Whatever enthusiastic musicians or "philosophers" may have said of a music of the future without rhythm, I always feel inclined to interpret their prophecies poetically rather than scientifically, and believe that what Gurney said on the other side will remain true:—"Wherever rhythm is perceived with enjoyment, there is implied a nascent stimulation of the dance-instinct, and, however much music 'ought to be' independent of time, I am afraid that in listening to it, with our present physical organisms, we shall retain a prejudice for rhythmical phenomena in preference to unrhythmical noumena".

II. By Prof. JAMES McKEEN CATTELL.

Mr. Spencer's paper on *The Origin of Music*, contributed to MIND No. 60, calls up a subject of widespread interest. It is likely that most readers of the paper will agree with Mr. Spencer in holding that music had its origin in vocal sounds expressing emotions of all kinds, and not solely in vocal sounds prompted by amatory feelings. It may be suggested that the theories of Darwin and Mr. Spencer, like so much in the writings of those who have developed the doctrine of evolution, describe what probably took place, rather than explain why it was necessary that it should have taken place. The theory that art had its origin in overflowing energy is important, but it in no wise explains why art should have followed its historical course of development, nor why we judge one work of art to be good, another bad. It is, however, the part of Mr. Spencer's paper concerned with harmony to which I wish to take exception. Mr. Spencer writes:—

"It goes without saying that there must be otherwise accounted for that relatively modern element in musical effect which has now almost outgrown in importance the other elements—I mean harmony. This cannot be affiliated on the natural language of emotion; since, in such language limited to successive tones, there cannot originate the effects wrought by simultaneous tones. Dependent as harmony is on relations among rates of aerial pulses, its primary basis is purely mechanical; and its secondary basis lies in the compound vibrations which certain combinations of mechanical rhythms cause in the auditory apparatus. The resulting pleasure must, therefore, be due to nervous excitations of kinds which, by their congruity, exalt one another; and thus generate a larger volume of agreeable sensation."

It is strange that the great advocate of the theory of evolution should hold that harmony, which has been gradually developed from melody, should owe its emotional effects to an entirely different origin. Mr. Spencer's conclusion amounts to saying that harmony gives pleasure because it is pleasant. The researches of Helmholtz, indicated by Mr. Spencer,¹ have thrown much

¹ Not quite correctly; since the "secondary basis" does not consist of vibrations formed in the ear, as was formerly supposed, but of vibrations in the air exactly like the other "aerial pulses".

light on the physical basis of music. Helmholtz has shown that those combinations of tones which are considered the most harmonious are the freest from "beats". Beats are undoubtedly disagreeable. We do not know why this is the case, but we have the analogies of flickering lights and tickling, and may suppose that these rhythms are obstructive or hurtful to bodily and mental life. The pleasure of harmony is not explained, however, by showing that it avoids disagreeable sounds. Wundt has laid stress on the fact that harmonious tones are most nearly related to each other through their overtones and difference-tones, and holds that we derive pleasure from detecting such hidden resemblances. This is doubtless a fact, but it does not go far toward explaining the great emotional effects of music.

Mr. Spencer seems to hold that nothing in a single tone corresponds to a combination of tones, and that the intervals used in music are not found in nature. The facts are, however, different. Rameau and d'Alembert knew, more than a hundred years ago, that the overtones (harmonics) given by a single tone are in harmony with each other, and Helmholtz has shown that all difference in the timbre (quality) of sounds rests on the number and strength of the overtones present. Thus, if the string of a violin be plucked, it will vibrate, and will give a tone whose pitch corresponds to rate of vibration. But, in addition to vibrating as a whole, the string will vibrate in two equal parts; each of these parts will vibrate twice as fast as the whole string, and give a tone an octave higher than the fundamental tone. The string will also vibrate in 3, 4, 5, 6, &c., parts, and will give a series of tones corresponding to these rates of vibration. If the string give *c* as its fundamental tone, in addition to this *c* we can hear *c'*, *g'*, *c''*, *e'*, *g''*, *b'''*, *c'''*, &c. In a single tone are included, therefore, octaves, fifths, major and minor thirds, and, indeed, all the intervals and chords used in music. Thus music is not, as is commonly supposed, a creation of the imagination, freer than the other arts from a physical basis, but is rather a discovery and a development. All the combinations of music are latent in the sounds of nature, and the history of music bears witness to the gradual adoption of such as are more remote. Thus, after the octave, the fifth was used, then the major and later the minor third, and so on to the combinations of modern music. In like manner, harmony has been developed from melody, and the complex orchestration of Wagner's operas from the reed and lyre. The gradual perfecting of the scales used in music was simply the discovery of the relations present in every tone of the human voice.

As we have seen, all differences in the timbre of tones depend on what overtones are present, and on their relative loudness. A tuning-fork does not have harmonious overtones, and it gives a thin and empty sound. A flute has only the first overtone emphasised, and we consider its tone sweet, but thin and cloying.

In the trumpet the higher overtones discordant with each other are prominent. The violin possesses the complete series of overtones, and the player can emphasise such as he chooses, hence it is an instrument unrivalled in its power of expression. The difference in the vowel sounds depends on the overtones present. Thus, *u* (as *u* in *flute*) is poor, *i* (as *ea* in *beat*) rich in overtones. The difference in voices—and nothing is more characteristic than the voice, even in ordinary speech—rests on the overtones present. As the voice changes in expression, different overtones are emphasised, and when it is swayed by emotion its quality still depends on the strengthening or weakening of certain overtones.

The theory I suggest to account for the immense emotional effects of music is, that music expresses the emotion of the human voice. And this, not in any mystical manner, but simply by using and developing those combinations of tones which the voice uses when moved by sorrow and joy, despair and exultation.¹

Owing to reasons purely physical and in harmony with the other bodily expressions of the emotions, certain overtones are strengthened, and certain others weakened, according to the emotion which moves the mind. Even in the lower animals, we are greatly stirred by the joy in the song of birds, or the pain in the cry of a hurt dog. In man it is the voice which, before all else, expresses and excites emotion. We cannot fill the voice with feeling as we will, but the great musician, having the passion and the art, can combine tones and instruments so as to express his emotion. Music is thus exactly in harmony with the plastic arts. It copies, selects, combines, idealises, and uses the power of association. Art does not surpass nature, but it makes the best of nature a part of daily life.

¹ These overtones might be determined for the voice in real or simulated emotion; it is likely that we should thus find an interpretation of major and minor keys, &c. Such an experiment will be crucial for this theory. In the meanwhile I suggest: (1) the tones of the human voice are those used in instrumental music, the overtones of the lower instrumental tones and the overtones of the voice making the correspondence complete; (2) the power of detecting discord in musical instruments is greatest within the compass of the voice; (3) the voice in singing is more expressive than any musical instrument; and (4) instruments like the piano, which cannot express true or varied intervals, do not have much emotional effect. I do not, of course, want to ignore other sources of pleasure in music, least of all rhythm, which, in a popular audience, is probably the most potent. Indeed, I should like to suggest that in the combination of melody and harmony, which are stirring, with rhythm, which is soothing, we get an emotional effect analogous to that produced by stimulant and narcotic drugs—alcohol, tobacco, opium, &c.