CHAPTER IX.

ON MUSICAL PITCH.

§291. MUSICAL PITCH IN GENERAL.—292. EFFECTS OF VARIATION OF TEMPERATURE.—293. MEASUREMENT OF PITCH.—294. *THE SIREN.*—295. *SCHEIBLER'S TONOMETER.*—296. CALCULATION OF c'' FROM a', AND a' FROM c''.—297. MR. ELLIS'S HISTORY OF MUSICAL PITCH.—298. *EXTRACTS FROM THAT PAPER.*—299. ERRONEOUS NOTIONS ON THE RISE OF ENGLISH PITCH.—300. OBJECTIONS TO LOWERING THE ENGLISH STANDARD.

291. Musical Pitch in General. Although music depends chiefly on the relation of notes to each other, absolute pitch is nevertheless a subject of which it is difficult to overrate the importance, not only because a note with a definite number of vibrations is the only *datum* from which musical intervals can be reckoned, and the only standard by which they can be judged, but also because the character of a musical composition is materially affected by the pitch at which it is performed; moreover, were it not for some approach to uniformity of pitch, music could not be rendered by the voices or instruments for which it was composed: see §19. The desirability of a uniform standard being indisputable, we may proceed to consider the obstacles which prevent its attainment.

292. Effects of Variation of Temperature. One of the chief difficulties in obtaining uniformity of pitch is due to the effects of heat. It is stated in §37 that the pitch of a tuning-fork is very slightly altered by heat: unfortunately this is not the case with musical instruments. Those of which the sounds are formed by free reeds, without pipes, such as the harmonium, are less liable to interference from this cause than

others, but they are not by any means exempt from its influence. The ordinary wind and stringed instruments are grievously affected in opposite directions by heat. In a paper that I contributed to the discussion at St. James's Hall (1885), I stated that "a difference in temperature of about 35° [Fahrenheit] will cause a discrepancy of a semitone between a wooden flute and a pianoforte, the piano rising in pitch while the flute falls." I have since seen no reason to modify that general statement. Of course the converse is equally true.

The fluctuations in the pitch of pianoforte strings are mostly due to the expansion or contraction of the metal, and the consequent alteration of tension: see §43. Catgut strings are less affected by heat than metal ones, but they are not exempt from the effect of moisture in the atmosphere, which sharpens their pitch. The sounds of wind-instruments, being almost entirely produced by the vibrations of the air within their tubes, are seriously influenced by changes of temperature. The instruments themselves of course lengthen by the effect of heat, in varying degree according to the nature of the material of which they are constructed, but this effect is as nothing compared to that of the temperature of the tube on the column of air within it. In precise language, *the pitch varies directly as the temperature of the air-column.*

293. Measurement of Pitch. This subject long ago attracted the attention of philosophers, but their efforts to devise instruments for the accurate computation of the number of sound-vibrations in a given time, were unsuccessful until about fifty years since. The earliest attempts at counting vibrations appear to have been made by means of strings, but these experiments failed signally, as might have been expected; it is therefore unnecessary to describe them. Sauveur (1700 and 1713) utilized the beats of organ-pipes for the purpose of determining his celebrated "*son fixe*," which was intended to give one hundred vibrations in a second, but his results were necessarily uncertain.

294. *The Siren.* This ingenious instrument was invented in 1819 by Baron Cagniard de la Tour. In its most simple form, it consists of a circular revolving plate pierced with holes arranged in a ring near its outer edge. Wind is forced through a tube against these holes, as the plate revolves, and escapes through them in a series of puffs. When these follow in sufficiently rapid succession, they coalesce and form a continuous note. See §§13, 18 and 80. The siren has since been considerably modified and improved. The complete instrument is furnished with dials and indicators which register its sound-vibrations. Even in its most improved form it is but a rough means of measuring pitch, on account of certain inherent defects, and it is better fitted for display in the lecture-room than for research in the study.

295. *Scheibler's Tonometer.* Passing over numerous clever and more or less useful inventions for pitch measurement, an account of which would be beside the purposes of this book, it is necessary to devote a few words to the description of probably the most accurate as well as the most generally serviceable of all tonometers, that of Scheibler, a silk manufacturer of Crefeld in Germany. This instrument, and the manner of using it, are fully described in the inventor's pamphlet (1834). It consisted of fifty-two tuning-forks which ranged from *a* 219⅔ to *a'* 439⅓ at 69° Fahrenheit. Mr. Ellis (1880A) found Scheibler's counting "wonderfully perfect," but his method laborious, he therefore suggested a more simple mode of using the forks than that of the inventor, in the following terms: "If two tuning-forks, making an octave with each other, very nearly but not exactly, be held over a resonance-jar, tuned to the higher by pouring in water, beats are heard, and may be counted for from ten to twenty seconds, between the precise octave of the lower fork, and its approximate octave, while the low note is practically inaudible. If then, a number of tuning-forks be interposed between the two, beating roughly four times in a second, two and two, and, after having rested sufficiently for their pitches to become permanent, are accurately counted, the vibrations of the lower fork, and hence that of all the intermediate forks, can be determined."

296. Calculation of *c''* from *a'*, and *a'* from *c''*. Mr. Ellis gives the following convenient methods of calculating *c''* from *a'*, and *a'* from *c''*.

To find c'' from a'. In theoretical intonation increase the vibration number of *a'* by one-fifth.

In equal temperament first find the vibration number of the theoretical *c''*, and from that number subtract 1 in 111.

To find a' from c''. In theoretical intonation reduce the vibration number of *c''* by one-sixth.

In equal temperament first find the vibration number of the theoretical *a'*, and to that number add 1 in 110.

297. Mr. A. J. Ellis's "History of Musical Pitch" (1880A). The truly marvellous paper from which I have borrowed the foregoing and the following extracts, was justly characterized by Dr. Pole, the chairman of the meeting before which it was read, as "a monument of research which would be referred to in future ages, as a credit to the musical science of the day." The original paper consists of forty-four pages, royal octavo, in exceedingly small type, hence it is obvious that only small portions of it could be given here. Few, who have not seen it, will read these extracts without astonishment, and it may be hoped that their perusal will assist in dispelling the popular error of supposing the general orchestral pitch of this country to have risen a semitone in the last twenty or thirty years.

298. Extracts from Mr. Ellis's Tables. The first record in the subjoined table, is the lowest on which any reliance can be placed. In order that comparison with other pitches may be conveniently made, I have selected the vibration number of the *a'* of equal temperament, when *a'* was not the note actually measured. The *c''* is calculated, according to equal temperament, from the *a'*. The pitches are assumed to be taken at 59° Fahrenheit.

Vibns. of *a'*.	Vibns. of *c''*.	Place.	Date.	Description.
376.3	447.5	Lille,	1700 (*ante*)	Dilapidated small organ of *L'Hospice Comtesse*. Pitch taken by Delezenne.
378.8	450.5	Paris,	1766	Pitch calculated from *data* given by Dom Bédos in *L'Art du Facteur d'Orgues*.
380.0	451.9	Heidelberg,	1511	Pitch calculated from *data* given by Arnold Schlick.
392.2	469.1	St. Petersburg,	1739	Euler's clavichord.
395.8	470.7	Versailles,	1789	Organ of the palace chapel.
[398.0	473.3	Berlin,	1775	See §462.]
[400.0	475.7	Paris,	1756 (*circa*)	See §446.]
401.3	477.8	Paris,	1648	Mersenne's Spinet.
405.8	482.6	Paris,	1713	Sauveur's calculation.
407.9	485.0	Hamburg,	1762	Organ of St. Michael's church.
409.0	486.4	Paris,	1783	Fork of Pascal Taskin, court tuner.
415.5	494.1	Dresden,	1722	Organ of St. Sophia.
419.6	499.0	Seville,	1785 } 1790 }	Organ of the cathedral.
421.6	501.3	Vienna,	1780	Mozart's supposed pitch.
422.5	502.4	London,	1751	Handel's fork.
425.5	506.0	Paris,	1829	Pianoforte at the Opera.
427.6	508.5	Paris,	1823	*Opéra Comique*.
430.8	536.4	Paris,	1830	Opera, as given by Drouet [the celebrated flutist].
432.0	513.7	Brussels,	1876	Proposed standard.

Vibns. of *a'*.	Vibns. of *c''*.	Place.	Date.	Description.
435.0 435.4	517.3 } 517.8 }	Paris,	1859	The French "*Diapason Normal*." [The pitch is supposed to be *a'* 435 but Mr. Ellis gives 435.4 as the mean of several forks.]
437.0	519.7	Paris,	1836	Italian Opera.
,,	,,	Toulouse,	1859	*Conservatoire*.
440.0	523.25	Paris,	1829	Orchestral pitch at the Opera. [See §425.]
440.0 440.2	523.25 } 523.5 }	Stuttgart,	1834	Stuttgart congress, and Scheibler's standard [440.2 is Mr. Ellis's correction for temperature.]
[441.0	524.4	Rome,	1725 (*ante*.)	See §430.]
444.0	528.0	London,	1860	Intended standard of the Society of Arts. See 445.7.
444.5	528.6	Madrid,	1858	Theatre Royal.
[,,	,,	London,	1810 (*circa*)	Flute by Wm. Hy. Potter. Mean pitch of the instrument. R. S. R.]
444.6	528.7	London,	1877	Organ of St. Paul's Cathedral.
444.8 ,, ,,	528.9 ,, ,,	Turin, Weimer, Würtemberg,	1859 } ,, } ,, }	Taken from the French Commission.
445.7	530.1	London,	1860	Actual pitch of the fork tuned by Mr. J. H. Griesbach for the Society of Arts. See 444.0.
446.0	530.4	Paris,	1854 (*ante*)	Pleyel's Pianos. Pitch taken by Delezenne.
,,	,,	Dresden,	1859	Opera. It has been denied that the pitch ever was so high.
,,	,,	Pesth,	,,	Opera.

Vibns. of *a'*.	Vibns. of *c''*.	Place.	Date.	Description.
["447.11	[531.7]	London,	1845	Pitch of the Philharmonic Society, according to a fork tuned at that date by Mr. R. S. Rockstro." *Addenda to History of Musical Pitch.* (1885.)]
448.0	532.8	Hamburg,	1839 } 1840 }	Opera.
„	„	Paris,	1854	*Opèra Comique.*
„	„	„	1858	*Grand Opèra.*
„	„	Liège,	1859	*Conservatoire.*
[450.0	535.1	London,	1850 to 1885 }	A fair average of the pitches of the principal orchestras. R. S. R.]
450.5	535.7	Lille,	1848 } 1854 }	Opera, during performance.
451.0	536.3	Brussels,	1879	Intended standard for Belgian Army. The fork was actually 451.9.
451.5	536.9	St. Petersburg,	1858	Opera.
451.7	537.2	Milan,	1867	Opera. *La Scala.*
451.8	537.3	Berlin,	1859	Opera.
451.9	537.4	London,	1878	British Army Regulation.
452.0	537.5	Lille,	1859	Conservatoire.
[„	„	London,	1889	This is the highest pitch that is intentionally used in English orchestras at the present time. It was the "official pitch" at the "Inventions" Exhibition in 1885. R.S.R.]
452.5	538.2	London	1846 to 1854 }	Mean pitch of the Philharmonic Band under Costa. Tuned in 1859 by Mr. J. Black, from records made by Mr. Hipkins.

Vibns. of *a'*.	Vibns. of *c''*.	Place.	Date.	Description.
[453.3	539.0	London,	1838 (*ante*)	Flute made by Messrs Rudall and Rose, and tested by Mr. Ellis and myself. (1885, *Flute Intonation.*) I have since ascertained that this flute was probably made as early as 1827, and that it could not have been made after 1837. The *a'* here given is calculated from *g'* 404, the mean pitch of the flute. See 461.0. R.S.R.]
454.7	540.8	London,	1874	Fork representing the highest pitch of the Philharmonic concerts. Tuned by Mr. Hipkins.
„	„	London,	1879	Messrs. Steinway's English pitch.
„	„	London,	1879	Messrs. Bryceson's pitch.
455.3	541.5	London,	1879	Messrs. Erard's pitch.
455.5	541.7	Brussels,	1859	Band of the *Guides.*
456.1	542.4	London,	1857	Fork sent by M. Bettini to the French Society of Pianoforte Makers.
457.2	543.7	New York,	1879	Pitch used by Messrs. Steinway, in America.
457.6	544.2	Vienna,	1640 (*circa*)	Great Franciscan organ.
[461.0	548.3	London,	1838 (*ante*)	Actual pitch of the *a'* of the flute cited at 453.3. R. S. R.]
474.1	563.8	Durham,	1683	Cathedral Organ, by Bernhardt Schmidt.
„	„	London,	1708	Organ at the Chapel Royal, by B. Schmidt.
480.8	571.8	Hamburg,	1543 } 1879 }	Organ at St. Catherine's church.
484.1	575.7	Lübeck,	1878	Cathedral, small organ.

Vibns. of a'.	Vibns. of c''.	Place.	Date.	Description.
489.2	581.8	Hamburg,	1688 } 1693 }	Organ at St. Jacob's Church.
505.6	601.4	Paris,	1636	Mersenne's church pitch.
506.9	602.9	Halberstadt,	1361	Cathedral organ.
567.6	675.2	Paris,	1636	Mersenne's chamber pitch.
570.7	678.7	Germany,	1619	North German church pitch called by Praetorius, 'chamber pitch.'

299. Erroneous Notions on the Rise of English Pitch. On comparison of the above table with that in §273, it will be seen that the lowest a' was once 3.7 vibrations lower than our present $f'\sharp$, while the highest a' was about 1.2 vibration higher than our $c''\sharp$, a variation exceeding the interval of a perfect *fifth*. The mean of these pitches would be 21.5 vibrations above the highest orchestral or military band pitch in present intentional use in this country. Taking into consideration the flattening power of rust on tuning-forks, and the improbability that the forks tested were in perfect preservation, it may safely be assumed that the English pitch has risen in the last sixty or eighty years, even less than is indicated by the above table, and that the idea of its having risen a semitone in the last twenty or thirty years, is utterly without foundation.

300. Objections to lowering the English Standard. There is really very little that can be reasonably urged in favour of a general lowering of our pitch to the French standard. The argument that musical compositions should be performed at the pitch which prevailed at the time and place at which they were written, amounts to nothing, because, in the first place, such a general depression of pitch would not bring us any nearer to that result; in the next place, it must be evident that though the desired end can never be attained by means of any fixed standard, we may easily arrive at a close approximation to it by the simple process of transposition.

The argument that it is difficult for vocalists to sing at varying pitches, amounts to no more than the former one. In our variable climate, the pitch of a pianoforte may change in a few hours to an extent almost, if not quite, equal to the difference between English and French pitch, and the majority of singers would not notice the variation. If one uniform pitch could prevail in all countries, and at all times, it would indisputably be a great blessing, but this is impossible, and, even if we could obtain it, lowering our own pitch to that of France would be too great a price to pay for it. We have arrived at our present useful pitch by a process of natural selection, induced no doubt by a general agreement amongst performers as to the best compromise between the pitches most suitable for their respective voices and instruments, and mutual forbearance, due to true artistic feeling, has enabled us to obtain a pitch that is fairly well adapted for every voice and every musical instrument. Had not the Imperial decree suddenly brought down the pitch in France, it is probable that there would have been a considerable approach to uniformity all over the world. The meeting held at St. James's Hall (1885) must have done a great deal to dispel ideas of the possibility of the general adoption of the French pitch in this country. Even the warmest advocates for the proposal despaired of seeing it carried out, and the committee (of which I was a member), appointed to consider it, was compelled to recognise its utter impracticability. We may therefore reasonably hope that we shall hear no more of this last new craze.

Excellent forks tuned to a' 450, or to the official pitch of the Inventions Exhibition of 1885, a' 452, may be obtained of Messrs. Keith Prowse and Co., 48, Cheapside, London. The first mentioned pitch is recommended as the most generally convenient for the pianoforte, as it allows a margin for the effect of change of temperature. If a piano were tuned to a' 452 in warm weather, its pitch would be liable to rise beyond the reach of a wind-instrument.

Fascinated by the interesting subjects which it has been necessary to bring under the notice of my readers, I have been led to exceed considerably my proposed limits, and yet the brief acoustical sketch that I have given is far from being as complete as I could wish, but the chronological list of writings will at least point out the way to further information for those who may think that I have not gone far enough, while to those who consider that I have said too much, the excellent Dr. Marsh must be my apologist. "I have been thus large," he writes, "that I might give you a little prospect into the *Excellency* and *Usefulness* of *Acousticks*, and that thereby I might excite all that hear me, to bend their thoughts towards the making of Experiments for the compleating this (yet very imperfect, though noble) Science."

PART II.

THE CONSTRUCTION OF THE FLUTE AND THE HISTORY OF ITS DEVELOPMENT.

"Qui non libere veritatem pronunciat, proditor est veritatis."