὗ δὲ, ἐπὶ τοῖς παλαιῶν οἱ ἐλεύθεροι ἐχόντων αὐτοὶ. Πολλοὺς οὖν ἀγωνιστικῶς ἔδει, χαλεπὸν ἦν. Ὅστεν ἐπαρμένια μᾶλλον μέλη ἔπαιον. Μετὰ τῶν γὰρ πολλὰς μεταβολὰς τῷ ἐλ βῆεν, ἢ τοῖς παλαιῶν, καὶ τῷ ἀγωνιστῇ, ἢ τοῖς τοῦ ἥμου*

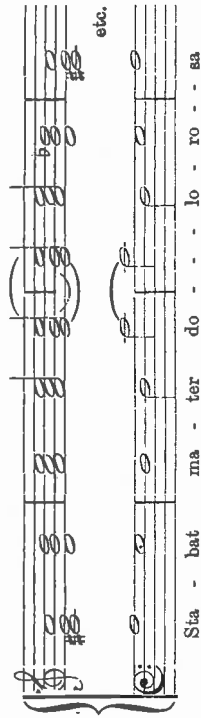
The practical consequences of this neglect of harmony are conspicuous in various ways in musical compositions. The composers confined themselves on the whole to the diatonic scale; 'accidentals,' or signs of alterations of tone, were seldom used. The Greeks had introduced the depression of the tone *B* to *B $\flat$* in a peculiar tetrad, that of the *synmēmon*, and this was retained. Besides this *f*, *c*, *#*, and *g*, *#* were used, to introduce leading tones in the cadences. Hence modulation, as we understand it, from the key of one tonic to that of another with a different signature was almost entirely absent. Moreover, the chords used by preference down to the end of the fifteenth century, were formed of the Octave and Fifth without the Third, and such chords now sound poor and are avoided as much as possible. To medieval composers who only felt the want of the most perfect consonances, these chords appeared the most agreeable, and none others might be used at the close of a piece. The dissonances which occur are universally those which arise from suspended and passing tones; chords of the dominant Seventh, which, in modern harmony, play such an important part in marking the key, and in connecting and facilitating progressions, were quite unknown.

Great, then, as was the artistic advance in rhythm and the progression of parts, during this period, it did little more for harmony and the tonal system than to accumulate an undigested mass of experiments. Since the involved progression of the parts gave rise to chords in extremely varied transpositions and sequences, the musicians of this period could not but hear these chords and become acquainted with their effects, however little skill they shewed in making use of them. At any rate, the experience of this period prepared the way for harmonic music proper, and made it possible for musicians to produce it, when external circumstances forced on the discovery.

3. HARMONIC MUSIC.

Modern harmonic music is characterised by the independent significance of its harmonies, for the expression and the artistic connection of a musical composition. The external inducements for this transformation of music were of various kinds. First there was the Protestant ecclesiastical chorus. It was a principle of Protestantism that the congregation itself should undertake the singing. But a congregation could not be expected to execute the artistic rhetorical labyrinths of Netherland polyphony. On the other hand, the founders of the new confession, with Luther at their head, were far too penetrated with the power and significance of music, to reduce it at once to an unadorned unison. Hence the composers of Protestant ecclesiastical music had to solve the problem of producing simply harmonised chorales, in which all the voices progressed at the same time. This excluded those canonic repetitions of the same melodic phrases in different parts, which had hitherto formed the chief unity of the whole piece. A new connecting principle had to be looked for in the sound of the tones themselves, and this was found in a stricter reference of all to one predominant tonic. The success of this problem was facilitated by the fact that the Protestant hymns were chiefly adapted to existing popular melodies, and the popular songs of the Germanic and Celtic races, as already remarked, betrayed a stricter feeling for tonality in the modern sense, than those of southern nations. Thus as early as in the sixteenth century, the system of the harmony of the ecclesiastical Ionic mode (our present major) developed itself with tolerable correctness, so that these chorales do not strike modern ears as strange, although they were still without many of our later contrivances for marking the key, as, for example, the chord of the dominant Seventh. On the other hand, it was much longer before the other ecclesiastical modes, in harmonising which much uncertainty still prevailed, were fused into the modern minor mode. The Protestant ecclesiastical hymns of that time produced great effects on the feelings of contemporaries—a fact emphasised on all sides in the liveliest language, so that no doubt can exist that the impression made by such music, was something as new as it was peculiarly powerful.

In the Roman Church also a desire arose for altering their music. The divisions of polyphonic music scattered the sense of the words, and made them unintelligible to the unpractised public, and occasioned even a learned and cultivated hearer great difficulties in endeavouring to disentangle the knot of voices. In consequence of the proceedings of the Council of Trent, and by an order of Pope Pius IV. (A.D. 1559-1565), Palestrina (A.D. 1524-1594) carried out this simplification and embellishment of ecclesiastical music, and the simple beauty of his compositions is said to have prevented the complete banishment of part music from the Roman liturgy. Palestrina, who wrote for choruses of singers practised in their art, did not entirely drop the more complicated progression of parts found in polyphonic music, but by appropriate sections and divisions he separated and connected both the mass of tones and the mass of voices, and generally distributed the latter into several distinct choirs. The voices also are more or less frequently heard together in such progressions as were used in chorales, and in this case consonant chords greatly predominated. By this means he made his pieces more comprehensible and intelligible, and in general extremely agreeable to the ear. But the deviation of ecclesiastical modes from the new modes invented in modern times for the treatment of harmonies, is nowhere so remarkable as in the compositions of Palestrina and those of contemporary Italian composers of ecclesiastical music, among whom Giovanni Gabrieli, a Venetian, should be particularly named. Palestrina was a pupil of Claude Goudimel (a Huguenot, slain at Lyons in the massacre of St. Bartholomew), who had harmonised French psalms in a way which, when the scale was major, was but very slightly different from modern habits. These psalm melodies had been borrowed, or at least imitated from popular songs. Hence Palestrina was certainly acquainted with this mode of treatment, through his teacher, but he had to deal with themes from the Gregorian *Cantus firmus* that moved in ecclesiastical tones, which he was forced to maintain strictly even in pieces where he himself invented or adapted the melodies. Now these modes necessitated a totally different harmonic treatment, which sounds very strange to moderns. As a specimen I will only cite the commencement of his eight-part *Stabat mater*.



Here, at the commencement of a piece, just where we should require a steady characterisation of the key, we find a series of chords in the most varied keys, from *A* major to *F* major, apparently thrown together at haphazard, contrary to all our rules of modulation. What person that was ignorant of ecclesiastical modes could guess the tonic of the piece from this commencement? As such we find *D* at the end of the first strophe, and the sharpening of *C* to *C $\sharp$* in the first chord also points to *D*. The principal melody too, which is given to the tenor, shews from the commencement that *D* is the tonic. But we do not get a minor chord of *D* till the eighth bar, whereas a modern composer would have been forced to introduce it in the first good place he could find in the first bar.

We see from these characters how greatly the nature of the whole system of ecclesiastical modes differed from our modern keys. We cannot but assume that masters like Palestrina founded their method of harmonisation upon a correct feeling for the peculiar character of those modes, and that, as they could not fail to be acquainted with the contemporary advances in Protestant ecclesiastical music, their work was neither arbitrary nor unskillful.

What we miss in such examples as the one just adduced, is first, that the tonic chord does not play the same prominent part at the very commencement that is assigned to it in modern music. In the latter, the tonic chord has the same prominent and connecting significance among chords as the tonic or key-note among the tones of the scale. Next we miss altogether that feeling for the connection of consecutive chords which in modern times has led to the very general custom of giving them a common tone. This is evidently related to the fact that, as we shall see hereafter, it was not possible in the old ecclesiastical modes to produce chains of chords so closely connected with each other and with the tonic chord, as in the modern major and minor modes.

Hence, although we recognise in Palestrina and Gabrieli a delicate artistic sensitiveness for the esthetic effect of separate chords of various kinds, and in so far a certain independent significance in their harmonies, yet we see that the means of establishing an internal connection in the tissue of chords had still to be discovered. This problem, however, required a reduction and transformation of the previous scales, to our major and minor. On the other hand, this reduction sacrificed the great variety of expressions which depended on diversity of scale. The old scales partly form transitions between major and minor, and partly enhance the character of the minor, as in the ecclesiastical Phrygian mode [p. 245*d*]. This diversity being lost, it had to be replaced by new contrivances, such as the transposition of the scales for different tonics, and the modulational passage from one key to another.

This transformation was completed during the seventeenth century. But the most active cause for the development of harmonic music is due to the commencement of opera. This had been occasioned by a revival of acquaintance with classical antiquity, and its avowed object was to rehabilitate ancient tragedy, which was known to have been recited musically. Here arose immediately the problem of allowing one or two voices to execute solos; but these again had to be harmonised so as to fit in between the choruses, which were treated in the polyphonic manner, the object being to make the solo parts stand prominently forward and keep the accompanying voices well under. These conditions first gave rise to Recitative, invented by Giacomo Peri and Caccini in 1600, and solo songs with airs, invented by Claudio Monteverde and Viadana. The new view taken of harmony shews itself in written music by the appearance of figured basses in the works of these composers. Every figured bass note represented a chord, so that the chords themselves were settled, but the progression of the parts of which they were constituted was left to the taste of the player. And thus what was merely secondary in polyphonic music, became principal, and conversely.

Opera also necessitated the discovery of more powerful means of expression than were admissible in ecclesiastical music. Monteverde, who was extremely prolific in inventions, is the first composer who used chords of the dominant Seventh without preparation, for which he was severely blamed by his contemporary Artusi. Generally we find a bolder use of dissonances, which were employed independently, to express sharp contrasts of expression, and not, as before, as accidental results of the progression of parts.

Under these influences, even as early as in Monteverde's time, the Doric, Eolic, and Phrygian ecclesiastical modes [p. 254*c, d*] began to be transformed and fused into our modern minor mode. This was completed in the seventeenth century, and these modes were thus made more suitable for giving prominence to the tonic of the harmony, as will be more fully shewn hereafter.

We have already given an outline of the nature of the influence which these changes exerted on the constitution of the tonal system. The mode of connecting musical phrases hitherto in vogue—canonic repetitions of similar melodic figures—had necessarily to be abandoned as soon as a simple harmonic accompaniment

had to be subordinated to a melody. Hence some new means of artistic connection had to be discovered in the sound of the chords themselves. This was effected, first by making the harmonies refer their tones much more definitely to one predominant tonic than before, and secondly by giving fresh strength to the relations between the chords themselves and between all other chords and the tonic chord. In the course of our investigations we shall see that the distinctive peculiarities of the modern system of tones can be deduced from this principle, and that the principle itself is very strictly carried out in our present music. In reality the mode in which the materials of music are now worked up for artistic use, is in itself a wondrous work of art, at which the experience, ingenuity, and esthetic feeling of European nations has laboured for between two and three thousand years, since the days of Terpander and Pythagoras. But the complete formation of the essential features as we now see it, is scarcely two hundred years old in the practice of musical composers, and theoretical expression was not given to the new principle till the time of Rameau at the beginning of last century. In the historical point of view, therefore, it is wholly the product of modern times, limited nationally to the German, Roman, Celtic, and Slavonic races.

With this tonal system, which admits great wealth of form with strictly defined artistic consistency, it has become possible to construct works of art, of much greater extent, and much richer in forms and parts, much more energetic in expression, than any producible in past ages; and hence we are by no means inclined to quarrel with modern musicians for esteeming it the best of all, and devoting their attention to it exclusively. But scientifically, when we proceed to explain its construction and display its consistency we must not forget that our modern system was not developed from a natural necessity, but from a freely chosen principle of style; that beside it, and before it, other tonal systems have been developed from other principles, and that in each such system the highest pitch of artistic beauty has been reached, by the successful solution of more or less limited problems.

This reference to the history of music was necessitated by our inability in this case to appeal to observation and experiment for establishing our explanations, because, educated in a modern system of music, we cannot thoroughly throw ourselves back into the condition of our ancestors, who knew nothing about what we have been familiar with from childhood, and who had to find it all out for themselves. The only observations and experiments, therefore, to which we can appeal, are those which mankind themselves have undertaken in the development of music. If our theory of the modern tonal system is correct it must also suffice to furnish the requisite explanation of the former less perfect stages of development.

As the fundamental principle for the development of the European tonal system, we shall assume that *the whole mass of tones and the connection of harmonies must stand in a close and always distinctly perceptible relationship to some arbitrarily selected tonic, and that the mass of tone which forms the whole composition, must be developed from this tonic, and must finally return to it.* The ancient world developed this principle in homophonic music, the modern world in harmonic music. But it is evident that this is merely an esthetic principle, not a natural law.

The correctness of this principle cannot be established *a priori*. It must be tested by its results. The origin of such esthetic principles should not be ascribed to a natural necessity. They are the inventions of genius, as we previously endeavoured to illustrate by a reference to the principles of architectural style.

produce only harmonic upper partial tones. On the other hand, bodies excited by blows have a peculiar value for clearly defining the rhythm.

A second reason for preferring compound tones with harmonic upper partials is subjective and conditioned by the construction of our ear. In the ear even every simple tone, if sufficiently intense, excites feeble sensations of harmonic upper partials, and each combination of several simple tones generates combination tones, as I have explained at the end of Chap. VII. (p. 157d-159c). A single compound tone with irrational partials, when sounded with sufficient force, thus produces the sensation of dissonance, and simple tones acquire in the ear itself something of the nature of composition out of harmonic upper partial tones.

We are justified in assuming that historically all music was developed from song. Afterwards the power of producing similar melodic effects was attained by means of other instruments, which had a quality of tone compounded in a manner resembling that of the human voice. The reason why, even when constructive art was most advanced, the choice of musical instruments was necessarily limited to those which produced compound tones with harmonic upper partials, is clear from the above conditions.

This invariable and peculiar selection of instruments makes us perfectly certain that harmonic upper partials have from all time played an essential part in musical constructions, not merely for harmony, as the second part of this book shews, but also for melody.

Again, we can at any moment convince ourselves of the essential importance of upper partial tones to melody, by the absence of all expression in melodies executed with objectively simple tones, as, for example, those of wide-stopped organ pipes, for which the harmonic upper partials are formed only subjectively and weakly in the ear.

A necessity was always felt for music of all kinds to proceed by certain definite degrees of pitch; but the choice of these degrees was long unsettled. To distinguish small differences of pitch and intonate them with certainty, requires a greater amount of technical musical power and cultivation of ear, than when the intervals are larger. Hence among almost all uncivilised people we find the Semitones neglected, and only the larger intervals retained. For some of the more cultivated nations, as the Chinese and Greeks, a scale of this kind has become established.*

It might perhaps have seemed most simple to make all such degrees of pitch of equal amount, that is, equally well distinguishable by our sensations. Such a graduation is possible for all our sensations, as Fechner has shewn in his investigations on psychophysical laws. We find such graduations used for the divisions of musical rhythm, and the astronomers use them in reference to the intensity of light in determining stellar magnitudes. Even in the field of musical pitch, the modern equally tempered chromatic scale presents us with a similar graduation. But although in certain of the less usual Greek scales and in modern Oriental music, cases occur where some particular small intervals have been divided on the principle of equal graduations, yet there seems at no time or place to have been a system of music in which melodies constantly moved in equal degrees of pitch, but smaller and larger intervals have always been mixed in the musical scales in a way that must appear entirely arbitrary and irregular until the relationship of compound tones is taken into consideration.*

On the contrary, in all known musical systems the intervals of Octave and Fifth have been decisively emphasised. Their difference is the Fourth, and the difference between this and the Fifth, is the Pythagorean major Tone 8 : 9, by which (but not by the Fourth or Fifth) the Octave might be approximately divided.

The sole remnants that I can find in modern music of the endeavour sometimes made in homophonic music to introduce degrees depending on equality of interval and not on relationship of tone, are the chromatic intercalated notes, and

* [See, however, App. XX. sect. K.—*Translator*.]

difficulty in hitting, must naturally also appear an unusual and forced skip to the hearer. By *false relations* is meant the case when two tones in consecutive chords, which belong to different voices, form false Octaves or false Fifths. For example, if one voice in the first chord sings b_1 , and another voice in the next chord sings b_2 , or the first has c and the second $c\sharp$, there are false Octave relations. False Fifth relations are forbidden for the extreme voices only. Thus in the first chord the bass has b_1 , in the second the soprano has f , or conversely, where $b_1 \dots f$ is a false Fifth. The meaning of this rule is, probably, that the singer would find it difficult to hit the new tone which is not in the scale, if he had just heard the next nearest tone of the scale given by another singer. Similarly, when he has to take the false Fifth of a tone which is prominent in present harmony as lowest or highest. There is therefore a certain sense in the prohibition, but numerous exceptions have arisen, as the ear of modern musicians, singers and hearers, has become accustomed to bolder combinations and livelier progressions. All these rules were essentially intended for the old ecclesiastical music, where a quiet, gentle, well-contrived, and well-adjusted stream of sound was aimed at, without any intentional effort or disturbance of the smoothest equilibrium. Where music has to express effort and excitement, these rules become meaningless. Hidden Fifths and Octaves and even false relations of Fifths are found in abundance in the chorales of Sebastian Bach, who is otherwise so strict in his harmonies, but it must be admitted that the motion of his voices is much more powerfully expressed than in the old Italian ecclesiastical music.

CHAPTER XIX.

ESTHETICAL RELATIONS.

LET us review the results of the preceding investigation.

Compound tones of a certain class are preferred for all kinds of music, melodic or harmonic; and are almost exclusively employed for the more delicate and artistic development of music: these are the compound tones which have harmonic upper partial tones, that is compound tones in which the higher partial tones have vibrational numbers which are integral multiples of the vibrational number of the lowest partial tone, or prime. For a good musical effect we require a certain moderate degree of force in the five or six lowest partial tones, and a low degree of force in the higher partial tones.

This class of compound tones with harmonic upper partials is objectively distinguished by including all sonorous motions which are generated by a mechanical process that continues to act uniformly, and which consequently produce a uniform and sustained sensation. In the first rank among them stand the compound tones of the human voice, man's first musical instrument in time and value. The compound tones of all wind and bowed instruments belong to this class.

Among the bodies which are made to emit tones by striking, some, as strings, have also harmonic upper partials, and these can be used for artistic music.

The greater number of the rest, as membranes, rods, plates, &c., have inharmonic upper partial tones, and only such of them as have not very strong secondary tones of this kind can be singly and occasionally employed in connection with musical instruments proper.

Although sonorous bodies excited by blows may continue to sound for some time, their tones do not proceed with uniform force, but diminish more or less slowly and die away. Constant power over the intensity of tone, therefore, which is indispensable for expressive performance, can only be attained on instruments of the first kind, which can be maintained in a state of excitement, and which

the leading note of the key when similarly used. But this is always a Semitone (p. 352c), an interval well known in the series of related tones, which, owing to its smallness, is easily measured by the sensation of its difference, even in places where its tonal relationship is not immediately sensible.

The decisive importance acquired by the Octave and Fifth in all musical scales from the earliest times shews, that the construction of scales must have been originally influenced by another principle, which finally became the sole regulator of every artistic form of a complete scale. This is the principle which we have termed *tonal relationship*.

Relationship in the first degree between two compound tones consists in their each having a partial tone of the same pitch.

In singing, the similarity of two musical tones which stand in the relation of Octave or Fifth to one another, must have been very soon observed. As already remarked, this gives also the Fourth, which has itself a sufficiently perceptible natural relationship to have been remarked independently. To discover the tonal similarity of the major Third and major Sixth, required a finer cultivation of the musical ear, and perhaps also peculiar beauty of voice. Even yet we are easily led by the familiar sharp major Thirds of equal temperament, to endure any major Thirds which are somewhat too sharp, provided they occur melodically and are not sounded together. On the other hand, we must not forget that the rules of Archytas and Abdul Kadir,* both of which were applicable to homophonic music only, gave a preference to the natural major Third, although its introduction obliged both musicians to renounce a musical system so theoretically consistent and invested with such high authority as that of Pythagoras.

Hence the principle of tonal relationship did not at all times exclusively determine the construction of the scale, and does not even yet determine it exclusively among all nations. This principle must, therefore, be regarded to some extent as *a freely selected principle of style*, as I have endeavoured to shew in Chapter XIII. But, on the other hand, the art of music in Europe was historically developed from that principle, and on this fact depends the main proof that it was really as important as we have assumed it to be. The preference first given to the *diatonic scale*, and finally the exclusive use of that scale, introduced the principle of tonal relationship in all its integrity into the musical scale. Within the diatonic scale various methods of execution were possible, and these generated the ancient modes, which had equal claims to attention in homophonic song, and hence stood on a level.

But the principle of tonal relationship penetrated far deeper in its harmonic than it did in its melodic form. In melodic sequence the identity of two partial tones is a matter of memory, but when the notes are sounded together the immediate sensible impression of the beats, or else of the undisturbed flow of sound forces itself on the hearer's attention. The liveliness of melodic and harmonic impressions differs in the same way as a recollected image differs from the actual impression made by the original. As an immediate consequence arose that far superior sensibility for the correctness of the intervals which is seen in the harmonic union of tones, and which admitted of being developed into the finest physical methods of measurement.

It must also be remembered that relationship in the second degree can in harmonic music be reduced to audible relationships of the first degree, by a proper selection of the fundamental bass, and that generally more distant relationships can easily be made clearly audible. By this means, notwithstanding the variety of progression, a much clearer connection of all parts with their origin, the tonic, can be maintained and rendered objectively sensible to the hearer. It cannot be doubted that these are the essential foundations of the great breadth and wealth of expression which modern compositions can attain without losing their artistic unity.

* [For Archytas of Tarentum, about a.c. 400, see p. 262c, and for Abdulqadir, see p. 281, note †.—*Translator*.]

We then saw that the requirements of harmonic music reacted in a peculiar manner on the construction of scales; that properly speaking only one of the old tonal modes (our major mode) could be retained unaltered,* and that the rest after undergoing peculiar modifications were fused into our minor mode, which, though most like the ancient mode of the minor Third, can at one time resemble the mode of the minor Sixth, and at another time that of the minor Seventh, but does not perfectly correspond with any one of these.

This process of the development of the elements of our modern musical system lasted down to the middle of the last century. It was not until composers ventured to put a minor chord at the close of compositions written in the minor mode, that the musical feeling of European musicians and hearers can be admitted to have become perfectly and surely habituated to the new system. The minor chord was allowed to be a real, although obscured, chord of its tonic.

Whether this admission of the minor chord expressed a feeling for another mode of unifying its three tones, as A. von Oettingen † has assumed,—relying on the fact that the three tones $c-e\flat-g$ have a common upper partial g' ,—must be left to future experience to decide, should it be found practicable to construct long and well-connected musical compositions in *Oettingen's phonic system* (this is the name which he gives to the minor system which he has theoretically developed, and which is essentially different from the historical minor mode). At any rate, the minor mode has historically developed itself as a compromise between different kinds of claims. Thus it is only major triads which can perfectly indicate the compound tone of the tonic; minor chords contain in their Third an element which, although nearly related to the tonic and its Fifth, does not thoroughly fuse with them, and hence in their final cadence they do not so thoroughly agree with the principle of tonality which had ruled the previous development of music. I have endeavoured to make it probable that the peculiar esthetic expression of the minor mode proceeded partly from this cause and partly from the heterogeneous combinational tones of the minor chord.

In the last part of my book, I have endeavoured to shew that the construction of scales and of harmonic tissue is a product of artistic invention, and by no means furnished by the natural formation or natural function of our ear, as it has been hitherto most generally asserted. Of course the laws of the natural function of our ear play a great and influential part in this result; these laws are, as it were, the building stones with which the edifice of our musical system has been

* [But see *supra*, p. 274, note *, scale 1.—*Translator*.]

† *The System of Harmony Dually Developed*, Dorpat and Leipzig, 1866. Herr v. Oettingen, as already observed, p. 308, note §, regards the minor chord as representing the harmonic undertones of its Fifth, and hence as standing in place of a part of its compound tone. He calls it the 'phonic' chord, as opposed to the 'tonic' major chord which stands in place of the upper partials of its root. He proceeds to deduce the formation of the minor system from the relations of the harmonic undertones in a manner precisely analogous to that by which I have deduced the major system from the relations of the upper partial tones. The tonal mode thus constructed is, however, in our language the mode of the minor Sixth (p. 274, note *, scale 7), and the usual minor, a mixed mode. Latterly Dr. Hugo Riemann has given in his adhesion to this view, and in his lately published *Musical Symbols* has attempted to examine and establish the consequences of this system by examples from acknowledged composers. The application of this critical method appears to me very commendable, and to be the indispensable condition to advancing

in the theory of composition. For the rest this author justifies (p. 54) the assertion I have made in the text by remarking: 'I am sorry to say that I am unable to adduce a single example from the whole of our musical literature, of the carrying out of (v. Oettingen's) pure minor mode harmony even in the simplest manner.' I have not been able to convince myself of the correctness of the fact adduced on p. xiii. and p. 6, that the undertones of a tone strongly struck on the piano sound when the corresponding dampers are raised. Perhaps the author has been deceived by the circumstance that with very resonant instruments (especially older ones) very strong shakes, and therefore probably a violent blow on the digitalis, will cause some one or several of the deeper strings to sound its note. [The undertones have always each an upper partial tone of the pitch of the note struck; the striking of this note must then sympathetically excite those upper partials of the undertones, and thus reinforce the prime of the note struck, just as striking the undertones sympathetically excites the higher tone itself. Can this have deceived Dr. Riemann?—*Translator*.]

erected, and the necessity of accurately understanding the nature of these materials in order to understand the construction of the edifice itself, has been clearly shewn by the course of our investigations upon this very subject. But just as people with differently directed tastes can erect extremely different kinds of buildings with the same stones, so also the history of music shews us that the same properties of the human ear could serve as the foundation of very different musical systems. Consequently it seems to me that we cannot doubt, that not merely the composition of perfect musical works of art, but even the construction of our system of scales, keys, chords, in short of all that is usually comprehended in a treatise on Thorough Bass, is the work of artistic invention, and hence must be subject to the laws of artistic beauty. In point of fact, mankind has been at work on the diatonic system for more than 2500 years since the days of Terpander and Pythagoras, and in many cases we are still able to determine that the progressive changes made in the tonal system have been due to the most distinguished composers themselves, partly through their own independent inventions, and partly through the sanction which they gave to the inventions of others, by employing them artistically.

The esthetic analysis of complete musical works of art, and the comprehension of the reasons of their beauty, encounter apparently invincible obstacles at almost every point. But in the field of elementary musical art we have now gained so much insight into its internal connection that we are able to bring the results of our investigations to bear on the views which have been formed and in modern times nearly universally accepted respecting the cause and character of artistic beauty in general. It is, in fact, not difficult to discover a close connection and agreement between them; nay, there are probably fewer examples more suitable than the theory of musical scales and harmony, to illustrate the darkest and most difficult points of general esthetics. Hence I feel that I should not be justified in passing over these considerations, more especially as they are closely connected with the theory of sensual perception, and hence with physiology in general.

No doubt is now entertained that beauty is subject to laws and rules dependent on the nature of human intelligence. The difficulty consists in the fact that these laws and rules, on whose fulfilment beauty depends and by which it must be judged, are not consciously present to the mind, either of the artist who creates the work, or the observer who contemplates it. Art works with design, but the work of art ought to have the appearance of being undesignated, and must be judged on that ground. Art creates as imagination pictures, regularly without conscious law, designedly without conscious aim. A work, known and acknowledged as the product of mere intelligence, will never be accepted as a work of art, however perfect be its adaptation to its end. Whenever we see that conscious reflection has acted in the arrangement of the whole, we find it poor.

Man fühlt die Absicht, und man wird verstimmt.
(We feel the purpose, and it jars upon us.)

And yet we require every work of art to be reasonable, and we shew this by subjecting it to a critical examination, and by seeking to enhance our enjoyment and our interest in it by tracing out the suitability, connection, and equilibrium of all its separate parts. The more we succeed in making the harmony and beauty of all its peculiarities clear and distinct, the richer we find it, and we even regard as the principal characteristic of a great work of art that deeper thought, reiterated observation, and continued reflection shew us more and more clearly the reasonableness of all its individual parts. Our endeavour to comprehend the beauty of such a work by critical examination, in which we partly succeed, shews that we assume a certain adaptation to reason in works of art, which may possibly rise to a conscious understanding, although such understanding is neither necessary for the invention nor for the enjoyment of the beautiful. For what is esthetically beautiful is recognised by the immediate judgment of a cultivated taste, which declares

it pleasing or displeasing, without any comparison whatever with law or conception.

But that we do not accept delight in the beautiful as something individual, but rather hold it to be in regular accordance with the nature of mind in general, appears by our expecting and requiring from every other healthy human intellect the same homage that we ourselves pay to what we call beautiful. At most we allow that national or individual peculiarities of taste incline to this or that artistic ideal, and are most easily moved by it, precisely in the same way that a certain amount of education and practice in the contemplation of fine works of art is undeniably necessary for penetration into their deeper meaning.

The principal difficulty in pursuing this object, is to understand how regularly can be apprehended by intuition without being consciously felt to exist. And this unconsciousness of regularity is not a mere accident in the effect of the beautiful on our mind, which may indifferently exist or not; it is, on the contrary, most clearly, prominently, and essentially important. For through apprehending everywhere traces of regularity, connection, and order, without being able to grasp the law and plan of the whole, there arises in our mind a feeling that the work of art which we are contemplating is the product of a design which far exceeds anything we can conceive at the moment, and which hence partakes of the character of the illimitable. Remembering the poet's words:

Du gleichst dem Geist, den du begreifst,
(Thou'rt like the spirit thou conceivest),

we feel that those intellectual powers which were at work in the artist, are far above our conscious mental action, and that were it even possible at all, infinite time, meditation, and labour would have been necessary to attain by conscious thought that degree of order, connection, and equilibrium of all parts and all internal relations, which the artist has accomplished under the sole guidance of tact and taste, and which we have in turn to appreciate and comprehend by our own tact and taste, long before we begin a critical analysis of the work.

It is clear that all high appreciation of the artist and his work reposes essentially on this feeling. In the first we honour a genius, a spark of divine creative fire, which far transcends the limits of our intelligent and conscious forecast. And yet the artist is a man as we are, in whom work the same mental powers as in ourselves, only in their own peculiar direction, purer, brighter, steadier; and by the greater or less readiness and completeness with which we grasp the artist's language we measure our own share of those powers which produced the wonder.

Herein is manifestly the cause of that moral elevation and feeling of ecstatic satisfaction which is called forth by thorough absorption in genuine and lofty works of art. We learn from them to feel that even in the obscure depths of a healthy and harmoniously developed human mind, which are at least for the present inaccessible to analysis by conscious thought, there slumbers a germ of order that is capable of rich intellectual cultivation, and we learn to recognise and admire in the work of art, though draughted in unimportant material, the picture of a similar arrangement of the universe, governed by law and reason in all its parts. The contemplation of a real work of art awakens our confidence in the originally healthy nature of the human mind, when uncribbed, unharassed, unobscured, and unfalsified.

But for all this it is an essential condition that the whole extent of the regularity and design of a work of art should *not* be apprehended consciously. It is precisely from that part of its regular subjection to reason, which escapes our conscious apprehension, that a work of art exalts and delights us, and that the chief effects of the artistically beautiful proceed, *not* from the part which we are able fully to analyse.

If we now apply these considerations to the system of musical tones and harmony, we see of course that these are objects belonging to an entirely subordinate

and elementary domain, but nevertheless they, too, are slowly matured inventions of the artistic taste of musicians, and consequently they, too, must be governed by the general rules of artistic beauty. Precisely because we are here still treading the lower walks of art, and are not dealing with the expression of deep psychological problems, we are able to discover a comparatively simple and transparent solution of that fundamental enigma of esthetics.

The whole of the last part of this book has explained how musicians gradually discovered the relationships between tones and chords, and how the invention of harmonic music rendered these relationships closer, and clearer, and richer. We have been able to deduce the whole system of rules which constitute Thorough Bass, from an endeavour to introduce a clearly sensible connection into the series of tones which form a piece of music.

A feeling for the melodic relationship of consecutive tones, was first developed, ¶ commencing with Octave and Fifth and advancing to the Third. We have taken pains to prove that this feeling of relationship was founded on the perception of identical partial tones in the corresponding compound tones. Now these partial tones are of course present in the sensations excited in our auditory apparatus, and yet they are not generally the subject of conscious perception as independent sensations. The conscious perception of everyday life is limited to the apprehension of the tone compounded of these partials, as a whole, just as we apprehend the taste of a very compound dish as a whole, without clearly feeling how much of it is due to the salt, or the pepper, or other spices and condiments. A critical examination of our auditory sensations as such was required before we could discover the existence of upper partial tones. Hence the real reason of the melodic relationship of two tones (with the exception of a few more or less clearly expressed conjectures, as, for example, by Rameau and d'Alembert) remained so long undiscovered, or at least was not in any respect clearly and definitely formulated. I believe that I have ¶ been able to furnish the required explanation, and hence clearly to exhibit the whole connection of the phenomena. The esthetic problem is thus referred to the common property of all sensual perceptions, namely, the apprehension of compound aggregates of sensations as sensible symbols of simple external objects, without analysing them. In our usual observations on external nature our attention is so thoroughly engaged by external objects that we are entirely unpractised in taking for the subjects of conscious observation, any properties of our sensations themselves, which we do not already know as the sensible expression of some individual external object or event.

After musicians had long been content with the melodic relationship of tones, they began in the middle ages to make use of harmonic relationship as shewn in consonance. The effects of various combinations of tones also depend partly on the identity or difference of two of their different partial tones, but they likewise partly depend on their combinational tones. Whereas, however, in melodic relationship the equality of the upper partial tones can only be perceived by remembering the preceding compound tone, in harmonic relationship it is determined by *immediate sensation*, by the presence or absence of beats. Hence in harmonic combinations of tone, tonal relationship is felt with that greater liveliness due to a present sensation as compared with the recollection of a past sensation. The wealth of clearly perceptible relations grows with the number of tones combined. Beats are easy to recognise as such when they occur slowly; but those which characterise dissonances are, almost without exception, very rapid, and are partly covered by sustained tones which do not beat, so that a careful comparison of slower and quicker beats is necessary to gain the conviction that the essence of dissonance consists precisely in rapid beats. Slow beats do not create the feeling of dissonance, which does not arise till the rapidity of the beats confuses the ear and makes it unable to distinguish them. In this case also the ear feels the difference between the undisturbed combination of sound in the case of two consonant tones, and the disturbed rough combination resulting from a dissonance. But, as

a general rule, the hearer is then perfectly unconscious of the cause to which the disturbance and roughness are due.

The development of harmony gave rise to a much richer opening out of musical art than was previously possible, because the far clearer characterisation of related combinations of tones by means of chords and chordal sequences, allowed of the use of much more distant relationships than were previously available, by modulating into different keys. In this way the means of expression greatly increased as well as the rapidity of the melodic and harmonic transitions which could now be introduced without destroying the musical connection.

As the independent significance of chords came to be appreciated in the fifteenth and sixteenth centuries, a feeling arose for the relationship of chords to one another and to the tonic chord, in accordance with the same law which had long ago unconsciously regulated the relationship of compound tones. The relationship of compound tones depended on the identity of two or more partial tones, that of chords on the identity of two or more notes. For the musician, of course, the law of the relationship of chords and keys is much more intelligible than that of compound tones. He readily hears the identical tones, or sees them in the notes before him. But the unprejudiced and uninstructed hearer is as little conscious of the reason of the connection of a clear and agreeable series of fluent chords, as he is of the reason of a well-connected melody. He is startled by a false cadence and feels its unexpectedness, but is not at all necessarily conscious of the reason of its unexpectedness.

Then, again, we have seen that the reason why a chord in music appears to be the chord of a determinate root, depends as before upon the analysis of a compound tone into its partial tones, that is, as before upon those elements of a sensation which cannot readily become subjects of conscious perception. This relation between chords is of great importance, both in the relation of the tonic chord to the tonic tone, and in the sequence of chords. ¶

The recognition of these resemblances between compound tones and between chords, reminds us of other exactly analogous circumstances which we must have often experienced. We recognise the resemblance between the faces of two near relations, without being at all able to say in what the resemblance consists, especially when age and sex are different, and the coarser outlines of the features consequently present striking differences. And yet notwithstanding these differences—notwithstanding that we are unable to fix upon a single point in the two countenances which is absolutely alike—the resemblance is often so extraordinarily striking and convincing, that we have not a moment's doubt about it. Precisely the same thing occurs in recognising the relationship between two compound tones.

Again, we are often able to assert with perfect certainty, that a passage not previously heard is due to a particular author or composer whose other works we know. Occasionally, but by no means always, individual mannerisms in verbal or ¶ musical phrases determine our judgment, but as a rule we are mostly unable to fix upon the exact points of resemblance between the new piece and the known works of the author or composer.

The analogy of these different cases may be even carried farther. When a father and daughter are strikingly alike in some well-marked feature, as the nose or forehead, we observe it at once, and think no more about it. But if the resemblance is so enigmatically concealed that we cannot detect it, we are fascinated, and cannot help continuing to compare their countenances. And if a painter drew two such heads having, say, a somewhat different expression of character combined with a predominant and striking, though indefinable, resemblance, we should undoubtedly value it as one of the principal beauties of his painting. Our admiration would certainly not be due merely to his technical skill; we should rather look upon his painting as evidencing an unusually delicate feeling for the

significance of the human countenance, and find in this the artistic justification of his work.

Now the case is similar for musical intervals. The resemblance of an Octave to its root is so great and striking that the duller ear perceives it; the Octave seems to be almost a pure repetition of the root, as it, in fact, merely repeats a part of the compound tone of its root, without adding anything new. Hence the esthetic effect of an Octave is that of a perfectly simple, but little attractive interval. The most attractive of the intervals, melodically and harmonically, are clearly the Thirds and Sixths,—the intervals which lie at the very boundary of those that the ear can grasp. The major Third and the major Sixth cannot be properly appreciated unless the first five partial tones are audible. These are present in good musical qualities of tone. The minor Third and the minor Sixth are for the most part justifiable only as inversions of the former intervals. The more complicated intervals in the scale cease to have any direct or easily intelligible relationship. They have no longer the charm of the Thirds.

Moreover, it is by no means a merely external indifferent regularity which the employment of diatonic scales, founded on the relationship of compound tones, has introduced into the tonal material of music, as, for instance, rhythm introduced some such external arrangement into the words of poetry. I have shewn, on the contrary, in Chapter XIV., that this construction of the scale furnished a means of measuring the intervals of their tones, so that the equality of two intervals lying in different sections of the scale would be recognised by immediate sensation. Thus the melodic step of a Fifth is always characterised by having the second partial tone of the second note identical with the third of the first. This produces a definiteness and certainty in the measurement of intervals for our sensation, such as might be looked for in vain in the system of colours, or otherwise so similar, or in the estimation of mere differences of intensity in our various sensual perceptions.

Upon this reposes also the characteristic resemblance between the relations of the musical scale and of space, a resemblance which appears to me of vital importance for the peculiar effects of music. It is an essential character of space that at every position within it like bodies can be placed, and like motions can occur. Everything that is possible to happen in one part of space is equally possible in every other part of space and is perceived by us in precisely the same way. This is the case also with the musical scale. Every melodic phrase, every chord, which can be executed at any pitch, can be also executed at any other pitch in such a way that we immediately perceive the characteristic marks of their similarity. On the other hand, also, different voices, executing the same or different melodic phrases, can move at the same time within the compass of the scale, like two bodies in space, and, provided they are consonant in the accented parts of bars, without creating any musical disturbances. Such a close analogy consequently exists in all essential relations between the musical scale and space, that even alteration of pitch has a readily recognised and unmistakable resemblance to motion in space, and is often metaphorically termed the ascending or descending *motion* or *progression* of a part. Hence, again, it becomes possible for motion in music to imitate the peculiar characteristics of motive forces in space, that is, to form an image of the various impulses and forces which lie at the root of motion. And on this, as I believe, essentially depends the power of music to picture emotion.

It is not my intention to deny that music in its initial state and simplest forms may have been originally an artistic imitation of the instinctive modulations of the voice that correspond to various conditions of the feelings. But I cannot think that this is opposed to the above explanation; for a great part of the natural means of vocal expression may be reduced to such facts as the following: its rhythm and accentuation are an immediate expression of the rapidity or force of the corresponding psychological motives—all effort drives the voice up—a desire to make a pleasant impression on another mind leads to selecting a softer, pleasanter quality of

tone—and so forth. An endeavour to imitate the involuntary modulations of the voice and make its recitation richer and more expressive, may therefore very possibly have led our ancestors to the discovery of the first means of musical expression, just as the imitation of weeping, shouting, or sobbing, and other musical delineations may play a part in even cultivated music, (as in operas), although such modifications of the voice are not confined to the action of free mental motives, but embrace really mechanical and even involuntary muscular contractions. But it is quite clear that every completely developed melody goes far beyond an imitation of nature, even if we include the cases of the most varied alteration of voice under the influence of passion. Nay, the very fact that music introduces progression by fixed degrees both in rhythm and in the scale, renders even an approximately correct representation of nature simply impossible, for most of the passionate affections of the voice are characterised by a gliding transition in pitch. The imitation of nature is thus rendered as imperfect as the imitation of a picture by embroidery on a canvas with separate little squares for each shade of colour. Music, too, departed still further from nature when it introduced the greater compass, the mobility, and the strange qualities of tone belonging to musical instruments, by which the field of attainable musical effects has become so much wider than it was or could be when the human voice alone was employed.

Hence though it is probably correct to say that mankind, in historical development, first learned the means of musical expression from the human voice, it can hardly be denied that these same means of expressing melodic progression act, in artistically developed music, without the slightest reference to the application made of them in the modulations of the human voice, and have a more general significance than any that can be attributed to innate instinctive cries. That this is the case appears above all in the modern development of instrumental music, which possesses an effective power and artistic justification that need not be gainsaid, although we may not yet be able to explain it in all its details.

Here I close my work. It appears to me that I have carried it as far as the physiological properties of the sensation of hearing exercise a direct influence on the construction of a musical system, that is, as far as the work especially belongs to natural philosophy. For even if I could not avoid mixing up esthetic problems with physical, the former were comparatively simple, and the latter much more complicated. This relation would necessarily become inverted if I attempted to proceed further into the esthetics of music, and to enter on the theory of rhythm, forms of composition, and means of musical expression. In all these fields the properties of sensual perception would of course have an influence at times, but only in a very subordinate degree. The real difficulty would lie in the development of the psychological motives which here assert themselves. Certainly this is the point where the more interesting part of musical esthetics begins, the aim being to explain the wonders of great works of art, and to learn the utterances and actions of the various affections of the mind. But, however alluring such an aim may be, I prefer leaving others to carry out such investigations, in which I should feel myself too much of an amateur, while I myself remain on the safe ground of natural philosophy, in which I am at home.