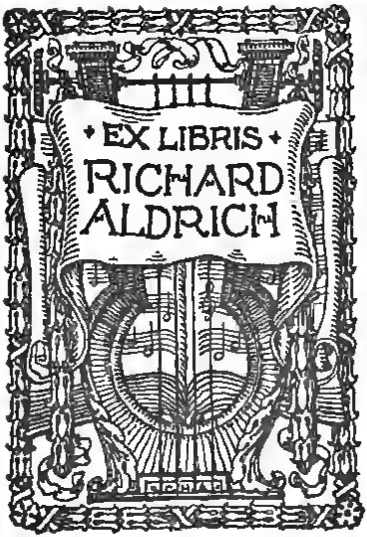
PROCEEDINGS OF THE MUSICAL ASSOCIATION

Musical Association (Great Britain)



PROCEEDINGS

OF THE

MUSICAL ASSOCIATION

FOR THE INVESTIGATION AND
DISCUSSION OF SUBJECTS CONNECTED WITH THE
ART AND SCIENCE OF MUSIC

FOUNDED MAY 29, 1874

THIRD SESSION, 1876-77

LONDON
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CONTENTS.

The Authors of the respective Papers are alone responsible for the opinions expressed in them, as well as for the correctness of the illustrations.

RULES AND REGULATIONS

Passed at Two Special General Meetings of the Members, held at 27 Harley Street, W., on February 7 and April 3, 1876.

Objects and Constitution.

This Association is called the Musical Association, and is formed for the investigation and discussion of subjects connected with the Art, Science, and History of Music; and is intended to be similar in its organisation to existing Learned Societies.

It is not intended that the Association shall give concerts, or undertake any publications other than those of their own Proceedings, or the Papers read at their meetings.

Members.

The Association shall consist of practical and theoretical musicians, as well as those whose researches have been directed to the science of acoustics, the history of the art, or other kindred subjects.

Any person desirous of being admitted into the Association must be proposed by two members

Elections will take place by ballot of the members present at any of the ordinary meetings, and one adverse vote in four shall exclude.

No newly elected member shall be entitled to attend the meetings until the annual subscription be paid.

Subscription.

The annual subscription to the Association is one guinea, which shall become due on the first of November in each year

Should members desire to withdraw from the Association, they should give notice to the Hon. Sec. on or before the 31st of October

Meetings.

An ordinary meeting shall be held on the first Monday in every month, from November to June inclusive, at 5 P.M., when, after the dispatch of ordinary business, Papers will be read and discussed

An annual general meeting of members only shall be held at 4 P.M. on the last Monday in October, to receive and deliberate on the Report of the Council, and to elect the Council and officers for the ensuing year.

Special general meetings may be summoned whenever the Council may consider it necessary; and they shall be at all times bound to do so on receiving a requisition in writing from five members, specifying the nature of the business to be transacted. At least one week's notice of such special meeting shall be given by circular to every member, and ten members present at any general meeting shall constitute a quorum.

Every member shall have the privilege of introducing one visitor at the ordinary meetings, on writing the name in a book provided for that purpose, or sending a written order.

Communications.

Papers proposed to be read at the meetings may treat of any subject connected with the Art, Science, or History of Music, Acoustics, and other kindred subjects.

Papers will be received from or through any member of the Association.

Experiments and performances may be introduced, when limited to the illustration of the Paper read.

All communications read will become thenceforth the property of the Association (unless there shall have been some previous arrangements to the contrary), and the Council may publish the same in any way and at any time they may think proper.

Reports.

A Report of the proceedings of the Association, including the Papers read or abstracts of the same, and abstracts of the Discussions, shall be printed and distributed to the members as soon as possible after the end of each session.

This Report will be arranged and edited by the Honorary Secretary, under the direction of the Council.

Council and Officers.

The management of the affairs of the Association shall be vested in a Council, to be elected by ballot at the general meeting of the members on the last Monday in October.

The Council shall consist of a President, Vice-Presidents, and ten ordinary members of the Association.

The President, Vice-Presidents, Auditors, and five ordinary members of the Council shall retire every year, but shall be eligible for re-election.

At the annual general meeting in October, the Council shall present a balloting list, showing the names of the persons whom they propose for the offices of President, Vice-Presidents, and ordinary members of Council for the ensuing year. A copy of this list shall be given to each member present.

In voting, each member may erase any name or names from the balloting list, and may substitute the name or names of any other person or persons whom he considers eligible for each respective office; but the number of names on the list, after such erasure or substitution, must not exceed the number to be elected to the respective offices as above enumerated. Those lists which do not accord with these directions shall be rejected.

The Chairman of the meeting shall cause the balloting papers to be collected, and after they have been examined by himself and two scrutineers, to be appointed by the members, he shall report to the meeting the result of such examination, and shall then destroy the balloting papers. Auditors shall be appointed at the annual general meeting by the members, and the statement of accounts shall be sent by the Treasurer to the Auditors, and be remitted by them to the Secretary in time to enable the Council to judge of the prospects of the Association, and to prepare their report in accordance therewith.

The Council and officers shall meet as often as the business of the Association may require, and at every meeting three members of Council shall constitute a quorum.

Enactment or Alteration of Rules and Regulations.

No rules and regulations can be enacted, altered, or rescinded, except at a special meeting of members summoned for the express purpose, the summons stating distinctly and fully the matter to be brought under consideration.

Musical Association

FOR THE INVESTIGATION AND DISCUSSION OF SUBJECTS CONNECTED WITH THE ART AND SCIENCE OF MUSIC.

FOUNDED MAY 29, 1874.

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REPORT

OF THE COMMITTEE,

Read by the Honorary Secretary, CHARLES K. SALAMAN, Esq., *at the Annual General Meeting of Members, held at* 27 *Harley Street, Cavendish Square, on Monday, October* 30, 1876.

Your Committee have the pleasure of presenting to the members of the Musical Association their Second Annual Report.

Notwithstanding unavoidable losses from death and retirement, they are happy to state that the numerical strength of the Society remains unimpaired, and now amounts to 170 members.

New rules and regulations have been passed at two special General Meetings, held respectively on February 7th and April 3rd. They are published with the volume of proceedings lately issued, and may be obtained, with the list of members, in a separate form of Messrs. Chappell & Co., 50 New Bond Street.

The following have been the Sessional Arrangements for 1875–76:—

First Meeting—Monday, November 1, 1875. Paper by Charles Kensington Salaman, Esq., Hon. Mem. Acad. St. Cecilia, Rome, 'On Musical Criticism.'

Second Meeting—Monday, December 6, 1875. Paper by William Pole, Esq., F.R.S., Mus. Doc. Oxon., 'On the Graphic Method of Representing Musical Intervals. With Illustrations of the Construction of the Musical Scale.'

Third Meeting—Monday, January 3, 1876. Paper by the Rev. Sir Frederick Gore Ouseley, Bart., M.A., Mus. Doc. Oxon., Professor of the University of Oxford, President of the Association: 'Considerations on the History of Ecclesiastical Music of Western Europe.'

Fourth Meeting—Monday, February 7, 1876. Paper by Victor de Pontigny, Esq., 'On Kettledrums.' Paper by Professor W. H. Monk, of King's College, 'On some Points in the Received Method of Writing an Orchestral Score.'

Fifth Meeting—Monday, March 6, 1876. Paper by Dr. W. H. Stone, F.R.C.P., M.A., 'On Standards of Musical Pitch.'

Sixth Meeting—Monday, April 3, 1876. Paper by Lord Rayleigh, M.A., F.R.S., 'On our Perception of the Direction of a Source of Sound.'

Seventh Meeting—Monday, May 1, 1876. Paper by Professor William Grylls Adams, F.R.S., 'On the Musical Inventions and Discoveries of the late Sir Charles Wheatstone, F.R.S.'

Eighth Meeting—Monday, June 5, 1876. Paper by Lennox Browne, Esq., F.R.C.S., Edin., Hon. Surgeon and Anral Surgeon to the Royal Society of Musicians, Surgeon to Her Majesty's Italian Opera, &c., 'On Medical Science in Relation to the Voice as a Musical Instrument.'

It will be seen by the foregoing that the Association has been able to maintain the high standard of scientific interest in the communications addressed to it which was originally contemplated on its institution. At the same time the Committee beg to suggest to the members generally that much individual activity on their part is needed for the perpetuation of so desirable a condition. They venture to hope that short papers, several of which might be taken on the same occasion, and provoke interesting discussion, may be frequently contributed in the course of the ensuing session.

The financial position of the Association is unusually satisfactory.

The accounts have been audited by Dr. W. H. Stone and Mr. Arthur D. Prendergast.

In accordance with the new rules and regulations, the members have this day to elect a President, Vice-Presidents, ordinary Members of Council, and two Auditors.

The Executive has hitherto consisted of nine members, termed the Committee.

By the new rules this number is to be raised to ten, to be called the Council—five members of which are to retire each year.

The President, Vice-Presidents, the ordinary Members of the Council, and Auditors, are eligible for re-election.

The Chairman said the next business was to ballot for the Council and honorary officers for the ensuing year.

Dr. Stainer said they had now such an excellent list of members, that he felt some diffidence in retaining office, unless the members really thought it desirable; and he wished to say most distinctly, that he should not feel the slightest disappointment at finding his name left out on this occasion.

Mr. Prendergast expressed himself to the same effect.

The Honorary Secretary said he had received a letter from Dr. Pole, who was travelling in Italy, anticipating in effect what had been said by Dr. Stainer.

Dr. Stone said he shared the feelings of the gentlemen who had already spoken. They were quite willing to go on doing their duty as members of the Council, but they did not think it desirable that the same members should remain on the lists so long. It was not that they wished to shirk their work in any way, for they would still be willing to do their best for the Association, but they had now such a good list of members, that they did not think themselves entitled to hold office any longer. He

should therefore beg leave to retire, if he might be permitted to do so.

Mr. STEPHENS said he should vote for all the present members of the Council, but he hoped that on future occasions the list would be prepared in such a way that the members might see which five of the Council were to retire according to the rule.

The whole of the Council were then re-elected for the ensuing year.

Chas. E. Stephens and W. H. Cummings, Esqs., were elected Auditors for the ensuing year.

Otto Goldschmidt, Esq., was elected a Vice-President.

The HONORARY SECRETARY said he hoped that the members would exert themselves during the coming session to procure practical papers, and that they would do so without being more specially invited. He then read a list of papers already promised, the first of which would be read on the ensuing Monday, by Mr. Alexander J. Ellis, F.R.S., F.S.A., on 'The Sensitiveness of the Human Ear for Pitch and Change of Pitch of Notes in Music.' He also begged to draw attention to the suggestion in the Report, that short papers be brought forward, two or three of which might be taken on the same evening.

Dr. STONE agreed that it was very desirable to have short papers, even notes on subjects likely to lead to an interesting discussion. It was not at all necessary that they should always have a long essay containing a subject, a counter-subject, a stretto, and a conclusion.

Mr. STEPHENS proposed that Mr. Salaman be requested kindly to continue his services as Honorary Secretary. In making that proposition, it was hardly necessary to detain the meeting to point out the inestimable services he had already rendered to the Musical Association. They knew the great demands that such an office made on his valuable time, and when they found Mr. Salaman so willing to give that time to the Association, they must see that he was heart and soul in the work, and that he was 'the right men in the right place.'

Dr. STONE seconded the resolution, which was carried unanimously.

Mr. SALAMAN said he should be happy to continue to perform the duties of Honorary Secretary as long as his health and strength would permit of his doing so. The Musical Association was always in his thoughts, and he would use his best endeavours to promote the continuance of its success. He wished that musicians would come more prominently forward, and actively take part in its proceedings, and he also hoped that every member would induce his friends to interest themselves in the objects of the Association.

Thanks were then voted to S. Arthur Chappell, Esq., for his services as Treasurer, to Charles K. Salaman, Esq., for his services as Honorary Secretary; to the Auditors and the Members of the Council.

SESSIONAL ARRANGEMENTS

FOR 1876-77.

First Meeting.—Monday, November 6, 1876.

Paper by ALEX. J. ELLIS, Esq., F.R.S., 'On the Sensitiveness of the Ear to Pitch and Change of Pitch in Music.'

Second Meeting.—Monday, December 4.

Paper by W. H. CUMMINGS, Esq., 'On Henry Purcell and his Family.'

Third Meeting.—Monday, February 5, 1877.

Paper by JAMES HIGGS, Esq., Mus. Bac. Oxon., 'On John Sebastian Bach's *Art of Fugue*.'

Fourth Meeting.—Monday, March 5.

Paper by WILLIAM POLE, Esq., Mus. Doc. Oxon, F.R.S., 'On the Philosophy of Harmony.'

Fifth Meeting.—Monday, April 2.

Paper by W. A. BARRETT, Esq., Mus. Bac. Oxon, 'On Music in Cathedrals.'

Sixth Meeting.—Monday, May 7.

Paper by STEPHEN S. STRATTON, Esq., *Birmingham*, 'On the Gymnastic Training of the Hand for Performing upon Keyed Instruments.'

Seventh Meeting.—Monday, June 4.

Paper by CHARLES K. SALAMAN, Esq., Hon. Mem. Acad. St. Cecilia, Rome, 'On the English Language as a Language for Music.'

Eighth Meeting.—Monday, July 2.

Paper by H. BASSETT, Esq., F.C.S., 'On Improvements in Trumpets,' illustrated by his 'Teleophonic Trumpet.'

Paper by R. H. M. BOSANQUET, Esq., M.A., F.R.A.S., F.C.S., 'On Some Points in the Harmony of Perfect Consonances, illustrated by his Enharmonic Harmonium.'

NOVEMBER 6, 1876

GEORGE ALEXANDER OSBORNE, Esq., IN THE CHAIR.

ON THE SENSITIVENESS OF THE EAR TO PITCH AND CHANGE OF PITCH IN MUSIC.

By ALEXANDER J. ELLIS, Esq., B.A., F.R.S., F.S.A., &c.

THE principal aim of the present paper is to bring before the Musical Association some results obtained last autumn from numerous and very careful experiments by Dr. W. Preyer, Professor of Physiology in the University of Jena, because those results are not accessible in an English form, and seem to have a very practical bearing upon tuning and singing.* My subordinate purpose is to exhibit a method of representing pitch and intervals, which shall be more consonant to the habits of musicians than that adopted by Dr. Preyer for the statement of his results. For the idea of this method I am indebted to Mr. Bosanquet, though I have worked it out somewhat differently from him.

Considered arithmetically (as distinguished from physiologically), the pitch of a note depends upon the number of (double, or complete, backwards and forwards) vibrations or *swing-swangs* as De Morgan termed them, made by a particle of air in one second. As this vibration depends on the length of a path described in a given time, we may readily talk of any fraction, or even any incommensurable part of a vibration which would be represented by that fraction, or part, of the path described. A pitch is higher or lower according as this number of vibrations is greater or less.

Considered arithmetically, likewise (again, as distinguished from physiologically), an interval is measured by the ratio of the pitch of the lower to the pitch of the higher note, and is usually represented by an improper fraction in which the larger number is the numerator. The principal large intervals which will be

* *Ueber die Grenzen der Tonwahrnehmung* (on the Limits of the Perception of Musical Tone), Jena, 1876, preface dated 'Autumn 1875,' 8vo. pp viii, 72.

here considered are the Octave $\frac{2}{1}$, the Fifth $\frac{3}{2}$, the Fourth $\frac{4}{3}$, the major Sixth $\frac{5}{3}$, the major Third $\frac{5}{4}$, the minor Third $\frac{6}{5}$, the minor Sixth $\frac{8}{5}$ and the major Tone $\frac{9}{8}$. The minor Tone $\frac{10}{9}$, the diatonic Semitone $\frac{16}{15}$, and intervals greater than an Octave (for which the fraction exceeds 2), and the intervals involving 7 will not be considered, because Dr. Preyer has not investigated them. But a large number of intervals differing from the above by very small intervals which have no regular names, will require attention.

By means of beats we are probably able, under favourable circumstances, to determine Pitch to the tenth or the hundredth, or even, as Scheibler imagined, to the six-hundredth part of a vibration: that is, under favourable conditions we can appreciate one beat in ten or a hundred seconds of time—or, to take Scheibler's estimate, one beat in ten minutes; and consequently, the interval between two notes with the same exactness, since one beat represents a difference of one vibration in that time. But then subsidiary notes are required, and we must be able to sustain two notes together without any alteration in either for ten or one hundred seconds, and to count the beats accurately for that time.* Under such favourable circumstances, therefore, we can approximately realise the meaning of arithmetical pitch and arithmetical interval. But the perception of beats requires nothing more than the power of hearing. A so-called 'musical ear' or sensitiveness of ear with regard to pitch and change of pitch is not required. The determination may therefore be called mechanical. It is by such mechanical observations alone that we can check the judgment of the ear, and hence arrive at a mode of measuring sensitiveness in estimating the intervals between two notes sounded in succession, and not at the same time. The existence of beats, I may remark, indicates only that the beating tones are not of the same pitch, and does not point out which is the sharper. To determine this we have to make one note sharper or flatter, and then see whether the number of beats increases or diminishes. As they increase by enlarging, and diminish by contracting the interval, this gives a mechanical means of determining which is the sharper. In the case of tuning forks, placing one under the arm for a minute will generally flatten it sufficiently, when two forks are nearly of the same pitch, beating not more than twice in a second, to determine whether the beats increase or slacken in speed: if the former, the warmed fork was already the flatter, if the latter, it was the sharper. Sensitiveness of ear is thus required solely for judging of melodic intervals: that is, of the difference of the pitch of two tones sounded in succession. Before examining this, however, it

* In verifying Appunn's Tonometer in the Loan Exhibition of Scientific Instruments, I counted the beats during 20 seconds. An error of one beat could therefore have only produced an error of one-twentieth of a vibration in a second. Any decent tuning-fork will give audible beats with a neighbouring tone for 5 or 10 seconds, and hence allow of measurements to one-fifth or one-tenth of a vibration.

is necessary to have a means of noting small deviations of pitch in a way which, while it is consonant with the existing habits of musicians, shall rest upon a strictly arithmetical basis.

All musicians are familiar with the Octave, and accustomed to divide the whole range of musical sounds into Octaves. This amounts to selecting a series of tones on the principle of continually multiplying the corresponding number of vibrations by 2. Arithmetically, we are therefore bound to begin with less than 2 vibrations in a second, which, not being multiplied by 2 at all, may be said to commence the *Zero Octave*, and the simplest such number that can be selected is 1 itself.* Then from 2 up to 4, we multiply the former number of vibrations *once* by 2, and have the *first Octave*. At 4, or twice 2, we multiply *twice* by 2, and have the *second Octave*. The Octaves will there correspond with the numbers of vibrations with which they begin, thus—

Oct	0	1	2	3	4	5	6	7	8	9	10	11	12
Vib	1	2	4	8	16	32	64	128	256	512	1024	2048	4096

And so on.† Supposing the notes C, D, E, &c. to occur in any Octave, the number of the Octave is prefixed: thus 8E means E in the 8th Octave. The Octave being always supposed to begin with C, 8C will be a note having 256 vibrations. The difficulties arising from habits of using different standards of pitch and temperaments are met by assuming some fraction (as $1\frac{1}{16}$) in place of 1 for the initial number of vibrations. But what is commonly called the 'theoretical,' or as I prefer to term it the 'arithmetical' pitch 8C=256 vib is the only one suggested by pure arithmetic. When any other initial pitch is used, we may accent the letters: thus, 8C′=264 vib gives 0C′=33÷32 vib. In Table III. I give the values of 0C′ for such values as 8A′ and 9C′, as cover the whole range of usual vibration of pitch.

This simple contrivance for marking the Octave variation of standard pitch obviates a vast number of difficulties. Observe the following synonyms —

4C=16 vib means C in the Sub-Contra Octave, or double under-accented or under-lined Great Octave, C_{11} or $\underline{\underline{C}}$ or twice indexed Great Octave C_2, or twice negatively indexed Great Octave $\underline{C}_2$ or C^{-2}, or 32-foot Octave, or triply repeated Great Octave CCC.

5C=32 vib means C in the Contra Octave, or once under-accented or under-lined Great Octave C_1 or $\underline{C}$, or once indexed, or once negatively indexed Great Octave C_1, $\underline{C}_1$ or C^{-1}, or 16-foot Octave, or doubly repeated Great Octave CC.

* This selection of 1 as the initial pitch is made on purely arithmetical grounds. The mode of treating other cases will be explained immediately. There is here no intention of deciding on the best standard pitch for practical purposes.

† See also the bottom of Table I. In higher arithmetic the number of the Octave is the index of the power of 2, that gives the number of vibrations with which the Octave begins. Thus $256=2^8$ begins the 8th Octave.

6C=64 vib means C in the Great or 8-foot Octave, with one large C, without accents or indexes, the lowest note of the Violoncello.

7C=128 vib means C in the Small or 4-foot Octave, with one small c, without accents or indexes, the lowest note of the Tenor or Viola da Braccia.

8C=256 vib means C in the once accented or 2-foot Octave, with a small c and one acute accent as c′, once over-lined c as $\bar{c}$, or two small c's as cc, commonly called 'middle C,' being on the one leger line between the bass and treble staves.

9C=512 vib means C in the twice accented or twice over-lined or 1-foot Octave, with a small c and two acute accents as c″, or two lines as $\bar{\bar{c}}$, or three small c's as ccc.

10C=1024 vib means C in the thrice accented or ½-foot Octave, with a small c and three acute accents or over lines as c‴, or $\bar{\bar{\bar{c}}}$.

And so on for higher Octaves, the number of the Octave being 7 more than the number of acute accents or over-lines.

The next division, with which the pianoforte in recent times has rendered all musicians perfectly familiar, is that of the large interval of an Octave into twelve smaller intervals called Equal Semitones, which I shall contract into the word *sem*. Anyone who plays up the chromatic scale on a piano has a sensation of sameness of interval in passing from any one note to the next in succession. But the actual sensation of the interval sem is very indistinct, and few, I apprehend, if any, would venture to tune a piano by that interval only. It happens to be one of those intervals which cannot be exactly expressed by figures, but, far nearer than any human ear can detect, we may speak of it as $1\frac{782}{1000}$ or $1\frac{1000}{1782}$,* so that if we know the number of vibrations, or vib of any note, say 8C=256, we have only to multiply it by 100, giving 25600, divide this by 1682 to two places of decimals, giving 15 22, and add it to the vib of the lower or 256, giving 271 22 vib for 8C♯, which is correct to two places of decimals. Hence we obtain a perfectly clear arithmetical conception of a sem or the twelfth part of an Octave.

Now take an imaginary fingerboard of a pianoforte, 40 feet in length, and at the beginning and at the end of each 40 inches introduce a single string which on being struck vibrates exactly 100 in 1682 vib more than its predecessor. We shall then have a fingerboard which may be represented by the annexed diagram (Table I.),† in which, for convenience, the long line of 40 feet is

* Of course this has been obtained by higher arithmetic, and is a close approximation to the 12th root of 2. Observe that $\frac{1782}{1000^2}$ gives the well-known approximations $\frac{1}{17}$ (too large) and $\frac{1}{18}$ (too small). It will be seen by Table II, col B, below, that the vibrations of A are to those of A♯ as 1,681,793 to 1,781,797, which gives the above ratio. A whole Tone is very nearly indeed 10000÷8909, which is obviously less than the Major Tone 9÷8, and greater than the Minor Tone 10÷9.

† When the paper was read, a diagram, having the dimensions here

divided into 12 lines of 40 inches each, and the note which ends any one also begins the next, as indicated by the usual name which is placed at the beginning and end of each line.

But this is still a very rough division. We can readily imagine 9 other strings introduced between the extremes of each line, at equal distances of $\frac{1}{10}$ inches, and giving notes proceeding by equal intervals, which repeated ten times produces a sem. Such an interval, which may be called a *tithe*,* is represented with great exactness by $\frac{1731}{1732}=1_{\frac{1}{1732}}$. So that to find a tone which is a tithe higher than 8C=256, we multiply by 10, giving 2560, and divide, to three places of decimals, by 1726, giving 1·425, and then add this to 256, giving 257·425 vih. The mode of noting this will be given presently.

We must carry this division further, and suppose that between each pair of strings, which give notes separated by a tithe, we introduce 9 other strings separated from each other by $\frac{1}{10}$ tenths of an inch, and proceeding by equal intervals, which repeated 10 times will produce a tithe. Such an interval, which will be naturally called a *cent*, is represented almost precisely by $\frac{1732}{1731}=1_{\frac{1}{1731}}$, so that to find an interval which is one cent sharper than 8C=256 vih we divide 256 by 1731 to 2 places of decimals, giving ·15, and add to 256, giving 256·15 vih.

For many theoretical calculations we require to go further, and find an interval which is the tenth part of a cent, and may be called a *mil*. The ratio of a mil is $\frac{17311}{17310}$ or $1_{\frac{1}{17310}}$. We even find it necessary to imagine an interval which is the tenth part of a mil, and may be called a *dime*, having the ratio $\frac{173101}{173100}$ or $1_{\frac{1}{173100}}$.† Such intervals are, of course, far beyond all power of ear to appreciate when the notes are struck in succession, and can scarcely be heard by beats except under wonderfully favourable circumstances, yet in accumulating a large number of intervals we should often commit very appreciable errors in calculation, if we did not use the mil, and occasionally the dime. But the cent is the practical limit.

In the diagram the tithes are marked by alternate black and blank parallelograms, the upper boundary forming the line considered. The separation of the colours gives the position of each

indicated, was exhibited. It is by no means large or unwieldy, but for the purposes of printing it, the length of the imaginary key-board has been reduced to 48 inches, divided into 12 parts of 4 inches each, that is, it appears as one-tenth of its actual size. The statement of the actual dimensions is, however, retained in the text.

* *Tithe*, of course, means a *tenth*, but the word *tenth* itself had to be omitted because it is the name of well-known intervals, the major Tenth, or $\frac{5}{2}$, and the minor Tenth, or $\frac{12}{5}$.

† To reduce these relations to one common standard, suppose that the starting note makes 1,000,000 vibrations in some known interval of time. Then a note which is a sem higher than the starting note makes 59,462 vibrations more in the same time; a note which is a tithe higher makes only 5,793 vibrations more; one a cent higher only 578 more, one a mil higher only 58, and one a dime higher only 6 vibrations more than the starting note, in the same time.

tithe as a geometrical line. The cent and mil are determined by a scale, easily drawn, each cent being represented by a space of $\frac{4}{10}$ tenths and each mil by one of $\frac{4}{100}$ hundredths, that is 1 twenty-fifth of an inch; but a dime, occupying $\frac{4}{10}$ inch, is far too small to be noted even on a keyboard of 40 feet to the Octave. To mark the position of any particular string or note terminating a cent or mil, a pointer is used, in the shape of half a square, or two half-squares superposed.* Where the vertical edge of the pointer cuts the line of sem we have a mathematical point which exactly shows the interval, even in a large diagram.

Any pitch can therefore be fixed to the nearest mil or dime by stating that it is so many Octs, so many sems, so many tithes, so many cents, and so many mils, or so many dimes: as 8 Oct, 5 sem, 3 tithes, 7 cents, 9 mils, and 6 dimes. But since 8 Oct contain 8 times 12 or 96 sem, and 96 sem + 5 sem is 101 sem, this result can be more conveniently represented by the decimal fraction 101·3796 sem or to the nearest cent (in which case a cent must be added if there are 5 mils or more over) as 101·38 sem.†

It is evident that, by a laborious calculation, the number of sem would enable us to find the exact number of vib, just as a number of vib would give us the complete result in sem. By Table II. this calculation is reduced to simple multiplication and long division, which, though rather lengthy when we wish to go as far as dimes, is really shorter and simpler than the usual processes as far as cents, and involves no references to other tables.

In writing any note, then, we may use such a form as 101·381 sem, or, since 5 sem corresponds to equally tempered F, and 96 sem to 8 Octaves, we might write 8 F + ·381, that is, 381 mils sharper than 8 F to the standard 8 C = 256 mil. Suppose, however, it was more than half a sem, or 500 mils sharper, such as 101·683 sem or 8 F + ·683, it would be more intelligible generally to consider it as 8 F♯ − ·317, that is, as a flat F♯, to which it is nearer, rather than a sharp F from which it is more distant. But, suppose that we want to represent the pitch with reference to another standard as 8 C′ = 264 vib. Then we must find the interval $\frac{264}{256}$ = $1\frac{1}{32}$ = ·533 sem, and having laid down that C′ D′ &c. now mean notes sharper than C D &c. by ·533 sem, we have 8 F′ = 8 F + ·533 first, and hence 8 F′ − ·152 = 8 F + ·381, so that the pitch will be expressed as a flat F′ rather than as a sharp F. The difference ·152 sem is clearly found by deducting ·381 from ·533. Similarly 101·683 sem = 8 F♯ − ·317 = 8 F + ·683 = 8 F′ + ·150,‡ giving a sharp F′ instead of a flat F♯. It is quite evident, however, that if we confine our notation to figures, as 101·381 sem, or 101·683 sem, we avoid all confusions depending on variable pitch, and obtain a clear and distinct representation of any pitch, from which we

* In order to be visible, the pointers were really about $\frac{1}{10}$-inch wide at the bottom, but the measurements were determined by the vertical side.

† See examples of this mode of expressing pitch in Tables IV. and V.

‡ In Table III. a means is given for finding 0 C from any value of 8 A′ or 9 C′ that is usually employed.

can form any number of intervals following any given relations of intonations with ease and certainty. Supposing we stopped at cents, the ideal Octave would consist of 1,201 strings each 4 hundredths (or one-twentyfifth) of an inch separated from its nearest neighbour, and covering 40 feet in length, as in the diagram (reduced to 48 inches in Table I.). If this were continued for 12 octaves, we should have a keyboard 480 feet long, containing 14,401 strings. Now, preposterous as this may appear, it is a very close representation of the actual constitution of the cochlea in the internal ear, which is of course microscopic in detail. This contains (according to the latest calculations of Hensen, as cited by Dr. Preyer, p. 41), about 16,400 capillary nerve fibres, which act as the single strings of our ideal monster pianoforte, and are struck, not by hammers, but by the vibrations of a peculiar fluid in which they float. When we ascend on a piano, we pass from the left to the right by degrees, and we fix the pitch by stopping at a certain digital. Thus also in the ear we pass over the nerve fibrils in succession, and fix the pitch by stopping at one of them. The only difference appears to be this: that on our ideal piano we have made the number of strings in each octave, and the interval between the notes, exactly the same, while in the ear it is probable that the intervals differ, and that the number of nerve fibrils is different in each octave. We must also remember that very few musical tones are simple, so that the motion of the fluid affects a number of fibrils at the same time and with unequal force. The old experiment of raising the dampers on a flat piano, and shouting a vowel on to the sounding board, which will be in a small, but appreciable fraction of a second re-echoed from the strings, exhibits the action of the whole mechanism with sufficient exactness to make it comprehensible.

The arithmetical pitch of a compound note is that of its lowest constituent or partial simple tone, but all the other partials help to give individuality to the sensation, and it is found that differences in the quality of tone, in the loudness, or duration of the notes, or even in the length of silence between two notes, materially affect the estimation of pitch and interval by the ear. It is therefore for many purposes advisable to construct a table which gives the exact interval between the lowest and any other partial. This I have done in Table IV. at the end of this paper, up to 64 reckoned to dimes. By adding these sem to the sem of the note, as far as we please (it is seldom necessary to proceed beyond 12 or 16, or higher than 12 C=144 sem) we obtain a very precise indication of the real phenomenon presented by sounding a compound musical note. Thus, if we sound a strong reed tone of which the lowest partial is 77 sem or 6 F, we really hear to the nearest cent the simple tones 77, 89, 96·02, 101, 104·86, 108·02, 110·69, 113, 115·04, 116·86, 118·51, 120·02, 121·41, 122·69, 123·88, 125 · that is, 6F, 7 F, 8 C + ·02, 8 F, 8 A − ·14, 9 C + ·02, 9 D♯ − ·31, 9 F, 9 G·04, 9 A − ·14, 9 A♯ + ·51, 10 C + ·02, 10 C♯ + ·41, 10 D♯ − ·31, 10 E − ·12,

10 F. And it is evident that these numerous fixed points, or at least the first 8 of them, which do not in general beat together, will be very instrumental in determining the sensation of pitch. In fact, for simple or nearly simple tones the sensation of pitch is found to be very imperfect, and for different qualities of tone it is apt to be very different, even when their arithmetical pitch is identical.* On the diagram (Table I) I have given the odd-numbered partials only, reduced to the same octave, because the evenly numbered partials will always be octaves of some of these. The marks for these are double wedges with the number of the partial placed near them, and, if they correspond to any named note, its name is placed below. A single glance at their position will show that the harmonic theory of the scale implies a selection of tones as well as any other. I have also marked by single wedges (when they are not in the harmonic series) and with names below, a series of 52 just Notes arranged systematically, with the pitches attached, in Table V. These exhibit in a striking manner the differences of a great comma of 235 mils, an ordinary comma of 215 mils, and a skhisma of 20 mils which frequently occur, and hence become the starting points for temperament.

Having spent so much time over the representation of intervals, by a musicianly process, on an arithmetical basis, I use the sem, cents and mils thus obtained to represent the results obtained by Prof Preyer in comparing the actual physiological powers of exceptionally good and highly cultivated ears, in approximating to these arithmetical results.

First, *What are the lowest musical tones audible?* that is, *What is the smallest number of vibrations in a second which can be heard as one continuous tone?*

For this purpose Dr. Preyer had an instrument constructed by Herr Appunn which was shown in the Loan Collection of Scientific Apparatus in 1876. It consists of a series of metal tongues vibrating from 8 to 32 times in a second, and increasing by 1 vibration for each note, and then increasing by 2 vibrations for each note to 64 vib, and then by 4 at a time to 128 vib.† It must be remembered that the resulting tones are very compound, and give numerous disagreeable beats. But it is the lowest partial only on which attention must be fixed, and Dr Preyer found that if the wind were allowed to die out gradually this lowest tone was heard best just at the moment of disappearance. The result is, that Dr. Preyer could hear a tone of 15 vib, and could not hear one of 13 vib. For 14 he was uncertain. Most ears could not hear below 24 vib.‡ When I played down the

* See Dr Stone's observations on the difficulty of distinguishing a difference of pitch in the Oboe and Clarinet, and Mr Hipkins's remark on pianos tuned to the same pitch but having different qualities of tone. Dr. Stone, in *Concordia*, 'On Tuning an Orchestra.'

† This instrument was purchased by the South Kensington Museum at the close of the exhibition.

‡ Dr Preyer gives the following as the final result of experiments repeated hundreds of times when the listener did not know what number of

series on Appunn's instrument, most persons heard quite well to 32 vib but after that, somewhere about 30 vib (varying with different persons), the tone suddenly seemed to jump up an Octave; thus arose from the lowest partial ceasing to be audible. Those who, applying the ear carefully to the box of the instrument, seemed to hear a deep tone, were generally hearing the Octave above that which they really fancied they heard. If the lowest partial were strongly reinforced by resonators, possibly the lower tone would be heard better. But the means of producing easily audible simple tones, which are lower than 23 to 15, seem to be not as yet discovered.*

The result is, that the existence of the *simple* tone 4 C=16 vib is a very doubtful, but it may be musically effective when associated as a compound tone with higher partials, and that 5 C= 32 vib. is the lowest compound tone of which the lowest partial can be made musically effective.

The next question is, *What is the highest musical tone that can be heard?*

vibrations he had to hear, but was somewhat accustomed to observe, and listened with his ear close to the wood of the instrument as the wind was allowed to die out —.

8, 9. No musical tone; an intermittent frictional noise is heard, and the intermittences can be counted.

10, 11, 12, 13, 14. No musical tone; the tremor is felt, and the vibrations are visible; the rattle is feebler.

15. No musical tone; some perceive an obscure sensation of sound.

16, 17, 18. The sensation of musical tone commences; in addition to the tremor of the air, which is sensible to the touch, many hear an obscure sound.

19, 20. With many the sensation of tone is distinct; the tone itself buzzes gently.

21, 22. Many hear a humming tone.

23, 24. Everyone whose sensation of hearing is not impaired now hears a very deep, mild, beautiful tone.

25, 26, 27, 28, 29, 30. As the pitch of the tone increases it becomes less easily heard, because the length of the time for which it lasts, as the wind dies off, becomes shorter, but it is distinct.

31, 32. The tone is still distinct, but short.

34, 36, 38. The tone is very short and difficult to hear.

40. Impossible to hear anything, because the vibrations of the reed, as the wind dies out, have become too feeble.

* The case is different for beats. If a major Third $\frac{5}{4}$ be sounded, the beats arising from the 4th partial of the lower and the 3rd of the upper note, relatively 16 and 15, are well heard separately, and their number is exactly $\frac{1}{4}$ of the number of vibrations made by the lower note in one second. But at the same time the differential tone arising from sounding 4 and 5 together is also heard, and it makes exactly the same number of vibrations in a second as the beats which are heard as separate sounds. I have heard this distinctly for the just major Third 256 : 320, beating 64 times in a second by its partials, and producing the differential tone 64, on Appunn's Tonometer. Dr Preyer thinks that different parts of the ear hear the discontinuous beats and the continuous tone. But in the case of an original tone itself the separate beats are not heard. I believe the two phenomena to be totally distinct, and that beats and differential tones have no physical connection. They seem to me to have a different origin and to follow different laws.

This is not solved. Herr Appunn has made 31 tuning forks, forming just major scales from 11 C=2048 vib to 15 E−·139 or 183·863 sem=40960 vib. These were shown at the Loan Exhibition,* and I could hear them all distinctly, when carefully bowed, at the distance of 100 feet. Up to 14 C=16384 vib there was no difficulty at all, but 15 C, 15 D+·040, 15 E−·137 were not easy to hear. They were very distressing to many ears, though not to mine. Captain Douglas Galton exhibited a means of producing still higher tones, but with less power. For musical purposes tones higher than 12 C=4096 vib become useless, on account of the difficulty of recognising their intervals, and the mere mechanical tuning of such tones presents enormous difficulties †

Hence the researches of Dr. Preyer tend to make the practical musical scale extend over 7 Octaves from 5 C to 12 C (32 to 4096 vib), though for the purpose of strengthening partials, as in organ mixture stops, 9 Octaves from 4 C to 13 C (16 to 8192 vib) may be available—certainly no more.

The next question is, *How accurately can we estimate pitch by the ear only?* Which is quite different from the question, *How accurately can we measure pitch?* The estimation of pitch demands a musical ear. The measurement of pitch is purely mechanical, and requires simply the power of hearing and counting beats.

The best means of measuring sensitiveness is difficult to determine. But without declaring it to be, *for a given pitch*, inversely proportional to the smallest number of mils perceived or the largest number of mils *not* perceived, it is evident that either set of numbers will serve as a very convenient scale for the purpose of comparing the sensitiveness of different persons. Observe that I have inserted the words 'for a given pitch,' for the sensitiveness of every ear seems to vary with the pitch of the note under observation.

To examine the sensitiveness of the ear for pitch, we must sound two notes in rapid succession, with either the same or different pitch, the exact difference having been first determined mechanically, and must take care that the quality of tone, loudness, duration, and steadiness of tone, should be as nearly as possible the same in each case. An alteration in any one of these four points confuses the ear. Then arise two questions—first, *Are the tones different?* secondly, *If so, which is the sharper?* These two questions are entirely different. Many ears will answer the first correctly which will not answer the second correctly. To prevent any influence on the judgment of the ear, no person should be present except the examiner and examinee, and the latter should not see what keys or valves are touched to produce the sound. Every precaution has to be taken, also, to have the ears and the whole nervous condition fresh and unwearied.

* These forks were also purchased by the South Kensington Museum at the close of the exhibition.

† Herr Appunn informed me that a hundred guineas would not pay him for the mere labour of making these 31 forks mentioned in the text.

To try his experiments Dr. Preyer had two instruments constructed by Herr Appunn, a Tonometer and a Differential Apparatus. The Tonometer contained 33 tones, from 7 C = 128 vib to 8 C = 256 vib, proceeding by differences of 4 vibrations, so that any two adjacent tones beat with each other 4 times in a second. But as this would have given a succession of perfect consonances, Dr. Preyer slightly altered the pitches, and carefully measured the result by counting the beats. The exact pitch of each note is therefore given in Table VI. in vib, and the sem between each and the lowest is annexed. The Differential Apparatus had 25 tones, from 500 to 501 vib proceeding by tenths of a vibration, and then 504, 508, 512, 1000, 1000·2, 1000·4, 1000·6, 1000·8, 1001, 1008, 1016, 1024, 2048, 4096 vib respectively.* Both were constructed with harmonium reeds and a wind regulator, to give a tone which could be depended on, and both were constantly proved by counting beats. With these, including Delezenne's results, Dr. Preyer found (p. 31) that—

at vib	or about	a difference of	giving an interval of	
119·791	6 B	4·15 vib	60 mils	*was* perceived.
439·636	8 A	3·64 „	14 „	
500	9 C	3·00 „	10 „	
1000	10 C	·500 „	9 „	

But,

at vib	or about	a difference of	giving an interval of	
59·895	5 B	·209 vib	60 mils	was *not* perceived.
109·909	6 A	·091 „	14 „	
250	8 C	·150 „	10 „	
400	8 G♯	·200 „	9 „	

The intervals in the two cases are the same, but the pitch in the latter case was about an Octave lower than in the former, and hence the difference in the numbers of vibrations for the same interval is very different.

Combining all the results, we may state generally that throughout the scale $\frac{1}{5}$ vib is *not* heard;

but from 5 G♯ to 8 G♯, $\frac{2}{5}$ vib
and „ 8 A „ 9 C, $\frac{1}{4}$ „ } is heard.
„ „ 7 C „ 10 C, $\frac{1}{2}$ „

These differences, however, give very different intervals. Thus

$\frac{1}{5}$ vib	= 215 mils	at 4 C	= 16	vib.
„	= 107 „	5 C	= 32	„
„	= 54 „	6 C	= 64	„
„	= 27 „	7 C	= 128	„
„	= 14 „	8 C	= 256	„
$\frac{1}{3}$ „	= 13 „	5 A	= 430·54	„
„	= 11 „	9 C	= 512	„
$\frac{2}{5}$ „	= 136 „	5 G♯	= 50·80	„
„	= 17 „	8 G♯	= 406·37	„

On examining the smallest intervals which could occur in just

* The Tonometer with 33 reeds (proper tune and not altered as for Dr. Preyer's purposes), together with another with 65 reeds (C 256 to C 512 proceeding by 4 vibrations at a time), was exhibited at the Loan Collection of Scientific Apparatus, and both were purchased at the close of the exhibition by the South Kensington Museum. The Differential Apparatus was not exhibited.

intonation, from the great Limma $\frac{2187}{2048} = 1\frac{9}{100}$, or 1·352 sem, to the skhisma $\frac{32805}{32768}$ or 20 mils, we see that it is only the last which runs any danger of not being heard by good ears. When the number of vibrations is less than 220, that is, when a note is below 7A, and two tones are sounded which are but a skhisma apart, they will differ only by $\frac{1}{4}$ vib, and hence the best ears may fail to detect the difference. But from 440 vib, that is from 8 A upwards, the difference will be $\frac{1}{2}$ vib or more, and will be always detected. The feeling of a singer, however, will allow him, even in the 7th octave, to take a Fifth with such precision, that, on sounding a tempered and just Fifth with his note, beats will be immediately heard in the first case and none in the second. I had an opportunity of witnessing this at a lecture given by Dr Stone, at the South Kensington Museum, on July 25, 1876. This is, however, a different case. The same singer might not have detected that two notes, differing by a skhisma and sounded in succession at the pitch of the higher of his two notes, actually differed in pitch. In harmony, the beats produced by a skhisma are very distinct above 8 C, and without them we could hardly hope for equal temperament at all.

The above results refer principally to tones between 7 C and 10 C. Beyond these limits the sensitiveness of the ear decreases materially. Below 5 E = 40·32 vib practised ears will not recognise a whole vibration (which even at 5 E amounts to 424 mils), and unpractised ears will not perceive 2 or 3 vib (the first gives 839 mils, and the second 1·242 sem at 5 E). Above 10 C the sensitiveness probably diminishes, and after 11C the judgment becomes very uncertain. Unpractised ears, including those of pianists, did not distinguish even a minor Third in the 12th octave, although the difference was more than 1000 vib. Much of this want of sensitiveness, however, depends upon want of practice.

But it is also very singular that many of those who can tell that the pitch is different in the two cases cannot say with certainty which note is the sharper when the interval is small. Out of 398 trials, in 11 cases the ear could not say which tone was sharper, the difference amounting to $\frac{2}{3}$, $\frac{3}{5}$, and $\frac{3}{10}$ vibration out of 1000 or 500 (giving in the former case about 7, 10, and 15 mils, and in the latter 14, 20, and 30 mils respectively). But these 11 observers were better off than 154 others, who pronounced the flatter tone to be the sharper, or conversely. Even in the case of 1000 and 1001 vib (17 mils at 10 C—·41), the very best observers have sometimes mistaken the sharper for the flatter tone. (See P.S., p. 24.)

One practical result of this investigation is that, as already indicated, in comparing the relative sensitiveness of two ears, we must give not only the number of cents which they failed or succeeded in distinguishing, but also the pitch, or at least the approximate pitch, of the tone on which they were tried. It will be quite enough to give this pitch to the nearest whole number of sem, which can always be determined with sufficient exact-

ness by a common harmonium or pianoforte. We may say that *a good ear for unisons* hears an error:

100 mils at	6C=	64 vib, and	gradually	less on ascending	
80 „	7C=	128 „	rapidly	„	„
13 „	8C=	256 „	not so rapidly	„	„
10 „	9C=	512 „	nearly the same	„	
8 „	10C=1024	„	not quite so little	„	

For intervals greater than a unison it will be enough for musical purposes to note the semitone nearest to the *lower* note, and the amount of error heard or not heard in the *upper* note. In the following tables error will be always expressed in mils, and the marks ♯, ♭, placed before the number of mils respectively, will indicate that the upper note was too sharp or too flat by that amount. It does not always follow that the same amount of error was heard in both cases. The degrees by which the error was perceived will be distinguished by the expressions 'unheard, scarcely heard, just heard, heard, well heard, very well heard, very distinctly heard,' and the statements of observers, as given by Dr. Preyer, are interpreted by this scale. Sometimes the observer states whether the second note appears too sharp (♯) or too flat (♭). The principal opinions cited are those of Herr Georg Appunn, of Hanau, marked A, and those of Herr Michael von Davidoff, of Moscow, professional violinist, marked D, both men of a very great degree of sensitiveness of ear, highly cultivated by long practice. The letter U marks the judgments of other less practised ears. When no letter is annexed the observer is not named.

For the *Octave* the two first experiments are from Dolezalek, the others from Dr. Preyer's own researches. In all the other intervals the Tonometer from 128 to 256 vib was used, carefully and constantly verified by counting the beats. All the lower tones, therefore, of the intervals are in the 7th Octave; hence the number 7 is omitted for convenience. The actual notes are indicated by the numbers explained in Table VI. I have given all the results contained in Dr. Preyer's pamphlet in this entirely new form, because, without examining them as a series, it is impossible to feel the great difficulties experienced in hearing an error, and still more in determining which direction it takes. Strange contradictions in this respect will be found in the minor Third, minor Sixth, and major Tone. The experiments are by no means sufficient for many intervals, especially for the Octave.*

* Mr. Hortman Smith writes to me that 'very few persons are able to discriminate between a perfect and a slightly imperfect interval of an Octave. It is only,' adds he, 'by interposing another interval that you can be certain of exactitude. I have often proved the best tuners at fault, to their great astonishment.' A mistuned Fourth above any note is a mistuned Fifth below the Octave of that note, and makes the same number of beats with each. Harmonium tuners, I believe, use this property to tune Octaves by. But this regards notes which are struck at the same time, not in succession, and merely shows the difficulty of observing the instant of the disappearance of beats, not the sensitiveness of the ear in recognising precision of interval when the notes are sounded successively.

Fifth, and major Sixth. It is to be hoped that Dr Preyer may be able to complete them by a larger tonometer of two Octaves, 7 C to 9 C, which will enable the observer to take intervals exceeding an Octave, because all these are very interesting and important.

OCTAVE = 2 ÷ 1 vib = 12 sem.

Actual Notes (*see* Table VI.)	Approximate Lower Note	Precise Error in Mils	Statements of Observers
	6 F♯	♯ 34	unheard (Delezenne)
	6 F♯	♯ 69	just heard (Delezenne)
	8 C	♯ 36	well heard
	9 C	♯ 17	very well heard
	10 C	♯ 8	very distinctly heard
0·52	7 C	♯ 7	unheard
0·31	7 C	♭ 271	well heard, U

FIFTH = 3 ÷ 2 vib = 7·0196 sem. 7th Octave.

4·22	D	♯ 1	unheard, A, D
0·16	C	♯ 7	unheard, A, D
2·19	C♯	♯ 12	unheard, A, D
8·28	E	♭ 4	unheard, A, D
5·26	D♯	♭ 17	unheard, D; a trifle ♭, A
10·31	F	♭ 20	unheard, A, D (= tempered Fifth)

FOURTH = 4 ÷ 3 vib = 4·9805 sem. 7th Octave.

16·52	G	♭ ½	unheard, D
13·28	F♯	♭ 3	unheard, D
4·16	D	♭ 6	unheard, D
10·24	F	♭ 7	unheard, D
14·29	F♯	♭ 96	unheard, A, D
11·25	F	♭ 102	heard, A, D
8·21	E	♭ 105	just heard, A, D
5·17	D♯	♭ 122	heard, D; a trace ♭, A
2·13	C♯	♭ 126	well heard, D, U
7·20	D♯	♯ 2	unheard, D
1·12	C♯	♯ 6	unheard, D
16·31	G	♯ 82	unheard, A, D; a trace too ♯, A (the tempered Fourth is ♯ 20)
12.27	F♯	♯ 95	unheard, D; extremely little wrong, A
9·23	E	♯ 100	unheard, D; a trace too ♯, A
6·19	D♯	♯ 103	scarcely heard, A, D
3·15	D	♯ 127	heard, A, D
14.30	F♯	♯ 186	too ♯, A; just heard, D
11·26	F	♯ 194	well heard, DADb
2·14	C♯	♯ 256	too ♯, D,
1.13	C♯	♯ 397	distinctly heard, D

MAJOR SIXTH = 5 + 3 vib = 8 8436 sem. 7th Octave.

Actual Notes (see Table VI.)	Approximate Lower Note	Precise Error in Mils	Statements of Observers
0.21	C	♭ 83	heard, A, D; very wrong, A
5 26	D	♭ 96	just heard, D, too ♭, D
6 31	D♯	♭ 121	well heard, A; too ♭, A
5.30	D♯	♯ 79	heard, A; just heard, D
2 25	C♯	♮ 109	unheard, D; too ♮, A
6 32	D♯	♯ 157	too ♮, A (this is the tempered major Sixth)
3 27	D	♯ 195	well heard
0.22	C	♯ 230	well heard, even by U

MAJOR THIRD = 5 + 4 vib = 3 8631 sem. 7th Octave

8.18	E	♭ 1	unheard, A
4 13	D	♭ 4	unheard, A
13 24	F♯	♭ 62	unheard, D; too ♭, A
17 29	G	♭ 71	unheard, D; too ♭, A
1. 9	C♯	♭ 87	heard, A, D; too ♭, A
5 14	D♯	♭ 106	heard, A, D; too ♭, A
14 25	F♯	♭ 147	well heard, A, D, too ♭, D
18 30	G♯	♭ 148	well heard, D
2 10	C♯	♭ 191	well heard, A; just heard, D, too ♭, D
6 16	D♯	♭ 204	very well heard
12 23	F♯	♯ 8	unheard, A
0 8	C	♮ 20	unheard, A, D
19 32	G♯	♯ 45	heard, A, D; too ♯, A
15 27	G	♮ 60	well heard, A, D
11 22	F	♮ 79	well heard, A, D
7.17	D♯	♮ 98	well heard, A, D; too ♭, D
3.12	D	♮ 99	well heard, D
18.31	G♯	♯ 120	unheard, D; scarcely heard, A; a little ♭, A (the tempered major Third is ♮ 137)
10 21	F	♮ 169	just heard, D, somewhat ♭, D
0. 3	C	♮ 448	a ♮ major Third, D

MINOR THIRD = 5 + 6 vib = 3 1564 sem. 7th Octave

8 16	E	♭ 12½	unheard, A, D
18 28	G♯	♭ 13	unheard, D
14 23	F♯	♭ 68	unheard, A
19 29	G♯	♭ 68	unheard, D
3 17	E	♭ 73	unheard, A
4 11	D	♭ 78	unheard, D; a trace too ♭, A
15 24	G	♭ 120	unheard, D; a very little too ♭, A
20 30	G♯	♭ 123	scarcely heard, A; too ♭, D
10 18	F	♭ 140	heard, D; too ♭, A (the tempered minor Third is ♭, 166)
6 12	D♯	♭ 172	unheard, D; too ♭, A
16 26	G	♭ 174	unheard; scarcely heard, D a little too ♭, too ♭, A
21.31	A	♭ 189	heard, D
11 19	F	♭ 199	just heard, D
17.25	G	♭ 245	heard, D
1. 7	C♯	♭ 247	too ♭, D

MINOR THIRD = 6 + 5 vib = 3·1554 sem.—*continued.*

Actual Notes (*see* Table VI.)	Approximate Lower Note	Precise Error in Mils	Statements of Observers
13 22	F♯	♯ 6	unheard, A, D
3 10	D	♯ 14	unheard, A, D
7 15	D♯	♯ 86	unheard, A; heard, D
12 21	F♯	♯ 83	unheard, A; heard, D
21 32	A	♯ 51	too ♯, A, D
2. 9	C♯	♯ 58	heard, A, D; too ♭, D
16 26	G	♯ 124	unheard, A; scarcely heard, D
6 14	D♯	♯ 130	heard, A, D
11 20	F	♯ 138	a little ♯, A; heard, A, D; too ♭, D
20 31	G♯	♯ 147	too ♯, A, D
15 25	G	♯ 187	much too ♯; too ♭, D
0 7	C	♯ 287	well heard
	MINOR SIXTH = 8 + 5 vib = 3·1369 sem.		7th Octave.
8 32	E	♭ 13	unheard, A, D
0 19	C	♭ 47	unheard, A, D
5 27	D♯	♭ 76	unheard, A
2 22	C♯	♭ 120	unheard, D, somewhat too ♭, A
7 30	D♯	♭ 121	unheard, D, somewhat too ♭, A (the tempered minor Sixth is ♭ 137)
4 26	D	♭ 180	unheard, D, too ♭, A, scarcely heard, D
1 20	C♯	♭ 245	heard, D
8 31	E	♭ 291	just heard, D
3 28	D	♭ 304	heard, too ♭, D
8 24	D	♯ 7	unheard, A, D
1 21	C♯	♯ 91	unheard, A, D; just heard, D
4 26	D	♯ 118	heard, D; too ♯, A
7 31	D♯	♯ 148	heard, D
2 23	C♯	♯ 198	heard, A, D; too ♯, A
0 20	C	♯ 289	well heard
	MAJOR TONE = 9 − 8 vib = 2·0362 sem.		7th Octave.
8 13	E	♭ 11	unheard, A, D
24 31	A♯	♭ 13	unheard, D
1. 5	C♯	♭ 37	unheard (F); too ♭, D (the tempered major Tune is ♭ 39)
17 23	G	♭ 42	heard, A, D; too ♭, A
25 32	A♯	♭ 42	heard, A; too ♯, A
9 14	E	♭ 57	heard, D; unheard, A
18 24	G♯	♭ 82	heard, D
2 6	C♯	♭ 90	heard, D
19 28	G♯	♭ 113	scarcely heard, D
11 16	F	♭ 144	heard, D
14 19	F♯	♭ 243	heard, D
16 22	G	♯ 8	unheard, A
23 30	A	♯ 28	unheard, A; a little too ♯, A, just heard, D
7 12	D♯	♯ 38	unheard (F), heard, D
15 21	G	♯ 56	heard, A, unheard, D
22 29	A	♯ 64	a little ♯, D
14 20	F♯	♯ 94	heard, D

The order in which the above results are given is not that which Dr. Preyer has adopted, nor exactly that in which he subsequently says that the consonances seem to arrange themselves in respect to sensitiveness of the ear, for I have reversed the order of the major Sixth and major Third. It will be seen that in no case is any error detected when it does not exceed a cent or at least 8 mils. This justifies us in using the convenient cent as the practical unit for small intervals. We have no proper indications of sensitiveness for the unison and Octave in the 7th Octave, and hence these are conjecturally placed in the following Table, which for the other intervals gives the actually smallest intervals heard, and actually greatest intervals unheard by any observer in the 7th Octave, as recorded in the preceding Tables, and then in the last column subjoins the equivalent of Dr. Preyer's mean. This mean does not represent the precise mean of the recorded observations, but is obviously founded upon other trials in addition, and is, perhaps, partly theoretical. This is acknowledged to be the case for the Fifth, and is certainly so also for the major Sixth. At present the jump from the Fifth to the Fourth is quite surprising:

Through the 7th Octave (128 to 256 vib).

For the Interval	The least ♯ or ♭ error heard, had cents	The greatest ♯ and ♭ error unheard, had cents.	Dr. Preyer's mean, has cents
Unison ?	♯ 5	♯ 1½	—
Octave ?	♯ 5	♯ 2	—
Fifth	?	♯ 1, ♭ 2	4
Fourth	♯ 8, ♭ 10	♯ 10, ♭ 10	10
Major Sixth	♭ 8	♯ 11	12
Major Third	♯ 5, ♭ 5	♯ 12, ♭ 7	11
Minor Third	♯ 7, ♭ 8	♯ 12, ♭ 17	13
Minor Sixth	♯ 9, ♭ 12	♯ 9, ♭ 18	13
Major Tone	♯ 3, ♭ 4	♯ 4, ♭ 4	—

The great difference which practice produces in the judgment formed by the ear, leads me to suppose that its real sensitiveness depends not only upon original constitution of the ear, but, as in most other cases of nervous action, more especially on steady, continued exercise, and that consequently with the same original constitution those intervals most frequently used are most accurately gauged. Now of unisons in melodic succession we have comparatively little practice, except in tuning the piano, (and then the notes are often struck together,) for in playing music a unison is produced generally by repeating an excitement under the same circumstances without any judgment of the ear. I observed that the unison reeds on my English concertina were tuned as Fifths to the same note, and not as unisons to each other, and the tuner told me that he found that the easiest plan, although such reeds could be easily made to sound simultaneously, and thus to give beats. In the unison-strings of a pianoforte it seems to me that the tuner relies more on the Octave than on the unison itself, but here I may be wrong. The Octave when

played or sung requires totally different preparation, and hence the attention of the performer is early and constantly directed to it. He is also constantly hearing it in the voices of men and women, or men and boys. Would equal sensitiveness be shown for the double Octave, which does not lie within the compass of perhaps the greater number of singer's voices? The Fifth is the very foundation of the musical scale, and to master it thoroughly is a necessity of life to the violinist. We should, therefore, expect that for all singers and violinists, and especially for such men as Herr Appunn and Herr Davidoff, the sensitiveness for the Fifth would be abnormally high. We see, indeed, by the tables, that it is widely distinguished from all other consonant intervals and is only approached by the dissonant interval of a Major tone. This, again, is merely an Octave lower than the double Fifth, and is more likely to be heard correctly than the semitone. In ordinary equal temperament it is only 4 cents too flat, and this is precisely the amount of error marked as heard and unheard for the interval. This leads to the conception that the habit of hearing equal temperament and of singing and playing to equally tempered instruments has probably much concern in determining the sensitiveness of the cultivated, as distinguished from the uncultivated but naturally sensitive ear. The other intervals, except the Fourth, are so materially affected in character by temperament, that we are even surprised to find any observers who detect the tempered Thirds and Sixths as false. Possibly singers brought up to sing just intervals only would feel the error more acutely. I have noticed that in trying to judge of a tone or interval given by any instrument, the observer almost mechanically sings it to himself, that is, translates it into the quality of tone with which he is most familiar, and he seems to me (I may be quite wrong), to found his judgment rather upon this imitation (which, of course, is liable to differences) than upon the original sounds. I would thus account for the seizure of intervals between simple tones, which in themselves have so slight a hold upon the internal ear, on account of the absence of upper partials.

The principle by which the consonant intervals are perceived, seems to me to be that conjectured by Helmholtz—the remembered identity of a partial tone in the second note, with a partial tone in the first (Helmholtz, 'Sens. of Tone,' p. 394). This conception has been somewhat differently carried out by Dr. Preyer (p. 60), who, reckoning each note as having 8, or 12, or 16, or 24 partials, determines how many partials would be identical in the two tones. But I think there is more than mere repetition. The tones compared have rarely more than 8 or 12 effective partial tones, and the higher of these are generally so high and weak, that they would probably not much affect the judgment of the ear. In the following Table each tone is supposed to have only 8 partial tones. For convenience, the 7 just tones $6c$, $7c$, $7g$, $8c$, $8e_1$, $8g$, $9c$,* are taken so that the numbers

* C, D, &c. are used for the equally tempered notes of the arithmetical

assigned to the various partials, when multiplied by 64, will give their vib. Now observe that 7*c* contains exactly 4 partials (2, 4, 6, 8) the same as those of 6*c* the Octave below, but 7*g* contains only 2 partials (6, 12) the same as those of the Fifth below 7*c*, and 8*c* also contains 2 partials (12, 24) the same as those of 7*g* the Fourth below. Hence this principle does not distinguish the Fifth and Fourth without taking more partials into consideration. Again, in all the other intervals the major Third 8*c* to $8c_1$, the major Sixth 7*g* to $8c_1$, the minor Third $8c_1$ to 8*g*, and the minor Sixth $8c_1$ to 9*c*, the upper tone has only 1 partial in common with the lower. It seems, therefore, necessary to be satisfied with one common partial only, and to suppose that the differences depend upon the position of that partial with respect to the others. Now the higher the partial the less distinctly it is perceived and the more it is veiled by the lower and louder partials below it. This is but an illustration of Prof. Alfred Mayer's recent investigations on the extinction or at least veiling of a higher weaker tone by a lower and stronger tone, while conversely a higher stronger tone does not extinguish or veil a lower weaker tone.* Now for the Octave $\frac{2}{1}$ the first identical partial is the lowest in the upper note and the lowest but one in the lower note. For the Fifth $\frac{3}{2}$ it is the 2nd of the upper which is identical with the 3rd of the lower note. The result ought to be more difficult to perceive then in the former case, and I cannot doubt that more special practice is generally necessary to recognise a Fifth then an Octave. I recommend this point to the attention of teachers of beginners in naming intervals heard, and distinguishing whether the second note is too sharp or too flat. For the Fourth $\frac{4}{3}$ it is the 3rd partial of the upper tone, which is identical with

6*a*	7*e*	7*g*	8*c*	$8c_1$	8*g*	9*c*
1						
2	2					
3	..	3				
4	4	.	4			
5	.	..	..	5	..	..
6	6	6	.	..	6	..
7	..	..	..	.	..	..
8	8	..	8	..	..	8
	.	9	.	..	..	.
	10	.	..	10	..	..
	12	12	12	..	12	..
	14	..	..	..	..	.
	..	15	.	15	..	..
	16	..	16	..	.	16
		18	..	..	18	..
		..	20	20	..	..
		21	..	..	..	..
		24	24	..	24	24
			..	25	..	..
			28	..	..	..
			..	30	30	..
			32	..	..	32
			..	35	..	..
			..	..	36	..
			..	40	..	40
			..	..	42	..
			..	..	48	48
						56
						64

scale, where 0 C marks 1 vibration in a second; C′, D′, &c., are used for the equally tempered notes when the initial pitch 0 C′ is not 1. Similarly the small letters *c*, *d*, &c., with the additional conventions shown in Table V., represent just tones, beginning with 0 C and *c*′, *d*′, &c., with the same additional conventions, the just tones commencing with 0 C′.

* See his paper in *Nature*, for 10th Aug. 1876, p. 318.

the 4th of the lower, and this must require very much more attention and care. The Fourth is also an interval much more seldom practised now, as we do not usually tune by it, so that it is best known as the inversion Fifth, and not as a substantive interval. Possibly when the old Greek Tetrachord was founded on the Fourth, the ear was practised into much greater sensitiveness for that interval. In case of both the major Sixth $\frac{5}{3}$ and major Third $\frac{5}{4}$, the common partial is the 5th partial of the lower note, but it is the 3rd partial of the upper note for the major Sixth, and as high as the 4th partial of the upper note for the major Third; this would certainly cause it to be best perceived for the major Sixth, and best remembered; so that we should naturally expect the ear to be more sensitive for errors in the major Sixth than in the major Third. But the major Sixth is the worst tuned of all the intervals in the equal temperament, being 16 cents too sharp, and it is of much less frequent occurrence than the major Third, hence there is a possibility of the latter being better heard, notwithstanding that it is 14 cents too sharp in the equal temperament. On account of the few examples of mistuned major Sixths, which Dr. Preyer could produce on his altered tonometer, it is not possible to decide between the cultivated sensitiveness of the ear for these two intervals. For the minor Third $\frac{6}{5}$ and minor Sixth $\frac{8}{5}$ the common partial lies so far up in each case that it is only surprising that so much sensitiveness was met with. In the examples of minor Thirds and minor Sixths, obtained by Messrs. Cornu and Mercadier (see my translation of Helmholtz, p. 791), they were always taken too flat. For the minor Third their amateur violinists made the upper note from 13 to 35 cents too flat, and a professional violoncellist made it 5 to 21 cents too flat. For the minor Sixth the amateurs were from 12 to 33 cents flat, and the professional violoncellist once only 4 cents, but three times 20 cents too flat. These serve to show how very imperfectly fixed this interval is in the minds of performers.

If we carried out this principle for the ordering of intervals according to sensitiveness, including intervals of more than one but less than two octaves, we ought to arrive at the following natural order, which, however, would be materially affected by practice. Instead of using fractions, as $\frac{3}{2}$, $\frac{4}{3}$, &c. to express the interval, the equivalent expressions $3 \div 2$, $5 \div 4$, &c. are employed, as they are easier to see, and as these numbers show the order of the common partials, the higher number giving the partial in the lower note, it is important to see them at a glance. These are placed in the column headed 'vih.' The name of the interval and an example occupy the last column. The cross line separates consonant from dissonant intervals. This would of course not necessarily be the order of the comparative value consonances and dissonance, the feeling for which depends on other matters.

Vib	Sem	Name
1÷ 1	0	Unison, $8c$ to $8c$
2÷ 1	12	Octave, $8c$ to $9c$
3÷ 1	19·0196	Twelfth, $8c$ to $9g$
3÷ 2	7·0196	Fifth, $8c$ to $8g$
4÷ 3	4·9805	Fourth, $8g$ to $9c$
5÷ 2	15·8631	major Tenth, $8c$ to $9e_1$
5÷ 3	8·8436	major Sixth, $7g$ to $8e_1$
5÷ 4	3·8631	major Third, $8c$ to $8e_1$
6÷ 5	3·1564	minor Third, $8e_1$ to $8g$
8÷ 3	15·9805	Eleventh, $7g$ to $9c$
8÷ 5	8·1459	minor Sixth, $8c_1$ to $9c$
8÷ 4	14·0391	major Ninth, $8c$ to $9d$
8÷ 5	10·1780	large minor Seventh, $8e_1$ to $9d$
8÷ 8	2·0391	major Tone, $8c$ to $9d$
10÷ 3	20·8436	major Thirteenth, $7g$ to $9e_1$
10÷ 9	1·8240	minor Tone, $8e_1$ to $8d$
12÷ 5	15·1564	minor Thirteenth, $8e_1$ to $9g$
13÷ 4	22·8827	major Fourteenth, $8c$ to $9b$
15÷ 8	10·8827	major Seventh, $8c$ to $8b$
16÷ 5	20·1469	minor Thirteenth, $8e_1$ to $10c$
16÷ 9	2·9609	small minor Seventh, $8d$ to $9c$
16÷15	1·1173	diatonic Semitone, $8e_1$ to $8f$

There are at least four popnlar ways of teaching to sing · first, by the feeling for intervals, between two successive notes, which is Mr Hullah's plan ; next, by the feeling for diatonic succession only, the successive notes being mentally connected by such a chain, which is M Chevé's plan ; thirdly, by the mental effect of each tone in the major and relative minor scales, which is the Tonic Solfa plan ; and last of all, most general I fear, by playing the air on a piano, and imitating it. The extreme variety of intervals in just intonation confines the first plan to tempered intonation, and yet it is only in just intonation that the principle of an identified partial, giving the true feeling of an interval, is possible The second plan was originally developed for a tempered scale, differing from the nsnal equal temperament,* and it is hardly applicable to just intonation The third method was suggested by the practice of just intonation, to which it appears exactly suited. The fourth plan reduces everything to learning 'by ear' There is a fifth plan possible for those who can remember every tone within the compass of their voice Determining what is the precise interval heard, and proceeding by a known interval from one tone to another, are two different things, and probably the second is much easier than the first. Dr Preyer is, however, dealing only with the first.

* Galin, the introducer of the method, advocated Huyghens' cycle of 31 notes to the Octave, with nearly perfect major Thirds and flat Fifths (*Exposition d'une Nouvelle Methode pour l'Enseignement de la Musique*, 1815, reprinted 1852, p 162) Emile Chevé, its chief propagator, uses the cycle of 29 to the Octave, which gives sharper major Thirds than the Greek, and also sharp Fifths, of which he was apparently not aware, for no one could have endured them (*Méthode Élementaire de Musique Vocale*; this division results from p. 292)

For the 6th Octave the sensitiveness is less than the 7th, which is that to which all the above experiments on intervals relate. Below the 6th Octave, sensitiveness decidedly diminishes. In the 8th and 9th Octave sensitiveness increases, but in the 10th it decreases, and from the 11th upwards it is very small indeed, one reason being, of course, that the ear is little practised in estimating such sounds with accuracy. The following results actually obtained by observation show how exceedingly uncertain are the judgments of the ear, on such unusual positions.

In the first list referring to the 4th and 5th Octaves, only erroneous judgments are given; the correct opinions were, however, more numerous than the incorrect

Lower Tone in 4th Octave, 16 to 32 vib.

Vib	Sem to cents	Real Name of Interval	Name assigned to the Interval	Error in sem to cent
32÷16	12	Octave	about a Fourth	♭ 7·02
48÷16	19·02	Twelfth	doubtful	?
36÷18	12	Octave	doubtful, Octave	?
38÷19	12	Octave	Octave of the Fourth	♯ 4·98
30÷20	7·02	Fifth	doubtful, Octave	?
50÷25	12	Octave	major Sixth	♭ 3·13
30÷29	3·43	59 cents sharper than a major Sixth	minor Sixth	♭ 1·29
50−30	8·84	major Sixth	minor Sixth	♭ ·70

Lower Tone in 5th Octave, 32 to 64 vib.

64÷32	12	Octave	doubtful	?
40÷36	1·82	minor Tone	major Tone	♯ ·22
128÷56	14·51	27 cents sharper than a major Ninth	major Ninth	♭ ·22

In the next table the opinions of four of Dr. Preyer's best observers, distinguished as A, D, N, and Z, alone are given, and they possess much interest as being the judgments formed by excellent musicians, on hearing such tones for the first time. The intervals were all just. The trials were made with König's rods and Appunn's forks.

The Lower Tone in the 12th Octave, 4096 to 8192 vib.

Vib	Sem to cents	Real name of Interval	Names assigned to the Interval by			
			A	D	N	Z
5120÷ 4096	3·86	ma. 3rd	5th	4th	major 2nd	—
6144÷ 4096	7·02	5th	3rd, 5th	?, 5th	Tone, mi 3rd	?, major 2nd
8192÷ 4096	12	Octave	—	Octave	4th	major 3rd
6144÷ 5120	3·16	mi 3rd	—	? (4th)	nearly Unison	—
8192÷ 5120	8·14	mi 6th	5th	?	—	—
" "	"	"	—	?	?	—
10240÷ 5120	12	Octave	—	8th, Oct.	—	7th
8192÷ 6144	4·38	4th	3rd	5th, Oct.	Tone	—
12288÷ 6144	12	Octave	Octave	5th	—	—

The Lower Tone in the 13th Octave, 8192 to 16384 vib

Vib	Sem to cents	Real name of Interval	Names assigned to the Interval by			
			A	D	N	Z
8192 ÷ 8192	0	Unison	—	Unison	—	—
10240 ÷ 8192	3·86	ma. 3rd	6th	?	?	—
" "	"	"	—	5th, ?	—	—
12288 ÷ 8192	7·02	5th	—	6th	—	4th; and 6th
" "	"	"	—	?	3rd	—
16384 ÷ 8192	12	Octave	Octave	Octave, ?	—	—
12288 ÷ 10240	3 16	mi. 3rd	5th	—	—	4th, ma. 3rd, 3rd
16384 ÷ 10240	8 4	mi. 6th	—	ma. 6th	—	—
20480 ÷ 10240	12	Octave	—	?	?	—
16384 ÷ 12288	4·98	4th	4th	Unison	—	2nd, 4th
20480 ÷ 12288	8 84	ma. 6th	—	6th	?	—

This table, however, does not represent the full amount of confusion. From 7 C=128 vib, to 10 C=1024 vib, the four observers never once stated the intervals incorrectly The observers were often in doubt, shown by (?) in the above table. A never doubted, D doubted 35 4 times per cent, N 36 3 times per cent, and Z 7 1 times per cent But when they did not doubt, A was wrong 54 5 times per cent, D 42 3 times per cent, N 63 6 times per cent, and Z 64 2 times per cent. Or taking the actual numbers, out of 48 cases where no doubt was expressed, 31 judgments were wrong (or 64 5 per cent) Of these 31 errors, 20 gave the interval too small, and 11 too large

Dr. Preyer deduces from this investigation, that a 'physiological temperament' would bear to have greater errors below 6 C and above 11 C, than elsewhere. It is evident, however, that no treatment would be useful for harmonic purposes, in which the Octave was not treated in the same way throughout. That such a proposal could be made, shows the fundamental differences between melody, or successions of tones, of which no two are sounded together, and harmony, or the simultaneous sounding of two or more tones. The question of temperament, therefore, depends upon a multitude of other considerations, which do not come within the scope of this paper. But it is evident that, when an ear is constantly exercised in hearing and using any temperament, its sensitiveness for consonant intervals must necessarily be impaired. And, from experiment made on the differences between the harmonic effects of a major Tone $\frac{8}{9}$, a minor Tone $\frac{9}{10}$, and even a diatonic semitone $\frac{15}{16}$, when taken just, or slightly mistuned, I am led to think that the same is likely to be true for dissonant intervals.

To sum up by a single question, *What is a good ear for Music*, considered merely in its melodic relations? We may, perhaps, give the following partial answer * A good ear is one which,

* The limitation 'partial' must not be overlooked. As far as my own opinion goes, a very great deal more is required. But here it was necessary to confine myself to the matter brought out in this paper.

within the 6th, 7th, 8th, and 9th Octaves appreciates, both in existence and direction, an interval of one or two cents in Unisons, Octaves, and Fifths, and ten to fifteen cents in other intervals. Such an ear must in the 8th and 9th Octaves appreciate that an equally tempered Fifth is flat, and an equally tempered Fourth is sharp, and in all the Octaves that the equally tempered major Sixth and major Third are decidedly much too sharp, and, perhaps, but not so certainly, that the equally tempered minor Third and minor Sixth are too flat. As regards the equally tempered major Seventh, there is such a habit of using a still sharper tone for the 'leading note,' that no ear of singer or violinist can be trusted for it.* A good ear ought also in these Octaves to distinguish a minor from a major Tone.

In conclusion, I would observe that I did not answer the question by saying 'a good ear knows when a note is in tune,' because the meaning of 'being in tune' is at present unfixed both as to standard pitch and desired interval.

* In Messrs. Cornu and Mercadier's experiments, cited in my translation of Helmholtz, there are very few specimens of major Sevenths, but the four instances by amateurs are 21, 17, 32, 29 cents too sharp, and the four of the professional violinists are 34, 40 (thrice) cents too sharp as compared with the tone which makes a just major Third with the Fifth of the scale, or $b = 10\,88$ sem., the actual pitches were 11 09, 11 05 11 20, 11 17 (the 61st harmonic duly reduced) for amateurs, and 11 22, 11 28 (thrice) for professionals. This is almost as bad as the sharp F' (11th harmonic, 53 cents too sharp) on the trumpet, and in all chords of the dominant in which it occurred the effect would be horrific. But it is evident that ears attuned to such intervals are likely to be offended at just major Sevenths intended for harmony, and still more at the major Sevenths of the mean tone temperament which are a quarter of a comma or 5½ cents flatter still, as I had occasion to remark when Mr. Bosanquet played a specimen of mean tone temperament (the only one used by Handel) before the Musical Association. (Proceedings for 1874–5, p. 128, note.)

P. 8.—To show the difficulty of appreciating slightly disturbed unisons, as mentioned on p. 12, I exhibited two forks and asked for opinions as to which was the sharper. Dr. Stainer, Dr. Stone, and many others were of one opinion, and Mr. W. H. Cummings and many others held the contrary opinion. In my hurry I said that the first were wrong and the second right. (See the discussion on p. 30.) But on subsequently very carefully proving the forks I found that I was in error, and that Dr. Stainer and Dr. Stone were right, and I communicated the result of my proofs of the forks to the Association, through Dr. Stone, at the next meeting. The absolute pitches, by Appunn's tonometer, were, 529·3 and 529·5, as nearly as I could determine. That is, the difference was at the limit of the power of the ear to determine (p. 11). I tried the same two forks on another occasion before very sensitive ears, with a similar division of opinion. Some other excellent ears, which finally decided correctly, were a long while before they could come to a conclusion. I decided by slightly warming each fork alternately under my arm, which flattened its pitch, and then observing whether the beats were increased or diminished in frequency, as proposed on p. 2. A. J. E.

Table 1

Division of the Octave into Sem, Tithes, Cents & Mils

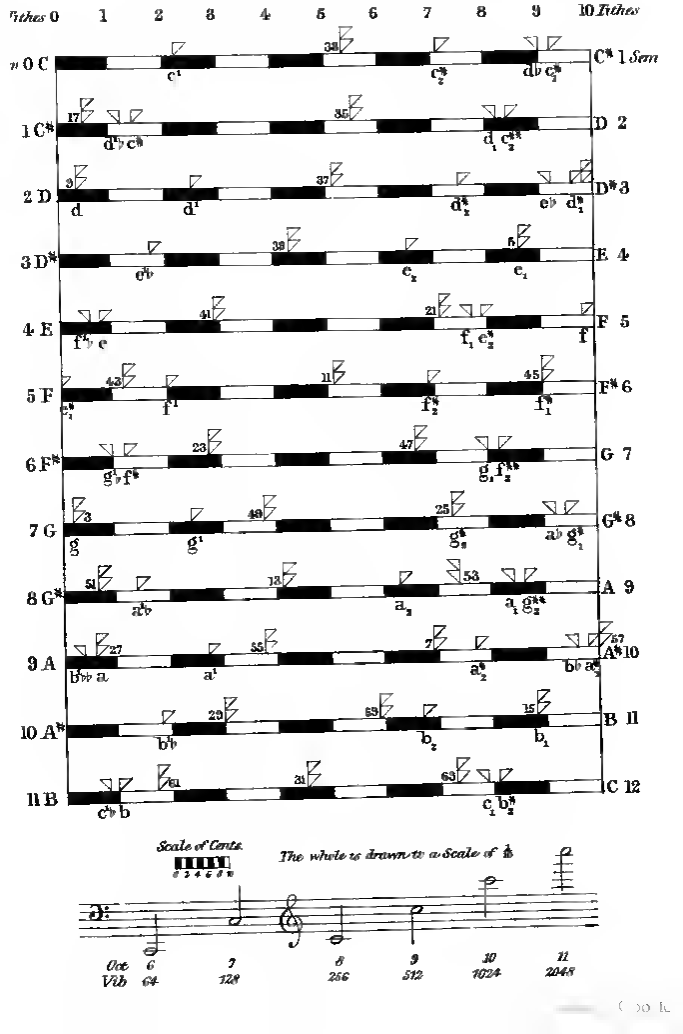


Table II

CALCULATION OF INTERVALS AS SEM, TITHE, CENT, MIL, AND DIME

A. Octave			B Sem		
Note	Sem	Vib	Note	Sem	Quotient
0 C	0	1	C	0	1,000,000
1 C	12	2	C♯	1	1,059,462
2 C	24	4	D	2	1,122,462
3 C	36	8	D♯	3	1,189,207
4 C	48	16	E	4	1,259,921
5 C	60	32	F	5	1,334,840
6 C	72	64	F♯	6	1,414,213
7 C	84	128	G	7	1,498,307
8 C	96	256	G♯	8	1,587,401
9 C	108	512	A	9	1,681,793
10 C	120	1,024	A♯	10	1,781,797
11 C	132	2,048	B	11	1,887,748
12 C	144	4,096			
13 C	156	8,192			
14 C	168	16,384			
15 C	180	32,768			
16 C	192	65,536			

C. Tithe		D. Cent		E. Mil		F. Dime	
Tithe	Quotient	Cent	Quotient	Mil	Difference	Dime	Difference
0	1,000,000	0	1,000,000	0	0	0	0
1	1,006,793	1	1,000,578	1	58	1	6
2	1,011,619	2	1,001,156	2	116	2	12
3	1,017,480	3	1,001,734	3	173	3	17
4	1,023,374	4	1,002,313	4	231	4	23
6	1,029,302	5	1,002,892	5	289	5	29
6	1,035,265	6	1,003,472	6	347	6	35
7	1,041,262	7	1,004,052	7	405	7	41
8	1,047,294	8	1,004,632	8	463	8	46
9	1,053,361	9	1,005,212	9	521	9	52

Directions for using Table II.

1. *Calculation of a Pitch to Dimes.*—Given any pitch as 440·57; look in A. for the next least vib, 256; this determines that the note is in the Octave begun with 8 C, or 96 sem.

Multiply the pitch by 1,000,000, giving 445,570,000, and divide by the 256 just found, to the nearest unit. That is, if the last remainder is less than half the divisor, neglect it; if as much, or more, increase the quotient by one. This quotient will always have 7 figures, and in this case is 1,744,410.

Look in B. for the next least quotient, 1,681,793, giving 9 sem. Multiply the previous quotient by 1,000,000, and divide the result by this next least quotient to the nearest unit. Then 1,744,410,000,000 divided by 1,681,793 gives 1,037,238 as quotient.

Look in C for the next least quotient, 1,035,265, corresponding to 3 tithes. Multiply the greater quotient by 1,000,000 and divide by the lesser to the nearest unit. Then 1,037,238,000,000 divided by 1,035,265 gives 1,001,906 as quotient.

Look in D. for the next least quotient, 1,001,734, giving 3 cents. Subtract this from the last quotient, giving remainder 172.

Look in E. for the next least remainder, or a larger remainder, not

differing by more than 3. We find 173 giving 3 mils, and as this is in excess, but does not differ by so much as 3, there are no dimes. If it had differed by 3 or more, we should have reckoned one dime less.

Result, 446·57 vib, gives 8 Octaves, 9 sem, 6 tithes, 3 cents, 3 mils, and no dimes; or, since 8 Octaves = 96 sem, it gives 105·6330 sem.

2. *Calculation of Pitch to Cents.*—If the result is only wanted to the nearest cent, much labour may be saved by multiplying at first by 1,000 only, for B and C; that is, omitting the three last figures in the quotients of B and C, and then multiplying by 10,000; that is, omitting the two last figures in D, taking care always to increase the last figure retained by 1, if the first figure omitted is 5 or more. Thus in the last case, dividing 4,465,700 by 256, we have 1,744, to which 1,682, giving 6 sem, is nearest in B. Dividing 1,744,000 by 1,682, we have 1,037, to which 1,035, giving 3 tithes, is nearest in C. And dividing 1,037,000,0 by 1,035, we have 1,001,9, to which 1,001,7 is nearest in D, giving 3 cents. Hence the result is 105·63 sem, which is correct.

3. *Calculation of an Interval.*—If an interval is given as a fraction, as $\frac{18}{2}$, first multiply the smaller number as often by 2 as is necessary to make the fraction less than 2, and for each such multiplication add 12 sem. Here we must multiply twice by 2, giving 15 + 8, and shall have to add 24 sem. Now proceeding for cents only, which is generally sufficient, 15,000 ÷ 8 gives 1875, the nearest to which in B is 1,782 (last figure increased by 1) giving 10 sem. Then 1,875,000 ÷ 1,782 gives 1,052, the nearest to which in C is 1,047, giving 8 tithes. And 1,052,0000 ÷ 1,047 gives 1,004,8, the nearest to which in D is 1,004,8, giving 8 cents. Result, 34·88 sem. This process is even more rapid than by a table of logarithms.

4. *Calculation of a Pitch or Interval from Cents.*—The inverse process, to find the pitch or interval from the sem and cents, is a mere inversion of the preceding. Thus, to find the fraction expressing the interval 10·88. By D, 8 cents gives 1,004,8, and by C, 8 tithes give 1,047. Multiply, product 10,518,182, from which the four last figures, 8,162, have to be omitted, and since the first of these is 8, we must increase the one before it by 1, giving 1,052. By C, the 10 sem give 1,782, and multiplying this by 1,052 we have 1,874,664, from which the three last figures, 664, have to be omitted, giving 1,875. Dividing this by 1,000 we have 1·875, which is the expression of $\frac{15}{8}$ as a decimal fraction.

5. *Calculation of all the usual Intervals.*—All the intervals commonly used in music can be calculated by Table IV. to dimes. Thus, opposite 18 is 46·8827 and opposite 8 is 36; on subtracting we find that $\frac{18}{8}$ gives 10·8827 sem. Similarly for $\frac{81}{80}$, since 81 = 9 × 9, we must double what is opposite 9, or 38·0391; the result is 78·0782. Then 80 is 5 × 16, opposite 5 is 27·8631, and opposite 16 is 48, the sum being 75·8631. Subtracting this from 78·0782, the number found for 81, we have 2·151 sem. The preceding processes (1, 2, 3) need therefore only be used for unusual combinations in which the numbers are not the product of others less than 64.

For more exact processes see my translation of Helmholtz's *Sensations of Tone*, Appendix XIX., Table I., pp. 743–5.

Table III.

TO FIND THE INITIAL NUMBER OF VIBRATIONS FOR ANY STANDARD PITCH.

Division A.—The column 8 A′ contains the extreme range of the values of 8 A′ in use, proceeding by four vibrations at a time. The columns 9 C′ and 0 C′ give the corresponding values of 9 C′ and 0 C′, and the column 'mils' the number of mils by which the given standard is flatter or sharper than the Arithmetical Standard. For intermediate values multiply the number in the columns D by the difference between the value of 8 A′, given, and the next least value of 8 A′ in the table. Thus, if 8 A′ = 437·27, the next least value in the table is 436, and difference 1·27. The products of this

1·27 by 1·18, ·00232, and 40 (the numbers in the three columns D), are 1·51, ·00295, and 51, and these results added to 518·49, 1·01258, 219 ♯; which opposite to 435 give 520, 1·01563, and 270, which agree with the values opposite 9 C′ = 520 in Division B.

Division B.—The column 9 C contains the extreme range of the values of 9 C′ in use, proceeding by four vibrations at a time. The other columns give the corresponding values of 8 A′, 0 C′, and mils sharper or flatter than arithmetical pitch as before. Intermediate values found as in Division A.

Note.—The results of these divisions, A and B, can be obtained directly thus:—Multiply 8 A′ by 1·1892 to find the corresponding equally-tempered 9 C′. Multiply 8 C′ by ·8409 to find the corresponding equally-tempered 8 A′. Divide 8 A′ by 8 A = 430·539, or 9 C′ by 9 C = 512, to find 0 C′. From 0 C′ find the mils by Table II.

Division C.—It is not easy to determine the exact vibrations of any given note purporting to be 8 A′ or 9 C′. Until Appunn's Tonometer was exhibited in the Loan Collection of Scientific Apparatus there was no instrument in England by which it could be done accurately. The standard French 8 A′, or Diapason Normal, intended to be 435, is really 439, and this has been the cause of many errors. The Society of Arts 9 C′, intended to be 528, was really 529·4. The fork originally published for Mr Hullah, intended for 9 C′ = 512, is really 529½. The fork published for Mr Curwen, also intended for 9 C′ = 512, was 517, but has recently been corrected. The results I obtained by Appunn's Tonometer were published in the *Athenæum* for 2nd and 30th Dec 1876, pp. 751 and 893, subsequently to the reading of this paper, although some of them were mentioned to the Musical Association at the time. These are incorporated with many other interesting results in a paper read by me before the Society of Arts on 23rd May 1877. In preparing this table for the press I have thought it best to add some of the most interesting of those results in Division C, arranged as in other divisions.

DIVISION A.

8 A′	9 C′	D	0 C′	D	Mils	D
424	504·22	1·19	0·38481	·00232	265 ♭	41
428	508·36	1·19	0·99410	·00232	104 ♭	40
432	513·73	1·19	1·00339	·00232	59 ♯	40
436	518·49	1·19	1·01258	·00232	219 ♯	39
440	523·25	1·19	1·02197	·00232	378 ♯	39
444	528·00	1·19	1·03127	·00232	533 ♯	39
448	532·75	1·19	1·04055	·00232	688 ♯	39
452	537·52	1·19	1·04984	·00232	842 ♯	38
456	542·28	1·19	1·05914	·00232	995 ♯	38
460	547·03		1·06843		1148 ♯	

DIVISION B.

8 A′	D	9 C′	0 C′	D	Mils	D
423·81	·84	504	0·98438	·00195	274 ♭	34
427·18	·84	508	0·99219	·00195	135 ♭	34
430·54	·84	512	1·00000	·00195	000 ♯	34
433·90	·84	516	1·00781	·00195	135 ♯	33
437·27	·84	520	1·01563	·00195	269 ♯	33
440·63	·84	524	1·02344	·00196	401 ♯	33
444·00	·84	528	1·03125	·00195	533 ♯	33
447·36	·84	532	1·03906	·00195	664 ♯	32
450·72	·84	536	1·04688	·00195	793 ♯	32
454·09	·84	540	1·05469	·00135	922 ♯	32
457·45	·84	544	1·06250	·00135	1049 ♯	32
460·82		548	1·07042		1178 ♯	

DIVISION C.

8 A'	8 C'	C'	Mils	Remarks
426·4	507 14	·99051	185 b	Handel's own fork
430·539	512	1·00000	0 ♯	Arithmetical Pitch
434·75	517	1·00976	168 ♯	Messrs. Curwen's and J. H. Griesbach's, 512
435	517 3	1·01036	178 ♯	Theoretical French, 8 A'
439	512·06	1·01956	337 ♯	Actual French, 8 A', *Diapason Normal*
439·78	523	1·02148	367 ♯	Broadwood's 'Low Pitch'
440	523 25	1·02197	376 ♯	Scheibler's or Stuttgart Pitch
444	528	1·03125	532 ♯	Theoretical 9 C' of Society of Arts
445·09	529·3	1·03364	575 ♯	Mr Hullah's 8 C, meant for 512
449·88	535	1·14492	761 ♯	Broadwood's 'Medium Pitch'
453·6	539·4	1·05355	903 ♯	Actual 9 C', made by J. H. Griesbach for the Society of Arts
456 19	542 5	1·05957	1001 ♯	Mean of wind band of the Philharmonic, 1849–1874
458 46	545 2	1·06484	1088 ♯	Broadwood's 'High Pitch,' Philharmonic, July 1874

TABLE IV.

HARMONICS, AS INSERTED IN TABLE I, AFTER REDUCTION TO THE SAME OCTAVE, CALCULATED TO DIMES.

No.	Sem	No.	Sem	No.	Sem	No.	Sem
1	0	17	49·0498	33	80 5328	49	57.9765
2	12	18	50·0391	34	81 0496	50	67 7262
3	19·0196	19	50·9781	35	81·5514	51	68·0699
4	24	20	51·8631	36	62·0391	52	68 4053
5	27·8631	21	52·7079	37	62·5134	53	68·7351
6	31·0196	22	53·5132	38	62 9751	54	69·0587
7	33 6883	23	54 2827	39	63 4249	55	69·3763
8	36	24	55 0196	40	63·8631	56	69·6883
9	38·0391	25	55·7262	41	64 2906	57	69·9947
10	39 8631	26	56 4053	42	64 7074	58	70·2958
11	41 5132	27	57·0587	43	65·1152	59	70·5917
12	43·0196	28	57 6883	44	65 5132	60	70 8827
13	44 4053	29	58 2958	45	65 9022	61	71·1686
14	45 6883	30	58·8827	46	66 2827	62	71·4504
15	46·8827	31	59 4504	47	66 6551	63	71 7274
16	48	32	60	48	67·0196	64	72

See No 5 of Directions appended to Table II. Reduce to the same Octave by subtracting 12, 24, 48, 60, or 72, so as to leave a remainder less than 12.

TABLE V.

THE 52 JUST NOTES IN THE DIAGRAM.

The small letters indicate Just Intonation. The table consists of four columns proceeding from bottom to top by just Fifths up (add 7 0195 sem, and to keep in the same Octave subtract 12 sem when necessary), and of 13 lines proceeding from left to right by just major Thirds up (add 3 8631 sem, and to keep in the same Octave subtract 12 where necessary) To complete the table for all the 117 tones of just intonation, three more columns on the left and two more on the right are required (See my Appendix to Helmholtz, pp. 668–671.)

Against each note is written its pitch to a dime, the pitch of C being taken as 0 sem.

The notes with an inferior $_1$ and $_2$ as a_1, a_2 (read A-one, A-two), are respectively one and two commas (or 0·2151 and 0·4302 sem) flatter, and the notes with a superior ^{1}, as a^1 (read one-A) are one comma sharper, than the notes of the same name without numbers.

	Sem		Sem		Sem		Sem
a^1	9·2737	$a\sharp$	1·1369	$e_1\natural$	5·0000	$g_2\sharp\,\natural$	8·8631
d^1	2·2542	$f\sharp$	6·1173	$a_1\natural$	6·9805	$c_2\sharp\,\natural$	1·8436
g^1	7·2346	b	11·0978	$d_1\natural$	2·9609	$f_2\sharp\,\natural$	5·8240
c^1	0·2151	e	4·0782	$g_1\natural$	7·9413	$b_2\natural$	11·8048
f^1	5·1655	a	8·0587	$c_1\natural$	0·0216	$e_2\natural$	4·7849
$b^1\flat$	10·1760	d	2·0361	$f_1\natural$	5·0022	$a_2\natural$	9·7654
$e^1\flat$	3·1564	g	7·0196	b_1	10·8827	$d_2\natural$	2·7456
$a^1\flat$	8·1369	C	0	e_1	3·8631	$g_2\natural$	7·7263
$d^1\flat$	1·1173	f	4·9804	a_1	8·8436	$c_2\natural$	0·7067
$g^1\flat$	6·0976	$b\flat$	9·9606	d_1	1·8240	$f_2\natural$	5·6872
$c^1\flat$	11·0782	$c\flat$	2·9414	g_1	6·8045	b_2	10·5676
$f^1\flat$	4·0587	$a\flat$	7·9218	c_1	11·7849	e_2	3·6461
$b^1\flat\flat$	9·0361	$d\flat$	0·9022	f_1	4·7554	a_2	8·5285

Table VI.

TABLE OF THE NOTES ON DR. PREYER'S TONOMETER.

The notes are numbered 0, 1, to 32. Against each is placed the actual number of vibrations, and the pitch in relation to the lowest note 0, calculated to dimes. The numbers of the notes are given in the tables in the text.

No.	Vib	Sem	No.	Vib	Sem
0	127·6	0			
1	131·6	0·5342	17	195·53	7·3646
2	135·63	1·0566	18	199·53	7·7451
3	139·63	1·5585	19	203·53	8·0866
4	143·66	2·0525	20	207·53	8·4265
5	147·73	2·5361	21	211·65	8·7607
6	151·80	3·0065	22	215·51	9·0735
7	155·68	3·4455	23	219·51	9·3917
8	159·68	3·8828	24	223·48	9·7023
9	163·68	4·3108	25	227·48	10·0033
10	167·68	4·7285	26	231·41	10·3056
11	171·52	5·1312	27	235·33	10·5958
12	175·53	5·5210	28	239·35	10·8868
13	179·63	5·9116	29	243·35	11·1769
14	183·53	6·2928	30	247·35	11·4591
15	187·53	6·6553	31	251·23	11·7285
16	191·46	7·0207	32	255·30	12·0058

DISCUSSION.

Dr. Stone said there was so much of interest in Mr. Ellis's paper, that he could go on asking questions upon it for an hour. He was very glad that he and his friend Dr. Stainer had been so mistaken in judging of the two tuning-forks exhibited by Mr. Ellis, because he had always contended that absolute pitch could not be detected by the ear, and he was confirmed by Mr. Hipkins. One of the tuning-forks was much thinner in metal than the other and produced a thinner quality of tone, which to the ear sounded sharper. In the same way Mr. Hipkins told him he had two grand pianos absolutely in tune together, but one, which was somewhat softer in tone than the other, was always pronounced by musicians to be the flatter. There was a reason for this effect because the thinner fork being of thinner metal was more thrown into irregular vibrations on account of its shape, and produced a sharper effect on the hearer. (See P.S., p. 24.)

Mr. Ellis said he had mentioned in the paper that it was desirable always to have exactly the same quality of tone, and as this was not the case with these two forks, it was not, of course, a fair trial.

Dr. Stone said he had gone into the question physiologically some time ago, and he found, certainly, that the absolute determination of pitch was impossible, but that it differed at different times and in different persons. Some persons even had different conceptions of unison. He knew a gentleman, a very good violoncello player, who always tuned a unison decidedly sharp. This was easily accounted for if the tympanum were a little thicker than ordinary, as was the case when one had a bad cold, for this condition affected the sensation of pitch very much. If then they were changing from day to day and from moment to moment, and some persons absolutely could not tell which was the sharper or flatter of two notes, that was a strong physiological argument against there being an absolute sense of pitch in the organs of sense.

Mr. Ellis remarked that he had spoken particularly at the beginning of the paper of arithmetical, not physiological pitch.

Dr. Stone said he had always held that tuning-forks were very bad tests of pitch, because they were influenced so much by temperature and other causes. He wished to ask what was the test by which Mr. Ellis tried these forks?

Mr. Ellis.—Mr. Appunn's tonometer.

Dr. Stone said the question was, *Quis custodiet ipsos custodes?*

Mr. Ellis said he counted the beats and found the Octave was perfect, and then carefully tested several other intervals. The reed of the instrument was very slightly indeed affected by temperature, and it was mathematically impossible, if these intervals were correct, that the pitch could be other than that he assigned to it from counting the beats. All the intervals were proved in

this way. He did not trust his own ear. Mr. Hipkins and Mr. Greaves were both perfectly satisfied with the experiments.

Dr. Stone asked how the absolute pitch was determined from the beats.

Mr. Ellis said it was easily determined by a mathematical equation.

Dr. Stone said this was new to him, and was of very great importance. How was it that the French pitch was not determined in this way?

Mr. Ellis replied that at that time Koenig had not constructed his tonometer. Scheibler had made his, but it could not be obtained in France, and probably was not known. The discovery that absolute pitch could be determined mathematically from beats was due to Scheibler, but unfortunately it was not generally known at the time the French diapason was determined. That was quite wrong; but the Society of Arts pitch was worse. The discovery was published in 1834, but the forks could not be obtained. Koenig now made them, but Mr. Appunn's instrument was much easier to work with.

Dr. Stone said he was sure this discovery that absolute pitch could be determined from beats was very little known, and it was much to be desired that tuning-forks should be corrected by it as soon as possible. Another point he was going to mention was the physiological question with regard to membranes of Corti. He had never been able to see in reading Helmholtz's works, including his recent pamphlet, that he was justified in the assertion which he virtually made, that one fibre always vibrated to one note. If you tried on an ordinary instrument, striking one string between two others, they would both vibrate to a certain extent. With reference to the lowest audible pitch, it did not follow because the organ of Corti was not long enough to vibrate to a low note, that two of them vibrating consentaneously would not produce a different sensation, and one of a much lower note than any single one.

Dr. Stainer said he had once before stated that some musicians were gifted with a sense of absolute pitch, but he did not mean thereby, that they could state with precision how many vibrations per second any particular fork would give. What he meant was, that a great many people could tell within a very small interval, on hearing a note, whether it was $b\flat$, a, $g\sharp$, or whatever the particular note was. He should like to know from Mr. Ellis if it was found that the ear improved in delicacy by listening to the same intervals several times in succession.

Mr. Ellis replied that Dr. Preyer stated that practice improved the ear very much indeed; it was particularly noticeable in attempts to assign the intervals of any high notes, where at first the guesses were perfectly wild.

Mr. W. H. Cummings said that neither he nor Dr. Verrinder had been deceived by the two forks which had misled Dr. Stone and Dr. Stainer. He concurred with Dr. Stone that the sense of

pitch differed with the condition of the body. When out of sorts he generally heard ont of tune, and of conrse it was almost impossible to sing in tune nnder snch circnmstances. He knew a case of a very clever mosician, now a pensioner of the Royal Academy of Mnsic, who was at one time a very admirable performer, hnt who had snffered from paralysis, and at the present moment he heard perfectly in tnne with one ear, hnt the other ear was ont to the extent of a semi-tone.

Mr. Ellis remarked that this agreed to a considerable extent with the observations of Dr. Oscar Wolff, who had found a great difference in the different ears of the same person with regard to their power of hearing and jndging of intervals.

Mr. W. H. Cummings said that some people imagined that it was impossible to distinguish exact pitch or intonation without education, hnt he had a case in his own family of a child, eight years old, who could tell any note strnck npon a pianoforte in the next room.

The Chairman added that he had a sister who, at the age of six, could tell any note, so that it was a natural gift, not the result of edncation.

Dr. Stone remarked that even at six years old Mozart was a good player; so that if playing could be acquired, this faculty could be also.

Mr. W. H. Cummings said the child he referred to had been taught.

Mr. Stephens said that he himself possessed this faculty, and so did his friend Dr. Stainer. It was well known that Dr. Crotch and several others had the same gift. When he was a child he could tell if his father pnt his arm on the pianoforte, what notes he strnck and what he left out.

Dr. Stainer said he did not doubt the fact, only he believed it to be acquired, and not a natural gift.

Mr. Ellis then exhibited four different C forks, which differed considerably in pitch; one being the copy sold by Cramer of the Society of Arts fork, which Mr. Sims Reeves stated he had sent to Hersford for the organ to be tuned to, and another, giving Broadwood's high pitch.

Dr. C. G. Verrinder said he did not believe the organ was so tnned, and to show how easily persons might be deceived in this way, he narrated an anecdote of Sir George Smart. He had to snperintend the building of an organ, and being very particular abont the pitch, he took his own fork ont of its case and gave it to the bnilder to tnne the organ by. The bnilder pnt the fork on one side, and forgot all abont it; the organ was voiced, tnned, and erected. When Sir George Smart came to ask for his fork, the voicer found he had made a mistake, hnt he soon with his file tuned the fork to the organ, and handed it back to Sir George Smart, who did not discover the triok until some time afterwards.

DECEMBER 4, 1876.

JOHN HULLAH, Esq., LL.D., VICE-PRESIDENT, IN THE CHAIR.

ON HENRY PURCELL AND HIS FAMILY.

By W H CUMMINGS, Esq.

A most pleasant and picturesque introduction to the Purcell family is to be found in Pepys' Diary, under date Feb 21, 1659, where we find this entry 'After dinner I back to Westminster Hall with him (Mr. Crewe) in his coach Here I met with Mr Lock and Purcell, Masters of Musique, and with them to the Coffee House, into a room next the water by ourselves, where we spent an hour or two . . Here we had variety of brave Italian and Spanish songs, and a canon for eight voices, which Mr Lock had lately made on these words, *Domine Salvum fac Regem*, an admirable thing . . Here out of the window it was a most pleasant sight to see the City from one end to the other with a glory about it, so high was the light of the bonfires, and so thick round the City, and the bells rang everywhere.'

Lord Braybrooke's edition of Pepys has a note which is reprinted in the new one now in course of publication, to the effect that the two gentlemen named in the text were 'Matthew Lock and Henry Purcell, both celebrated composers;' but this is an undoubted error, to which I have called the attention of the learned Editor, the Rev. Mynors Bright It certainly could *not* have been Henry Purcell the composer, for although we know that he commenced his musical career at a very early age, he was only one year old at the date Pepys made the entry in his diary; and admitting he might have had a very lovely voice even at that period, I cannot believe he would have been considered a desirable addition to Mr Pepys' musical party. As no mention is made of the Christian name of Purcell, we must conclude that Pepys met either the uncle, Thomas Purcell, or the father, Henry Purcell.

The uncle was undoubtedly a musician of reputation and ability. Various entries in official and Court records testify to

the numerous appointments he held, such as Gentleman in Ordinary of the Voice and Lute to his Majesty, Composer to the Violins to his Majesty, and Lay Vicar of Westminster Abbey. His compositions are now lost, with the exception of two chants in frequent use in our Cathedrals. A year before his death, probably feeling age or infirmities creeping on, he seems to have retired from active service, for he then executed a power of attorney authorising his son *Matthew* to receive all payments due from His Majesty's Treasury, Exchequer Coffery Office, 'or any other place or office whatsomever.' On his death in 1682 he was buried in the cloisters of Westminster Abbey. The power of attorney I have brought for inspection; it is interesting, on account of the autograph signatures of Thomas Purcell and of his niece Frances, the wife of the celebrated Purcell. I am inclined to think that Pepys met *Thomas* Purcell, from the little circumstance that the son of the latter was named Matthew, possibly out of compliment to Locke. But it may after all have been his brother, Henry Purcell, father of the great Henry, for he also was a musician of reputation, a member of the Royal Band, a Gentleman of the Chapel Royal, master of the chorister boys of Westminster Abbey, and music copyist of the last-named church, an appointment of considerable importance at that time. He is generally accredited with the composition of one chant still in use bearing the name of Purcell. He died in 1664, and was buried in the cloisters of Westminster Abbey. His wife survived him five years, and although we have no record of their respective ages, it is probable that they were both young at the time of their deaths.

We now come to their son, Henry Purcell, 'the boast and pride of English Musicians,' who was born in St. Anne's Lane, Old Pye Street, Westminster, in 1658.

Purcell was only six years old when deprived by death of his father's care, but his uncle Thomas, of whom I have been speaking, bestowed on him all the loving devotion of a parent, and immediately placed him where his precocious genius would receive nurture and cultivation. It was an early age to commence life as a chorister-boy in the Chapel Royal, but at that time, and for long after, children generally entered choirs at the age of six or seven. When young Purcell joined the Chapel Royal establishment he had the advantage of instruction from a most able master, Captain Cooke, a man who had won laurels in the battle field fighting for his king, and also in the more peaceful arena of music. He was composer, actor, and singer, and is frequently mentioned by Pepys. On the death of Cooke, his pupil Pelham Humphrey—or Humphries—became master of the boys, and he, a man of considerable genius, must have done much to develop the powers of the young prodigy under his charge. He lived two years to carry on the work, and was succeeded by Blow, also a pupil of Cooke, who doubtless did something toward educating Purcell. At the age of eighteen Purcell, probably through Blow's

interest, was appointed music-copyist to Westminster Abbey, and four years later Blow resigned the post of organist in his favour: from which fact we can imagine how highly he must have estimated the genius and ability of Purcell. Blow was himself a remarkable musician and composer, and fifteen years afterwards, when Purcell died, he was re-appointed organist of the Abbey. Blow must have possessed a most amiable and generous disposition, devoid of jealousy or mean envy, for, in addition to this instance of self-sacrifice on behalf of Purcell, he similarly resigned his post as master of the boys of St. Paul's Cathedral in favour of another remarkable pupil, Jeremiah Clarke. Purcell's triumphs rapidly increased, and we soon find him occupying the distinguished post of Organist of the Chapel Royal, and Composer in Ordinary to his Majesty. He wrote music for the Church, the Court, and the theatre, producing works for each in great number. But, alas! his sunshine was all too short, for at the early age of thirty-seven (a period which has proved fatal to more than one great musical genius) he ceased from his labours and was borne to an honoured grave in Westminster Abbey, beneath the organ which had so often resounded to his divine harmony. This was in the year 1695. I must now retrace my steps to speak of Purcell's married life. He took to himself a wife when twenty-two or twenty-three years of age, about the time he succeeded to the organship of Westminster, and had six children, four of whom died young. I have already referred to the probability that Purcell's parents were short-lived. Coupling these significant facts together—the brief lives of father, mother, son, and grandchildren—we have presumptive evidence of hereditary delicacy of constitution. Purcell's wife, Frances, survived him eleven years, and, dying in 1706, she found a quiet resting-place by his side in the old Abbey.

I suppose most of you are familiar with the aspersions which have been cast on the memory of Purcell's wife—the idle tale which attributes, with such particularity of detail, harsh and unfeeling conduct, resulting at last in the premature and untimely death of Purcell.

It is always easy to promulgate a scandal, but very difficult to trace its origin, and oftentimes still more difficult to refute it. In this case, I have little doubt, the whole story is a base and wicked invention; but, reflecting as it does on the memory of both Purcell and his wife, I propose briefly to state my reasons for the opinion I have formed. Sir John Hawkins, the musical historian, printed the narrative, and although he doubted its authenticity, and suggested that Purcell might have died of decline, yet he added some grave reflections on Purcell's presumed habits of dissipation, and of the bad company he associated with, particularly the notorious Tom Brown. On Hawkins, therefore, rests a large share of responsibility for perpetuating the slander. Miss Hawkins, his daughter, indignant at some idle stories in circulation respecting her mother's treatment of Sir John, wrote thus:

'Mrs. Purcell, I should conjecture, had other modes of attracting Mr. Purcell, yet *perhaps the whole story may have been as gross falsification as that by which Lady Hawkins is vilified.*'

The late Richard Clarke cannot be considered blameless in this Purcell matter. He was an enthusiastic and kind-hearted man, but wanting in discrimination, and too ready to draw conclusions from unproved and insufficient evidence. His volume of Glee Poetry contains the words of Purcell's catch, 'Jack, thou'rt a toper.' I will read the lines and Clarke's comments thereon:—

> Jack, thou'rt a toper, let's have t'other quart;
> Ring, we're so sober, 'twere a shame to part,
> None but a coward, bully'd by his wife
> For coming late, fears a domestic strife;
> I'm free, and so are you, to call and knock
> Boldly the watchman cries, Past two o'clock.

Clarke informs us that the 'Jack' apostrophised as a 'toper' was Dr. John Blow, and goes on to say: 'There is a tradition that Purcell's death was occasioned by a severe cold, which he caught waiting for admittance into his own house. It is said he used to keep late hours. He appears to have spent much time with Tom Brown, who wrote the words of most of his catches. The wits of that day used to meet at Owen Swan's in Bartholomew Lane, and at Purcell's Head in Wych Street. His wife had given orders to the servants not to let him in if he came home after midnight. Unfortunately his companions had got hold of this and had kept him late, as usual, which was the cause of Tom Brown writing the words of the above catch, which Purcell set to music before he went home. Being refused admittance at home, he sat down on the step of his own door and fell asleep, and through the inclemency of the night contracted a disorder of which he died. This hint ill agrees with the expressions of grief she makes use of in the Orpheus-Britannicus, for the loss of her dear lamented husband.'

These interesting particulars are so precise that it would seem to be almost impossible to controvert them, but fortunately they can be shown to be untrue from beginning to end. The words of the catch were not written by Tom Brown, and are, of course, not to be found in his works; moreover, instead of Brown having written most of the words of Purcell's catches, it is tolerably certain that Purcell never set a line of Brown's poetry.

In the year 1768, Dr. Arne gave a concert at Drury Lane Theatre, the programme consisting of glees and catches, and for that concert he published a book of the words, which I have here. In it we find Purcell's 'Jack, thou'rt a toper,' with the following note: 'The words of this last catch are said to be written by Purcell, wherein it is obvious that he meant no elegance with regard to the poetry, but made it entirely subservient to his extreme pretty design in the music.' 'Jack, thou'rt a toper' is

to be found in Purcell's opera 'Bonduca,' composed by him the year before he died. The libretto was an adaptation from the play of the same name by Beaumont and Fletcher, but the alterations and additions were made anonymously; it is therefore highly probable that Arne is correct in assigning the words and the music of that particular catch, 'Jack, thou'rt a toper,' to Purcell.

Now let us deal with Purcell's alleged intimacy with Tom Brown. In the year 1693, about seventeen or eighteen months before Purcell died, Brown wrote and printed some very complimentary verses addressed to the great musician, which he headed thus: 'Lines addressed to his *unknown* friend, Mr Henry Purcell.' These were reprinted after Purcell's death without note or addition, and we may therefore reasonably conclude that Purcell and Brown never became acquainted. Brown's lines are too long to quote *in extenso*, and the following must suffice:

> What praises, Purcell, to thy skill are due.
> Who hast to *Judah's* monarch been so true!
> By thee he moves our hearts, by thee he reigns,
> By thee shakes off his old inglorious chains,
> And sees new honours done to his immortal strains
> In thy performance we with wonder find
> Corelli's genius to Bassani join'd.
> Thus I, *unknown*, my gratitude express,
> And conscious gratitude could do no less
> This tribute from each *British* muse is due;
> The whole poetick tribe's oblig'd to you
> For where the author's scanty words have fail'd,
> Thy happier graces, Purcell, have prevail'd.
> And surely none but you, with equal ease,
> Cou'd add to David, and make D'Urfey please.

Purcell, in his last will and testament signed on the day of his death, bequeathed to his loving wife Frances all his estate, real and personal, for her sole use, and also nominated her executrix We cannot find evidence here of anything but mutual affection and confidence Many of you can call to mind how differently Shakespeare treated his wife in his will *

Purcell's widow made frequent public reference to the dear memory of her husband, and the following extract from her last will is especially interesting, as it shows how mindful she was of his wishes, and also that Purcell himself did not cultivate convivial society to the neglect of his family and their worldly interests. Mrs. Purcell says: 'According to her husband's desire, she had given her dear son Edward good education, and

* Subsequent to the reading of this paper, a friend directed my attention to Knight's able remarks on Shakspeare's will, satisfactorily proving that Shakspeare's widow was well provided for, and that the special bequest to her, which has commonly been regarded as a slight, was, on the contrary, an additional indication of favour and regard I am glad to have this opportunity of expressing my regret for the injustice done to the memory of Shakspeare.

she also did give him all the books of music in general—the organ, the double spinett, the single spinett, a silver tankard, a silver watch, two pairs of gold buttons, a hair ring, a mourning ring of Dr. Busby's, a larum clock, Mr. Edward Purcell's picture, handsome furniture for a room, and he was to be maintained until provided for.'

I have now said sufficient respecting Purcell's domestic life, and will only add that his fellow-pupil, Dr Tudway, has borne written testimony to the studious habits of Purcell, and of his constant endeavours to excel in every branch of his profession.

Let me now direct your attention to the portrait of Purcell kindly lent for this occasion by that admirable and benevolent institution, the Royal Society of Musicians. This interesting picture has somewhat of a romantic history attached to it, which has never before been made public. A parchment deed in possession of the Royal Society of Musicians runs thus: 'Redmond Simpson having presented the portraits of Handel, Corelli, Geminiani, and Purcell to the Directors of the Ancient Concerts (now held in Tottenham Street), of which Sir Watkin William Wynn, Baronet, is Treasurer, so long as the said concerts shall continue, upon condition that when the same shall break up then the portraits are to be given and delivered over to the Royal Society of Musicians, to be by them kept for ever after. In witness and testimony whereof the said Redmond Simpson and Sir Watkin William Wynn have hereto set their hands this 25th day of April, 1785.' Mr Simpson, the donor of the pictures, left a statement in writing that the portrait of Purcell was painted by Closterman in 1694, and was many years in possession of Purcell's son Edward, who said it was very like his father, but that the latter had grown very thin before he died. From the son Edward the picture passed to the grandson Edward Henry, who sold it to Dr Boyce, from whom it was bought by Mr. Simpson, and at the dissolution of the Ancient Concerts it came to the Royal Society of Musicians.

I have only time to say that the son, Edward Purcell, became an organist—report says, of moderate ability—and that *his* son, Edward Henry, was educated in the Chapel Royal under Bernard Gates, and succeeded his father in his organ appointments. So much for the family of Purcell, musicians, as we have seen, for four generations.

Purcell was pre-eminent above all his predecessors and contemporaries—a composer of vocal and instrumental, orchestral, harpsichord, and organ music—sacred, secular, and dramatic. He was an accomplished organist and also a finished vocalist. How early he commenced the practice of composition we cannot tell, but I will now play a little melody or song, 'Sweet Tyranness,' of his, published when he was only nine years of age.

To be able to appreciate the value of his work we must first consider what was the state of music *just prior* to his day. The civil wars and the Protectorate had destroyed organs, music-

books, and dispersed and banished choirs so effectually that at the Restoration of Charles music had to be composed for man's voices only, or if soprano parts could not be dispensed with they were played on cornets, for there were no treble boys capable of singing. Dramatic music there was none; it is true Locke had attempted something in that line, but the very piece on which his fame has been chiefly sustained was really not his at all, but the composition of Henry Purcell when a youth. I refer to the well-known 'Macbeth music.' This music, however, sinks into insignificance when placed in comparison with later works of Purcell's. Take, for instance, his little Opera 'Dido,' composed when he was twenty-two years of age—not nineteen, as stated by Sir John Hawkins. This Opera is complete, with recitative, solo, and chorus—not one word of dialogue,—it is full of beautiful music, and one of the airs, 'When I am laid in earth,' although constructed on the confined limits of a ground base, is most touching in its pathos. It may be noted in passing that S. Bach has used nearly the same ground in his B minor Mass for the chorus to the words of the 'Crucifixus.'

Purcell was gifted with a soul for melody, and possibly it was the unwonted exhibition of this heaven-born faculty in his works which first attracted and captivated the public ear, for before his time we English, as a nation, had cultivated madrigals and part-songs with diligence and success, but in all solo-songs, till those of Purcell appeared, the chief effects were produced by the words, not by the melody. As for the airs, 'they were, till this time, in general as unformed and misshapen as if they had been made of notes scattered about by chance.' This last quotation, from Burgh's 'Anecdotes of Music,' is too sweeping. Dowland had printed some most melodious songs in 1597. Morley, his contemporary, and other names could also be cited as melodists, but the Puritans had probably swept away both the memory and practice of all such compositions, and Purcell's immediate predecessors were not remarkable for tunefulness. As a scientific musician and harmonist Purcell was equally great and successful. At the age of twenty-four years he published a set of 'Twelve Sonatas for Two Violins and Bass, with Organ or Harpsichord.' From that work I have selected a fugue, which I will now play. One of the favourite exercises of learned musicians in his time was canon-writing, and you need only examine the four volumes of his sacred music, collected and edited by Vincent Novello, to see that Purcell was not a whit behind the most accomplished of his brethren in that cramped and fettered school. The volumes published by Novello contain 123 sacred compositions, chiefly anthems, and there are many still remaining MSS. Purcell's harmonical progressions were so remarkable that they may truly be termed discoveries, so much in advance of the age were they, that I have frequently heard foreign musicians, to whom his works were previously unknown, exclaim on examining them, 'Oh, that is Schumann; that is Beethoven,' &c. There are some remark-

able harmonies in Purcell's Latin Psalm, 'Jehovah quam multi.' When you hear them you may possibly doubt their authenticity, but as I enjoy the friendship of the present owner of the original autograph MS, I can vouch for their correctness.

Purcell wrote more music than we can ever hope, after these long years of neglect, to recover. Still, fresh material is turning up in various quarters, and I trust before long it will be possible to point to a considerable series of his published compositions. I have made a catalogue or list of works for which he composed music, and it includes 47 operas or dramas, 28 odes, and 202 short fugitive pieces of various kinds, vocal and instrumental. I have spoken of his skill as composer, organist, and vocalist. In the latter capacity he assisted in the choir at the coronation of James II, and there is a quaint record of his having sung one of his own songs at Stationers' Hall with 'incredible grace.' We must not forget, also, that he stood at the head of his profession as a teacher. One of his pupils—his brother Daniel, older than himself, was no mean composer, but he has suffered partial eclipse by the superiority of the genius of the younger Henry. Another pupil, Weldon, is renowned for his exquisite compositions. Witness his anthems 'Hear my crying' and 'In thee, O Lord.' Purcell's 'Lessons for the Harpsichord' formed the model for most of the succeeding writers for that instrument, and his treatise on 'The Art Descant' is remarkable for its clearness and conciseness.

Dr. Crotch has said of Purcell: 'He was the greatest master this country ever produced, and the greatest composer of the latter part of the seventeenth century. Eminent both in the sublime and the beautiful styles, and blended with them a considerable proportion of the ornamental, he composed for the Church, oratorio, stage, and chamber, and thus rested his character both on his individual and on his collected talents. His productions are sometimes simply beautiful, but are generally in a great degree pathetic and scientific, and that without any apparent effort; but when he manifestly endeavours to exert all his powers of expression and to show the whole depth of his learning, then indeed he surpasses all his rivals.' I wish we had the means at hand for immediately proving the truth of this eloquent passage—that is, of course, impossible, but I trust before long frequent opportunities will be afforded of hearing Purcell's music with the colouring of orchestra and chorus. To make this practicable, publication is the first and chief necessity. To rescue and publish what remains to us of this master-musician—described by all who have had the opportunity of judging, as the greatest we ever possessed,—is a work which commends itself to the sympathy of all: to us Englishmen in particular, for the honour of our Fatherland, and to the universal nationality of musicians generally, for the glory of their art, which alone has the power to

> Dissolve us into ecstasies,
> And bring all heaven before our eyes.

DISCUSSION.

The CHAIRMAN said he should like to ask if there was any record of the kind of voice Purcell possessed.

Mr. CUMMINGS said his voice was alto, though he sang bass at the Coronation of James II. The fact might account for the great number of alto solos to be found in Purcell's works.

The CHAIRMAN said there was also a great number of excellent bass songs, which might have led to the inference that he was a bass singer.

Dr STONE asked if Mr. Cummings thought that Lulli had any influence upon Purcell.

Mr. CUMMINGS said there could not be much doubt that Purcell was slightly influenced by Lulli, but more, he thought, by Bassani. He was not a copyist of Lulli, and the character of his works was most distinct. Matthew Locke's music was in the style of Lulli when he attempted dramatic composition, but Purcell's was totally dissimilar.

Mr. STEPHENS asked if the fact of the music of Macbeth having been written by Purcell was well authenticated, because it had not only been attributed to Locke, but also to a bass singer of the period named Leveridge, who sang at Sadler's Wells.

Mr. CUMMINGS said Leveridge was a singer at the Duke's Theatre, not at Sadler's Wells. He had under him the management and arrangement of the music for Macbeth, the whole of it was under his care, and copies could only be obtained with his permission. Hence it came to be supposed that he was the author, but he was in possession of an autograph letter by Leveridge, written on a piece of the music of Macbeth, which plainly showed that he had nothing to do with it.

Mr STEPHENS said he thought Purcell was very little credited with the authorship of this music.

Mr. CUMMINGS said Dr. W. Hayes, Dr. P. Hayes, Dr. Arnold, Joseph Warren, and others, had always attributed it to Purcell. It was Dr. Rimbault who started the notion that it was Leveridge's. He found that it was not Locke's and therefore came to the conclusion that it must be Leveridge's, because his name was put on the theatre bills as composer of the music. He was, however, simply composer of music to the theatre, and when Dr. Rimbault saw the letter which had been referred to, written on a piece of the Macbeth music, believed to be in Purcell's own handwriting, Dr. Rimbault replied, 'You know we antiquarians live to learn and unlearn,' and he quite gave up the idea that Leveridge was the author.

The CHAIRMAN remarked that Dr. Rimbault had stated in his memoirs of music that it was by Leveridge.

Mr. CUMMINGS said that was in 1845, and it was only in 1856 that Purcell's MS. and Leveridge's letter came to light. Mr.

Cummings further stated that he had it in Dr. Rimbault's own handwriting that he renounced the Leveridge theory.

The Chairman said there was nothing else in existence of Leveridge which would give countenance to such an idea.

Dr. Bridge asked if there was any record of Purcell having written any theoretical works?

Mr Cummings replied that he wrote the 'Art of Descant,' and also an instruction book for the harpsichord

Dr. Bridge said his 'Art of Descant' was published by Playford some years after Purcell's death, and he did not know whether he was really the author of it.

Mr. Cummings said Playford's book went through about twenty-two editions. The 'Art of Descant' being printed in 1694, no one had ever suggested a doubt of its being Purcell's work,—he died in 1695.

Professor Macfarren said he desired to record his thanks to Mr Cummings, not only for the very interesting particulars of Purcell's life, and the insight into his genius, which he had given that evening, but also for having set on foot the Purcell Society, by means of which the publishing and, he hoped, the performing of Purcell's works would be accomplished, for he believed it was entirely owing to Mr. Cummings' suggestion that that Society had come into existence. He considered it a matter of very great consequence that Purcell's merits should be known and acknowledged. English music had been long under a stigma from which he believed the present time was freeing it, for people were now beginning to admit that Englishmen could not only admire the music of others, but that there had been some amongst them who could add to the treasures of musical art. If one could suppose a person to be born at Christmas at the North Pole who never saw the sun, it would be to him a vain expectation that there could ever be daylight, and if we were born in this country with the idea that there never had been good English musicians, it would be almost a hopeless aspiration to dream of becoming such. But now that it could be proved that before the darkness set in there was such a light as Purcell, it might, perhaps, be an encouragement to aim at the new dawning. He was convinced that Purcell was a very remarkable genius, and the more remarkable because of the hard circumstances by which he was surrounded. Mr Cummings had, perhaps, done one little injustice to English music at and before Purcell's time, when he said that the faculty of melody was not possessed by previous musicians. He could not but think of the beautiful songs of Henry Lawes, which were gems of melody, and of those of his brother William. Henry Lawes might have known Purcell, but he was his elder, and going still farther back there were part-songs, to be sung by a solo voice when the other three were not there, some of which were more remarkable for the melody than for the harmony. One in particular was scarcely known in its original form, namely, Ford's 'Since first I saw

your face,' which was tuneful enough for any country. Then, again, there were the songs of John Dowland, which contain most acceptable melodies, and many of them had had great popularity, as, for instance, 'Now, oh now, we needs must part.' Reference might also be made to the long string of National melodies which in number and variety would hold their own with the National music of any other country; however, the great merit of Purcell was not in being the first of our countrymen to write tunes, because others had done that before him, but in his harmonies, many of which the speaker considered prodigious as being really in anticipation of the harmonic progressions of modern times, and showed him to have had a complete insight into the beautiful, and to have felt the principles of harmonic construction and harmonic derivation in a manner which he could only have done by possessing the most keen sensitiveness to musical propriety. It was a great glory, not to our country only but to the art of music, that at this early period, preceding the works of Handel and Bach, there was a man writing music which amazed one even now with its beauty and its likeness to modern compositions. Many instances of what seemed to be deep research into the acoustical derivation of chords appear in Purcell, and showed him to be a most original thinker, and although he made some experiments which were not so successful, there was a character of beauty in his music which justified the highest admiration. There was, however, one quality in Purcell more remarkable than his beautiful melodies or his wonderful anticipation of modern harmony, and that was his very grand power of musical declamation and strong dramatic feeling. The form of operas in his days very narrowly restricted his dramatic powers, it being then the habit to construct dramas for speaking, in accordance with the prejudice set forth by Dryden, that it was incompatible with dramatic action to have persons sing their words, and that the music of the stage should for the most part be restricted either to supernatural beings or to madmen. Purcell had such strong dramatic feeling as would have made him a great master in this kind of music, had dramas then been constructed to give him such an opportunity. Nothing could be more picturesque than the 'Frost Scene' in 'King Arthur,' and nothing could be more expressive than the pathetic music in several of his pieces. For instance, in the two great scenes in his opera of 'Don Quixote,' one the song of Cardenio when he is mad and thinks of Lucinda's eyes as the only light that can warm him in his coldness, and the other the soprano scene from 'Rosy bowers.' It was very pleasing to think that there had been such a great pre-eminent English musician, and they could not be too grateful to Mr. Cummings for having given them so much information about him.

Mr. Cummings said it might be interesting to know, especially after what Dr. Macfarren had said, that some years ago he had shown almost prescience with regard to some of Purcell's music.

In editing Dido and Æneas for the Musical Antiquarian Society, he spoke of certain places where he imagined there ought to be some more libretto and music, and recently the original libretto of the opera had turned up in the library of the Sacred Harmonic Society, which Mr. Cummings examined, and found the Professor's surmise correct. Thus encouraged, Mr. Cummings searched on all favourable occasions for the missing music, and had the gratification last September of finding in the library of Sir Frederick Ouseley a considerable portion of that which was wanting. This showed the marvellous instinct of Dr. Macfarren in having felt that something was needed

FEBRUARY 5, 1877.

GEORGE ALEXANDER OSBORNE, ESQ., IN THE CHAIR.

BACH'S 'ART OF FUGUE.'

By JAMES HIGGS, Esq., Mus. Bac. Oxon.

WHEN, some time ago, I was invited to read a paper before this Association, and I ventured to select Bach's 'Art of Fugue' as my theme, I did so because the study of the work had recently afforded me much enjoyment, and circumstances had led me to the conclusion that it was neither widely nor deeply known. When, however, I began to prepare for my task, I soon discovered that I should be in the position of the preacher who, in a thinly attended Church, scolded his congregation for the neglect shown by staying away from public worship, and then had to apologise when he remembered that his remarks could not apply to those present. I find myself in a somewhat similar position, when I reflect that many in this room must know the work on which I have undertaken to offer a few remarks, far better than I do. I can only ask their indulgence, and rely on the belief that in proportion as Bach's 'Art of Fugue' is known, its value and importance will be acknowledged, and its manifold beauties appreciated.

Bach's 'Art of Fugue' is not a work containing rules and precepts for the construction of fugues, but it is a practical exemplification of the art of fugal counterpoint, exhibited in a series of twenty or twenty-one compositions all founded upon, or at least connected with a single subject. It belongs to a class of works of unique character, such as Bach alone has invented—works of exhaustive scope. Such I reckon the forty-eight preludes and fugues in all the keys; the thirty variations containing Canons in all the intervals; the musical sacrifice or offering in which Bach so diversely treated the theme given to him by Frederick the Great, on the occasion of his visit to that monarch at Potsdam; and in this list too we may include the little known, but very beautiful canonic variations on the Christmas Hymn,

which Bach condescended to write as a test of his qualifications for admission to the Mizler Society of Leipzig (an institution of very similar aim to that of the Musical Association). But chief in the list of works designed to display exhaustive treatment of one principal idea, must be placed 'The Art of Fugue.' This work may be regarded as the ripened fruit of its composer's mature powers. According to the account of one of his biographers, it appears to have been the last work of the great composer, who was seized with the blindness that proved the precursor of his death while he was engaged upon it, and we have the sad evidence of the interruption in the unfinished condition of the final fugue.

The editions I have met with of this work are not very numerous. After diligent search I have only been able to discover the original edition, said to have been engraved by the composer himself, or by his sons; the Zurich edition, the so-called French edition—which is really printed from the same plates as the Zurich copy; an edition edited by Czerny in Griepenkerl's complete collection of Bach's works (this is now included in Peters' cheap reissue); and an English copy of Czerny's edition, published by Messrs. Robert Cocks and Co.

The original edition, published shortly after the death of Bach, was printed in open score. It has a commendatory preface by Marpurg, dated 1752, and contains at the end the Chorale Prelude which Bach dictated on his death-bed to his son-in-law *.

Carl P. E. Bach advertised the plates of this work as for sale in 1756, and in the advertisement says 'only thirty copies have yet been sold.' (This was four years after its first publication.) It is said that no more than fifty copies were ever printed from these plates. What became of the plates is, I believe, unknown: certainly this original edition is very rare.

I will take the present opportunity to express my acknowledgment to Messrs. Schott for their courtesy in allowing me, for the purpose of this paper, to inspect some valuable early editions of Bach's works which they possess.

The next edition, the Zurich edition, did not appear until about the beginning of the present century. In addition to the open score of the original edition, it has a compressed part as for a keyed instrument. The French edition is identical with the Zurich edition in every respect, indeed, a careful comparison of the two copies leaves no doubt that they were both printed from the same plates.

In 1839 Czerny edited 'The Art of Fugue,' in the complete German edition of Bach's works, undertaken in conjunction with Dr. Griepenkerl and others, but he wholly omitted the open score of the earlier editions, and gave only the arrangement that had appeared in the Zurich edition. This he fingered for the piano. About the same time, or somewhat later, Messrs. R.

* Wenn wir in hochst Nöthen sein. (See *Organ Works*, vol. vii. p. 74.)

Cocks and Co. reprinted Czerny's edition, giving the fingering in English form. These proceedings have, I think, tended very much to obscure Bach's intention. As 'The Art of Fugue' came from his hands no mode of performance was indicated, if indeed *performance* in any ordinary sense of the expression was intended, but with the score suppressed, and the pianoforte form of the work elaborately fingered, the work has all the appearance of a real clavier work, especially as not a word appears on the title of these arrangements giving a hint of what has been done. It is true two numbers, being fugues *a due clavecimbalorum*, are so inscribed in the original edition, but this only makes the presumption stronger, that had Bach intended the bulk of the work for performance on a keyed instrument, he would have said so. The effect has been that some of these compositions have been pronounced almost unintelligible, through being brought to trial in a manner that was probably never intended. As an example let me instance the 12th Fugue and its inversion, here we see (Figs 12 H and 12 I, page 65, may afford some idea of my meaning) a mode of writing which Bach did not shrink from employing when writing for an orchestra or even occasionally in his choral works, where he makes passing notes advance fearlessly through notes held in some other part, in a manner and to an extent that is without parallel in his music for a single clavier.

In the earlier editions, these compositions were called 'counterpoints' except in three cases, viz. the two fugues for two instruments, and the final fugue on three subjects. In Czerny's edition the term is changed into fugues; the alteration is in some respects convenient, but not altogether an advantage, as it perhaps helps the idea that their *primary* object is performance. It seems to me that they rather bear such analogy to performable music, as a painter's studies (in which he sketches, or may be elaborates, some single feature or detail) bear to his finished picture. We shall find Bach devoting an entire composition, or rather group of compositions, to an exhaustive elaboration of one kind of fugal device, excluding for the time all other variety of treatment, in a manner that is certainly not usual in compositions whose ultimate end is performance. While, however, making this remark, I must not neglect to say that it is the real musical value of these noble works, that removes them out of the province of mere dry examples of the possibilities of musical combination, and lifts them into the region of artistic creations.

I must forbear attempting any analysis of the wondrous and ever fresh harmonies, of the beautiful sequences, and surprising and delightful modulations with which the work abounds, nor must I do more than barely mention how Bach having seemingly exhausted every resource of harmony, yet generally finds something 'new and strange' wherewith to enrich his often gorgeous cadence. My business will be with the more prosaic matter of the imitative device or design, exhibited in 'The Art of Fugue.'

Before looking at the several numbers in detail, I will mention, that they naturally group themselves as thus. The four first fugues are in simple counterpoint, without regular and recurring counter-subjects. The three next are built on a modified form of the subject, and exemplify answers by contrary movement: No. 5 being in notes of equal value, No. 6 in notes of shortened value (diminution), and No. 7, in which the diminished form of the theme is used as the subject, illustrates the employment of augmented and doubly augmented replies. The third group of counterpoints, Nos. 8, 9, 10, 11, show the subject, or some modified form of the subject, in combination with a new subject. The new subject in Nos. 8 and 11 being combined with a form of the original subject, according to the laws of double counterpoint at the octave, while No. 9 employs double counterpoint at the twelfth, and No. 10 makes use of double counterpoint at the tenth.

The next group contains two counterpoints, Nos. 12 and 13. These display the effect of inversion and reversion, as applied to the entire counterpoint. No. 14 is a slightly varied form of a previous number. Nos. 15 and 16 are the two fugues for two pianos. Nos. 17, 18, 19, and 20 are four canons in two parts; while No. 21 is the fugue to which I have already alluded as being incomplete. It is on three subjects: tradition says that Bach intended to add a fourth subject, to reverse all the subjects in all the parts, and so to close this marvellous work; but man proposes and God disposes.

I think those who study Bach's habit of writing will have little difficulty in believing that he may have intended to introduce a fourth subject, nor will it perhaps be impossible to discover what that fourth subject would have been, or at least to imagine its general form.

With this hasty sketch of the 'Art of Fugue' in your minds, I will ask you now to bear with a somewhat more detailed examination of the several groups of counterpoints.

Fig 1. Subject.

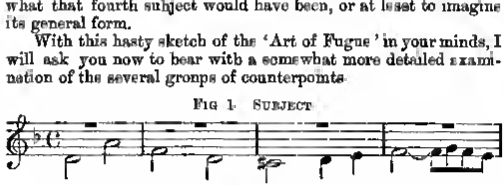


Fig 2. Answer.

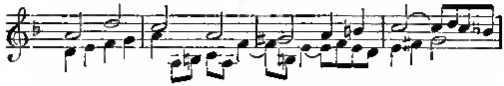


Fig 3.

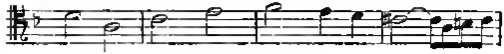
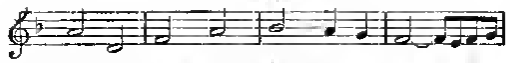


FIG. 4.



The primary aspect of the subject is shown in Fig 1. Fig 2 shows the answer, which is tonal, while Fig. 4 and 3 display inversions of the original subject and answer, that serve respectively as the subjects of the third and fourth fugues. These subjects are also answered tonally.

I may perhaps be permitted to explain, that the answer of a fugue subject is its reproduction on some other degree of the scale, usually its 5th above or 4th below. An answer, if direct, is either real or tonal. It is real whenever the melody of the subject is exactly reproduced, though transposed to another pitch. When, however, to avoid the impression of, or a positive modulation to a foreign key, a slight change is made in the melody of the subject; on its appearance as answer, it is tonal.

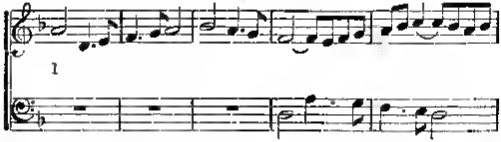
The only ultimate modulation proper to a subject of fugue (if it modulates at all), is to the key of the dominant. When such a modulation takes place, if it be answered by a mere transposition a 5th higher, it will lead to the dominant of the dominant, e g, If a subject in the key of C modulates, as it may, to the key of G, the answer beginning in G will, without the tonal change, modulate to D, a modulation too remote, for at least the outset of a strict composition The tonal answer is a contrivance that, by means of a slight and skilfully managed melodic change, neutralises the progression or modulation of the subject, and restores the original key.

In making a real answer there is no difficulty whatever; it is, as has just been said, an exact transposition, but with regard to the tonal change there are two difficulties—first to know *when* it should be made, and next to know *how* it should be made. It is a test of some advance in musicianship to be able to give the correct tonal answer to a difficult subject of fugue. To do this correctly involves the necessity for such a lively perception of the harmonic and melodic relation of the several notes of the subject, as is probably more an instinct of the musician (if I may so express myself) resulting from close observation and much practice, than possible of being reduced to absolute rule in every case. Still they will have little difficulty in discovering the correct tonal reply who will observe the rules given, that tonic answers to dominant, and dominant to tonic *absolutely* at the *beginning* and *end* of the subject, and *whenever it modulates*, and *generally* whenever prominence is given to the critical note by the method of its approach, by its length, position, or other incident of emphasis; always remembering that whatever was of tonic character in the subject will be translated into dominant in the answer, while all dominant expressions in the subject will become tonic in the reply. The tonal change must disfigure the subject melody as little as possible. To this short and imperfect résumé of the rules of

tonal change I will add a valuable rule that Mr. Banister gives in his most excellent work. He says, 'All alterations must be made in quitting or approaching the tonic or dominant.'

The four first fugues thus tonally answered are all without regular counter-subjects; they are also conspicuous for the absence of any kind of double counterpoint. The device of 'the stretto,' the drawing of the subject and the answer closer together, is almost absolutely wanting. They are, in fact, simple fugues in simple counterpoint, but notwithstanding they display the vast resource of the master in inventing ever fresh yet consistant figures of counterpoint. Each fugue possesses its own well-marked individuality, and it is truly astonishing to observe the unity without monotony that pervades each composition, when we consider the narrow means of development which the composer allowed himself. These four fugues abound in episodes of canon and imitation, and it is not difficult to trace a progressive richness of treatment in harmony, modulation, and sequence throughout the first group of counterpoints.

FIG. 5 A



Bach prepares for the devices he designs to introduce in the second group of fugues, Nos. 5, 6, and 7, by filling up every skip in the original subject, except the first, with passing notes. Thus altered, the subject becomes exceedingly flexible and capable of very varied treatment and combination. Fig 5A shows the subject to be the *inversion* of the *original* subject: that is, it is identical in its outline with Fig. 4, but having the passing notes as already described. The answer is by contrary motion, and of course agrees in its outline with the original form of the subject as seen in Fig 1. The distance of the reply is three bars. The exposition and counter-exposition contained within the first 32 bars is strikingly regular and methodical, the subject being presented in each form, original and inverted, in each of the four voices at the constant distance of three bars, as at the beginning. Afterwards, however, the subject and the reply are approximated at the several distances of a bar and a half, a bar, half a bar, and ultimately the two parts in opposite motions are brought together. Figs. 5B and C show the imitations at the distance of a bar and a half, the imitation being by similar movement. It will be observed that C is not a mere inversion of B, as the direction of the theme is also changed.

I ought to say that the small figures inserted between the staves indicate the bar from which the extract is taken. The number of the example agrees with the number of the fugue.

The general idea of presenting these extracts is borrowed from Professor Hauptmann's* 'Essay on Bach's Art of Fugue,' to which I am also otherwise much indebted; but the form in which they are presented is different, as he reduced all the examples he gave to one key I have thought it better to give the examples as they actually appear in the work. It is, perhaps, hardly necessary that I add, these fragments (with one or two exceptions) show only the imitating parts, and that *they* are generally accompanied by others that complete and justify the harmony.

FIG 5 B.

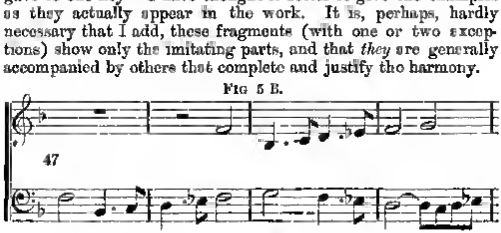
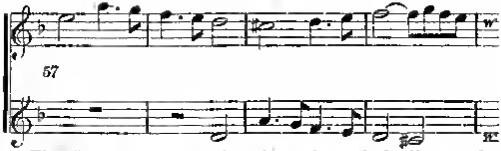


FIG 5 C



Figs 5 D and E present the subject also with the direct reply, but the distance is now contracted to a single bar; as in the previous examples, it is led in opposite directions in addition to being inverted

FIG 5 D

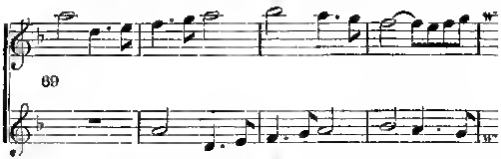
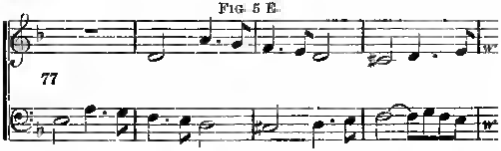


FIG 5 E



* *Erläuterungen zu Joh Seb Bach Kunst der Fugue von M Hauptmann* Peters, Leipzig

In Fig. 5 F and G the distance of the reply is reduced to *half a bar*. This time the answer is by contrary motion, and, as in each of the other approximations, is presented in two-fold form. In F the bass leads with the rising form of the subject, while in G the tenor leads with its falling form.

Fig 5 F

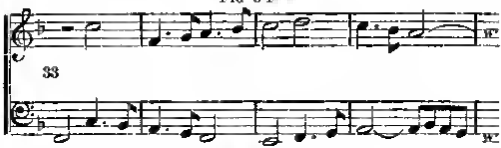
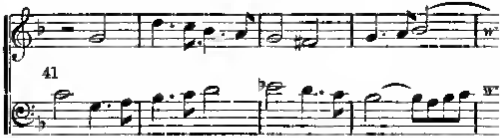
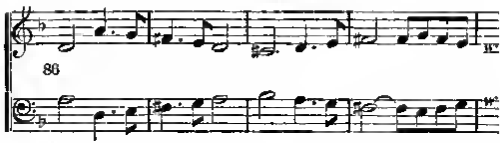


Fig. 5 G.



Finally, the subject is entered in the two motions (by ascent and descent) absolutely together, as exhibited in 5 H.

Fig 5 H



It is worthy of notice that these several examples of close reply (except those at the half-bar 5 F and G) follow the general law of the stretto, and become closer and closer as the composition advances; the bar-and-a-half reply occurring at the 47th and 57th bars, the one-bar reply at the 69th and 77th bars; and the simultaneous entry in the two directions at the 86th bar, within a few bars of the close of the composition.

The place of the half-bar replies was directly after the counter-position, where an anticipation of the stretto not unfrequently occurs.

Among other episodical matter there are two fragments of canonic imitation that demand a word of passing notice. They are indicated by Figs. 5 J and K. 5 J is at the 8th, 4th, and 11th below, and 5 K at the 12th, 5th, and 9th below. The theme being

led in opposite directions in the two examples. Throughout this fugue, although so artificially constructed, every part proceeds in the most natural and unconstrained manner possible, and the result is, not a dry example of only clever combination, but a piece of real music.

FIG. 5 J.

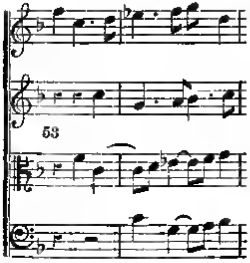
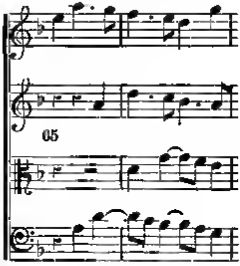


FIG 5 K



In the fugue we have been considering, the elaboration has wholly resulted from the combination of the theme with itself by contrary or similar motion, *but always in notes of equal value.* Fugue No. 6 employs the same subject, but now attended by its diminished form—i.e, by notes of half value. This is shown in

FIG. 6 A.

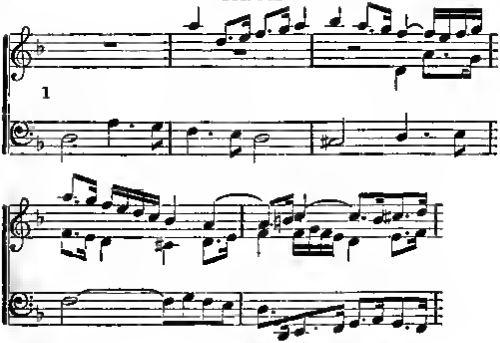


Fig. 6 A. Where we see the subject (it agrees in outline with Fig. 1) led by the bass, the reply enters in the treble by contrary

motion, and in notes of half value in the 2nd bar, and has run its career before the leading theme has come to an end So another voice, the alto, now enters with the short form of the subject against the 3rd and 4th bars of the original subject. In the 7th bar (I regret that my illustration does not show this) the tenor begins with the diminished form of the subject, and in the 8th bar the longer form appears, so that we have three different combinations of the long and short forms of the subject in these few first bars. 1st. We have the diminished form of the subject against the 2nd bar of the original subject; next we get the diminished form in reversed movement against the 4th and 5th bars of the longer form; and lastly, the short form is led with the longer form starting against *its* second bar.

FIG. 6 B.

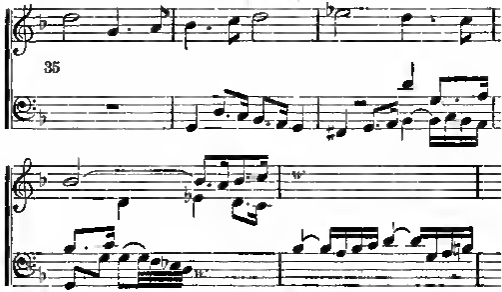


Fig 6B shows most of the above in reversed movement, and also inverted.

FIG 6 C

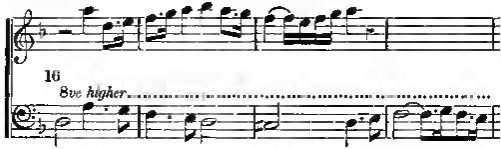
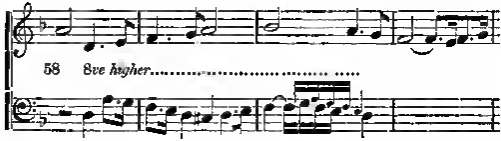


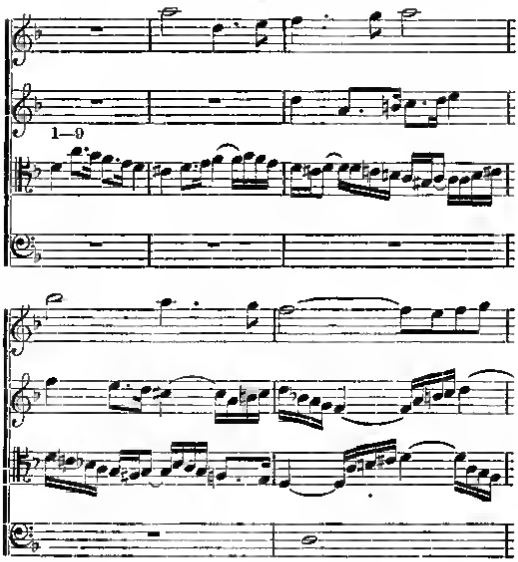
FIG. 6 D.



Figs 6C and D exhibit approximations at the half-bar, but as the imitations are by diminution, no one will regard them as in any way identical with the somewhat similar devices practised in the previous fugue. This composition is described, I presume, by Bach himself, as being in the 'French style' an expression that has evident reference to the figures of ornamentation with which it abounds.

Fugue No. 7 is a yet further variety of the combination of the subject with itself, in notes of augmented and doubly augmented value. The commencement of the fugue is displayed in Fig. 7 A, where we see the tenor leads with the shortest form of the subject, and is answered in contrary motion by the treble in notes of double value. In the third bar, the alto enters with the short form of the subject against the second bar, as given by the treble; finally, the bass enters in notes of doubly augmented value, and on this there are other entries of the subject in tenor and alto, but always in some new relation.

FIG. 7 A.



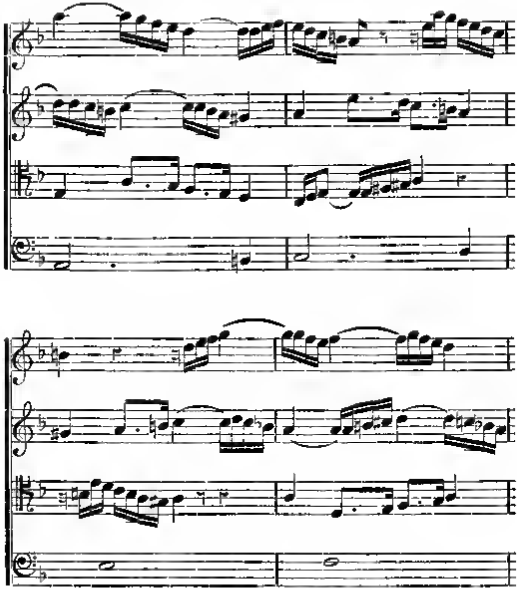
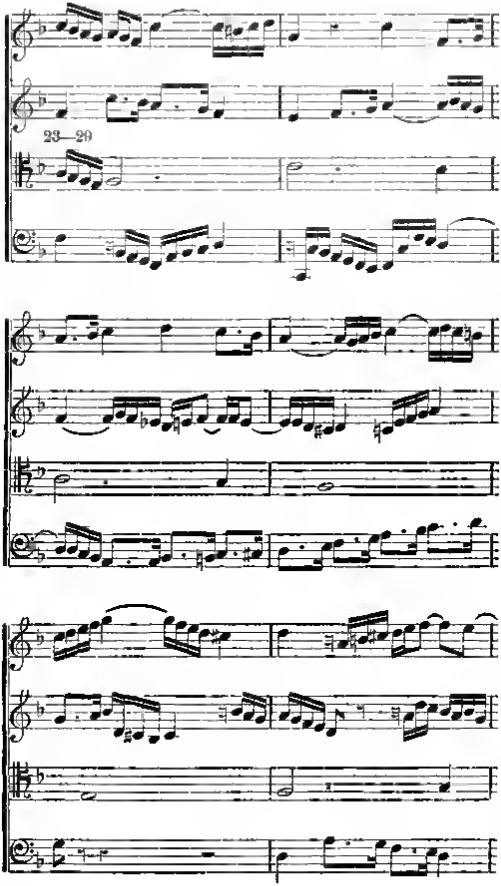


Fig. 7 B and C show yet other combinations of these varied forms of the one subject. In 7 B we see the longest and shortest forms of the subject in fresh relation tho one to the other, and 7 C is an example of an imitation that has not been employed before. Perhaps, at a first reading, some may think that this fugue in its devices is to a considerable extent the same as No. 6, but on close investigation they will find it is not so. The conditions of the combinations are changed: the parts reply at altered intervals of time, or in an altered direction.

Each of these three fugues, although closely connected with the others by identity of subject and general mode of treatment, has yet its own distinctive elements of individuality and interest. Throughout the three fugues that have just engaged our attention, I believe there is not a single repetition of a previous device or combination.

FIG. 7 B



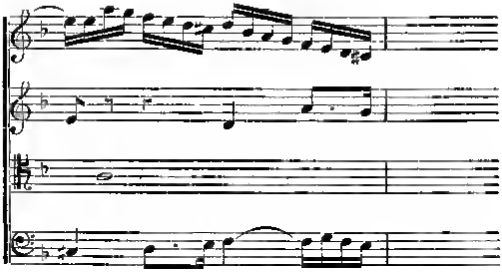
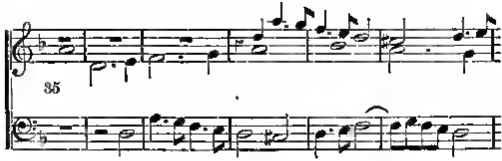


FIG. 7 C.



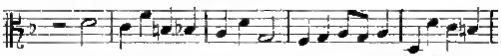
The four fugues that next come under our notice are examples of a mode of treatment entirely different from the foregoing: *they* have been exhaustive in the treatment of the one subject, by employing it in different motions, and in notes of varied value; *these* exhibit the subject, or rather another form of it, in combination with a wholly new idea. This new subject is generally first developed alone, and its capacity for employment with the chosen form of the original subject by double counterpoint is discovered afterwards.

Double counterpoint, I may explain, is a counterpoint that admits of a double method of performance—a counterpoint in which the two parts or voices may mutually change places; that which was the higher part in the model becoming the lower part in the inversion, and conversely. There are many varieties of double counterpoint, named according to the interval of the inversion. Double counterpoints at the 8th, 10th, and 12th are most common and most useful.

The 8th fugue employs double counterpoint at the octave; the 9th is written in double counterpoints at the 12th, and the 10th fugue is an example of double counterpoint at the tenth. While the 11th fugue, using to a great extent all the material of the 8th, but by inversion furnishes an additional illustration of double counterpoint at the octave.

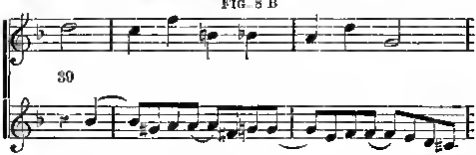
The 8th fugue is in three parts (bass, alto, and treble). The new subject is shown in Fig 8 A.

FIG 8 A



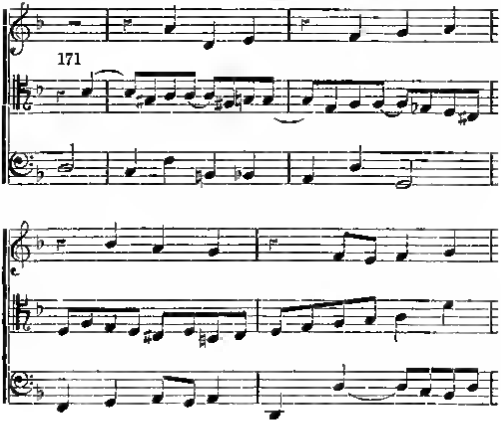
The exposition of this subject (the answer being strict) occupies the first thirty-eight bars of the composition. In the thirty-ninth bar this subject is heard with a new countersubject, that subsequently becomes very important. The subject and countersubject are shown in Fig. 8 B.

FIG. 8 B



In the ninety-fourth bar the altered form of the subject, to be seen on the upper stave of Fig 8 C, first appears; it is only heard in each voice in turn, being accompanied by free counterpoint in the other two parts. Finally, after further use of the earlier material of the fugue, the three subjects are brought together in a regular triple counterpoint, as shown in Fig. 8 C.

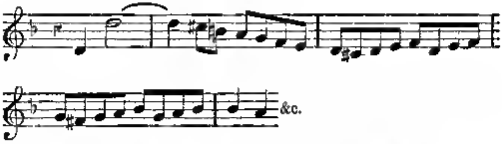
FIG. 8 C



Triple counterpoint admits of six inversions, and in the piece under consideration four of these inversions are actually used in the course of twenty-four or twenty-five bars, beginning with bar 147. As a somewhat rare example of the practical utilisation of triple counterpoint, this composition is of peculiar value.

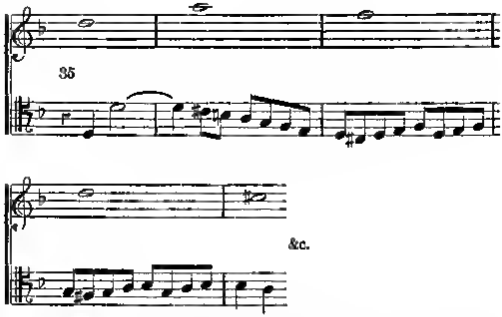
No 9 is a fugue having for its leading idea a subject of florid character, designed for employment with the augmented form of the original subject by counterpoint at the 12th. The new subject is only partly shown in Fig. 9 A.

Fig. 9 A.



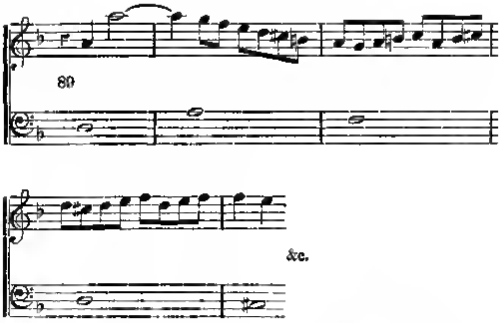
This new subject is developed by itself for thirty-four bars. At bar 35 the combination with the selected form of the original subject commences, as seen in 9 B, where the primary subject is seen

Fig. 9 B.



in the treble, and the new subject in the tenor. Throughout the remainder of this composition, the original subject is thus attended by the new subject, or its inversion at the 12th, as shown at 9 C.

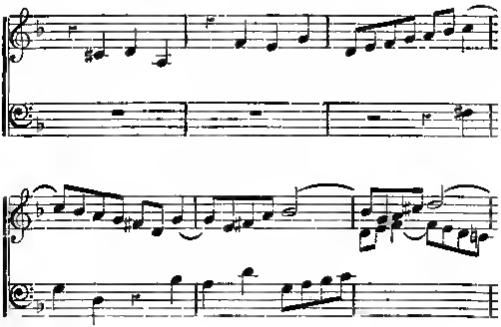
Fig 9 C

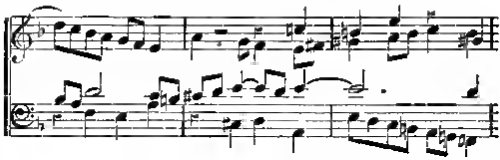


Some slight modification in the matter of accidentals is occasionally necessary (as is commonly the case in double counterpoints in any other interval than the octave), owing to the exigencies of key. This may be seen by a comparison of the upper part of 9 C with the lower part of 9 B.

The 10th fugue employs the last variety of double counterpoint that Bach illustrates in the present work. Fig 10 A shows the exposition of a new subject, the treatment of which is somewhat remarkable, the answer being at the 5th *below* (in the key

Fig 10 A





of the subdominant (and the third and fourth replies being by contrary motion. This subject is worked alone for twenty-two bars, and then the form of the original subject, with which we are already familiar in Fig. 5 A, is tonally developed in a separate exposition for about the same time. In the forty-fourth bar, the two subjects are used together, and afterwards inverted by double counterpoint at the 10th, as shown at 10 B and 10 C.

Fig. 10 B.

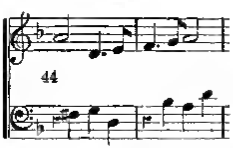
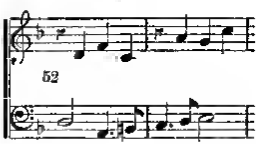


Fig. 10 C.

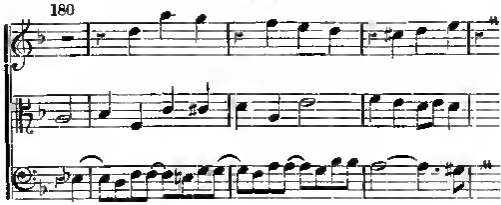


It may be convenient here to refer to the 14th fugue, which is only a variation of that which has just engaged our attention; indeed, the two compositions are almost identical except that the first twenty-two bars of the 10th fugue are wholly suppressed in the 14th fugue: that is, the separate exposition of the new subject (of the 10th fugue) is not heard, but the composition begins with the exposition of the chosen form of the original subject, and we only make acquaintance with the new subject in the more incidental manner of a new countersubject, and I suppose that this variation was included in the work to demonstrate the difference in effect that results from, in the one case, hearing each subject separately treated, and in the other, only hearing one of the subjects so displayed.

It will be remembered that when speaking of the 8th fugue I mentioned that the material of which it is built is employed almost entirely by inversion in the construction of the 11th fugue.

In this 11th fugue the leading subject is a form of the original subject; it is the inversion of the subject seen on the upper line of 8 C, and is displayed on the upper line of Fig. 11.

FIG. 11.



The answer, notwithstanding the skip at the ontset to the dominant, is not tonal hnt real, Bach evidently declining to disturb the scale-like passage, especially as the dominant is far less omphatic than in some other cases.

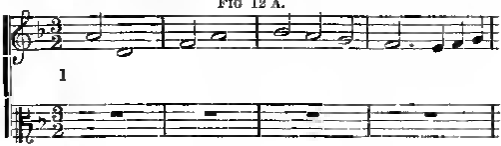
In the 8th fugue it will be remembered the new subject was first worked alone, and then the original subject. In the 11th fugue the selected form of the original subject is first treated for some twenty-seven bars, then an inversion of the new subject of Fugue 8 is worked for abont forty bars (compare the middle line of Fig. 11 with the uppor line of 8B for this subject)

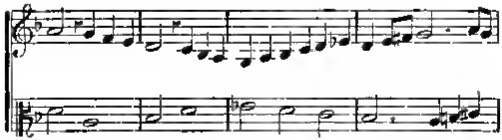
The subject on the *middle* line of 8C is not employed by any ordinary method of inversion in the 11th fugue, although it is very evidently the basis of the subject shown on the lower line of Fig. 11. It would seem that an ordinary inversion did not suit the composer's purpose, hnt he deduced the quaver subject of Fig. 11. from the corresponding subject of Fig 8, by the simple substitution of a falling second and rising third in place of a rising second and a falling third, and so he obtains a phraso of great similarity hut of opposite movement that suitably combines with the other more regularly inverted subjects This 11th fugue is one of the most closely constructed, as it is one of the longest of the whole series Its beanty in performance is by no means snperficial, nor is its full appreciation easy, hut it will well repay attentive study Full justice will not be done to the contrivance exhibited in fugues 8 and 11 nnless they are stndied in connection the one with the other.

The 12th and 13th connterpoints show anothor fugal device—viz., the inversion and reversion of the entire connterpoint; hnt this is effected in different ways in the two fugues

No. 12 is in four parts The snbject is altered into triple time as in Fig 12A.

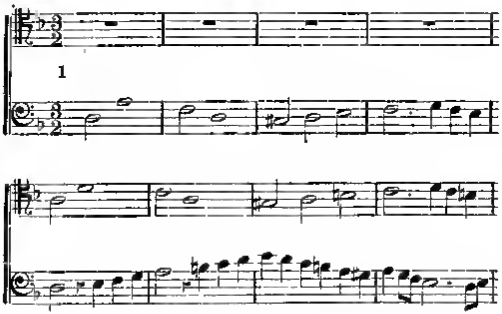
FIG 12 A.





The answer is at first somewhat puzzling, as it is really in the key of the subdominant and yet has a tonal change. If compared with Fig. A, with which the subject closely agrees, and with Fig. 3, which is identical with the answer to Fig. 4, the variation will be evident. This counterpoint is a regular composition of between fifty and sixty bars. In the inversion, which is an *inversion* and *reversion* of the whole composition, the original treble becomes the bass and the bass becomes the treble, while a similar change takes place between the alto and tenor, and each melody is reversed in the direction of its step. The inversion, therefore, opens as in 12B, where it will be seen the answer has become regular. I

FIG 12 B



think there can be little doubt that what appears as the inversion was really first written. The composer, exercising a wise discretion in allowing the more natural treatment to appear as the result of the inversion, rather than for the less natural to *follow* the more natural method.

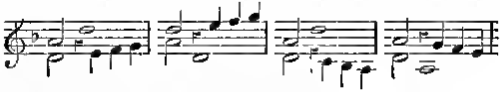
It may be remarked that as the result of inversion in the octave is to change the intervals in the well-known order:

1 2 3 4 5 6 7 1
8 7 6 5 4 3 2 8

so the result of reverse movement is similar, and the effect of

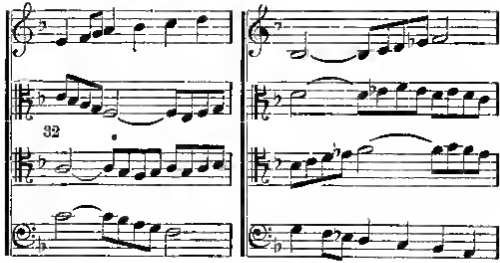
uniting both processes is to restore the several intervals. Figs. 12 C to F will make this evident; here C is the model, D shows

FIG. 12 C. FIG. 12 D. FIG. 12 E. FIG. 12 F.



the inversion of the parts, E the *reversion* of the under part resulting in corresponding intervals to those of D, and F shows both inversion and reversion, and that the resulting intervals are the same as those of the model. Such a composition must greatly tax the resources of the composer. I give two bars, chosen almost at random, to show the thoroughness of the inversion and reverse movement. These are marked 12 H and 12 I. H is the

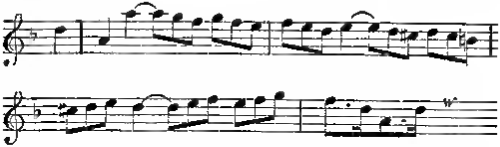
FIG. 12 H. FIG. 12 I.



thirty-second bar of the model, and I the corresponding bar of the inversion.

The 13th fugue exemplifies another variety of inversion joined with reverse movement. It is founded on an ornamental variation of the subject shown at 13 A. The fugue is in three parts

FIG. 13 A.



The answer in the model is by reverse movement. The composi-

tion being in three parts, it follows that the subject must take one direction in two of the parts, and the contrary direction in the other part This may be seen at 13 C (which is not a real extract from any part of the composition, but only shows the order, direction, and place of the reply; an interval of four bars is supposed to elapse between each entry). The consequence is that

FIG. 13 C

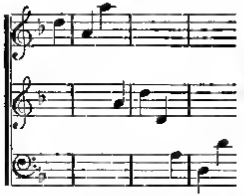
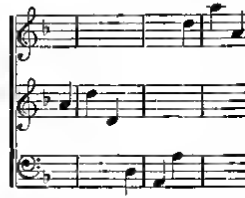
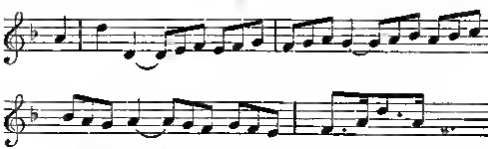


FIG. 13 D



when we come to the inversion it is impossible to change all the parts, both in respect of order, direction, and mutual relation. The upper and lower parts are inverted, the middle part remains as in the model, but the order and relation of *all* the parts is altered The form of the subject of the inversion is shown in 13 B, and the order of parts &c. in 13 D. This fugue and its in-

FIG 13 B.



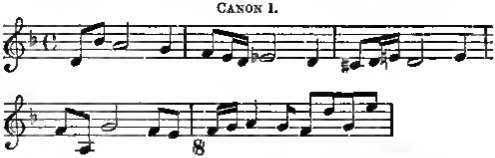
version form a very singular example of the effect of inversion in conjunction with reversed movement.

'The Art of Fugue' contains a variation on the foregoing number in the shape of two fugues for two pianos. These will be found very closely connected with the counterpoint that has just engaged our attention The chief features of construction are retained, but a fourth part is added; this added part is generally below the base of the original composition Although adding nothing new in the way of fugal device, these four-handed duets are instructive examples of the addition of a real part to an already complete composition.

I may only very briefly allude to the four canons in two parts, that stand next in the work No 1 is described as by augmentation

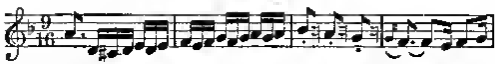
and contrary movement; it is also (although no mention is made of the fact) in double counterpoint at the octave. After the canon has run its course for fifty-two bars, the treble leading, and the bass following by contrary motion, and in notes of double value, a repetition begins, the bass, however, now leading, and the treble following by contrary motion and by augmentation. It is, as I have said, in double counterpoint at the octave. Canon 1 shows

CANON 1.



the theme, another ornamental variation of the subject. No. 2 is also a canon in the octave. The subject shown under Canon 2

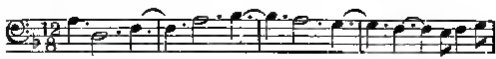
CANON 2.



agrees in outline with Fig. 4. After twenty-four bars of imitation on this, the treble again leads with such a modification of the subject as agrees with the outline of Fig. 3, starting as it were an answer to the previous subject; further on the leading part gives a contrary form of the subject, agreeing with No. 1, with kindred figures of ornamentation to those shown in the original theme of the canon. This canon may also afford some useful hints as to the management of the return in an infinite canon.

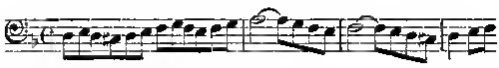
No. 3 is a canon in the 10th. It is also in counterpoint at the 10th; two totally different things, being a canon in the 10th led in the bass, the reply is a 10th higher, the intervals are strict as to kind, but not as to quality, a minor phrase in the subject often becoming a major phrase in the response. Being in double counterpoint at the 10th, means that the parts shall be susceptible of inversion at that interval. This inversion results in a canon in the octave. Under Canon 3 is shown the theme.

CANON 3.



The last of the four canons is perhaps the most artificial in construction. It is founded on a theme of eight bars, of which just a hint is given under Canon 4. It is a canon in the 12th, and

CANON 4



is also in counterpoint at the 12th. The theme is led by the bass, and answered a 12th above by the treble. It is thus conducted for thirty-three bars. In the thirty-fourth bar the treble, disregarding the arrear of eight bars it is expected to imitate, reverts to the original theme as started by the bass, (that is on D, not A), the bass continues to supply an apparently free part for the eight bars of the theme as led by the treble, so we have sixteen bars of (for the time) unimitated counterpoint in the bass. When the treble has completed the lead to which it reverted, the bass begins the inversion at a 12th below the original response, and this of course results in a canon in the octave, and when in this order the corresponding point is reached, the treble employs the sixteen hitherto unimitated bars of which I have spoken. I fear it is impossible to make this clear by words, but I am sure the examination of the canon will afford both pleasure and profit.

The last fugue is built on three themes, shown under Figs. 15 A, B, and C. It is incomplete, and in its present condition has

FIG. 15 A.

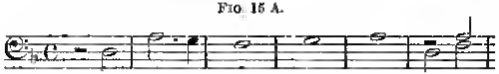


FIG. 15 B.

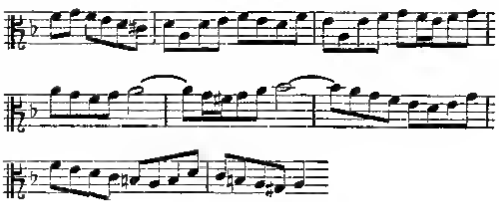
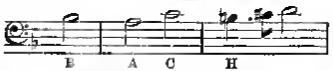


FIG. 15 C.



no evident connection with the rest of the volume in which it is included. The tradition that it was Bach's intention to add a

fourth subject offers, however, a clue of possible explanation, since it would only be in keeping with his method in the preceding part of the work, to delay the entry of the original subject until the last (let me recall to your memory the treatment of the 8th, 9th, and 10th fugues); so I conjecture the fourth subject would have been some form of the original subject. On trial, I have found that the subject 15A will combine with the form of the original subject seen in Fig 8 C, and that the second subject (15 B) combines with the augmented form of the original used at 9 B. I have not, in the casual attempts I have made, succeeded in combining the subject 15 C with any form of the original subject, except I find a retrograde order of the B A C H subject—that is H C A B will work with a portion of the original theme; but this is a kind of dednction from a subject that seems not often to have found favour with Bach, and is a device of which I think he gave no hint in 'The Art of Fugue.' Moreover I should expect that if the composer introduced a form of the original subject in this last fugue, it would be a single form capable of employment with each of the other subjects of the fugue.

There is another supposition that has occurred to me. I mention it only suggestively. May not this fugue have found its way into 'The Art of Fugue' by accident, or as supplemental matter?

There are four considerations that to some extent favour the idea.

1st. The want of connection shown by the absence of the original subject, and also, the similarity of the first subject with the original subject, does not agree with Bach's habit of selecting subjects for combination of marked contrast.

2ndly. The place of this fugue. Bach had exhibited his art in the several fugal compositions extending from 1 to 13, next are placed the three compositions that are evident variations on former numbers, and then follow four canons, and there does seem some want of method again to resume fugal treatment.

3rdly. All the other fugal treatments have been termed counterpoints (I quote from the early editions), and any verbal superscription has been in Latin. This last fugue has an Italian superscription, and is called a 'fuga.'

4thly. As the original editors of this work did not scruple to insert at the end of 'The Art of Fugue' a chorale prelude, truly of rare interest and exquisite art, but having no relation whatever to the previous work, it is no great stretch of imagination to suppose that they may have included this fugue rather because of its intrinsic value, than because it really belonged to the art of fugue. An inspection of the MS, which I have not been fortunate enough to enjoy, would probably show whether this composition is an integral part of 'The Art of Fugue' or not. Be this as it may, this last fugue, although unfinished, is a sublime composition.

We are sometimes almost told that the fugue is an effete and

worn-out musical form, and that its resources are exhausted. That good fugues of character and individuality are not often written now-a-days, few will deny; though the art was not lost when Mendelssohn lived, as witness his organ and pianoforte fugues. Schumann contrived to be Schumann still when using the same form, and within the last fifteen or twenty years Klengel has contributed a truly wonderful collection of 48 preludes (all canon) and 48 fugues, which are far removed from being copies of anything known before. Still, it may be admitted, worthy specimens of fugal art are rare; so, I would submit, are worthy specimens of the symphony or sonata, or even of the song form; but as it certainly would be rash to declare that symphony, sonata, and song can only be glories of a fading past, so I believe there must be in the nature of things a future for the further development of fugal forms: at least we may safely conclude from all past experience, that only in proportion as music is leavened with the leaven of imitative and contrapuntal design, does it gain the prospect of outliving the passing fashion of the period that gave it birth.

DISCUSSION.

Mr Banister said that he experienced almost a feeling of jealousy at Mr Higgs having accomplished a purpose which he had had in his mind for the last twenty years, namely, that of analysing the marvellous work to which their attention had that day been called. The fact was, however, that Mr. Higgs had done it so ably and so exhaustively, that he thought his long cherished purpose would not now be carried out. He thanked Mr. Higgs for his very kind mention of what he had called a valuable rule, which he (Mr Banister) had given. He was not aware that he was the originator of it; but was very glad if in any way he had put forward clearly that which would be useful to students in connection with the matter. He thoroughly endorsed all the observations with which Mr Higgs concluded his paper, with regard to the exceeding importance of the fugal and contrapuntal form of composition. There was, he believed, a very prevalent notion among students that unless they were required to write fugues or canons they need not learn how to do so. But nothing could give students a more enduring interest in any form of composition than the habit or a capability in them for the development so marvellously carried out in the work of which they had been hearing. Therefore, if there were any young professors or students present, he would say to them that nothing could be more instructive than to pursue such an analysis of all fugal works which they could get hold of that were worth any-

thing, pursuing that analysis with a view, not so much to write works like them, as to improve the quality even of their own lighter compositions. If they took the lighter fugues of Bach himself, the comparatively easy ones—e.g., the well-known No. 2 of the 48, in C minor—nothing would be easier than to show, by taking such a paper as had been laid before them that day, that the whole fugue was constructed in similar contrapuntal order. Writing out in open score was the most valuable form of education that a student could possibly have, and should by no means be thought a waste of time. A student might often think—I have taken the book; I have read it; I see how it is. But he would say they would never learn better, than by taking the trouble even to transcribe all those works in open score, so as to be compelled to think and see how the various subjects were treated. He would say that in strong commendation of the habit of analysis, and thinking about presenting ideas in different aspects. He always liked to impress this latter matter upon pupils who came to him; and that was shown in a wonderful way in the work of which they had just been hearing. The true analysis for them to pursue was analysis of *form* and *construction*, rather than that of the supposed poetical intentions of the composer,—now so common; and no small service had been rendered by the excellent examples of this right kind of analysis which had been furnished that day. He repeated that he cordially endorsed every remark Mr. Higgs had made, and thanked him for taking out of his hands in the admirable manner in which he had, his long-cherished plan of many years.

The CHAIRMAN said he was perfectly sure that none present would thank Mr. Higgs for having taken the matter out of Mr. Banister's hands, because, if there was a subject he had worked for for twenty years, he hoped Mr. Banister would think seriously upon it, and give them the benefit of his thoughts. One remark everyone would endorse, and that was the necessity for students learning to write fugues and to analyse fugues, because even their lighter works would be very much benefited thereby. He would refer to a recommendation of the late celebrated John Cramer to his pupils—'Mind you learn how to write a fugue, and when you have thoroughly mastered it, don't do it.' He agreed with Cramer only as to the first part of his recommendation.

Dr. BRIDGE said there was one point already mentioned, in which he took a considerable interest, and that was the question of the tonal answer. They knew it was a great difficulty to hit upon it, and he might say that Mr. Banister's rule already alluded to had afforded him very great comfort when he was reading upon the subject. He never met with it anywhere else, and it was a very great aid to find that all alterations in the answer should be made either on approaching or quitting the tonic or dominant. That was a very great help to the student. Before he had learned the rule he used to be puzzled beyond measure continually. He was searching about for every possible

hint, and the only hint got from Cherubini was, answer the dominant by the tonic, and the tonic by the dominant. But then there were always exceptions. There was another little rule which Mr. Higgs did not mention, and which he had observed in Sir F. Ouseley's book, and that was that if there was an interval of the diminished 7th in the subject, it was never altered, it was the same in the answer. He thought it would be well to get all these little hints in one book, because the subject of answering was one that caused the greatest possible annoyance and trouble. He knew as a fact, that a fugue was written on a certain subject, and the writer was informed that the answer was wrong. He submitted the subject and the answer to an authority of equal weight with the one that told him it was wrong, and the new authority answered in the way he had done himself; thus showing that doctors differed. It continually made a student quite miserable. Dr. Bridge said, not being compelled to write a fugue, he did not write many now. But when one was looking forward to examination, it was a very great bother to find that he was not at all sure whether he would get the right answer or the wrong. The little hint about the alterations, when approaching or quitting the tonic or dominant, was an excellent one. He gathered a hint or two from a book he bought some years ago, by Kollman, who called attention to the fact that the 3rd of the tonic was generally answered by the 3rd of the dominant, and the 6th of the tonic by the 6th of the dominant. He had found that suggestion to be very useful.

Mr. Charles Edward Stephens remarked that the actual meaning of *tonal* as applied to fugue had never been fully defined. Did it mean that we were to keep to the original key, or did it admit of any modulation whatever from that key? If the key-note was to be answered by the dominant, then, as we must have dominant harmonies, the C natural in the answer now before the meeting should be C♯. He had found books differ altogether in the deductions made, simply because they had not started from any positive premisses. Perhaps Mr. Higgs could resolve the little difficulty, and tell what was actually meant by a tonal fugue.

Dr. Bridge said there was one place in Kollman's book in which he said the scale of the 5th in which the answer was to be made must appear as the upper part or scale of the key-note, and not as a substituted scale of the 5th, and he gave as an example a subject which he said was given by the king of Prussia to Bach to extemporise upon.

Mr. Stephens observed that that was not the dominant harmony of the minor key in which the fugue was written.

Mr. Higgs stated that he was not prepared to go into definitions at all; but his opinion would be entirely in agreement with what seemed to be the statement in Kollman. If the subject he had been bringing forward that afternoon had been in D major instead of D minor, the answer would have used C♯.

Mr Stephens said the second bar in the answer No 2 in the paper before the meeting was clearly in A minor. He could not call that a tonal answer; strictly speaking it was a transposition.

Mr. Higgs observed that Cherubini said the chords of the tonic would be reprodnced in the chord of the dominant, that is in the harmony of a fifth above, major or minor, according to the original key.

Mr. Stephens drew attention to the fact that the answer No 2, with the single exception of one note, was a pure transposition. The whole of the answer read in A minor, and but for the key-note going to the dominant, and answered by the dominant going to the key-note, it was a real fugue to all intents and purposes.

Mr. Higgs said it would be found that the characteristic of most tonal answers was that the least possible alteration was made.

Mr. Stephens repeated that what is a tonal fugue had never been accurately defined.

Mr Banister said his idea had been that in certain subjects there was necessarily an alteration in the interval, in order to prevent modulating beyond the dominant; and that in such cases the fugue was tonal. Where no such alteration was necessary, no modulation taking place in the subject, the fugue was real

March 5, 1877.

Professor W. H. MONK in the Chair.

ON THE PHILOSOPHY OF HARMONY.

By W. Pole, Esq., F R SS L. & E., Mus. Doc. Oxon.

Dr. Pole began by stating it was not the object of the paper to meddle with the practice of harmony, as determined by the best composers, nor with the teaching of harmony, so far as it was of a practical nature. Students must be taught what they were to do, and their instruction was generally efficient and admirable. But the writers of books on harmony were often not content with practical teaching; they thought it necessary to bring forward systems and theories with the object of explaining, deriving, and accounting for all the facts of harmony on grounds of natural necessity. The first who attempted this was Rameau, in 1722, who was a philosopher as well as a musician, and whose system, though it did not go far, was novel and useful, and laid the foundation for all that had been done since. But harmony had much extended since his day, and later theorists had supplemented Rameau's principles by theories and hypotheses of much more doubtful authority; hence had arisen a host of different systems, so conflicting and inconsistent that, instead of aiding the study of harmony, they were only calculated to throw stumbling-blocks in its way. A reaction had set in, and many of the best authorities had lately been inclined to doubt the possibility of explaining all the facts and rules of harmony on natural principles; many opinions to this effect being quoted in the paper.

But it would not do to go to the other extreme, and suppose that there were no relations whatever between harmony and natural phenomena. Such relations did undoubtedly exist, and their study formed what the author termed the 'Philosophy of Harmony,' the object of this study being to trace out, in a logical manner, and on philosophical principles, how far what we know as harmony in a musical sense is really founded on natural laws, or how far it is the result of æsthetic taste, a domain into which science cannot enter.

It is only lately that such an investigation has been possible, inasmuch as the physical nature of musical sounds, on which it must necessarily be based, was obscure, until such great light was thrown on the subject by the recent acoustical researches of Helmholtz. These, when better understood and appreciated, would probably tend to create a revolution in our modes of thought on musical theory.

In such an investigation it was desirable to use great caution in the argument drawn from an appeal to the ear. It had often been assumed that what our ear approved must be naturally right, and what it disapproved must be naturally wrong; but it must be recollected that the ear appealed to was not a natural ear, but one trained by habit and education to approve or to disapprove the things in question.

Harmony consists of several notes sounded simultaneously; but in such an investigation as the present it would be desirable to begin with the simplest possible combinations, namely, those of two notes together. There had long been an understanding that some of these combinations were more agreeable than others, and they had accordingly been divided into two classes, called consonances and dissonances. But the philosophical question at once arose, What was the true meaning or cause of this distinction?—had it any real foundation in nature, or was it merely empirical or conventional? The author alluded to various attempts made from time to time to answer the question, particularly the theory of the *simplicity of ratios*, as admirably worked out by the celebrated Leonard Euler; after which he passed on to the more modern and complete physical explanation of consonance and dissonance offered by Helmholtz, based on the roughness caused by the interference of beats in the harmonies of compound sounds. This was by no means easy to understand in the original work, but the lecturer gave an explanation at some length, aided by a series of diagrams, which had the effect of representing to the eye the complicated effects produced on the ear. He then exhibited the results in a table, which showed the various degrees of dissonance of the several combinations of two notes in ordinary use.

These results were remarkable, inasmuch as they showed that there was no definite line of demarcation, in a natural sense, between consonances and dissonances; they merged into each other; and all that could be said was that, generally speaking, the consonances were near the smooth end, while the dissonances were near the rough end of the scale. Hence the broad distinction drawn in practical music must be based on technical, rather than on natural grounds.

Passing on to harmonies of several notes, or what were called chords, the lecturer showed that every chord consisted of several combinations of two notes each, and the general effect of the chord, as regarded in its natural degree of dissonance or roughness, might be estimated by the summation of the various

elements it contained. In this way he had constructed the following table:—

COMPARATIVE DISSONANCE OF CHORDS.

Concords	
Major triad	28
Minor triad	28
Discords of Three Notes	
Diminished triad	81
Augmented triad	53
Italian augmented sixth	43
Discords of Four Notes	
Dominant seventh	97
Major triad with major seventh	103
Seventh on supertonic	74
Seventh on leading note	97
Diminished seventh	119
Augmented triad with major seventh	117
Augmented triad with minor seventh	123
German augmented sixth	87
French augmented sixth	103

This table did not take into account all the elements that affected the ear (as, for instance, the discordant combination-tones in the minor third), and therefore it could not be expected to be a perfect representation of the practical effect of the various chords, but still the general correspondence of the results of physical dissonance, thus reduced to actual figures, with the admitted musical character of the combinations, was a proof that this character had a real foundation in nature.

The lecturer remarked that a good deal might be said, in the way of philosophical discussion, in regard to each chord separately; but he had only time to speak of the two most important, namely, the major and minor triads. He pointed out the natural origin of the former by its existence in the most prominent harmonics of compound sounds, and showed that this was the foundation of Rameau's system. It was a consequence of this that there should be one important note from which the whole chord might be assumed to spring, this Rameau called the *générateur*, and English musicians the *root*. In regard to the minor triad the case was different, as no such natural origin could be traced, except very remotely, and hence the chord was of a more artificial character. For the same reason it had no generator in Rameau's sense, and the word root applied to it usually by English musicians must bear a more restricted or conventional meaning. The difficulties in regard to the application of this term increased with more complicated chords, and were, in fact, the chief cause of conflicting theories. Hence it was suggested that the meaning of the word root, as usually employed by English harmonists, should be better defined. The modern Germans appeared to have given up the idea of deriving every chord from some one note as a root, for no such idea

appeared in the latest and most authoritative book on harmony, that of Richter, the head of the theoretical department at the Leipzig Conservatoire. He sometimes used the word *Grundton*, but he only applied it to the lowest note of the chord in its normal position, and never to an imaginary base outside the chord. The idea of natural derivation could not consistently be carried out for complicated chords, and there was no option but to consider them as of artificial construction.

The lecturer said he had no opportunity of going into progressions, resolutions of discords, and other harmonic rules; if he did, it would be found that physical science would be still more at fault, for, although it was possible to show good motives for many of these things, yet these motives would be found to be of an artistic and æsthetical character, and not arising out of any natural necessity.

It must not, however, be imagined that the rules were, on that account, less binding on students of harmony. There had been great mistakes on that point; and, in fact, the chief reason why writers on harmony had invented their theories and systems was that they conceived such theories were necessary to warrant the inculcation of the rules. Such was not the case; an æsthetical motive was as good a warrant for a rule as a physical one; and hence the philosophical study of harmony, though it might correct hasty and erroneous theoretical views, did nothing to check the practical authority of the great composers, or to diminish our admiration and respect for the immortal works they had left behind them.

DISCUSSION.

Mr. ELLIS said he would begin with some of the last things Dr. Pole had alluded to. The form of calculating the roughness of a whole chord was very enticing, and at first glance it seemed perhaps to lead to correct results. But they saw the major chord and the minor chord producing precisely the same figures, because they both had the 3rd and the 5th, and the inversion of the one was the same as the inversion of the other; and yet they knew that where a major chord was interposed and a minor chord was interposed the difference was exceedingly marked. There was no mistaking one for the other. He was talking, of course, of pure chords, and Dr. Pole also dealt entirely with them; that was, chords in which the notes were exactly in the proportion represented by the figures in the diagram. Of course in ordinary music they were not such, and therefore ordinary musicians had not the power of hearing them. Although he had an instrument tuned twelve years ago, as well as he could

tune by the ear, for the purpose of studying the effects, yet he had never had any opportunity himself of hearing the exact relations until last summer, when Appunn exhibited his tonometers in the Loan Collection. He was there three days for the purpose of exhibiting them to those persons who wished to hear them, but he was very sorry to find very few practical musicians came in to hear them, when there was no other means of doing so. The study of the chords which he had made on that instrument, which was not yet complete—but he hoped it would be complete in the course of the year, for he was glad to say he understood the instruments were purchased by the South Kensington Museum—had led him to many considerations which he did not find sufficiently expressed in Helmholtz, or even by one who had supplemented it a good deal by investigation, namely, Professor Mayer. With regard to the minor chords, there were three forms, all of which required consideration. One was the usual one, where the relations of the vibration to numbers were 10, 12 and 15 in the closest form. But those were so very high as harmonics, that of course harmonics at that height were of no consequence to the ear. He would say, however, that in studying the minor third, 16 to 19, which was alluded to by the lecturer, he was able to demonstrate the effect of the 19th harmonic in as high an octave as that in which those notes were written. That had a very remarkable effect. It was only done by observing that there were two sets of beats which arose in chords. One set arose from the beat of the partial tones, which were all simple ones, and which were always very fast, generally once or twice the number of vibrations in the lowest tones, and which occurred when you had a sufficiently strong tone, with a partial sufficiently reinforced. When they heard the 32 and the 64 of Appunn, with the conical tubes attached to it, the rattle was so obvious that they could not hear the tone, and he had come to the conclusion that it was not, properly speaking, by the partial tones of the root that they had to study chords, but by the harmonics which he distinguished from the partials. The harmonic thus produced was not a simple tone; it was a compound tone of a peculiar character, and he proposed to confine the term harmonics to fundamental compound tone; that was, all compound notes which were built upon the partials of that fundamental tone in their lowest partials. That was to say, if the fundamental one had 12, 24, 56 as its partials, then if he began on 2 and got 24, 68, and so forth, he had one of its harmonics; the one that was really produced upon the harp or the violin when touched in the middle. If they began in 3, and got 3, 6, 9, and so forth, that was another harmonic. All the general chords arose from using the harmonics which, when united together, would produce nothing whatever but the partials of the fundamental tone, reinforced in different ways, and therefore making the two beats between the partials which were within the beating distance more distinct than before; and therefore, when only taken a few

at a time, producing effects so different from the original tone, that the artificial tones were recognised, and had been dealt with as something entirely different. Those beats there arose, for the harmonics thus formed might go on to any extent; not merely the audible partials, or the partials which could be made effective by beating with other beats, because they could always, upon any harmonium of four octaves, get a 16th exceedingly distinct, for if they made the lowest C sound, and then just slightly depressed the highest C, they would hear the beats arising from that flattened octave very clearly and distinctly But, he was going to say, that those of the beats which they heard were only the beats which would arise to the fundamental tone itself, provided the partials were audible to a sufficient height, and were sufficiently reinforced. That was very distinctly shown in Appunn's apparatus. Then, if they made the lowest tone very low, the partials became lower, and they came then to that which Helmholtz only vaguely knew, and which Mayer, as he had shown in the 19th Appendix, had more definitely shown, namely, that the beating distance depended on the pitch of the lower note; and that in a very deep bass there was a possibility of hearing the beat when the simple tones were two compounds; but it was only certain simple notes of them which did beat, and the others went on not beating, therefore rendering the beats more difficult to get. He desired to point out that in all those which were formed as harmonics there were necessarily coincident tones. Those he rather called coincident tones. If, then, they had a slight amount of tempering or flattening or sharpening of any one of those it would produce a dissidence, and those dissident beats were totally distinct from the rattle of the partials which arose even in the best chords they could form. They were much lower, and very much more annoying, for the annoyance of the chords did not so much depend upon the number of the beats as upon the interval between the two notes that beat. Helmholtz had partially pointed that out by showing that 33 produced a great number or series of chords, but with different effects according to the part of the scale in which they were produced. That was a most essential principle, and one which ought to be studied very much by composers, especially by those who wrote for the orchestra; because it was by separating the instruments properly, that they could produce the different effects of smoothness and roughness upon which so much depended. The dissident beats which were inevitable at present were totally different He had the opportunity of hearing this the other evening at Exeter Hall, when Mr Prondman was giving a demonstration with a choir of more than 100 voices, which sang partly without accompaniment and partly with. Without accompaniment the chords were all in tune, pure chords. When the organ, however, played, the chords were pulled aside from one and, and all the dissident beats came into play. During the last two lines of the chorale of Bach his ears were so pained

by those dissident beats in every chord that he could not hear the music. That was part of the acoustical theory upon which music was built, and it was only when those beats were not brought into great prominence that the ear could endure them. Helmholtz was the first to point out that we could endure such things as affect the flattened 5th to the ordinary equal temperament, and which must be expressed as a ratio in the most complicated numbers possible. He thought temperament had upset the whole theory of the simplicity of ratios from first to last. But when it came to be considered how it was that the larger numbers produced that effect, it would be found it was simply that the ratio expressed in larger numbers was reduced to its convergence; that was to say, when they obtained the simple ratio which was the nearest to it, it produced beats arising from tempering or mistuning that particular ratio. He was going to say there were three minor chords, 10, 12, 15, and there were 16, 19, 24, which was the one which Appunn himself said was the finest and most beautiful. And in his harmonium, which unfortunately was injured in passage, he had two rows of keys especially added that they might hear the effect of those chords. He had, however, studied them upon his instrument, and did not like those so well as the others. But they had one advantage which especially told in the harmonium, and which was that the differential tones, to which Dr. Pole did not allude, were more in harmony with the notes of the chord than the differential tones which arose from the ordinary minor chord. Helmholtz, as they who had seen his book would recollect, had especially dwelt upon the action of the differential tones as determining the extreme difference between the minor chord and the major chord which was always felt. But the other minor chord was very much simpler and not at all a bad chord, and that was the one which Poole wished to introduce, namely, 6, 7, 9. Those were very simple numbers, and it was a very good chord. The difference between a chord 4, 5, 6, 7 and the ordinary one, taking the subdominant of 4, 5, 6, 7 and a 9th, was that when you passed from one to the other, it was something perfectly awful. He had shown it to large audiences and to numbers of persons, who had been struck with the difference. They saw, therefore, that in playing on a tempered scale they would only get a kind of rough sketch of what harmony and music really were, and to argue merely from a theoretical knowledge and not a real knowledge of the effects of these ratios was rather a hazardous inquiry. Considering that their harmony was based originally upon a tempered scale, namely, on the mean tone scale, although modern harmonies went upon the actual temperament, and therefore had a very much greater range than the former harmonies, the rules which were deduced from those must have been practical rules. It was a well-known fact that two tuners would hardly ever tune the same piano with the same fork in the same way; and two tuners, in different rooms, would certainly not

make pianos agree note for note. Helmholtz had given a very simple rule which was exceedingly convenient, by following which they would never be the tenth part of a fraction out.

Dr STAINER said he had been so much pleased with what had fallen from the lecturer, that he had only to thank him. He thought that musical men might be said to have very wrongly used the term, theory of harmony; but books had been usually headed with that. He would like to tell Dr Pole a fact which he might not know, but which carried out his theory of the probable fact of intervals being divided into perfect and imperfect. In an old Latin treatise, the author of which he did not remember, he found intervals divided into three heads—perfect, medium, and imperfect. Perfect intervals were stated to be the unison of the octave, the medium were the 5th and the 4th, and the imperfect were the 3rd and the 6th. That was of great importance, because it showed that the division into a hard and fast line of perfect and imperfect intervals was really practically a modern division. As regarded the very difficult question why it was that such intervals as the augmented 5th, which musicians of course had to treat as discord, should really find their way amongst the chords, he thought the explanation must come from æsthetical grounds. He did not wish to enter into the question of tempered or untempered intervals; and as regarded the use of the word 'root,' he entirely agreed with what the lecturer had said. He thought some word was wanted to express, not the natural generator, and not merely the bottom note of the chord. They wanted something between the two. He had used the word 'ground-tone,' but he did not think it a good one. They wanted a word which would not be the root and not the base note of the chord, but which should imply a key relationship to the note above.

Mr BOSANQUET said some doubt existed as to the correctness of Mayer's interpretation of his experimental results, with reference to their bearing on Helmholtz's theory of the ear. The question was, what became of beats when they passed a certain number, say when they were considerably more than 100 per second? How did they affect the ear? Mayer tried to solve this question by taking a continuous note, and interrupting it many times per second, until a continuous sound was produced; he then inferred that beats consisted of analogous interruptions of sound, and would, in the same way, give rise to a continuous note. The objection to this direct inference was, that successive beats were in opposite phases, and tended to neutralise each other's impulses, and not to maintain them. Suppose the little moving thing in the ear, which communicated irritation to the nerve terminal, to have its motion represented by a small fly-wheel, as all pendulum motions could be represented, then the series of impulses in Mayer's experiment fell on a fly-wheel like a series of pats which were all in the same direction; under these circumstances the motion might be maintained, and a continuous

sensation of sound communicated to the nerve terminal. But in the case of beats, the impulses from successive beats acted like a series of pats succeeding each other in opposite directions, and if they ever could go fast enough to run into each other, which was doubtful, the ultimate effect must be to keep the little wheel at rest, since the total impulses in the two directions would cancel each other, and there must be silence. Mayer's experiments were therefore not directly applicable to the use of beats, as the speaker and others had formerly supposed, but they had a meaning of a different kind, out of which data could certainly be got for the treatment of beats. They gave direct determinations of the rate of extinction of sound in the ear, but this was only applicable to the case of beats with the assistance of calculations other than those employed by Mayer. The speaker entirely agreed with everything Dr. Pole had said at the beginning of the lecture as to the office of the philosophy of harmony, and thought it best to found treatises of practical music on the experimental facts of the existence of consonant intervals, octaves, fifths, and thirds, and so on. One could go and tune these for himself, and they were the actual things from which music originated. The object of the philosophy of harmony was to be kept distinct from that of practice. We liked to know the causes of things; but this study was not essential for excellence in practical acquirement.

In reply to Mr. Ellis, Mr. Bosanquet said that the difficulty about beats being in opposite phases had been pointed out to him by Lord Rayleigh.

Mr. Stephens said Dr. Pole had made some remarks upon the value of doubling notes at a very low part of the scale. He would mention a reason. Nature herself pointed out, at the very commencement, that the intervals were wide, and as the scale proceeded they became close. So that a chord distributed in that way, with a broad interval at the bottom and narrower at the top, had necessarily a better effect. As Dr. Pole's remarks had all been of a practical tendency, he would like to make one observation. Rameau, whom they must always mention with the highest esteem and respect, was supposed to be the discoverer of the theory of the inversion of chords. But there was no inversion of chords: it was simply selecting intervals of the same notes at different parts of their production.

Dr. Stone said perhaps the point was partly physiological. Inquirers seemed to be divided into two camps, and he belonged to a certain extent to both—the mathematicians and the practical musicians. But if they took it in a physiological sense, it would be seen that it depended a great deal on education, and still more was a question of the laws and of the power of the senses. This question ran through the whole of that branch of acoustics. Some of the illustrations were so striking that he was justified in mentioning them, because he hoped that out of that they would get a compromise, which would suit both the camps. The accurate mathematical rendering of music was practically very difficult, if

not impossible. Was it true or not that the unspoken axiom which had gone through all speeches and writings was part of the constitution of things which they looked for? There were many pleasures which were very akin to pain. There were many agreeable sensations of the body which if carried a little beyond a certain point were absolutely disagreeable. He believed sound came under this category. He believed the fibres of the ear, of which they heard so much, were liable to this discrepancy, as to which it was very difficult to say where the agreeableness began, where it rose to its greatest point, and where it gradually passed off into pain. Certainly the power of appreciating sound had that sort of gradation in it; because it was a well-known thing that deaf people had been able to hear better when a drummer was playing his drum beside them or when the air all round was disturbed with vibrations. They might take it in many other ways. There was the analogy of taste. Delicate taste superinduced on another stronger taste was more sensible. They might take it again on the musical side. They knew that certain instruments of a noisy character did undoubtedly enhance their appreciation of musical tone, or they would not use cymbals, drums, and tom-toms. Again, as to the question of objection to new sounds. That was a matter of history. He had been accessory to bringing certain new noises into prominence, and he had found that, not many years ago, the French horn, which was now looked upon as their most delicate and pure instrument, was regarded as a vile barbarism. They would find that in Dr Burney. Therefore, after all, it was to a great extent a question of education. Then again, he heard from an advocate of the mathematical theory, that there were two or three minor chords, but the same speaker let out in the course of a purely theoretical speech, that one was not liked so much as the other. He would only say that that was not mathematics, but was a question of æsthetics, and that the question of æsthetics must underlie all musical sensation.

Mr Ellis said he wished to refer to a paper he had read in 1864, in which he pointed out that the minor scale arose from combining with major chords, the roots of which, in the ordinary sense of the term, formed the identical major scale.

Dr. Pole said he had no objections to answer. With regard to the difference between the major and minor triad, it would be recollected that he had said there were some elements which were not taken into account, and that was one. The major and minor triad, considered by the notes only, came out as he had shown. He regretted that want of time had prevented him from noticing in the paper many important points that the speakers had alluded to.

April 3, 1877.

Professor W. H. MONK in the Chair.

MUSIC IN CATHEDRALS.

By W. A. Barrett, Esq., Mus. Bac. Oxon, F.R.S.L., &c.

I have undertaken a difficult and delicate task, in proposing to read before an important musical body a paper treating of Music in Cathedrals. Difficult, because of the risk one runs in yielding to a temptation to be either historical or polemical; and delicate, as it is almost impossible to speak on the matters necessarily connected with my subject without calling for the assistance of one or both of these qualities in order 'to point the moral' or illustrate the remarks I shall have to offer. The difficulty and the delicacy of the subject will be fully understood by those who at any time have been connected with any one of our ancient cathedrals.

It is my wish to offer a few suggestions for the continuation of that long-needed improvement in the use and management of our cathedrals which has been so happily inaugurated in recent times. I will not enter into the question of the merits of certain of these reforms, for I am sure there cannot be two reasonable opinions concerning them. I will only express a regret that they did not originate with the bodies who have adopted them, but that they were accepted as a necessity, arising from external pressure, the consequence of the unexpected forms that awakened life outside the cathedral had assumed. If they had been the result of due deliberation, instead of hasty adoption, the necessity for my paper would not have existed, and I should probably have been addressing you on a totally different matter.

It would almost seem as though our cathedrals would resist to the last changes of any sort in their constitution and management. But they have taken most kindly to certain modifications of their old practices, and this leads all to hope that it is not the

determination of Deans and Chapters to be insensible to the necessity of adopting other reasonable alterations of their ancient customs. Some of the changes already introduced are good, and some are bad. In both good and bad there is enough ground for congratulation.

They are reforms, and they have been introduced into a soil into which they are likely to take kindly root, to flourish, and to fructify, contrary to all expectation. A considerable number of these reforms relate to matters of ritual, and it is needless for me to say that as they do not come within the scope of my subject, I do not propose to touch them.

The present time is one in which music and musicians are receiving a worthy recognition commensurate with their position and profession. Musicians have earned the right to speak, and can command some attention for what they have to advance. I therefore feel no hesitation in making a few statements with respect to the condition of Music in Cathedrals, both as regards the art and its adherents. I shall probably speak of matters upon which there are still divided opinions, but as I desire to learn, as well as, I hope, in some sort to teach, this part of my subject may be the means of eliciting valuable opinions on questionable points.

After these remarks, you will perceive that the delicacy of the questions at issue is equal to their difficulty. I shall not, however, shrink from the task I have undertaken, however it may be treated. I believe that I shall be able to find sufficient sympathy among those to whom I address myself, to encourage me for calling attention to one or two of the peculiarities connected with the theme I have selected. I shall endeavour to condense my remarks into a small compass, and, for the sake of method, propose to arrange my observations so as to make them relative to those officers and offices concerned in the provision, the ordering or regulating, and the performance of Music in Cathedrals.

With regard to the first-mentioned of these—the provision of the musical force in our cathedrals—I think we have much to learn. In those places where the change has not already been organised, a revised treatment of the choristers might not inaptly inaugurate reforms in all other departments. The education of the choristers should be of the highest and most carefully devised character, to fit them for the service of the Church while they are attached to it, and to qualify them for competition with the world when they are sent adrift. The manner in which choristers have been—and in many places yet are—treated in cathedral schools, is simply disgraceful. Their statutable rights have been placidly ignored, their musical tuition too often so neglected, that at the end of their time they are frequently ignorant of the very alphabet of their art, and their religious and moral culture is so shamefully disregarded or overlooked, that the familiarity with sacred things has brought with it, for them, the proverbial result of familiarity. Those who know the life of a chorister of this

pattern know that nine out of ten of the children of a choir, when their voices are broken, never set foot in the building in which they formerly ministered, although they may be living near it.

It may not be necessary for me to say how important it would be for the welfare of a cathedral, and for the furthering of its interests, that the sympathies of all, young or old, in any way connected with the establishment, should be enlisted and strengthened in the support of the true work a cathedral should have in view. The cathedral of a city should be to the religious life of the district what the heart is to the body—the centre of action.

It may be hoped that one day our cathedrals may be made the centres of musical as well as of theological instruction and knowledge. Then the ability in music displayed by the child may be so regulated and developed in the young man, that he may become an honour to the place to which he was formerly attached, and nothing he has learned be lost either for himself or for society. Supposing that it was discovered in due time that God had gifted him with a voice worthy of taking part in the service as a man, no one would be better fitted by education and training to hold so important an office in the Church as that of lay-clerk. If, however, neither in voice nor inclination should he be qualified to take his part as a musician, would it not be well to make the endeavour to utilise the knowledge he has already acquired, by employing it as a foundation upon which to erect a superstructure which would fit him for some of the minor clerical or lay offices necessary in a well-ordered parish? I am of opinion that the work of the Cathedral and of the Church will be greatly aided and advanced where there is a strong staff of officers educated according to one design, drilled to one purpose, and having in mind one object. Cathedral service will be a different thing to what it is at present, with all its divided interests. In order, however, to secure so desirable a result, not only must the children be well looked after, but the rulers should be better chosen. The system of appointments must be altered. The higher officers should be selected as the lower ones are, not for what they *have* done, but for what they have to do. No capitular body with any degree of wisdom, either worldly or clerical, would ever think of appointing lay clerks or choristers because they had been of service somehow or somewhere before they were placed in their stalls in the cathedral, unless there was a reasonable hope of having a large amount of work out of them afterwards. Cathedral offices, from the highest to the lowest, should be given as trusts, not as rewards; and if the State is to retain the privilege of presentation to the clerical dignities, place-hunters and office-seekers should be ignored in the appointments. Because a man had served this or that party in the State, he should not necessarily be remembered; for no cleric is justified in meddling with politics, not even if his scholarly abilities are so hopelessly below mediocrity as to render his chance of promotion for his learning extremely doubtful. If, however, politics are considered useful plaything

for the clergy, for those who determine upon making use of this particular line as a means for promotion, a special purse should be made out of the State funds, and all schemers should be kept in their original cures, although more money might be allowed them as a solace for their advocacy. But the stalls in cathedrals should be given to those whose previous life has been such as to create a confidence in their integrity, and no fear that the solemn trust of a cathedral office would ever be abused by them. If this had been the case in past years, many of the scandals which still cling to the skirts of capitular vestments would never have been cast up to disfigure them.

The office of lay-clerk, which many who hold make as honourable as the offices held by those who confer, and are supposed to regulate it, might never have been an office of pity and contempt, exposing the holder to all the unseemly slights the ingenuity of the capitular mind can devise, if the value of the office had been understood by those who occupy and those who regulate it. Here, again, the dawn of new feeling gives promise of a better regard for this office and its holders, but still there is much yet to be done to remove the contumely of centuries.

There is no doubt but that the services of the lay-clerks in many, if not in most cathedrals, are valued not according to their actual worth, but according to the money value given for them. The Chapter that pays little justifies its payment by a corresponding small estimate of the ability of the recipient. This is the way of the world, and capitular bodies are not yet out of the reach of worldly considerations and influences, as well as worldly ways of thought, to hope for a thorough reform in this respect. The lay-clerks in many instances have themselves to thank for the low ground upon which they are placed as citizens of the world; for instead of maintaining a proper sense of their own dignity by a superior behaviour when not under the influence of a special fear, they very frequently do injustice to themselves and to the high office they hold (however inadequately such office may be paid), by consorting with the lowest and the basest, and so contracting habits which make their name and title a 'scoffing and a hissing.' The love of worldly approbation, the stimulating food which nourishes every artist's life, is the secret of this failing. Is it not possible to turn even this peculiarity to good account? The lay-clerk in a cathedral is a sort of Ishmaelite in the sanctuary: belonging to, yet unregarded by the more prosperous members of the same family. He is frequently kept to his work with a surprising degree of severity, and his conduct during service is watched with a view to present or future punishment, summary or cumulative. Outside the cathedral the authorities take no more notice of him than of the least regarded thing they must of necessity come in contact with. Where he lives the Chapter Clerk knows by his books; how he lives, and after what manner, is a matter of concern only to himself; and so long as he is present in his place, and at rehearsal, no one cares what becomes of him

or how he spends his time I do not think this is the right course to adopt. I think that the authorities might show a little more interest in the concerns of these their poorer brethren on a principle of policy, if not on a higher ground, for too often the lay-clerks of a cathedral, knowing how little sympathy there is between themselves and their rulers, doggedly oppose Chapter decrees with the least show of reason, even when they are for mutual advantage. The common point of interest, the welfare of the cathedral, and the benefit of the Church, should be made the point of common concern, and all connected by one bond should have common cause. It is needless to specify here the disadvantage arising from a house divided against itself

The want of sympathy between the holders of statutable offices in a cathedral is much to be regretted It has led to a sort of internecine war, the more powerful attempting to absorb, if not wholly to destroy, the weaker. It is true that the lesser corporations found in most cathedrals have been greatly abused by the several members, but is it not also true that the members of the greater corporations themselves set the example of misusing trusts? Is it because of the remembrance of this that cathedral officers are often divided into a series of what may be called factions? Even where these do not exist, there is much that might be mended

In no other community of men are there so many marked and insurmountable barriers between the officers as there are in cathedrals The great Duke of Wellington said once, that in taking part in the service he felt of no more value in the eyes of the All-seeing than the poorest labourer on his estate; that all men were equal in church. I am afraid, if he had had experience of cathedrals, he would probably have modified his statement. It is necessary that there should be distinctions, and that rulers should be treated with respect due to them; but I do not think it has yet been found that the work of that cathedral ceases to prosper where the dignitaries manifest a small amount of human interest in their humbler fellow labourers

The most popular officer of a cathedral is often the organist, probably for the reason that he is able to show some concern in those inferior to him in position. The organist, after all, if he be a man of tact and judgment, is the real ruling spirit of a cathedral He knows how much depends upon the right management of the choir, in order to ensure a good character in the performance of the music furnished for the daily edification of the faithful, and the consequent popularity of the place in which he ministers. The tendency of the present day is to make, and rightly to make, the cathedrals popular It is unnecessary for me to adduce examples to prove this. In former times there was a peculiarity of independence in the manner in which the cathedrals were managed, that cannot but impress the observer of the present day with an idea of amusement. Rulers now consider that the buildings and the services are held by them in trust for the pub-

lic. Formerly it was not so. The public also is beginning to feel that it has a right in structures built and maintained at its own expense, and to enter with all the pride of right, instead of the deference coming of sufferance. Services are increased and their performance improved, and naturally music plays an important business; and notwithstanding the existence of a precentor, the organist is the more important functionary.

The proper mediator between the choir and the Chapter should be the organist, from his position and connection with music. It is only in a few cases, however, that an organist is found in loyal alliance with the inferior brethren. Not that he has little feeling for his fellow-workers, but the temptations offered by that magic circle, 'the society of the Close,' often cause him to cast the weight of his influence on the side of the more powerful. The precentor, or the officer who, according to the statutes of the cathedral, is supposed to be the means of approach to the higher officers, is rarely popular with those he is called upon to rule over. The reasons for his unpopularity are needless to particularise here. In this place I would venture to suggest that the precentor to each cathedral should be a layman and a professional musician skilled in the knowledge of music. I would not, however, exclude a truly competent clerical officer, one who has graduated in music, for example, but the precentorship should not be held by an amateur, whether he be a cleric or a layman, because there always is danger of an undue tendency to favour that one particular style of music which every amateur considers it necessary to affect as his hobby, and upon the superficial knowledge of which he too often bases his claim to consideration. This suggests a further remark which it is necessary to make, in consequence of the peculiar views which both precentors and organists seem to entertain at the present day with regard to the character of the music held to be suitable for the service. I consider that every style of good Church music of all ages should be represented at one time or another during the progress of the Christian year, but I think some degree of preference should be given to that which was expressly written for the use of the Church, over that which is a mere adaptation from one popular composer or another, the representative of the hobby of the organist or the precentor. Music written by Englishmen to English words, for the English service, has a greater claim upon our attention and sympathy than any adaptation from Romish masses or other sources, however good it may be as music. I will say nothing of the growing tendency to assimilate the service of the Protestant Church of England to that of the Romish observance, by the introduction of certain uses more consonant with the character of the views entertained by the latter. I do not believe it arises altogether out of a Romanising tendency on the part of those who introduce it, so much as out of a desire to make all Christian worship of a certain degree of uniformity. That some excesses are practised in those churches that make a point of

imitating cathedrals, I will not pretend to deny; there always will be foolish people who, in the excess of their zeal, will overshoot the mark. I have every confidence in the ultimate return of these zealots and their promptere to the simple regions of common sense, both with regard to ephemeral customs and the adaptations I have alluded to. I have no desire to ask any question here why such adaptations are made; I will only say that we have unregarded treasures of our own, which to my mind speak more eloquently, because more naturally, than any adaptation, however skilful it may be. The introduction of these adaptations has suggested to many of our modern composers a system of prolonging sentences, and fitting certain expressions with corresponding scale passages, which can only be effective when treated by genius of the highest order. As it is, these vain repetitions, these falsely accented words—in short, this plan of word-worrying, is irritating in the extreme. This is especially to be regretted, for Church composers have now an opportunity which I may say has never presented itself before, and such a practice has become a mannerism, which some accept as a standard style. Our Church composers also are occasionally led away by the beauty and variety of the effects modern organs are capable of producing, to write their music in the style of organ solos, with the accompaniment of voices. The effect of this has been to destroy the beauty of cathedral singing in our choirs. There is scarcely a body of men in any cathedral in England who know how to sing a 'verse' properly, and few are capable of singing a solo acceptably. The art of cathedral singing is lost, and chorus singing has taken its place—vocalisation has given place to vociferation. It is not apparently considered necessary that the expression of the voice should reach the heart of the hearer so long as its power smites the ear. Writers of cathedral music, equal to the occasion, write theatrical and sensational stuff, knowing that it can command the market. By sensational I do not wish you to understand that I mean emotional music. I think that Church music might be made to appeal to the higher emotions most successfully. I would make as broad a distinction between the sensational and the emotional, as I would between the theatrical and the dramatic. Many of our modern Church writers confuse the terms, and write music which they intend to be dramatic and emotional, which is after all so strongly suggestive of the theatrical and the sensational, that the ordinary stage accompaniments of these things are expected as a natural sequence by the listener. Until the right-minded composer can obtain a hearing, the gaps in Church music at present existing will be filled by those who spoil a good cause for their own profit. There is a public ready and willing to receive absolutely anything that is offered in the way of supplying the demand which the awakened vigour of the Church requires to illustrate the service. Composers may write, for the public pays, and it is not necessary to depend solely upon the scanty support of the cathedrals. Music, which forms so important a

part in the services of our cathedrals, until lately has hardly received the attention and encouragement which it deserves and demands. There has been therefore no steady supply of writers, necessary to form or to continue the traditions of a school. The history of the past contains numerous instances of coldness towards and of neglect of music, sufficient to crush all ardour on the part of composers, and all interest on the part of performers, had not a few possessed an enthusiasm and love for their art which elevated them above the paltry considerations which too often influence men in other matters. But a change has taken place: composers have arisen who, like other men, reason commercially. If a man in business finds by experience that a certain branch of his trade is unprofitable, he abandons it without remorse, however much liking he may have had for it. A different feeling inspired the true musician of the past. He produced works that rarely brought money profit to him, because he was sensible of the necessity of obeying the superior impulse within himself to bring them forth. It is perhaps because those outside the world of art have been wise enough to note this peculiarity, that of the musician to produce regardless of profit, that the want of substantial recognition for the author of musical works has existed. A mechanical production has a certain marketable value. Few artificers make work for pure love, as many a true musician does. Men knew in old time, that if music of a special character was wanted, they had only to wait silently, and some genius would rise up and supply the missing need. If they desired clothing or furniture for themselves or for their houses, they were compelled to reward the labourers who minister to their wants. For the service of the sanctuary, if music was required, they trusted to chance for the supply, and then comforted themselves with the assurance that because they did not order it, they were under no obligation to pay for it. The history of music does not contain many instances of composers who have become millionaires by writing for the Church. The history of society gives us many examples of men who have made fortunes in trade. Musicians have begun to perceive that sentimentality with regard to their art is a ridiculous fancy, and that they have a right to be recognised as members of an industrial community, who, having to meet certain claims of society, in their turn make demands which society must admit. A composer of this sort feels, with some amount of justice on his side, that he has as much reason to make a market for his genius, as a carpenter has to require a profit for the work of his hands. This is quite a new experience for the musician, and one which, carried out properly, cannot fail in the end to remove his reproach from among men. The time may be near, or it may be far away, but it is surely, though slowly coming, when works of art furnished for the use of the service of the Church will become a source of great emolument, if not a fountain of honour, to the producer. The time has hitherto been retarded by musicians themselves. If they, like

other communities, were to work only according to the laws of supply and demand, and were to unite in purpose and intention for mutual protection and support, they would ensure a recognition, if not an encouragement, for all branches of their art, and for all its professors and labourers in every grade in every place. Genius would, as hitherto, be independent, but the advantage to mediocrity would be incalculable. I am seriously of opinion that all cathedral musicians, composers, or performers, until the day that they receive due recognition on their own foundations, should form a trade union or guild, so that they might be able to command a fair price for their work, whether of the brain or of the body, and so, according to the way of the world, they would receive recognition of a higher character than they do at present, in proportion to the money value they are able to demand for their services.

It may be said, as it has been said before, that there is no necessity for a trade union of musicians, that consideration should be given to the value of the special privilege in being allowed to employ musical talents in the service of the Church, even though the remuneration and the recognition be small. That the privilege has a special value cannot for a moment be denied. It should be paid for, notwithstanding, as well as any other office, for it may also be asked why it is that an equally small remuneration is never offered to others who 'minister in the temple,' and why the special value of the privilege is not equally insisted upon in other cases, if this were the time for asking questions of the sort.

If a man confines the exercise of his talents to the service of the Church, he should have as fair a prospect of reasonable reward as if he devoted himself to any other profession. I do not think that the peculiar character of the work he has to do is a sufficient make-weight for ill-paid labour. Being a man, he must perforce eat, and drink, and be clothed and housed, and bring up his children in the fear of God, and to honour the laws of society. He, therefore, should be remunerated in proportion to his position. A cathedral musician should be able to devote the whole of his talents to the service of the Church. He should not be compelled, as all are, to eke out existence by all sorts of shifts and ends, frequently undignified and uncongenial, and too often to the scandal of the society to which he belongs, and the place to which he is attached. Everyone, therefore, who has the gift of music in any degree is justified in taking his talents to the best market. I cannot help feeling and expressing a doubt, however, whether the cathedral is the proper market for much of the stuff supplied. I doubt, also, whether many of the works printed are calculated to bring a creditable estimate of English musical genius, either in the present or the future. Cathedral music, like the cathedral service, ought not to be influenced by the wind of passing popularity or flying fashion. I am perfectly sure, of course, that the good alone among these compositions will survive, and that the poor will die a natural death, but I do not think *that* consolation

sufficient for all that must be endured until such times come. I think that the cathedral writers ought to approach their work with a greater sense of responsibility than they do. No man has a right to live a selfish life, or to regard the present as final and conclusive for him, not even a modern composer or a cathedral organist; something must be done for posterity, if only out of an ordinary feeling of gratitude for inheritances enjoyed. We may do all we can for the elevation of music in cathedrals, we may institute improved methods for the nurture and education of choristers, we may exalt the position, and augment the salaries of the several officers to whom the performance of the music is entrusted. We may make the services worthy of the building in which they are given and the traditions connected with them; but until the cathedral composer learns to employ the liberty allowed him with a less degree of licence than at present, the works of the old writers will stand as memorials of reproach for ill-used talents, and our cathedral music transmitted to posterity will go down, if not as a sorrow and a shame to us, at all events as nothing in any way worthy of our extended and extensive knowledge of the art.

DISCUSSION.

The CHAIRMAN said this was a most interesting and trenchant paper, containing sentiments with which he believed they would all not only agree, but which had long been with some of them almost part of their daily life. He could not himself claim the honour of being connected with any time-honoured cathedral, but it must not be supposed on that account that he was at all indifferent to their condition. He believed the publication of this paper, with other things of the same kind, could not fail to tell on the prospects of cathedrals in the present day.

The CHAIRMAN said he believed Mr Oshorne had been a cathedral organist, and perhaps he might have something to say on the subject.

Mr. G. A. OSBORNE said it was quite true that he began life as an organist at Limerick, and he was happy to say that he looked back with the greatest pleasure to that period of his life. His father was a lay vicar and organist of the cathedral, and he very frequently officiated for him, so that he might really claim to have been organist. It was said *On revient toujours à ses premières amours*, and whenever he went to Ireland, as he did every year, he always attended St. Patrick's Cathedral in Dublin, put

on a surplice, and joined in the choir. His conviction was, that you could not have a more perfect basis for musical education than a knowledge of Church music, because it gave a sobriety which was always an advantage. He could not say that he had done very much which displayed that quality, because he was called a popular composer, but he could plead, like the apothecary in 'Romeo and Juliet': 'My poverty, and not my will, consents.' Writers like himself were called upon by the publishers to produce works at a moment's notice, and under those circumstances all that they could do was to make their pieces as effective as possible, so as to please young ladies But still, whilst he had been writing pianoforte music for them, he had also considered it necessary to write other things, and he had produced trios for pianoforte, violin, and violoncello, a sestet, and two overtures, besides the duets in conjunction with De Beriot He mentioned this to show that all those who are obliged to write to suit the market should consider that if they wished to put forward any claim to the respect of their fellow musicians, they should also strive to provide something better. He was always delighted on hearing Church music, had a considerable library of it at home, and never passed a Sunday without playing some of it upon the pianoforte He not only went to cathedrals, but also to some of the highly ritualistic churches, where adaptations from masses are produced, and though he should much prefer hearing them as they were intended to be performed by Mozart and Beethoven, with orchestral accompaniments, he could not help feeling thankful for the opportunity of hearing them even as he did.

Mr. Benson said one great thing which struck him in the paper was the anxiety Mr. Barrett showed as to the well bringing up of the choir boys, for if they were not brought up well it was impossible that the future choir should consist of well educated and intelligent singers and musicians. He was very pleased, therefore, to bear testimony to the care bestowed by the Chairman on the boys under his care at King's College To him his own boys owed a great deal, for he not only took care of them musically, but in other ways as well.

Mr. Higgs expressed his cordial approval of everything which Mr. Barrett had advanced.

Mr. Stratton said he never had the honour of being connected with any cathedral, but, considering some of the statements which had been made, perhaps it was not so much to be regretted as at first sight it appeared. Mr. Barrett, in mentioning the reasons why the clerical authorities should treat musicians better, referred to the ground of policy, if not a higher principle. He had no objection to make to that, but he did think that in music they ought to insist on everything being done from the very highest motives. He had often heard clergymen appeal to persons on the ground of expediency, but his opinion was, that nothing was worth doing from a low motive. It was possible that even the

decadence of cathedral music might be owing to the prevalence of these low motives, people looking simply to that which paid for the time being, instead of to that which was really true in art; but a true musician could never think of anything but of following the dictates of his artistic conscience. All their efforts, therefore, for the reorganisation of musical arrangements should, in his opinion, be based on the very highest motives only.

The CHAIRMAN wished to remark that no credit whatever attached to him in reference to the matter to which Mr. Benson had alluded. It was true he had had the pleasure of having three of that gentleman's sons in the choir at King's College, but if the result was satisfactory it arose from the plan pursued by the Council of the College. The choir-boys were simply part of the collegiate institution, and received their education like any others. The plan arose some thirty years ago, and he had been simply one of those who had the pleasure of carrying it out. If the various cathedrals had only followed a similar plan, probably one great evil of the past system would long ago have disappeared. He remembered that some years ago the Rev. Mr. Whiston, of Rochester, made a great onslaught on the practice of the cathedrals in that particular, and published a pamphlet in which he proved beyond a doubt, by reference to ancient and incontrovertible documents, that the boys were entitled not only to schooling, but to be supported in the cathedral, and afterwards at the university. This was very far from being carried out even with the present improved arrangements, but they might hope that the activity shown primarily at their own cathedral, and more lately followed at Westminster Abbey, would have the effect of stirring other cathedrals to like exertions. He remembered with much regret such an occurrence as the withdrawal of the sons of a cathedral organist from the choir, in which they had entered, because of the impossibility of persuading the authorities to give them their proper statutable education. If he were not mistaken, it was the right of every boy who did duty in the Abbey of Westminster to receive his education in Westminster school, and an attempt was made within his recollection to carry that point, but unsuccessfully, he regretted to say. Another institution which might be adduced was that of the King's School at Canterbury, in which, there was no doubt, the boys of the choir had a statutable right to be educated. It was evident, therefore, that the intention of the founders of the cathedral system was that the boys should not be merely paid choristers, but that they should be educated and maintained. Might it not also be said that the cathedrals, as corporate institutions, had not in any fit way fulfilled their duties towards the English composer? It was true they might point with pride to a collection of compositions for the Church which they might declare without hesitation to be worthy of her service. Even the Romish Church, with all the advantages that her children had for centuries enjoyed, could not boast of a finer collection of

Church music than this which had come down to them from their forefathers; but it must be acknowledged that they owed the Church music written by Gibbons, Rogers, and Purcell, and their successors, to S. S. Wesley: not to the fostering care of the institutions under which they lived, but to their own love of their divine art. Might not the cathedrals do more for the encouragement of compositions as a part of their mission?

Mr. BENSON said there had been an improvement lately with regard to the boys at Westminster, and within the last three months a house had been furnished and every comfort provided for them. Their education was also better attended to, but they had not yet the privilege of attending the Westminster school.

The CHAIRMAN said they were no doubt on the eve of improvement, but it was not due to the cathedrals themselves, but to public opinion acting upon them; and like every other improvement, the influence came not from above but from below.

Mr. BENSON remarked that the father of Professor Walmisley, of Cambridge, was a choir boy at Westminster, and was educated at Westminster school.

Mr. MURRAY thought that, looking at the results, cathedral schools could not be quite so bad as was represented, because Mr Barrett, whose paper he had listened to with pleasure, was brought up in St. Paul's school, and he believed some of the best music was written by men educated in cathedral schools. Sir John Goss, Dr Blow and Purcell, were all cathedral boys; and though, no doubt, if they had had the advantage of a classical education, might have produced finer work, still there was no need to be ashamed of their productions. At the time of the Reformation, certain institutions, such as prebendaries and precentorships, were founded in order that what was called learned leisure might be provided for men who could follow particular studies which it was thought would never become popular, but by and by these things fell into obeyance, little encouragement was offered towards leisure, learned or otherwise; a school of music was never formed, and composers of all times wrote the greater part of their Church music simply for the shop. Nevertheless the musician who wrote from the love of art was sure to produce something which would live when all modern music had died out. He believed the old cathedrals were the best schools for music, for many of the men who had made a mark in this country, either as singers or composers, had learned the principles of their art from the cathedrals.

Mr. A. J. ELLIS, F.R.S., asked leave to make a few remarks with regard to the pitch of cathedral organs. He had been examining the question of pitch a great deal lately, and he found that the organ of Trinity College, Cambridge, was examined about 100 years ago by Dr. Robert Smith, who determined that the D in the higher octave gave 524 vibrations, which was not a high pitch for C, so that it was a whole tone lower than at present.

He had a fork tuned to the C of the Hampton Court organ of Father Smith, which he had not yet measured absolutely, but he believed it was about 480,* and when they recollected that 512 was now considered a very low pitch, it would show that this was more than a tone lower than the pitch at present used. With regard to the music played on these organs, if it was intended to be sung at the same pitch, which undoubtedly it was, it must have been about a tone lower than would be given at the present time; in other words, it would be necessary, for playing upon organs of the Philharmonic pitch, to transpose the music a tone lower in order to produce the effect which the writers of music at that time intended. With regard to Handel's works, they possessed the fork with which he conducted the Messiah, the last time it was performed at the Foundling Hospital; it was an A fork, of 426 vibrations, equal to about 510 for C, and therefore about five-eighths of a tone flatter than the Philharmonic pitch of the present day. The consequence was, that an oratorio would have to be transposed a semitone in order to give it the same effect which Handel wished to produce, and this became very important in such cases as the Hallelujah Chorus, where F♯, G, and A, had to be sustained by the soprano voices, while the other parts had to take a subordinate position.†

Mr. Barrett said it had been his desire simply to offer a few suggestions towards the improvement of the Cathedral system, and it was his wish especially, that many things which were on the eve of being amended should not be marred by a too great haste. The Cathedral system was one of long growth, and he thought the reforms should be matters also, not of equally long growth, but at all events influenced by a certain amount of deliberation before they were adopted. With regard to the observations of Mr. Benson, he believed that the right of the choristers of Westminster Abbey to attend Westminster school still existed, and if the Dean and Chapter were willing to upset Westminster traditions and disperse the associations connected with what Westminster men call the 'crucified pigeons' [the four birds surrounding the cross which was the emblem of the Westminster school], he was quite sure that choristers could be secured in their statutable and just right. There were many cathedrals throughout England in which the grammar schools were founded first of all for the choristers, and into which outsiders were admitted only on sufferance. But now, where choristers were admitted to these schools it was on sufferance only, and the outsiders claimed the

* Subsequent measurement showed it to be C 478·8.

† Mr. Ellis has since ascertained that the pitch of St. Paul's organ at Easter 1877 was C 533·2, just a trifle flatter than Broadwood's medium pitch, and about two commas above French pitch. Also, that the pitch of Westminster Abbey Organ in May 1877 was A 442, or C 525·6, being about half a comma sharper than French pitch. Both are very much flatter than our present concert pitch, C 545, or A 458. Mr. Ellis's researches on pitch, with full tables, will be found in the *Journal of the Society of Arts*, for 25th May 1877.

first right. He believed that St. Paul's school itself was founded with this object by Dean Colet; at all events, it is certain that the early choristers of St. Paul's, like Thomas Tusser and others, were 'Paulines.' The restoration of this right is not now perhaps necessary, as the Dean and Chapter have provided an excellent school. There are many places, however, where the choristers are excluded from schools primarily founded for their chief use and benefit. There was a school at Chichester founded for this purpose, also at Durham, at Carlisle, at Canterbury, and other places. Perhaps some of those present had had the privilege of knowing Miss Maria Hackett, a dear old lady who spent her life and fortune in endeavouring to restore choristers to their rights. She recently died at the age of 90, having devoted 70 years of her life to the endeavour to impress Deans and Chapters with a sense of their duty, and she was gratified at the last by seeing the dawn of improvement which she had so long desired to effect. He agreed with Mr. Stratton that Cathedral work should be written from a high motive, and had desired so to state most distinctly. Those Cathedral composers who had made any name at all were those who had written from artistic feelings, regardless of the money profit which accrued to them; it was the clergy alone who had discouraged them, and as Mr. Stratton pertinently remarked, the clergy often put reforms which they wished to see effected upon low grounds of policy. It was therefore on those low grounds that he appealed to them as men, addressing them upon their own level. He was brought up as a child within the thick walls of what he considered to be the pattern cathedral of the world, and which was now of itself trying to become so, and he hoped to see these reforms effected in other places. They might not be in his time, but still he should be happy if he had offered any suggestion which would have any influence in retarding hasty and undue excess which cathedral men in endeavouring to improve cathedral music were trying to introduce. The desire should be, not to adopt everything which was hastily brought forward, but to give it due deliberation; that there should be no anxiety and not too much enthusiasm, to accept things which attempted to supply the gaps which were felt to exist, of which time alone could prove the value.

MAY 7, 1877.

R. H. M. BOSANQUET, Esq., M.A., F.R.A.S., F.C.S., Fellow of St. John's Coll., Oxon, IN THE CHAIR.

ON THE GYMNASTIC TRAINING OF THE HAND FOR PERFORMING ON KEYED INSTRUMENTS.

By STEPHEN S. STRATTON, Esq.

BEFORE entering upon my subject, I beg one moment's explanation. I can claim no originality in this matter, my attention having been drawn to it some eleven years ago by a work on Finger Gymnastics by Mr. Ward Jackson. I was greatly taken with the subject, and did my best to make the work known. Wishing to communicate with the author, I made many efforts, by letter and otherwise, but without success. Subsequently, the Rev. Edward Young, of Clifton, who knew Mr. Jackson, informed me of the latter gentleman's death. Finding the Finger Gymnastics but little known, I thought I might be doing some good by bringing the subject before this Association, as it seemed of great importance. A recognition of the only scientific work on the subject (to my knowledge), and my indebtedness to it, seem to me only an act of justice to the author.

After the scientific subjects brought before this Association, the one I have the honour to introduce may seem, to many, hardly worthy of consideration; still, however imperfectly treated by me, I hope to prove at least its great importance. It is of some concern to every one possessing a pair of hands, and of greater interest to those whose skill in performance depends upon their hands. The voice (man's connate instrument, for a cry is his first action in life) has had much scientific attention. Its organs hidden, and operations mysterious, inquiry has been stimulated to explain its action. Yet that is, in a manner, automatic and perfect from the first—being instinctive. Man shares with lower animals the instinctive habits: a chicken has been seen to catch at a fly whilst the shell stuck to his tail; so, in the infant, actions of the lips and tongue are perfect from the beginning. Sir Chas. Bell, in his 'Treatise on the Hand' (from which I shall have to quote occasionally), says: 'The hand, destined to become the instrument

for perfecting the other senses, and for developing the endowments of the mind itself, is, in the infant, absolutely powerless. As soon as the fingers are capable of grasping, whatever they hold is carried to the mouth. Hence, the sensibility to touch and power of action in the lips and tongue are the first inlets to knowledge. The use of the hand is a later acquirement.' In fact, the hand is an instrument of mind, not an organ of instinct; and is capable of the highest education.

Now, pianoforte playing may be termed the most difficult and complicated work the hand can possibly execute; and, requiring much practice, great strength and control, it is worth considering how far we may help forward such work by a scientific training of the hand. I make pianoforte playing the basis of my subject, because the training requisite for it includes that necessary for any other instrument. This training, I consider, has received very little attention, possibly because the hand being a 'general servant,' its mode of action has not been deemed of any importance. There seems no mystery in it. Yet who can tell *how* a finger moves? We know *what* is done, but *how* it is done is none the less a mystery. In pianoforte playing, moreover, quite a new function devolves upon the hand—that of being the exponent of emotion. It is not going too far to say that it is as difficult to conceal emotion in vocal utterance as to express it by the fingers.

Instances are not rare of remarkable aptitude for the piano in very young persons; this I believe to be a faculty inherited. It is worthy of remark that nearly all celebrated performers have had parents of some, and often of great musical talent. Professor Ribot, in his great work on 'Heredity,' gives many instances. Still, education is a great factor in the production of an artist.

From the earliest introduction of the pianoforte, we find a recognition of the difficulty of hand training. What may have been the case with its predecessors I know not, and it is beyond the scope of this paper to inquire; but a brief consideration of the last instrument in general use—the harpsichord—may not be out of place. As you are aware, the tone of the harpsichord is produced by 'plucking' the string with a piece of quill or leather, attached to the upper end of the jack. The key cannot be pressed down without the note speaking, and the fullest tone is produced by gently but quickly pressing the key—not striking it. The finger's work, then, in this instrument, was simply that of overcoming resistance; in fact, similar to that of organ playing. The method of holding the hand was, I believe, different to that employed in piano playing, the wrist being lower than the knuckles. This was right, physically, as the flexor muscles, those principally employed, act more fully in that way. Possessing a large 'double' harpsichord, I tested the weight of the touch, which for the lower keyboard with three rows of jacks employed, I found to vary from nearly eight ounces in the bass to three ounces higher up, and barely two ounces on the highest keys;

and on the upper keyboard, on which one string can be struck with one, or two jacks, the pressure varied from six to less than two ounces. Trying various pianos, I found some—uprights—to require a pressure throughout of about five ounces; others—grands—a pressure of from six ounces in the bass to three in the treble. So far as key resistance goes, the piano is generally easier than the harpsichord; but, in the latter, key resistance, execution apart, ends the fingers' work, while in the former it only commences there. As I have just observed, the fullest tone on the harpsichord was produced by simple pressure, whereas, on the pianoforte, pressure, equal to the key resistance, produces the least tone, and frequently no sound at all. Now, here we have the seat of one great difficulty in hand training. For every successive degree of tone the force of the pressure or blow upon the key must increase till the weight reaches about sixteen ounces. I do not know if there be any dynamometer for measuring the force of blow in producing the fullest tone on the piano, but from experiment, I should say that sixteen ounces was not beyond the mark. Now, no occupation makes greater demands upon all the muscles of the hand than pianoforte playing; and, beyond strength, in a greater degree is required *control*. The following, from the *Pall Mall Gazette* of a few years back, is an illustration. 'Musical Athletics.—Of all the discoveries for which we are indebted to German professors, one just published by Professor Schmidt may claim to rank among the most singular. Hearing Herr Rubinstein play at a concert, he took it into his head to count the notes which that famous pianist had played by heart, and found them to amount to 62,990, fully justifying, therefore, an assertion previously made by the physiologist Haring, that a pianist's calling lays about the heaviest tax of any upon the memory. Herr Schmidt was, however, not satisfied with this enumeration. Applying Austrian neukreutzers as a dynamometer, he tested the pressure requisite to strike a key on Herr Rubinstein's piano, and found it to be equivalent to 24 neukreutzers, which is two ounces and a fifth. The force exerted by the pianist in playing the 62,990 notes, he therefrom calculated to amount to nearly ninety-four and a half cwts. Herr Schmidt then intruded in Herr von Bulow's room and tried his piano, which had a harder touch: here the pressure would have amounted to one hundred and eighteen and one-tenth cwts. The discovery may be of interest to pianists who are unaware how great an effort of muscle they go through in playing a piece, but surely it requires a German professor to draw such a lesson from a concert.' Personally, I am greatly indebted to the Professor for furnishing such powerful support to my argument. But he has not told all. We may safely affirm that every note was not played *pianissimo*, consequently, the added force must increase the total to something dreadful.

Could an old harpsichord player look through a music publisher's catalogue of to-day, he would be amazed at the immense

collection of technical studies for developing the mechanism of the hand. He would either think we had wofully degenerated physically, or we played upon some instrument of alarming construction; and such a statement as I have quoted would not re-assure him on the latter point.

Leaving the technical studies for a moment, let us briefly glance at various attempts to overcome the difficulties of hand training.

The earliest of which I can find any mention is noticed in the *Quarterly Musical Magazine*, 1821, No. 11. The apparatus was styled 'The Royal Patent Hand Moulds,' and the inventor was Major Hawker, mentioned as an amateur pianoforte player of great acquirements. The following is a description: 'If the under part of the hand and wrist, as far as the knuckles, of a player, when addressed to performance on the pianoforte in the best possible position, could be pressed upon a bed of clay, the impression thus given would convey the actual form of the hand moulds. They are thus modelled in wood or leather, and attached to the wrist by a band and clasp. To the bottom, directly under the part which raises the ball of the thumb and parallel with the knuckles, a wooden groove is fixed. The groove is so fitted as to run upon a rod, which is placed at any given height by a simple apparatus upon the ledge of the pianoforte which lies below the keys, and thus the wrist and hand are mechanically compelled to receive the best possible position on the keyboard.' However good the intentions of the inventor, this 'guido' must have failed, inasmuch as there is no *one* best possible position—except for one kind of passage.

Other mechanical contrivances were the chiroplast, hand guide, and gymnast: the latter I produce. All these things are mistakes. The capacity for certain actions must be intrinsic: and no external prop can make it so.

This 'gymnast' is simply an instrument of torture. It no more assists my finger to lift itself than I assist a child who wishes to walk by carrying it. We all know what Schumann did by tying his third finger back, and his fate as a pianist should be a warning to anyone interfering unwisely with nature.

Let us turn to the advice of writers on the subject. The *Musical Magazine* for 1835 contains a reprint from the *Atlas* newspaper of some excellent remarks (in general) on pianoforte playing. 'The genius of the pianoforte demands, as an essential quality, in every performer rapidity of finger. In reflecting for a moment on the vast variety of combinations that passages for the pianoforte assume—the new difficulty that grows out of every new form—and that out of the myriads of notes we hear in the concerto of some eminent player, each individual note is produced by the energy of some one out of the small human allotment of fingers—again, that each key must not be merely touched [strength], but that its force must be calculated [control], or there would be no equality in playing, we may,'—please note,—

'recollecting the original imperfections of the hand, imagine what labour goes to the formation of a perfect mechanism'

If the hand of man were originally created for the purpose of pianoforte playing only, the difficulty of acquiring mastery might argue some innate imperfection, but we must seek for the source of the alloged imperfection elsewhere.

Some remarks on technical proficiency and its development in 'The Music of the Nineteenth Century,' by Dr Marx, are very sensible and to the point, although one is very much like that before quoted. 'The fingers, as originally endowed by nature, are not by any means equally adapted to their purpose for the piano, the third and fourth are weaker than the others; the third is, through habit' [true, but not literally so; they are tied by tendons], 'tied to either the fourth or the second, and therefore less available for individual action; the thumb is less fitted than the others to produce a soft tone. Here full scope can be given to the operations of technical training; it is the more indispensable, as the general use of the fingers does not in any way tend to prepare them for the subtle and precise movement that the mechanism of the piano exacts.'

This is most true. He suggests analysing the task of training, showing the purely mechanical nature of technical practice, and advises the pupil always to bear in mind the fact that execution is but a means, not the end of art. He is in favour, but in a qualified way, of dumb keyboard and table practice, for sparing the ear, and even suggests a form of keyboard, a rough sketch of which I show you, but he is not in favour of any further mechanical aid. The keyboard is radiating, the keys raised, and not wider at the top than the black keys of the piano. By means of wedges the distance between the keys can be increased. Practice on such an instrument as this would bring into play muscles that are not affected in the ordinary close 'five finger' position. If the digitorium, good so far as it goes, were made on this model, it would be the best thing we could have for physical exercise of the fingers.

Wieck, too, in his little work, 'Piano and Singing,' gives some good advice on hand training, and he favours 'table practice.' The *English Mechanic* some time ago reprinted an article on 'The Education of the Hand,' from the *Scientific American*. The writer says: 'We should extend this article too much were we to attempt a minute analysis of the anatomy of the hand; but we assert that the most complete education and development of its powers can only be obtained through a perfect knowledge of its parts and their offices.' That is precisely my opinion; but, through most writers on the subject not attempting this analysis and withholding the essential knowledge, it has cost me much time and labour to acquire the little knowledge I possess. But further: 'This fact has been appreciated by at least one of the authors of pianoforte methods now in use in the schools, and also by private music teachers; and in a long experience and observation on this

subject we have found that pupils progress much more rapidly both in music and penmanship, who are first prepared by a knowledge of the structure of the hand, and by special exercises calculated to develop the weaker muscles, and to render each independent of the others.'

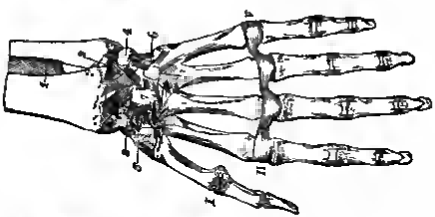
The Americans must certainly be in advance of us, for I do not know of any elementary work for piano which treats scientifically of the anatomy of the hand; nor do I know that such a subject is systematically taught here. I believe, moreover, that some movements of the fingers have only very recently been explained.

A paper by Mr Charles Lunn, 'On the Power and Education of the Hand,' appeared in the *Orchestra* of August, 1874. The subject is treated psychologically, and the author's views very cleverly set forth. Mr. Lunn advocates a position of the hand that will enable the finger to touch the key just where the extremities of the sensory nerves are situated. In passages of extreme delicacy, and when the piano has a light touch, this method is undoubtedly the best; but in passages requiring strength the angle must be lessened, and the sense of hearing, not touch, must check the result. Fault is found with the present shape of keyboard, and a semicircular one suggested as more suitable to the leverage of the human frame. The radiating pedal keyboard of the organ is commended as a first step in the right direction.

The article on 'Fingering' in Messrs Stainer and Barrett's 'Dictionary of Musical Terms,' is very instructive. For the first time, to my knowledge, out of a professedly anatomical work, we find the explanation of the apparent weakness of the third finger—in the attachment of the tendons. For the music student, however, Mr Ward Jackson's work on 'Finger Gymnastics' is the most important and useful. The subject is treated anatomically, scientifically, and practically; and the book deserves to be much more widely known than it is at present. Mr Jackson, in his introductory remarks, accounts for his discoveries in this way. He took his daughters to Germany for education generally, and musical instruction particularly. He found the method of teaching the piano very fatiguing and trying to the nervous system. He visited several music schools and conservatories, inquiring what was the best method known for strengthening the fingers and wrist. Everywhere he met with the same reply. 'The chief difficulties are muscular, and the only way of overcoming them is persevering practice of finger exercises.' It was admitted that such work was very trying, and students were sometimes obliged to discontinue playing for several months; but there was no other way of acquiring proficiency. He found that, on resuming the practice of the violin after many years' discontinuance, he experienced fatigue after a few minutes' exercise, although well and strong. He visited workshops of different kinds, and found men with arms like giants, but fingers

not used; and, extending his observations to general occupations, came to the conclusion that the fingers were the least used and weakest parts of the body. Then, repairing to the most renowned gymnastic establishments of the Continent, he was shown all the various exercises. 'Where are your gymnastics for the fingers?' he asked. 'We have none' 'Why?' 'We never thought of it' This disclosed another fact, namely, that the fingers are the only active members of the human body to which a properly constituted system of gymnastic exercises had not been applied. He then visited those establishments where men *do* work with their fingers, and found that paralysis, nervous weakness, and other diseases, were incidental to the various occupations. This set him to work to solve the difficulty, and the result was the book I have mentioned. It has been translated into German, and the author studied that language at the age of fifty-two, for the purpose of lecturing on the subject. Many flattering testimonials were given by musicians and anatomists, who said: 'Gymnastic exercises for the fingers ought to have been commenced 150 years ago; they are the real foundation of practical art' Notwithstanding all this, the work is so little known that I do not scruple to occupy a little time in drawing your attention to it.

After giving a description of the various muscles of the hand, the author presents a series of exercises with and without apparatus, having for their object the attainment of strength and freedom in the fingers and wrist. Time will not allow of my going through the exercises, but nearly all are of great value, if practised with *care* and *moderation* by young students while the muscles are still developing. For *all* players I would recommend the use of the cylinders a minute or two daily. Some improvement in the form is possible, as the pressure, confined to one point, soon causes pain. I would suggest a grooved wedge, such as I exhibit, which distributes the pressure equally.



This drawing shows the ligaments which form the articulations of the hand. I wish to draw your attention now to the transverse ligament on the inner (*palmar*) side of the hand. Some

time after exertion, and frequently from want of exercise, we are apt to say our muscles are stiff. This I believe to be a figure of speech. I think the ligaments stiffen, and probably the tendons. At any rate, after trying these cylinders or wedges for a few moments, a wonderful feeling of freedom and elasticity is the result. This treatment of the ligaments, and some exercise for lateral extension of the fingers, I consider the most valuable features of Mr. Jackson's system. For reasons which will appear later, I must again impress the necessity of care and moderation in these gymnastic exercises.

I have endeavoured to show you, to the best of my ability, what has been done for hand training, and especially by Mr. Jackson. Now I went to prove that there yet remains something to be done; that our knowledge has not exhausted the subject. Indeed, if Mr. Jackson's conclusions were altogether accurate, there would remain nothing further than a recommendation of his method without reserve. But the world does not stand still, and since 1865 (when Jackson's book was published), not only have opinions on the subject of gymnastics been considerably modified, but our knowledge of physiology and psychology has become more extended and advanced. The views I am about to submit, and the exercises, are therefore to be considered as supplementary to the work of Mr. Jackson.

In order to make my treatment of the subject as complete as possible, I must call your attention briefly to the anatomy of the hand and the views held on the subject of muscular contraction. This forms the physical part of the question. Then, on the other hand, an analysis of the springs of action and the part played by the will; how conscious actions can be converted into automatic—a subject not sufficiently considered by musicians—may be termed the mental side. I beg here to acknowledge my indebtedness to my friend, Dr. Campbell Pope, who carried out a thorough dissection of a hand for my guidance, and otherwise gave me much assistance. The drawings I propose showing you have been enlarged from woodcuts in Quain's 'Elements of Anatomy' by permission of the publishers (Messrs. Longmans, Green, & Co.) by another friend, Mr. William Breakspear, an artist to whom my best thanks are due for the admirable manner in which he has executed them. I intend saying nothing respecting the nervous or arterial systems of the hand, confining myself to the muscles, tendons, and ligaments, and with all submission, as one who knows but little of the subject. The bones of the wrist are eight in number, and united by ligaments which enable the wrist to move in any direction. The transverse ligament I have already mentioned. It is placed on the palmar side to prevent over extension or bending back of the fingers. Each joint of the fingers has its proper ligaments. Now look at a finger. I have found that some persons imagine that the muscles are in the fingers themselves; the fingers contain only the tendons (which are bound to them by fibrous sheaths), the

muscles themselves being lower down, in the hand itself or on the arm.

The briefest way of putting it is simply this: there is a muscle to bend each joint of a finger, and one to draw the fingers together when stretched laterally, with additional muscles for the thumb and little finger. These are situated on the under side of the arm or in the palm of the hand. Muscles to straighten the fingers or extend them laterally are placed on the back of the arm and hand. The thumb, first and fourth fingers have additional extensor muscles. The tendons of the long extensors of the second, third and fourth fingers are attached by slips passing from each side of that of the third finger. The muscles between the bones of the hand (the metacarpal bones) are very complicated in their action. In addition to the functions mentioned, they combine with the long extensors in straightening the second joints of the fingers, and alone extend the third joints. So that at times they act with, and at others antagonise the action of both the long extensor and flexor muscles. The wrist has its own extensors and flexors, but those of the fingers assist in its actions. The thumb has the greatest freedom of action among the fingers, and the greatest strength, being furnished with eight muscles, three for extension, two for flexion, and three for various lateral movements. Occasionally there are variations in the number of tendons, and even of the smaller muscles. Movement of a limb is effected by the contraction of the muscles.

If man were a simple machine this movement might go on without fatigue, but we all know that excessive muscular exertion causes not only weariness but sharp pain. The nature of muscular contraction may explain this. Sir Charles Bell says:—'A stationary condition of the limb results from a balanced but regulated action of all the muscles, which condition is called their *tone*. Nothing appears more simple than raising the arm, or pointing with the finger; yet in that single motion not only are innumerable muscles put into activity, and as many thrown out of action, but both the relaxing and contracting muscles are controlled or adjusted with the utmost precision, though in opposite states and under one act of volition—we perceive that the power taken from one class of muscles may be considered as bestowed on the other, so that the property of life which we call irritability, or action of muscle, is upon the whole less exhausted than would be the case on any other supposition.' Again:—'The power of contraction is a *vital* property. The continued action of a muscle therefore exhausts its *vitality*. Now to support that action there must be a means of increasing or maintaining the circulation of the blood within it, that being the source of all vital power.' From 'Quain's Anatomy' we learn that the muscular fibres are endowed with *contractibility*, 'a remarkable and characteristic property, by virtue of which they shrink or contract more or less rapidly under the influence of certain causes which are capable of exciting or calling into play the property in

question, and which are therefore named *stimuli*. Every fibre has a tubular sheath composed of elastic tissue. These fibres are arranged in bundles termed *fasciculi*, which extend continuously from one terminal tendon to the other, they very generally run parallel; and, although they converge towards their tendinous attachment with various degrees of inclination, yet in the voluntary muscles they do not interlace with one another.'

A view of a totally opposite character has been lately put forth by Dr. Chas Bland Radcliffe. His work 'Dynamics of nerve and muscle" is a remarkable book. Premising that every induction is the result of convincing experiments, I give you the substance in briefest form. 'The view of muscular action which I have long held is one which dispenses altogether with the help of a vital property of irritability or tonicity.' 'Instead of regarding the state of action in nerve and muscle as a manifestation of vitality, there is indeed reason to believe that it must be brought under the dominion of physical law in order to be intelligible, and that a different meaning, also based upon pure physics, must be attached to the state of rest. There is reason to believe that all kinds of electricity act upon nerve and muscle by way of charge and discharge, the charge antagonising, the discharge permitting, the state of action. The whole case is simple enough. It would seem indeed —

'(1) That the sheaths of the fibres in nerve and muscle are capable of being charged like Leyden jars, and that during the state of rest they are so charged.

'(2) That the sheaths of the fibres in muscle are highly elastic.

'(3) That the fibres are elongated during the state of rest by the charge with which their sheaths are charged, the mutual attraction of the two opposite electricities, disposed Leyden-jar-wise, upon the two surfaces of the sheaths, compressing the elastic substance of the sheaths, and so causing elongation of the fibre in proportion to the amount of charge.

'(4) That the muscular fibres contract when the state of rest changes for that of action, because the charge which caused the state of elongation during rest is then discharged, and because this discharge leaves the fibres free to return, by virtue of their elasticity simply, from the state of elongation in which they had been previously kept by the charge, and that the degree of contraction is proportional to the degree of elongation previously existing.'

The electric discharge, according to Dr Radcliffe, is analogous to that of the torpedo, which, I need hardly remind you, is a fish capable of giving an electric shock sufficiently powerful to knock a man down. This characteristic of the torpedo was at one time used as a remedy for gouts and fevers. In man the circuit of the electric discharge is wholly *within* the body—a fortunate thing, or shaking hands might be a dangerous practice. This action of

muscle cannot go on without intervals of rest, it being possible to exhaust the electricity, thus fatigue is easily explained. Does not this view of muscular action, if correct, seem to point out the natural remedy for local paralysis, brought on by over exertion?

Now a word on the mental aspect of the subject. The muscles of the arm and hand are termed voluntary muscles, and are set in motion by volition. Will implies consciousness—we must know what we want to do before we can do it. We have voluntary and involuntary muscles; consequently we perform actions with and without consciousness—the latter being termed *reflex*, of which breathing is one. Several *reflex* actions may go on at once. On the other hand, according to Ribot, 'Consciousness is one, and therefore it can at each instant hold only one idea. Its form is that of a simple series, and though certain states of consciousness seem to be simultaneous, they are in fact successive. If we try to think simultaneously of a lion and a mountain, a cube and a sphere, it will be seen that one idea excludes the other, and that we can think of them only successively or alternately' ('Heredity,' p. 49).

The eye is the most rapidly moving of all organs, and this searching motion, says Sir Charles Bell, is essential to vision. 'On coming into a room we see the whole side of it, as we suppose, at once—the mirror, the picture, the cornice, the chairs. But we are deceived; and that arises from our being unconscious of the motions of the eye, for each object is rapidly, but successively, presented to the most sensible spot in the eye.' The motor nerve of the eye is supposed to have as many as 15,000 fibres, and the optic nerve probably not less than 100,000, the former for movement and the latter for receiving impressions.

'Though velocity of thought seemed to defy all measurement, still it has been determined by Helmholtz and others by means of ingenious experiments.' Professor Bain, in his work 'Mind and Body,' gives some interesting examples. 'The rate of passage of nerve force has been shown to be about ninety feet per second. Now the time of a complete circuit of action, beginning at a stimulation of the senses and ending in certain movements, depends partly on the time of moving along the nerves, and partly on the time of passing through the centres, where a number of corpuscles must be transversed. The case of least internal delay is what is termed *reflex action*, where a motion answers to a stimulus, without the intervention of the will, as in the involuntary start from a pinch in the hand. By experiments on frogs, Helmholtz found that a period of from one-thirtieth to one-tenth of a second was occupied by the reflex act. Now the length of the entire nerve-tract could only be a few inches, which would hardly occupy the two-hundredth of a second, if that tract were an uninterrupted nerve-thread. Two persons are separated by a screen; one is to utter a syllable, and the other to repeat it as soon as possible. If the syllable has been agreed upon, the interval of repetition

occupies from one-sixth to one-fourth of a second; if it is not agreed upon, the interval is one-twelfth of a second more. Thus we have physiological evidence on the one hand, that a certain time is occupied by nerve-force, and we have mental evidence on the other, that an equivalent time is occupied by sensation, thought, and volition.' ('Mind and Body,' p. 36.)

Now you will ask: What has all this to do with the training of the hand? My answer must be, that the latter is only part of a larger question. What is pianoforte playing? A combination of actions the most wonderful to conceive. Just analyse the complex working of the mind in a 'first reading' of a piece. The first impression comes through the sense of sight—we see certain notes; this sensation has to pass into consciousness before volition acts on the motor nerves of the arm and hand, setting many muscles in motion, before the key is struck; then the sensation of sound is received through the ear, and passes into consciousness which has again to be exercised in comparing the sound with the written notes for purposes of confirmation or correction. No wonder 'the inward sense of labour and difficulty is corresponded to by the number of awkward and irrelevant gesticulations.' This case is supposed to be that of a beginner in the art. Thus pianoforte playing necessitates four distinct conscious actions. After a time memory and habit convert some of these movements into partially reflex actions, and the mind can concentrate itself upon one object. At present this is done at an expenditure of time and labour that is perfectly appalling; done, not by scientific application, but through sheer perseverance. And how is consciousness engaged? Not as it should be, with the ideas to be represented, but in a struggle with mechanism.

How seldom do we hear *music*, as compared with meaningless jingle! Of course, I refer to the mass of ordinary players, not to those finished artists who, aided by their genius, have succeeded in overcoming the tremendous difficulties of their education. As we can neither see, do, or think more than one thing at a time consciously, it follows that the attempt to do more must result in failure. Hence the long hours spent in pianoforte practice without scientific method only tend to destroy the action of the faculty most needed. Consciousness becomes deadened through exhaustion of the nerves of hearing. 'It is a familiar observation, that an unvarying action on any of our senses has, when long continued, the same effect as no action at all; a watchmaker is not conscious of the uninterrupted ticking of his clocks, but were they all suddenly stopped, he would at once become aware of the blank.'* A player at the pianoforte should be considered as an embodied *will*, having a certain end in view, and all the mechanism, mental and physical, so many means for the attainment of that end, and so trained, that their work is done without interfering with the will in producing the intended

* *Mind and Body*, p. 45.

effect. In other words, all actions but one must be reduced to secondary or cultivated reflex actions.*

I am obliged to give this general view of the subject, as the hand only forms a part of the mechanism employed, and cannot be considered without reference to the whole. Reading music, rhythm, and phrasing, I do not propose to enlarge upon; but I am strongly of opinion that much in connection with them can be done away from the keyboard.

Coming, now, immediately to my subject: what I propose doing is, to train the fingers to automatic action, and acquire complete control over the hand away from the piano, so as to give the performer a ready servant instead of a tyrannical master.

The importance to my argument of much I have already said will now be evident. Should anyone ask, 'How is this training to be done?' my answer may be rather surprising, when I say that we have more to *undo* than to *do*. I have stated that, in the infant, the hand is absolutely powerless; its use is not instinctive. Now, that is important for us to remember. Our hand becomes what we, day by day, cause it to become. Before I consider this, however, I wish to prove that Mr. Jackson is not quite correct in stating that the fingers are the least exercised, and consequently the weakest parts of the body. His statement is a partial truth: *Are* the fingers still—in childhood especially? *I* know some young fingers I should like, at times, to be less active. One cannot work physically without using one's fingers, and even indolent and lazy people cannot keep them still; for, if not properly employed, we are informed who

> '—— finds some mischief still
> For idle hands to do.'

Again:—Are they so very weak? Look at the palmar muscles (Illustration). What is one of their uses? 'In grasping with the hand, the strength with which it closes when all the muscles are combined in action must be very great. The amount of power is exhibited when we see a sailor hanging by a rope, and raising his whole body with one arm. What must be the pressure upon the hand? If the palms, and inside of the fingers, and their tips were not guarded by cushions beneath the skin, it would be too much for the texture even of bones and tendons, and certainly for the blood-vessels and nerves to sustain.'† Any 'three years' child' will hold on a stick and support the weight of his body by his hands. Is there anything in pianoforte playing calling for such exertion as this? Assuredly not. Further, try to bend the third joint of any finger. It is almost impossible. What, then, do we learn? Not that the fingers are little used,

* It is rather singular, that, since my paper was prepared, an article in the *Choir* of last month affords strong confirmation of my views in many points. The writer is Mr. W. Matthews, of Chicago, U.S.

† Sir C. Bell, p. 86.

or weak, but that we have little control over them. In fact, we have never educated them, and we throw the blame on nature.

Dr. Radcliffe's theory of muscular contraction seems to me to explain many things, especially with regard to this want of control over the fingers. Stated broadly, we may say that, in musical performance, individual muscular action is the rule and combined action the exception. In all other manual occupations combined muscular action is the rule and individual action the exception. To my thinking, these two movements are antagonistic. The infant's first action with its fingers is to grasp whatever comes within his reach. From infancy that habit is retained, and lasts as long as life itself (physically and morally); until 'grasp' becomes the motto of mankind, and 'close-fisted' passes into a proverb. Now, if we from childhood are constantly using our fingers in combination, we are doing our best to render it impossible to use them singly. The electric discharge is diffused over the whole muscle, or series of muscles, causing such strong sympathy between them that the utmost effort of the will to isolate or localise its effect all but fails. This sympathy extends, in a measure, to the two hands and arms, and by long usage, has been converted into a reflex action. In all sudden starts the arms go together, and it is easier to move any corresponding fingers, than, say, the second finger of one hand and the thumb of the other.

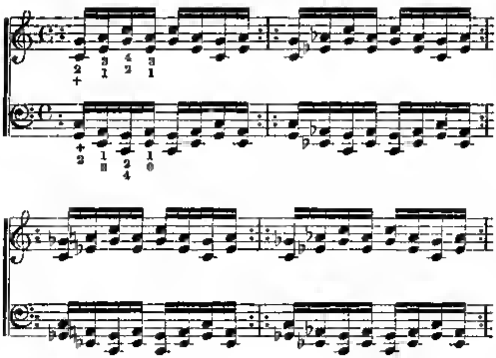
This 'sympathy' affords, I think, a satisfactory explanation of what was an enigma to Mr. Jackson: that men who worked as blacksmiths, &c., and had arms like giants and muscles of steel, could not use their fingers. Men who work with their arms work also with their fingers (we have seen that the most powerful muscles of the fingers are situated in the arm), but the action is combined, and being long continued, independence of the fingers is lost beyond recovery. It also explains—if we allow of the ligaments and tendons stiffening—the helplessness and fatigue which ensue on resuming an instrument long neglected. The faculty of independent action once possessed, is lost; and the effort required to overcome 'sympathy' is mistaken for weakness in the muscle.

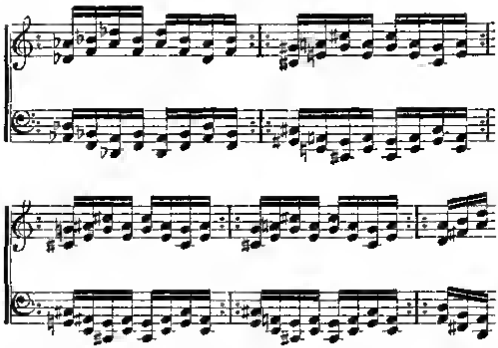
If individual action could be acquired before 'sympathy' sets in too strongly, much time, I feel convinced, would be saved in learning to play the piano. This subject I consider so important that I seriously commend it to all having the care of young pupils.

The muscles that are undeveloped for want of exercise are the *extensors*, on the back of the arm, and those which move the fingers *laterally*—situate in the hand itself. These used in 'grasping' are already strong enough for all practical purposes, and require 'curbing' if anything. Ask pianoforte students where they first experience fatigue, and in nine cases out of ten they will say, on the back of the arm.

For these muscles I would propose table practice, as the ear is

eparod ; and, to render the action automatic from the first, I would recommend the student to read, or study, while he is exercising the fingers. The hand should be placed upon the table, with the points of the fingers (which should be extended laterally) alone touching it, the wrist held much higher than the knuckles; and, for support, the elbow may rest on the table. The action is to be key-board practice reversed. The whole effort to be made in *raising* the fingers as high as possible, keeping them slightly bent, and descending upon the table very gently. Any order of five-finger exercise will do. As soon as the fingers are started, the student should endeavour to fix his attention on his book. Each hand should be exercised separately. Afterwards, the fingers should be raised in alternate pairs—still extended laterally. Many who play thirds fluently on the piano will find this exercise—with the left hand especially—much more difficult than key-board work. The fingers must be raised as high as possible, as in the preceding exercises. The velocity gained in a fall from a high position is an added force, as mechanicians know. These exercises should afterwards be performed with the fingers lying flat upon the table. At first, each hand should be worked for a short time only, and the period gradually increased. For evenness in the down-stroke of the fingers, the pupil may use the digitorium for a short time, and only overcoming key resistance. The following, which I extract from Carl Tausig's 'Daily Studies,' (Book 2, No. 26,) should then be played on the piano, softly throughout, and with fingers raised after striking the keys:





You will observe there are four harmonic combinations in each key, commencing in C, and rising chromatically till C is reached an octave higher. Each hand to be used separately, as fingers moving in the same order strengthen the sympathy it is our object to destroy. This exercise is very good for bringing the greatest number of muscles into action, and once playing will be found quite enough at a time.

These exercises for raising the fingers will be found most useful also to violinists, and players upon such wind instruments as the flute, clarinet, etc. In the early stages of progress, the difficulty of lifting the fingers independently is much greater than that of pressing them down, especially in the practice of shakes.

The next series of exercises I submit are for more effectually destroying 'sympathy,' and acquiring individual action.

First place the hand (fingers straight) flat upon the table, then, taking the second finger as a central line, remove the first, fourth, and third fingers as far as possible from it, finally moving the second finger right and left. The fingers should glide along the surface of the table, and not be raised. Then reverse the process, and draw the fingers in order toward the centre. This should be done several times by each hand separately. Afterwards, it may be practised with the hand raised, and it will not be found quite so easy to accomplish.

Next, for individual action in the *flexor* and *extensor* muscles. Here it is impossible to act on a single muscle; but 'sympathy' may be reduced to the least degree. Extend the fingers laterally, and try to move the third joint only of any one. This is so difficult, that its performance is regarded as something wonderful. The principal difficulty lies in the antagonistic action of the two sets of muscles, and the strong 'sympathy' between the *flexors*

of the second and third joints. This sympathy must at first be overcome by force. Wedges, such as these, must be placed to keep the lower joints in position while the upper joint is bent and straightened; then two joints together are to be moved; and, finally, the whole finger, which must be kept straight. Then the exercises may be tried with the hand free. The first of these may seem of little moment, as we never play with a single joint; but I submit that the neglect of this joint is an oversight, and its weakness causes a yielding at the instant of contact, which in many cases materially lessens the tone it was intended to produce. There is sufficient yielding afforded by the elastic cushion of the finger-tip, which is further supplemented by the loose wrist. To violinists, the strength and power of bending in the third joint is most important; for, if not bent before the second joint, the flexo-tendon, imprisoned in the angle, cannot act, and the top joint is rendered powerless. The thumb and wrist are sufficiently provided for in Mr. Jackson's work; but 'imaginary' octaves, sixths, and thirds—*staccato*—may, with advantage, be practised on the table, in order to render the wrist flexible and graceful in movement. If you draw the thumb away from the hand, and then across the palm as far as possible, you exercise nearly all the muscles, and prepare it for scale practice.

Just a word about the left hand. We all know that it is weaker and less capable of exertion than the right; but few go to much trouble to ascertain the cause. Sir Charles Bell says: 'The universal consent to give the preference to the right hand over the left, cannot be a conventional agreement: it must have a natural source. It is not the result of habit, but a natural provision, for a very obvious purpose: promptness of action, where hesitation would be dangerous. Moreover, the whole left side of the body is weaker than the right.' Such being the case, there is much force and common sense in the 'petition' of the left hand for equal education with the right which is found in the writings of Dr. Franklin. In the physical training of the left hand, great care is necessary, on account of its comparative weakness.

We must remember that exertion, whether of mind or body, consumes vital force; consequently, when severe and long-continued, instead of giving strength it produces exhaustion. My aim in training the hand is less for gaining strength than for acquiring control. Excessive key-board practice is, in my opinion, very injurious, and for delicate young pupils absolutely dangerous. They are frequently called upon to exert themselves to the utmost of their strength, and when that is the case, there is no capability of mental effort. Fingers working without mind reduce act to the level of conjuring. Moreover, this excessive practice is destructive of all enthusiasm, without which, as Schumann truly says, nothing genuine is accomplished in art. Everything at the key-board—even scales and exercises—should be

made artistic: the severance of the purely physical from the artistic is, therefore, not an unreasonable proposal.

This hand training not being in itself intellectual, the time it occupies may be profitably employed by the student in mental culture. Musicians are often reproached for their lack of other than musical knowledge, and sometimes for want of that too; pianists are considered inferior in musical feeling—I honestly believe, where this is the case, it is owing to their being literal slaves of the key board, and stupefied with excessive toil—to musicians generally anything that will enable them to become better informed and truer artists is therefore worthy of serious attention.

The exercises I have suggested for young students, with moderate daily use of Mr. Jackson's 'Gymnastics,' will, I feel convinced, amply suffice for physical training. The student will find his key-board work what it should be, art-work. Hands trained and obedient will enable him with one act of volition to reflect, as it were, upon the keys the impressions received from written notes, or mental conceptions.

This subject has long occupied my attention, and the conviction of its value is my only motive in bringing it forward. Should I have failed in making my argument clear, I beg you will accept intention for performance. This Association, which I hope will one day become the parliament of musicians, is most fitted to determine the merit of any question of musical education. The views I have expressed, and the cause advocated, I submit, with all deference, to your consideration.

DISCUSSION.

Mr. Salaman said that very difficult music had been composed for the harpsichord and its precursors, the clavichord, virginal, and spinet, which required for its correct execution a very admirable mechanism, and for which the fingers required as much exercise as in playing the pianoforte. Although feeble in tone, the harpsichord was clear, crisp, and effective, and it was considered far superior to the pianoforte in its infancy and indeed long after its invention. The harpsichord players of former days, being organists, touched the harpsichord as they did the organ. They were not aware of the expressive and sustained tones which could be drawn forth from the old instrument by the cultivated touch of the finger, a touch essential for the pianoforte not having then been dreamed of. The harpsichord owned by Mr. Stratton might possibly be in a bad condition, as most harpsichords now were, in which case he could not possibly judge of the real merits of the instrument. Mr. Salaman's

harpsichord had two rows of keys, and was therefore called a double harpsichord; it was made by 'Old Jacobus' Kirkman in 1768, and had never been allowed to get out of order. From this instrument sustained and expressive tones may be pressed or *squeezed* out, so to speak, which usually surprise those to whom the character of the ancient instrument was previously unknown. To avoid the tediousness of practising pianoforte passages necessary but wearisome, Mr. Stratton recommends students to place before them a paper or book, which they may read, in order to engage their attention while occupied in a purely mechanical exercise. Mr. Salaman agreed with Mr. Stratton in that plan of study, and he had always offered similar advice to his pupils, especially for the practice of the shake and double shake, which he considered one of the most dreary and monotonous operations conceivable. Mr. Salaman regarded Mr. Stratton's paper as one of considerable musical interest and importance, and its publication would, he was sure, be looked forward to with great pleasure by the members who had not had the advantage of hearing it read.

Mr. Charles E. Stephens agreed with what Mr. Stratton had said in the early part of his address as to the important part which the mental faculties have to play in musical performances. In playing the pianoforte, for instance, the mind had as much to do as the finger; it was not the brute force or brute strength of the finger which gave the tone, but the action of the mind on the finger. With regard to the Digitorium, the use of which Mr. Stratton, to some extent, favoured, he (the speaker) was open to confess that he entirely disapproved of its use, and he always recommended his pupils to avoid using it, his opinion being that unless the mind was brought to bear on the finger, the end desired could not be accomplished.

Dr. Campbell Pope had had something to do with the preparation of the paper which had been read by Mr. Stratton, having gone through some dissections by means of which Mr. Stratton had illustrated his theories, and he was personally gratified with the lucid manner in which that gentleman had put forward his arguments. He (Dr. Pope) thought that the training of the fingers was most essential for everyone, and a great many useful hints as to the methods of training might be taken from the observations which had been made, and the arguments brought forward to support them. One great mistake which had hitherto been made by those who had paid attention to this subject, was that almost exclusive attention had been paid to the training of the muscles on the front instead of on the back of the arm. As Mr. Stratton had pointed out, the most difficult thing was to raise the third finger. We had, of course, always the faculty of *grasping* things, but when we came to raising the fingers, and more especially raising them independently, then we found some difficulty, especially with the third finger; even those who had for some special purpose practised the raising of the fingers found some difficulty, but many persons were incapable of performing the action at all. And that

action was much more difficult when the fingers were expanded: [after illustrating this Dr. Pope proceeded] therefore he recommended, as a supplemental exercise, an exercise in which the hand was suspended in the air with the fingers downwards [illustrated by the speaker], then curved in towards the wrist to strengthen them, and then extended and separated the one from the other. This after a little practice could be done with great facility. By this action the small muscles in the palm of the hand, the interossei and other small muscles which were attached to the flexor tendons, were greatly strengthened. These muscles were ordinarily most neglected, but for pianoforte playing they should be most strengthened. The practice which he had described would be most beneficial *at first* if practised in the air, and if a board were used, as recommended by Mr. Stratton, the value of the exercise would be lessened. After a very short practice, the control which would be acquired over the hand muscles would be discovered and appreciated. Then he was of opinion that in time these actions would be carried on naturally and without any effort of the will. This he termed reflex action. The eye, the brain, and the hand must all be stimulated into action before a note could be struck. When learning to play, these operations were performed slowly and after mental effort, but by long continued practice they became reflex and independent of the action of the will. He thought the exercise with corks between the fingers, as recommended by Mr. Stratton, to be very beneficial, especially when the corks were used for the purpose of strengthening the third joints of the fingers.

Mr. Ellis observed that some years ago he found his hand so much strained by the gentle exercise of writing, as not to be able to write for more than an half an hour at a time, and he could only then use the pen by moving the whole arm. He could therefore quite understand that continuous practice on the piano would induce great fatigue and render desirable some special exercises for the strengthening of the muscles of the hand.

Mr. Stratton said, while consenting to the remarks of Mr. Salomon, with respect to expression on the harpsichord, he did not intend musical expression to form part of his subject; all he meant to say was, that when you press the key of the harpsichord down, you have done all the work that is necessary, whereas on the piano all the work was additional; for every increase of tone you have to add force, consequently the fatigue to the player on the piano was greater than on the harpsichord. With regard to grace of expression, there was much to be done on the harpsichord as well as on the piano. Referring to Mr. Salomon's remark about practising the 'shake' on the piano, the only objection which he (Mr. Stratton) had, was that one ought, when playing, to listen at the same time. At the key-board, everything should be done with reference to effect, and tone was everything in piano playing. He preferred rendering the action automatic, away from the key-board, because, if he added it at the

key-board, he lost in the process of rendering it the power of listening, and that was a very great fault in pianoforte players. Of course that remark applied to Mr. Stephens's observation. Every one would agree with Mr. Stephens that the mind ought to be at work the whole of the time: the work at the key-board should be mental. If they could get their hand so under control that the movement of the hand should not cause effort, then the mind would be free; but if the mind was engaged in what the hand was doing they could not listen, and that destroyed the fine feeling which every musician should have. For himself he might say, that the less he had played for a time, the more he enjoyed it when he returned to the instrument, and he accounted for that because his consciousness or feeling was not deadened by excessive work. The action of hearing and of the finger could not go on simultaneously without making the one reflex. He had spoken of the statement made by Professor Bain respecting the watch-maker who did not hear the clocks ticking around him, but when they stopped then he noticed it; so, if a person played for six hours at a stretch he could not listen, and when a player could not listen, then he would advise him to leave off. With regard to the remarks of Dr. Pope as to the action of the fingers being useful to everybody, he would observe that they should be made useful, for it was better to have a trained than an untrained servant. We had no reason to find fault with the hand, for if trained, persons who learnt music late in life had no difficulty in fingering, whereas those who learnt the theory of music, but whose hands had not been trained, were unable to execute when they came to the key-board. In playing, the hand must execute and the ear correct.

The Chairman said he thought they laid a little too much stress upon certain chance words which philosophers let fall about it being only possible for the mind to entertain one idea at a time. He believed it was the experience of musicians that philosophers had still a great deal to learn, for skilled musicians knew that they could carry three or four melodies in their minds simultaneously. This would require some consideration before accepting the dicta of philosophers as sufficient proof.

June 4, 1877.

Professor W. H. MONK in the Chair.

ON THE ENGLISH LANGUAGE AS A LANGUAGE FOR MUSIC.

By Charles Kensington Salaman, Esq., Hon. Mem. Acad. St. Cecilia, Rome.

An impression has long prevailed in the minds of Englishmen, no less than of foreigners, that our language is unfitted for music. This, I maintain, is a fallacy, originally accepted without due reflection, and since upheld, because no person, as it would appear, has deemed it his duty to subject to careful examination the foundation upon which it rests.

Intimately connected as this subject is with the vocal art, and more particularly with English vocal music and English singing, the Musical Association will doubtless welcome it as one of sufficient musical and national importance to claim attentive consideration. Should, as I hope, a discussion follow my Paper, I believe that ideas will be thrown out which cannot but prove of advantage to our poets, our musicians, and our singers. Opinions emanating from an association such as this should have weight and importance in all musical circles.

It is probable that the prejudice which still obtains against the English language as a language for song commenced with the introduction of the Italian opera into this country; for it is difficult to conceive that it could have had existence while the illustrious Henry Purcell flourished; he who, in every page of his vocal music, whether for the Church or for the stage, afforded irrefragable proof of the fitness of the English language for English music. 'Purcell,' says a contemporary writer, 'was particularly admired for his vocal music, having a peculiar genius to express the energy of English words, whereby he moved the passions as well as caused admiration in all his auditors.' With what perfection Purcell has married his immortal music to immortal verse need not be told to the privileged minority who have delighted in making acquaintance with his compositions. When Italian operas were first imported into England, and English translations of the Italian text were called for, it was

discovered that our language would not amalgamate with the music of Italy; and as it had already become the fashion to consider that nothing was worthy to be designated 'music' which was not of Italian origin, the notion that the English was not a musical language was then sown, it took root, and widely spread. 'I have more than enough discouragement to drop the pursuit of obliging my country,' wrote old Henry Playford, when publishing, in 1702, the second part of the 'Orpheus Britannicus,' 'since foreigners meet with a reception that is inconsistent with the interest of one that has the honour to be a native. But let them undersell me as long as they please, and transplant their foreign musick into these climates, the judicious will be of my side when they make an estimate of Mr. Purcell's works, which are equal to those of the best masters of Italy.' It does not seem to have occurred to those who then raved about Italian music, to the disparagement of their own, that every language should engender its own vocal music, and that as the Italian language had created Italian vocal music, so in like manner should the English language generate English vocal music. 'The only fault I find in our present practice,' wrote Addison, in 1711, in allusion to the introduction of *recitative* into English opera, 'is the making use of Italian *recitative* with English words. The *recitative* musick in every language should be as different as the tone or accent of each language; for otherwise what may properly express a passion in one language will not do it in another. Everyone who has been long in Italy knows very well that the cadences in the *recitative* bear a remote affinity to the tone of their voices in ordinary conversation, or, to speak more properly, are only the accents of their language made more musical and tuneful. Thus the notes of interrogation, or admiration, in the Italian musick (if one may so call them) which resemble their accents in discourse on such occasions, are not unlike the ordinary tones of an English voice when we are angry; insomuch that I have often seen our audiences extremely mistaken as to what has been doing on the stage, and expecting to see the hero knock down his messenger when he has been only asking him a question, or fancy that he quarrels with his friend when he only bids him "good morrow." For this reason the Italian artists cannot agree with our English musicians in admiring Purcell's compositions, and thinking his tones so wonderfully adapted to his words, because both nations do not always express the same passion by the same words'

I do not claim for the English language that it is the *best* for song; but I contend that it is at least as good a language for English men and women to sing as any other, and that, after all, is what we have chiefly to consider in this inquiry.

The successful alliance of native poetry and music, which is not sufficiently appreciated by our own countrymen, cannot be expected to appeal to the comprehension of foreigners, who find our language difficult to pronounce in speech, and yet more

difficult to articulate in song. The suitableness or unsuitableness of the English language for music, and the difficulties of its pronunciation by foreigners, are distinct questions, which must be argued separately. All educated English men and women are presumed to be capable of enunciating their native language with ease, fluency, clearness, and correctness in song as in speech. That this 'consummation, devoutly to be wished,' is rarely realised is patent to all. We hear mispronunciation on the stage, in the opera house, the concert room, the senate, at the bar, and in the church. The last time I attended a provincial cathedral service the precentor, while intoning the Litany, persevered in repeating 'mi*serubbul* sinners.' Many of our best reputed vocalists frequently mispronounce and indistinctly articulate their native language to such an extent, indeed, that an almost painful degree of attention is requisite in order to discover in what language they are singing. 'Bid me *dus*pair,' and 'I'll *dus*pair,' is frequently noticeable when Hatton's fine song, 'To Anthea,' is sung. Too much aspiration and the want of it is as often observable. In a song called 'Good bye, a long good bye,' I have heard, instead of

'He said 'twas hope, I only saw "good bye,"'
'He said 'twas *soap*, I only saw "good bye."'

A very common error, committed even by some of our most eminent singers, is to subdivide monosyllables.—'O re-*est* in the Lord' (*Elijah*) is commonly heard.

Such faults cannot be too strongly censured; for they tend to bring not only English singing, but the English language, into bad repute. As amateur vocalists more frequently imitate the defects than the perfections of public professional singers, these errors, widely spread, become chronic, and at length are accepted as correct. The difficulties of pronunciation by foreigners are certainly very great, and, in some cases, are insurmountable. They cannot pronounce the *th*. With them '*brothers*' are '*brozzurs*,' or '*brorthers*.' The irregularities, uncertainties, inconsistencies, and eccentricities in our pronunciation are indeed bewildering. I leave to grammarians and orthoepists to assign a reason why h-e-a-r-d is pronounced *herd*; h-e-a-r-t, *hart*; and b-e-a-r-d, *be-erd*; why t-h-e-r-e is *thare*, and h-e-r-e, *here*; b-e-a-r is *bare*, and t-e-a-r, *tere*. These eccentricities can no doubt be accounted for by tracing to foreign sources the origin of some of our words, but these and many other difficulties to foreigners in singing our language should not be regarded as such by our own countrymen.

Referring to the abundance of monosyllables in our language, which 'gives us an opportunity of delivering our thoughts in few sounds,' Addison remarks, 'This, indeed, takes off the elegance of our tongue, but, at the same time, expresses our ideas in the readiest manner, and, consequently, answers the first design of speech better than the multitude of syllables which make the words of other languages more tuneful and sonorous. The sounds

of our English words are commonly like those of string music, short and transient, that rise and perish upon a single touch, those of other languages are like the notes of wind instruments, sweet and swelling and lengthened out into varieties of modulation.' Words of one or more syllables difficult to pronounce should be slowly, firmly, and repeatedly uttered aloud, carefully dividing the syllables; and they should in this manner be as assiduously practised as a difficult passage upon a musical instrument.

I do not presume to discourse with authority upon this topic; but, having been occupied, in pursuance of my vocation, in composing music to English verse for more than forty years, I venture to think that, as the result of so long an experience, I may succeed in advancing some satisfactory *data* to prove that our language is in fact not *ill*-suited to music. I aver with confidence, that when the English language fails to fulfil the requirements of vocality, the fault will lie, not with the language, but with those who misuse it. It may be the poet who has not well chosen his words and arranged them for lyrical use with judgment and discretion; it may be the musician, who, perhaps, wanting in genius, experience, and good taste, and not having regard to the character and prosody of the language, has unskilfully set it to music; or it may be the singer, who has misinterpreted the words of the poet and the aim of the composer; who has failed to enunciate correctly, to articulate clearly, to utter distinctly; and who has, perhaps, neglected to give due emphasis to words and syllables, and to impart to both verse and song the true vocal expression.

While supporting the claim of our language to be regarded as one in every way suited to the requirements of English music and English singers, and to such foreign singers as can correctly pronounce our language, I shall not shrink from the avowal that the English vocabulary includes harsh and rough-sounding words in common with many other languages. I admit that it abounds in consonants, digraphs, gutturals, diphthongs, and sibilants, and that there are in it few vowel-ending words of pure Anglo-Saxon origin; but I do not concede that, upon that account, our language is not suitable for vocal music. It is suggested that the singing voice requires a language whose verse contains a majority of words formed of open syllables—free for vocal utterance. It must be allowed that the minority of words of this class is amongst the inherent difficulties of our language as a language for music. My experience in the composition of English vocal music has, however, shown me that every difficulty is capable of being surmounted, and must be overcome. Whatever defects may be discoverable in our language in the matter of gutturals, and consonants, and sibilants, and want of euphony, are amply compensated for by a balance of advantages. Where is there a language, ancient or modern, more copious in words adaptable to every class of subject, 'grave or gay, lively or severe,' and capable of portraying every phase of human passion and expressing every shade of human sentiment?

Let it not be forgotten that in our language roughness is tempered with smoothness; that harsh-sounding words are balanced by those that are euphonious, that what we lose in sweetness we gain in strength.

'Our language,' says a critic of the last century, 'has been thought to be very deficient in harmony of sound; yet the melody of its versification, its power of supporting poetical numbers without the assistance of rhyme, is a sufficient proof that it is far from being inharmonious. Even the hissing sound of which it has been accused obtains less frequently than has been suspected; in the final syllables, especially, where the letter s is transformed into a *z*, which is one of the sounds on which the ear rests with pleasure: as in *has, these, loves, hears, &c.*' In his essay on 'The Euphony of Language,' Dr. Burney has noticed that we have filed off 'the Saxon roughness in words in which the letters *gh* occur: as *cough, rough, trough, laugh, plough, thought, eight, freight, enough,*' which in early times were pronounced in the Teutonic manner, and which are still guttural in Scotland and in some parts of England.'

Words such as these should not be used for musical purposes, if they can be dispensed with; but if used should be introduced sparingly, and with judgment and discretion, and not in near proximity. It is a mistake to imagine that only soft-sounding, open-vowel, and vowel-ending words are required for vocal music. When energy and force are to be represented in song—when we have to express and describe rage, frenzy, revenge, despair, the natural war of the elements, and the unnatural war of human beings—we must use expressive words, albeit rough and tough and harsh sounding; we must set aside considerations of euphony, and only think of poetical and musical expression, but bestowing, at the same time, upon vocality as much careful attention as possible.

Exception, on vocal grounds, may perhaps be taken to the following spirited and pathetic lines by the late Rev. George Croly; but I have long considered them admirably adapted for music:—

Hark to the knell!
It comes on the swell
Of the stormy ocean wave.
'Tis no earthly sound,
But a toll profound
From the mariner's deep sea grave.

When the billows dash,
And the signals flash,
And the thunder is on the gale;
And the ocean is white
In its own wild light,
Deadly, and dismal, and pale;

When the lightning's blaze
Smites the seaman's gaze,
And the sea rolls in fire and in foam
And the surges' roar
Shakes the rocky shore,
We hear the sea knell come.

There! 'neath the billow,
The sand their pillow,
Ten thousand men lie low;
And still their dirge
Is sung by the surge,
When the stormy night winds blow.

Sleep, warriors! sleep
On your pillows deep,
In peace! for no mortal care,
No art can deceive,
No anguish can heave
The heart that once slumbers there.

In the foregoing, the poet, as a writer of lyric poetry, has fulfilled all its requirements. Should the composer be equally attentive to the exigencies of musical expression, and observe as carefully the rules of vocality, there will be nothing left to desire either in the poetry or the music.

I will turn for a moment to the language of Italy, which Dryden considered to have been invented for the sake of poetry and music, and which Metastasio designated 'La musica stessa.' 'The vowels,' says Dryden, 'are so abounding, and the pronunciations so manly and so sonorous, that their very speaking has more of music than German poetry and song' And yet Salvoni has calculated that out of forty thousand words in the Italian vocabulary, six thousand only can be used for the Italian *opera seria*. 'The others,' he says, 'are deficient in dignity and softness, qualities which are essential for vocal expression.' Despite the natural advantages which the Italian tongue is known to possess, its exquisite melody, its remarkable phancy and elegance, and its aptitude for vocal display, yet the old composers of Italian song deemed it necessary for the perfection of the vocal art to subject every word of this mellifluous tongue to a severe scrutiny before setting it to music. The Count Algarotti, an Italian writer of the past century, referring, in his 'Essay upon the Italian opera,' to Jacopo Peri, the reputed inventor of recitative, and the composer of *Euridice*—'La prima opera in musica'—says:—'He carefully observed the Italian words which are capable of intonation or consonance, and those which are not. He was exact in minuting down our several modes of pronunciation, as well as the different accents of grief, of joy, and of all the affections incident to the human frame.' . . . . 'So nicely scrupulous was he in his course of vocal experiments, that he scrutinised intimately the very genius of the Italian language.'

Of Tommaso Bai, the composer of the *Miserere* (1713), sung in the *Capella Sistina* at Rome during Passion week, Dr. Burney says: 'He is much commended for his attention to prosody, or the accentuation of words, in which his notation is generally so exact, that the proportion of long and short syllables is as strictly preserved, in singing this psalm, as it could be in reading it.'

'What,' you may perhaps inquire, 'has this to do with Eng-

lish verse?' Much. Had all our composers of vocal music studied their language as attentively as they studied their music, and had submitted it to as careful an examination as the Italians did their native tongue, ours, no doubt, would have been spared much unjust condemnation.

Our pliant language is susceptible of the utmost refinement and the highest polish, and can naturally, and as it were affectionately, lend itself to every kind of musical expression. We have such a wealth of words at our disposal that, when found necessary, on the score of euphony and variety, to substitute one word for another, we can do so to almost any extent with ease, and without the sacrifice of either sense or strength. My friend the late Sir Henry Bishop informed me in 1843 that when he and Thomas Moore were conjointly engaged upon the *National Melodies*, which he harmonised and adapted to Moore's original poetry, the poet, in order to ensure the most musically sounding words, so often substituted one word for another that in the end, after three years of revision, scarcely one word was retained that had appeared in the original manuscript.

The English language is confessedly wanting in some of the essential vocal qualities for which the Italian, above all others, is distinguished. It is not a less noticeable fact that we have in our vocabulary words almost as serviceable as vowel-ending words, and which may be used as equivalents with an almost equal effect if articulated, and sung with refinement, fluency, and grace; I refer to such words as heart, part, fair, tear, know, care, calm, charm, despair, depart, and others of a similar character, of which we possess a superfluity. I will read two stanzas from Swinburne's lovely poem, 'A leave-taking,' which I have lately set to music, in illustration of my meaning. You will find here a collection of final words of remarkable sweetness, and as useful for vocality as if they had been vowel-ending. Observe the last word of each line, how soft and musical it is!—

'Let us go hence, my songs, she will not hear.
Let us go hence together, without fear;
Keep silence now, for singing-time is over,
And over all old things, and all things dear,
She loves not you nor me as all we love her.
Yea, though we sang as angels in her ear,
She would not hear.

'Let us rise up and part; she will not know.
Let us go seawards as the great winds go,
Full of blown sand and foam; what help is here?
There is no help, for all these things are so,
And all the world is bitter as a tear.
And how these things are, tho' ye strove to show,
She would not know.'

The entire poem is of equal beauty. Can any lines more harmonious be desired in lyric poetry? Need any words be softer for musical expression?

It may be objected to these lines that the word 'singing' is

half a sibilant and half nasal, and that it closes the throat, that 'silence' begins and ends with a hissing sound, that 'up' closes the lips; that 'past,' although it opens the mouth, immediately after presses the tongue against the teeth; that 'foam,' and 'help' and 'world,' after the final consonants have been sounded, engender an added sound, a kind of literal echo. I cannot but admit—to borrow a line from Swinburne—that 'All these things *are* so'; but I emphatically deny that they are objectionable, or that they present any obstacles to free vocality.

Alliterations, which are regarded as ornaments in poetry intended to be read, should, as much as possible, be avoided in poetry intended to be sung. The following ill-chosen words are to be found in Balfe's *Bohemian Girl*:—

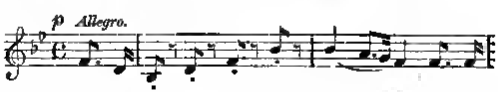
'When the fair land of Poland was plough'd by the hoof.'

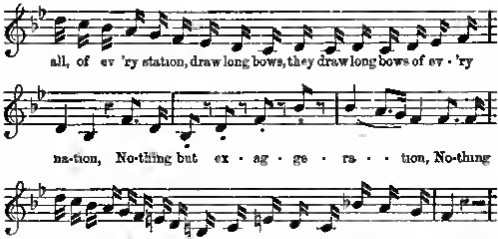
It has been remarked that the word 'song' is unsuited to be sung because it commences with a sibilant and terminates with a nasal sound. I must confess that I do not participate in this objection. The alliteration of sibilants is objected to. They abound in Shelley's famous serenade, 'I arise from dreams of thee.' When, in 1836, I set these exquisite lines to music, I was fully alive to the defects which might arise in consequence of the sibilants, and was determined to avoid their *ill* effects by separating them as far as possible. Observe the sibilants and alliterations.

'I arise from dreams of thee
In the first sweet sleep of night,
When the winds are breathing low,
And the stars are burning bright:
I arise from dreams of thee,
And a spirit in my feet
Hath led me—who knows how?
To thy chamber window, Sweet!'

Sibilants when slowly and carefully uttered in singing may be made to produce a soft and pleasing effect; a rapid enunciation of them results in hissings. Like every other difficulty in the English as a singing language, the ill effects of sibilants must be avoided.

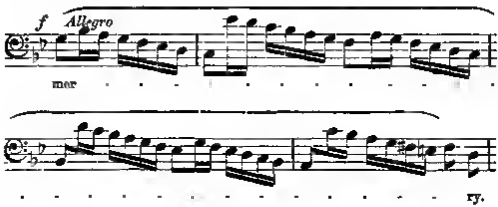
As an example of the misuse of our language, I would point to a comic air in Balfe's first English Opera, *The Siege of Rochelle*, in which English words intended to be rapidly sung are set to music which may have been intended for the Italian language. The English is unfitted for such uses; rapidity of utterance is inconsistent with its character.





This song, extremely clever as music, continues in the same manner through many pages. And upon such evidence the English language is held up to censure as an unmusical language. It is certainly unfitted for Italian *Roulades*. In Purcell's and Handel's music, however, we find, in the fashion of the period, upon monosyllables, effective musical passages of two or more bars' duration. The introduction to 'Oh, ruddier than the cherry!' may be cited as an instance

The rolling passages of scales in the *allegro* of the same song upon the divided word mer-ry is as effectively vocal as it would have been upon any Italian vowel-word:—

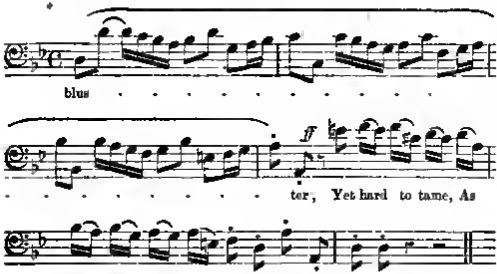


The music Handel has set to

> 'Yet hard to tame, as raging flame,
> And fierce as storms that bluster,'

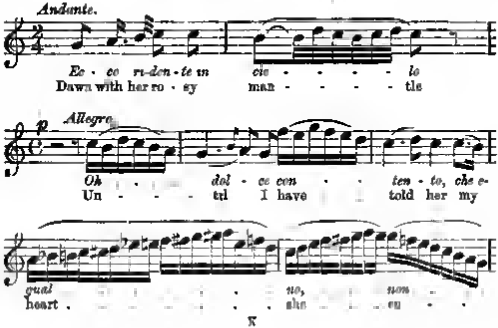
is in entire conformity with the sentiment sought to be conveyed

by the text. Words and music entirely agree, and leave nothing to be desired on the score of vocality.—



Translations of Italian operas into English are rarely satisfactory. The best I have met with are those by Mdme. Natalie Macfarren, as regards the successful application to brilliant vocal passages of words whose sounds resemble, as nearly as possible, the original Italian text. To place upon the same notes and phrases not only similar sounds, but meanings identical with the original text, would seem to be beyond the power of the most experienced translator.

The following example, from the first tenor aria, 'Ecco ridente in cielo,' in Rossini's *Il Barbiere di Siviglia*, will illustrate my theory. It is as good an English version, or translation, as may be found; but the alliance, after all, is unnatural and to some extent unsuitable:—



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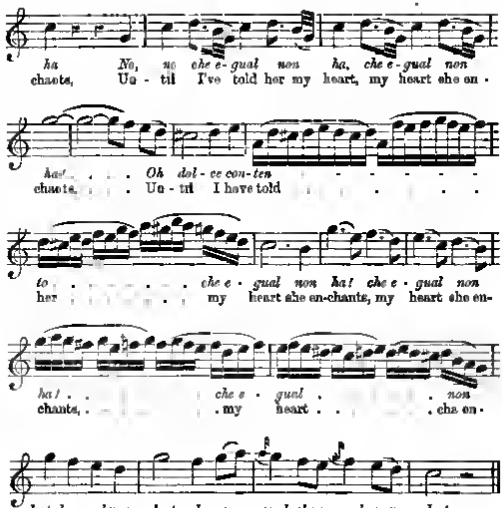


'Oh dolce contento, che egual non ha,' for the sake of vocality, is anglicised thus—'Until I have told her, my heart she enchants' The words 'my heart' and 'enchants' serve very well for the brilliant passages composed to the Italian words 'egual' and 'non ha', but, at the best, it is an unsatisfactory combination of both words and music, and is an additional proof of the unfitness of the English language for *Italian music*

The lyric poetry of Shakespeare, Milton, Dryden, Herrick, Shelley, Byron, Thomas Moore, Campbell, Proctor, Hemans, Longfellow, Tennyson, and the more recent poets, Swinburne, Rossetti, and O'Shaughnessy, has been set by many of our most eminent native composers, who have enhanced the special beauties of each poet by their music Such works, it is hoped, will endure as favourable specimens of the successful alliance of English verse with English music

While Handel was yet engaged upon the composition of Italian opera, and before he had entered upon the *Via Sacra* of Oratorio, whose sublimity has placed upon his brow the wreath of immortality, Addison penned the following lines in the *Spec-*

tator (June 14th, 1712): 'I could heartily wish that there was the same application and endeavours to cultivate and improve our Church music as have been lately bestowed on that of the stage. Our composers have one very great incitement to it. They are sure to meet with excellent words, and, at the same time, a wonderful variety of them. There is no passion that is not finely expressed in those parts of the Inspired Writings which are proper for Divine songs and anthems' 'Our language,' continues Addison, 'has received innumerable elegancies and improvements from that infusion of *Hebraisms* which are denied to it out of the poetical passages in Holy Writ They give a force and energy to our expressions, warm and animate our language, and convey our thoughts in more ardent and intense phrases than any that are to be met with in our own tongue. There is something so pathetic in this kind of diction that it often sets the mind in a flame, and makes our hearts burn within us.'

'Since we have, therefore, such a treasury of words, so beautiful in themselves, and so proper for the airs of musick, I cannot but wonder that persons of distinction should give so little attention and encouragement to that kind of musick, which would have its foundation in reason, and which would improve our virtue in proportion as it raised our delight' . . . . 'Musick, when thus applied, raises noble hints in the mind of the hearer, and fills it with great conceptions. It strengthens devotion and advances praise into rapture.'

Handel knew and appreciated well the language of his adopted country. 'Comfort ye My people,' 'He was despised,' 'I know that my Redeemer liveth,' 'Total eclipse,' 'Deeper and deeper still,' and other sacred works by the same illustrious master, will live everlastingly to testify to the aptitude of our Scriptural language for our sublime music, and to prove irrefutably that pathos, tender expression, energy, and force can more than compensate an Englishman for the want of vowel-ending words, and for the presence of words replete with consonants, sibilants, and every other objectionable quality which may be discoverable in our rich and noble language.

My auditors who hold views different from my own will no doubt express them, and thus give to the Musical Association the benefit of their experiences. Should my opinions be shared by others, I hope that they will supplement any points which I may have omitted, in order to add force to the arguments which I have this day ventured to bring forward in vindication of our language as a language for music.

DISCUSSION.

Mr. A. J. Ellis, F.R.S., said: The question of spoken sounds in relation to singing had engaged his attention for some years

past, not with regard to the English language especially, but with regard to language as a medium for the expression of music. It was a very difficult thing to understand what in fact made a language good for singing. If it were merely, as in a great part of Mr. Salaman's paper seemed to be assumed, the power of expressing good and noble thoughts, or all kinds of feelings and passions, such as would naturally lead a musician to compose music in accordance with them, one might almost say that every European language was good for singing, but when one examined the sounds of a language as adapted for the expression of musical sounds, considerable distinctions must be drawn, and each person would probably consider his own language the best adapted for the purpose. He was told, for example, that the Hottentots or Kaffirs were extremely fond of music, and that the sound of their language in singing was really beautiful, notwithstanding the interruptions formed by the 'clicks,' which were, of course, impossible to sing upon. In the English language there were a great number of sounds which would not lend themselves to music at all. Mr. Salaman spoke of singing the *s* softly and gently, but he (Mr. E.) must own he was totally unable to conceive an *s* being sung at all; it was an interruption of music, just as much as the wind which escaped over the embouchure of a flute was an interruption to the passage the flute-player was producing. The mute consonants, *p*, *t*, and *k*, could not be sung upon at all, and *b*, *d*, and *g* could only be sung upon for a very short time. Last year he had an opportunity in a class of thirty persons of trying experiments on this matter. He tried to make them sing merely on *b*, *d*, and *g*, but they were soon stopped altogether by the condensation of air inside the mouth. *F*, *th*, and *sh*, again, were quite unvocal. He was amused at Mr. Salaman thinking the *z* a rather nice sound for singing, and he illustrated it by some word such as *has*, in which he showed the unnatural unvocality of such a buzzing sound by dropping his voice before he finished it, ending it with an *s*, as was commonly the practice; and he was sorry to say that in much choral singing the final *s*, instead of being lightly touched, became very marked, so that words ending with a real *z* became words ending with a very disagreeable *s*. If you pronounced the *z* alone, without running into the *s*, the buzzing of it was about as musical as that celebrated instrument, a piece of paper over a comb. He had had a class sing passages in *z*, in *dh*, in *zh*, and so on, and the effect was enough to show them, at all events, that they must not allow any strong enunciation of such sounds if they wished to sing pleasantly. The only consonants which could really be sung were *r*, *l*, *m*, *n*, and *ng*. With regard to *m*, *n*, and *ng*, *m* was the least disagreeable; *n* was much more so, and *ng* was about as bad as could be; and he remembered an especial instance of this many years ago in the singing of 'The Sea, the Sea, the open Sea,' by Mr. Phillips, who insisted upon pronouncing the word 'open,' without any perceptible vowel between the *p* and *n*. The *l* was the most vocal of all consonants,

the *r* being disagreeable because it was sounded upon a beat, and was therefore like the beating stops which were sometimes heard on barrel organs and instruments of greater pretension The vowels were, of course, all vocal, and were the sounds relied upon for producing musical effects; but there were vowels and vowels, and on submitting them to a strict examination you found there was only one real musical vowel, namely, *ah*, and this was very deficient indeed in the English language. It was frequent enough in Italian, and with a slight modification in French, German, Spanish, and most languages. That it was the one which lent itself most naturally to singing was shown by the singer's habit of lah-laing passages, the *l* being the most vocal consonant, and the *ah* the most vocal vowel. A vowel was an original quality of tone produced in the larynx, which was afterwards modified in the resonance chambers above, between that and the lips. Those resonance chambers were more or less well or ill—generally ill—adapted to the expression of musical sounds, because they were not adapted to reinforce those partial tones of which the musical tones were composed, and which added greatly to their richness. The vowel *ee* was about the most abominable to sing upon, as might be proved by singing it near the middle register of the voice, and then running down upon it as low as possible, when the vowel became scarcely recognisable, and a harsh, disagreeable, reedy sound resulted This, of course, applied to the Italian *i* quite as much as to the English *ee*. The *a* sound was not so bad, and when broadened it became a pleasant musical sound. The peculiar English short sound of *a*, which replaced the short *ah* of other languages, as illustrated in the words 'that black cat,' was most horrible, and required very great judgment in the singer to produce it. For vocal purposes he recommended a slight alteration of it into the finest possible French *a*. The French *a* at present current in France was very much finer than the German *a* or the long *a* as the French used to be, and it was often heard even in England from the finest speakers, in such words as 'ask,' 'pass,' and so on He would not go further into detail on this subject, but he had found it necessary to advise that almost all English vowels should be slightly altered by the singers in order to render them more easy to sing upon at different pitches than the true spoken vowels. There was an inherent difference between speech and singing, which was a matter of great importance. In speech the pitch did not very very considerably, generally about a fifth, and rarely more than an octave; and, again, in speech the same pitch was not held for any length of time In singing, however, it was totally different. Again, in spoken language we were bound to certain stress of syllable and certain difference of rapidity in vowels, but composers very frequently set that at nought He had heard passages very similar to that from Balfe which Mr. Sala-man had put before them, in burlesque operas from the French, the effect produced being perfectly ridiculous; you heard very little of the music, and a great deal of hissing. Those were inherent

difficulties, not in the English language alone, because, if you examined languages separately to find which were the most vocal sounds they contained, you might arrive at very curious results, which, perhaps, would not be very valuable. The fact was, a singer brought out a musical expression, but he did so in words which were not always audible to those who did not know them previously, or had not a book of the words, but which sufficiently adumbrated those words for the audience to follow the meaning and expression. They were, however, often hampered by the unvocal sounds put before them. This might be readily noticed in the case of a long ballad or hymn in church where the same music was repeated to different words, a very different effect being produced on the qualities of tone according to the vowels pronounced. In order to show that upon a somewhat exaggerated scale, he had upon one occasion taken a simple air, 'See the Conquering Hero comes,' and got a chorus to sing eight bars of it, first to *lee*, then to *lah*, and then to *loo*, and the effect was like that of three different instruments. He thought with Mr. Salaman, that too much was said against the unvocality of the English language, an Englishman might speak, perhaps, as strongly against German as an Italian could against English. He recollected the first time he heard Polish spoken it seemed to him nothing but a series of hisses, yet an educated Pole told him he had been to see 'Hamlet' performed, and he described the sound of the English language much in the same way. That simply arose from non-acquaintance with it. One of the lines quoted by Mr. Salaman—

"The heart that once slumbers there"—

he thought very ill-adapted for singing, on account of the concurrence of *s* hisses in '*once slumbers*.' The Germans had a similar difficulty with their guttural *ch*, which they had to cut and chip in a way which sometimes rendered it scarcely intelligible; yet he must say, for his own part, he preferred German as a vehicle of music to English, and to show the different effects produced by different speakers, he might say that he had never heard any language spoken more softly and pleasantly than German, or more harshly and unpleasantly than Italian, and he had had opportunities of hearing both from a great number of people in their own countries. The conclusion he came to was, that the national language any person used was, for that person, the best language for singing.

Mr. G. A. Osborne thought, if the English language was not considered a good one for music it was mainly attributable to two causes. In the first place, to the musicians who composed music for English words—many of whom were not singers, and consequently did not sufficiently study the requirements of the vocalist. An interesting instance of this came under his notice on one occasion in Paris, where there was a young English lady who was a thoroughly good musician and an excellent reader

A composer had written a song and said he should like to hear it sung. The young vocalist offered to sing it, and her brother accompanied her on the piano After the symphony she opened her mouth to sing, and suddenly put her hand to her throat as if attacked by a spasm. The symphony was recommenced, but with the same result, and it then appeared that the cause of this curious effect was, that she had to commence the song with the word 'music' on a very high note, and of course the *m* had to be pronounced with the lips closed If the song had commenced on a low note probably there would have been no difficulty. For the other cause we were greatly indebted to foreigners, who came here in such large numbers We were glad to see them, and they were glad to come, and often liked to remain here. But they thought it necessary to patronise us by singing our language, sometimes without the slightest understanding of it, trusting to their good ear to catch the proper sounds. Thus he had heard 'Home, sweet Home' sung in a style to make it appear anything but a desirable place.

Mr. W. H. Cummings said He took considerable interest in this subject, having devoted attention for some years to the matter of vocal music. He thoroughly agreed with Mr Saleman that the English language was equal to any for musical purposes, but at the same time he differed from Mr Osborne in thinking that any word in the English language was not fit for singing He should be pleased to try any word which could be put before him. Mr. Ellis's experiments, he thought, were on a wrong basis altogether. He had a class of thirty persons to sing certain sounds; the question was, were those people educated vocalists? if not, surely they were not the people to test the English language; you could not sing without learning how to do it. He also found fault with consonants, but there were no such things as pure consonants; *t*, for instance, was a compound of a consonant and a vowel, and the vowels themselves were nearly all compounds. He also differed from Mr. Ellis as to the vowel *a* being the *only* proper one to sing upon, for singers very frequently employed some other vowel; and he maintained that vocalists who had given years to this study would be the persons to decide what were the best vowel sounds to use in practice. He thought there was not a letter or a sound which was not good for music. You might take the works of two great men, Purcell and Handel, who had set words of all kinds to music, and always successfully, and you would not find any difficulty even with Handel's fioriture, although sometimes there was want of taste in adapting the character of the music to the words, Handel not being sufficiently well acquainted with the language; but in Purcell you never found any difficulty at all Tom D'Urfey, the celebrated writer, once wrote a poem into which he contrived to put all the most difficult sounds the English language was supposed to be capable of, and defied Purcell to set them to music; but he did so, and fortunately the music was in existence, and was capable of being sung by anyone of moderate

powers. Mr. Ellis had complained of the vowel *e* as not being musical, but he had heard most excellent strains where the vocalisation was on *e* alone. Of course in good vocalisation the consonants almost disappeared; they came fairly at the beginning and ending of syllables, and a good singer sang principally on the vowels. There was now a school, fortunately with only one prophetess and, he hoped, few pupils, teaching that vocalists should shut up the nose and sing on the consonants, but he was quite certain that that would not obtain, it never had been the custom in England, at least, since Chaucer's time, and he trusted never would be.

Mr. STRATTON agreed with some of Mr. Ellis's remarks. He was, no doubt, a great master of the constituents of language, but it appeared on the whole that the English was about as good as any other. There was no doubt we ought to study our own language more. He should also like to draw attention to a work which was not very generally known, 'The Music of Nature,' by Wm. Gardiner. He said the French spoke in the nose, the Germans in the throat, and the English through their teeth, also that there was no more beautiful English spoken than by ladies, which he attributed partly to their knowledge of Italian; whilst in another place he said they spoke better than men from the superior shape of their tongues. Another thing was, that if they wished to speak properly they must study how to speak. He also gave the quality of different languages, and suggested that in southern climates speech was softer, and riper, and more flute-like, while in the northern climes, through people having to keep their mouth shut, they were more accustomed to speak in the throat. He gave a high character to the English language, as being most copious, though not rich in short words. He thought that every true musician was also naturally a poet, and if he would only master the mechanical difficulties of the language, would be able to write his own words, and in that way many of the anomalies they heard of would be removed. Wagner was an example of what might be done in that way. There were 10,000 words in the English language beginning or ending with *s* or *st*, and you sometimes found words in a song such as 'ask'st,' which, of course it was almost impossible to sing.

MAJOR MCCREAGH remarked that a foreign writer had said that the English was the language of snakes, and the German that of horses. No doubt there were difficulties in the English language with some of the consonants, although they were necessary. They had been called the crutches for the vowels to lean upon, and were certainly indispensable. Perhaps the best test of a language was its power of being translated for musical purposes. For instance, the 'Bohemian Girl,' which was written in English, had been translated into Italian; but some of the best airs in it, as, for instance, 'The heart bowed down,' were not nearly so effective in that language as in the original. There were other instances, such as the opera of 'Macbeth,' where the witches' scene was rendered perfectly absurd by its translation.

One great cause for the preponderance of the letter *s* in the English language might be mentioned, and that was the change which had taken place in the 3rd person singular of the present tense in every verb, which was comparatively recent; and in addition, the plurals of nearly every noun, and the possessive case, were all made to terminate in *s*. If they were met in solemn conclave to remodel the English language for musical purposes, he should be inclined to suggest a return to *th* for the 3rd person singular; for though it might be found fault with as a rather lisping termination, it would be preferable to the extraordinary number of *s's*. One reason given for this *th* being turned into *s* was for the purpose of rhyme, which some writers had found great fault with, and he thought the jingle at the end of each line might be compared without much exaggeration to a blow on a drum to mark each bar. Some people could not distinguish poetry from prose except from the jingling rhyme at the end; but he thought if we could go back to the classic times, when poetry was written without any rhyme, it would be a great improvement, though 'Paradise Lost' was originally snuffed out in popular favour by Hudibras mainly on this account. He believed that, on the whole, the English language might compare favourably with that of any nation, even with regard to smoothness, if the words were well chosen.

The CHAIRMAN (Professor W. H. MONK) said he could not help thinking that many speakers, as was natural under the circumstances, had been a little at fault as to the difference between language considered *per se*, and the vocal execution of language, which, after all, had been the point at issue. They had been professing to speak on the musical performance of language; and in that there were undoubtedly two component parts, for every syllable of every language contained a vowel, and sometimes one, or perhaps more than one, consonant, whether it were guttural, labial, or otherwise. The singer had to do primarily with the vowel, and the very classification of letters with which all were familiar into vowels and consonants was into what could be uttered by the *vox* and what could be only uttered by the help of something else, and was therefore called *consonant*. A singer produced his vocal effect, long or short, high or low, good or bad, on the vowel, and should be taught to sing passages of music on every one of the vowels indifferently. He might venture to say that if there were any Englishman who had not been taught to accomplish this, he stood at a disadvantage compared with a well-educated Italian. He thought also it would be useful for those who had so much difficulty in singing or speaking the English language, to begin by making a catalogue of all the English words they could discover in which no vowel was present. A singer could treat the vowels of the universal language successfully, whether he were singing English, German, or Italian. That the latter language enjoyed a rich advantage over all others in respect of smoothness would not be denied, and

the very growth of the language showed that such a result must have happened. It was founded mainly on the old Latin; but so much had been softened and beautified in pronunciation by the generations which had passed since it ceased to be a living language, that it might almost be said that the Italians had *lived* for their language. Those who had studied the history of the growth of the Romance languages would see that in many respects the Italian would be remarkable for this quality. But even this consideration did not touch the main point of the accusation against the English tongue, because, as it stood, no English syllable was without a vowel, and he did not see why a vocalist should be less successful in his own language than in any other. He agreed with Mr. Osborne that other causes had been at work, and he might mention one not alluded to by that gentleman. The cultivated foreigner, in singing English, attacked the language from a different point from the ordinary one at which an Englishman began. If you asked an English gentleman or lady to sing a passage, you got for each word, not the thing you should get, or that you would get from the same person if he or she were called upon to sing a passage in Italian or German, but a certain *Bourgeois* pronunciation with which we were accustomed colloquially to be satisfied. Now the vocal teacher ought to correct this universal English fault, and he had often occasion to ask his pupils to suppose that they were singing a language of which they understood not a syllable. In such a case they would look at every word as composed of certain letters, and for each of those letters they would try somehow or other to produce the vocal equivalent. But not so with English; they produced the *Bourgeois* word to which they were accustomed, not the word written. Looking at language from this point, what was wanted was not so much a reformation in the art of spelling as in that of pronouncing the letters visible to the eye. He agreed most entirely with Mr. Cummings with reference to the necessity of *learning how* to sing English. But there was also to be mentioned a prevalent failing in the immense number of musical compositions, constantly issuing from the press, the authors of which did not understand how properly to express their ideas, but it must be thought meant one thing and wrote something else; for he could not otherwise account for the frequent extraordinary misplacement of accent. He might remark that the Italian language had suffered quite as much as the English when operas written in another language had been translated into it. For example, *Faust* was very poorly rendered into Italian. The consonants and vowels being tilted against one another led to the English being called a consonantal language, and the Italian a vocal language; but there were many instances to be found in the writings of the great Italian composers where they had shown the difference between *vocalisation* and the treatment of *consonants*, and the extremely effective use which could be made of the latter in some cases. A most magnificent instance of this might be remembered in the baritone part in Rossini's *Semiramide*

Mr. Salaman said that he had very little to add to what he had already advanced in advocacy of the English language as a language in every way suited to music. He had treated the subject of his Paper from a musical point of view. He could not but agree with some of the remarks which Mr. Ellis had made. All the observations of a man of such celebrity, and such great experience as a philologist and scholar, were entitled to respectful attention. At the same time it must be stated that the consonants which Mr. Ellis says *cannot* be sung, and the vowels and sibilants which he considers difficult to sing, *are* sung by educated English vocalists, and have always been sung, and without any difficulty. Mr. Salaman thought that Mr. Cummings and Professor Monk had successfully replied to Mr. Ellis's objections. Those gentlemen are not only practical musicians, but famous and experienced instructors in the vocal art, and their opinions, the result of a long experience, are of the utmost value in such an inquiry as the present. It was patent to all that England possesses some of the best vocal music that has ever been composed, and that native singers capable of singing it have never been found wanting. Mr. Salaman believed that to the end of time England would produce native musicians who would compose good music to native verse, and that educated English vocalists of both sexes will be forthcoming to sing it effectively, with ease and fluency.

JULY 2, 1877.

WILLIAM CHAPPELL, ESQ., F.S.A. IN THE CHAIR.

ON IMPROVEMENTS IN THE TRUMPET.

By HENRY BASSETT, Esq., F.C.S.

THE two instruments which I have the pleasure of describing to the Association are the results of my endeavours to remedy some of the shortcomings of that ancient and important instrument, the trumpet.

In its original form its capabilities were of course very limited, by reason of the small number of notes to be obtained, these being no more than the natural series of harmonic intervals, though something was done to supplement them by the use of the hand in the bell, as in the case of the French horn.

By the addition of the moveable slide a great advance was made, as by this means many other intervals were rendered available. Still, however, the lower part of the scale remained imperfect, as, for various reasons, it was not possible to have a sufficient length of slide to supply all the notes for a complete scale, as is done by the trombones, the most important being that, from the great length of the tube in relation to its pitch, the instrument is what is called 'tender' or uncertain, and the use of a long slide, by altering the diameter or bore of the tube for too great an extent, has a very bad effect on the tone.

By the invention of valves or pistons a so-called complete scale was obtained on all brass instruments, together with great facility of execution, and the old slide trumpet has been in consequence to a great extent superseded by trumpets and cornets with three valves; a fact which is, I believe, generally regretted by those who have given attention to the subject, as these instruments, besides being decidedly inferior in quality of tone, are most faulty in intonation. It is not difficult to show by calculation, from the varying lengths of tube brought into action by the valves, that many of the intervals resulting from their combination are not in accordance with either the just or tempered scales. The unfortunate practice of transposing parts written in widely

different keys, so as to use only one or two crooks, greatly increases these errors, besides sacrificing the benefit of the natural true intervals and distinctive qualities of tone of the different crooks.

My first attempt was to construct a valve trumpet which should avoid these faults of intonation, and I claim for my 'Comma trumpet,' the production of a more correct scale than is given by any other valve instrument.

The first and second valves remain as usual: that is to say, they lower the pitch by the intervals of a major tone and a diatonic semitone respectively. The third valve *raises* the pitch of any note produced by the first valve by the interval of a comma; in other words, the first and third valves *together* lower the pitch a minor tone. When used with the second valve, or alone, it gives, of course, other modified intervals.

This system of valves, which is also applicable to the French horn (formerly called the tenor trumpet) enables the player to produce a practically perfect diatonic scale in the tonic, dominant, and subdominant keys, with the advantage of having only two valve slides to tune when changing the crook, the alteration theoretically required in the third valve being so small as to be inappreciable. This instrument nevertheless did not entirely satisfy me, for the following reasons:—

In the first place, though having a better tone than any other valve trumpet I have met with, it is distinctly inferior in this respect to the slide trumpet

Secondly, the A♭ below the stave is wanting; a note however which should be seldom required, as it might be easily avoided in composition by taking advantage of the facilities offered by a change of the crook or key of the instrument; moreover the lower notes of the trumpet should not be used too freely, as they are difficult of production, and would be much better rendered by the alto trumbone. Still much military and dance music can only be played on the usual three-valve trumpet or cornet, which latter is really much better suited for the purpose.

Thirdly, the advantages in correctness of tune will only be fully obtained by a performer having a sufficient theoretical knowledge of music to be aware of the slight differences in intonation, and consequently in the fingering, required by a change of key, whereas in a slide instrument, the trombone for example, these difficulties are overcome by the marvellous instinctive co-operation of the ear and the hand.

These considerations led me to further attempts, and I may say I have succeeded in attaining my object in the simplest possible manner: this second instrument, which I call the Telephonic or perfect-sounding trumpet, being nothing more than the ordinary slide trumpet, with the addition of a single valve tuned in unison with the open D, or harmonic ninth—in other words, lowering the pitch a minor tone. This valve is worked by the

first finger of the left hand, the instrument being held exactly in the usual manner, and does not injure in the slightest degree the pure tone of the old trumpet, the bore of the tube remaining perfectly straight.

By the use of this single valve and the slide, separately or together, it is possible to produce a complete scale, major or minor, with a perfection of intonation only limited by the skill of the player, as it is essentially a slide instrument. The valve not only supplies those notes which are false or entirely wanting in the ordinary slide trumpet (including even the low A♭ and E♭ when playing on the higher crooks), but greatly facilitates transposition and rapid passages, while comparatively little practice is required to become familiar with its use.

I may say in conclusion, after some months' practice with the instrument, that it answers all reasonable requirements in the most satisfactory manner, and from the increased facilities which it offers, I believe that its adoption in the orchestra would have no inconsiderable effect in rescuing the legitimate trumpet from the neglect into which it has fallen of late years, with great advantage to the proper rendering of all classical music.

DISCUSSION.

The Hon. Secretary asked Mr Bassett if every note in the scale could be played on his 'Telephonic trumpet'?

Mr. Bassett said that all the chromatic intervals could be played, but it was not suitable for very rapid passages, which indeed were not so well adapted for the trumpet, and could be as well played on the cornet. For legitimate trumpet music, however, his instrument was all that could be desired. In reply to Mr. Stephens, he said the instrument acted equally well in all ordinary keys.

Mr. Stephens asked how low a scale could be played? He had seen crooks for A.

Mr. Bassett said it was very undesirable to crook so low as A, as the tone became very uncertain and 'tender,' and the notes would be apt to split.

Dr. W. H. Stone said he had asked Mr. Bassett to bring forward the Paper because he felt very strongly the importance of applying true temperament to the orchestra, where he believed there was the greatest chance of its being attained. It was rather singular that this question had always been attacked from its most difficult side, viz., that of keyed instruments. It was far more easy of treatment in the case of instruments like those of the orchestra, which had a certain power of altering their tone, modifying the pitch, and bringing the chords into true intona-

tion. There was no doubt that this result had long been attained in the orchestra instinctively, to a certain extent, and this probably explained the superior power and force of the orchestra. But they ought to rise from τεχνη to ἐπιστήμη, and every credit ought to be given to Mr. Bassett for having made the first step in this direction. He was not aware of any other instrument which spoke with true intonation, or in which an attempt had been made to alter the recalcitrant commas, as in the 'Teleophonic trumpet,' or to attain the power of modifying the large intervals obtained by the slide. Mr. Bassett had mentioned in the course of his remarks what one seldom heard from players—that the valve slides required tuning, he had found the most marvellous ignorance prevailing on this subject. A great deal of the falsity of tone sometimes noticeable arose from the fact that horn players were not taught to tune their slides at all. No doubt they generally found that when crooked to play in such a low key as to render the horn almost double in length, it was desirable to make the valve slides longer, but, as a rule, the proper tuning of these slides was an unknown art. Another important remark was that with respect to the alto trombone. The trumpet was decidedly out of fashion, but some of the faults charged upon it no doubt arose from the fact that its natural neighbour in the orchestra, the alto tromhone, had been removed. The trumpet led down to the alto trombone, that to the tenor, and that to the bass, and there you had the only quartett of instruments in the orchestra which was perfect, except the strings, and yet this quartett was sacrificed. He was sorry to say that even Sir Michael Costa allowed the quartett to consist of a trumpet, two tenor trombones, and a bass, which was destroying one of the voices (*stimme*) of the orchestra. By restoring the alto trombone, you would not only gain the intrinsic beauty of the instrument itself, but would support the trumpet and strengthen those notes which the latter could not produce efficiently, if at all. The principle might be applied to other instruments, and he had, he believed, succeeded in doing so with the clarionet, though he was not yet in a position to bring it before the Society. He had obtained 19 notes in the octave, which gave abundant means of doing all that was required for true intonation. But there was one other thing which must be done simultaneously, and this bore somewhat on the question which, he believed, Mr. Bosanquet was about to deal with. You must tell the unfortunate player which note he was to play in each instance. Hitherto the necessary accommodation had been effected in a rough way by the ear, but if this idea were to be carried out the scores must be gone through, and the notes marked which required to be sharpened or flattened. When this was done, the requisite perfection in instruments being attained, and the music properly marked, they might hope that the orchestra, in *éclat*, splendour, and brilliancy of tone, would surpass anything which had yet been heard.

Mr. Blaikely said that, as a manufacturer of brass instruments, he entirely agreed with what had been said by Dr. Stone regarding the want of knowledge on the part of players of the use of the valve slides. It was quite common to have instruments returned for repair after being in use for years in military bands, with the valve slides stuck fast, so that the extent to which they must have often been out of tune was far beyond the slight differences of a comma. It also appeared to him that there was a difficulty in the way of the player who had only his own part before him. Unless he was guided by his ear, he could not tell whether the passage or chord he was playing was in C or F. It was evident, therefore, that improved instruments would be useless unless the music were properly written or marked.

ON SOME POINTS IN THE HARMONY OF PERFECT CONSONANCES.

By R. H. M Bosanquet, Esq., M.A., F.R.A.S., F.C.S., Fellow of St. John's College, Oxford.

The study of Harmony is the study of the combinations or chords which are formed from musical notes

The Harmony of Perfect Consonances is the study of combinations or chords formed from notes which have been constructed by tuning perfect consonances.

In the last edition of Dr Stainer's excellent work on Harmony, he says in the preface that he believes his theory will be found perfectly applicable to the system of just intonation. This may be so, but yet there are many points in the harmony of perfect consonances which are not covered by the discussions in Dr. Stainer's book, nor are they dealt with in any other book with which I am acquainted, except Helmholtz. I propose to call the attention of the Association to a few of these points, which certainly will be fundamental in any treatment of the harmony of perfect consonances that may eventually be undertaken.

As there is great tendency to mix up and confuse the different portions of the subject of improved intonation, I must point out the limits of that portion on which we are engaged to-day; and for this purpose I may usefully refer to the second reason given by Dr Stainer for omitting reference to the Tempered Scale, which is 'Because the attitude of scientific men to modern chromatic music has ceased to be that of hostility, inasmuch as they see that their system will never be adopted as long as it threatens the existence of a single masterpiece in musical literature, while, on the other hand, it will be universally accepted when it renders such works capable of more perfect performance.'

I may say, by the way, that I never heard of any scientific man, practically acquainted with the subject, who was hostile to modern chromatic music, or to masterpieces of any kind, and I cannot help thinking that it was the quite unfounded notion that this was the case, which gave rise to the feeling that recent musicians have undoubtedly had against the study of the various methods of tuning.

The division of the subject to which I above referred consists mainly in the distinction between the so-called mean tone system and systems based on perfect consonances For the details of the mean tone system I must refer to my book on Temperament It is enough here to say that the mean tone system adapts itself to

existing music: in fact, it was the musical language of Handel and others of our greatest composers; and by the application of my keyboard its performance has been rendered perfectly easy, so that the challenge in the passage from Dr. Stainer is taken up.

But our business to-day will be with an entirely different class of systems. Though to some extent applicable to existing music, it is to the future that we must look for the real development of perfect consonances; and it is partly in hope of endeavouring to interest rising composers in this new and beautiful material that I am calling your attention to it to-day.

Almost all recent writers state that whenever harmony has been practised the chords have been made up by combining certain sounds of the scale at that time in use.

As far, however, as my studies have carried me, there is no instance until quite recently in which even a theoretical writer has derived his chords in this way; nor is there any historical authority for the statement that they ever were actually so derived. Crotch and all the older writers derive the scales from the chords. It is only necessary to think of the processes by which instruments are actually tuned, to see that in fact scales are derived from chords, not chords from scales. In fact, I have little doubt that scales and modern tonality arose from the tuning of the harps or lutes of minstrels by consonances. The earliest ancient music depended on the lyre, whose notes were unquestionably determined by tuning consonances.

I come down at once to Crotch. He treats concords as the foundation of everything. He was thoroughly grounded in the knowledge of just intonation. I have had occasion recently to read his works with some care. My opinion is that he was greatly in advance of his time, and that in many points we should do well to go back to his careful, accurate, and logical treatment, as the surest foundation available. The following table is taken, with very slight modifications, from Crotch's Elements of Composition; it is an extremely simple and powerful mode of exhibiting many of the relations to which I shall have to call your attention. It is substantially the same in principle with, and but little different in detail from, the method recently published by Mr. Ellis under the name of 'Duodenes':—

CROTCH'S TABLE OF RELATIONS OF INTERVALS.

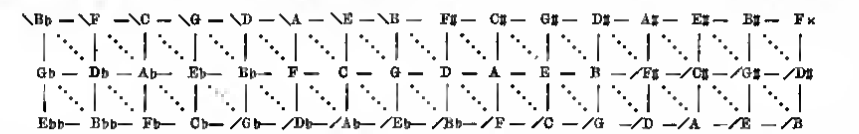
REPRINTED, WITH SLIGHT ALTERATIONS, FROM DR. CROTCH'S ELEMENTS OF MUSICAL COMPOSITION, p. 4. NOVELLO'S EDITION.

'The middle row consists of key notes, the upper row of major thirds to those notes, and the lower of minor thirds to them. . . . .

'Thus a major triad is any note with its major third and fifth, as E / C—G, and a minor triad is thus expressed, C—G \ Eb . . . . .

'Though the same letter is found in each of the three lines of the table (as \C in the upper line, the third to Ab. C in the middle line the key note, and /C in the lower line, the minor third to key note A), yet none of the notes contained in the one line are the same as those contained in either of the others, but differ from them in a slight degree, as the student will perceive when he comes to study tuning.'

Introducing my notation (\ /) to denote the difference indicated by Crotch between notes of the same name in different lines, and shifting the lower line one place so as to obtain similar forms for the same intervals throughout the table, it assumes the following form:—



Horizontal line — means an exact fifth. Vertical line | means a major third. Sloping dotted line ⋱ means a minor third.

I cannot hope to discuss any large number of chords to-day, and I propose to devote the time chiefly to chords formed from a series of thirds. Helmholtz has discussed several cases of these chords, but he confines himself principally to such forms as are derived from the notes of the scale. I shall consider also cases in which it is desirable to depart from the so-called notes of the diatonic scale.

Helmholtz enumerates first the different kinds of thirds, fourths, and fifths; these are the elements of our chords; we may reduce them to a small number of elements, from which the rest are derived by inversion and combination.

Perfect third . . .	$c-\backslash e$
Pythagorean third (a comma sharp)	$c-e$
Perfect fifth	$c-$
Fifth mistuned a comma . . .	$d-\backslash a$

To which we may add, as of occasional occurrence—

A third two commas sharp . . .	$c-/e$
A depressed minor seventh . . .	$c-\backslash b$

The minor thirds, augmented fourths, diminished fifths, and other intervals are generally determined by combinations of the above. These above enumerated are intervals which arise more or less directly from tuning; and it is to the tuning of the notes of a chord that I desire to refer its consideration.

For the way in which differences of a comma arise in actual tuning of fifths and thirds, refer to Crotch's table, and see by what processes you would pass, say from \A to A.

I proceed to consider the chords formed by a series of thirds on the dominant.

The common chord of the dominant is—

$$g-\backslash b-d$$

I call your attention to the following variations of it.

The equal temperament chord.

The chord $g-b-d$ with Pythagorean third.

The chord $g-\backslash b-\backslash d$ with depressed second of the key and false fifth.

[These chords were played on an ordinary harmonium, and the large enharmonic harmonium from South Kensington, with which the examples of just intonation were illustrated.]

The object of calling attention to these modifications is this: in subsequent chords we may be confronted with these as alternatives, and it is desirable to know what the effect would be if we were to adopt them. We conclude that the fifth false by a comma is quite inadmissible, and the Pythagorean third only less objectionable than the false fifth.

Add the minor seventh*—

$$g - \backslash b - d - f$$

This f is derived by tuning two-fifths from g; it represents the ordinary minor seventh, and is very rough.

Depress the f a comma—

$$g - \backslash b - d - \backslash f$$

This chord is nearly smooth, it is approximately the consonance of the harmonic seventh.

Raise the first f a comma—

$$g - \backslash b - d - / f$$

This is the chord of the seventh according to some of the old theorists, who made the $/f$ a minor third ($6 : 5$) to the d; it is disagreeable, as you hear.

Add the ninth to g; then, varying the seventh and ninth, we get the chords—

(1) $g - \backslash b - d - f - \backslash a$
(2) $g - \backslash b - d - f - a$
(3) $g - \backslash b - \backslash d - f - \backslash a$
(4) $g - \backslash b - d - / f - a$
(5) $g - \backslash b - d - \backslash f - a$

(1) Is the chord given by Helmholtz; it follows from selecting the notes of the diatonic scale; that is, the $\backslash a$ is made the major third to f.

But if I play this chord it sounds abominable. We perceive at once that this $\backslash a$ makes a false fifth with d, which is quite intolerable. We will now raise the $\backslash a$ to a, so as to make the fifth with d perfect, at the cost of the Pythagorean third $f - a$.

(2) Is thus obtained; it is still rough; we trace the roughness to the seventh $g - f$, and the sharp third $f - a$.

(3) Here we try depressing the d to $\backslash d$, which forms a fifth with the $\backslash a$, but we introduce the false fifth $g - \backslash d$, which is inadmissible.

(4) Here we raise the a, so that the fifths are both perfect, and raise the f to $/f$, so that it makes a perfect third with a. The bad seventh is the only dissonance, but it is very bad.

(5) Here we still have both fifths perfect, and give the seventh its smoothest position $\backslash f$, sacrificing the third, which is now two commas sharp. This is to my ear by far the most tolerable position of the chord, indeed the only one that is at all tolerable.

Helmholtz treats the employment of the fifth $d - \backslash a$ in these cases as correct; I can only say that if such combinations

* Reference should be made to Crotch's Table at p 147, to see what the relations of the different notes are to one another with respect to tuning.

are to be used I had rather stick to equal temperament, which involves nothing so bad.

It is not necessarily the case that inversions or derivatives of a chord are best taken in the same way as the chord itself; it frequently happens that the relative importance of the different notes is entirely changed, so far as the preservation of harmoniousness is concerned. For instance, in the dominant seventh, if the seventh is in the bass,

$$f — g — \backslash b — d$$

No appreciable increase of smoothness is obtained by depressing the f to $\backslash f$.

Some theorists say, what is the use of seeking for the smoothest forms of combinations? The ear likes dissonances. I say that if we are to use these chords, their smoothness or roughness is their principal characteristic, and deserves to be examined.

The statement that the ear likes dissonances I meet in this way. I do not believe that any healthy ear likes such dissonances as are produced by mistuning any consonance one or more commas. The dissonances in ordinary use, which deviate from consonances by not less than a semitone, are of quite a different character, and have nothing of the horrible sharpness of consonances mistuned by one or two commas. These last dissonances are audible through any quantity of the others, and I lay it down as a practical rule, that forms are to be preferred in which dissonances of mistuning, as I call them, are least offensive.

I will now consider one or two cases in which freedom is gained by the omission of a link of the chain of notes which constitutes the complete chord of the ninth. We have seen that the whole chain cannot be put together without the occurrence of dissonances.

Omission of the Fundamental g.

This permits us to depress the second of the key, so as to form a fifth with the sixth, $\backslash d — \backslash a$. The chord then becomes

$$\backslash b — \backslash d — f — \backslash a$$

The combination $\backslash b — \backslash d — f$ still possesses some roughness. We have passed over the study of the forms of the dissonant triad, which should precede that of these chords, and does precede them in Helmholtz; but we can admit that

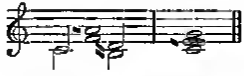
$$\backslash b — d — \backslash f,$$

part of the complete chord of the harmonic seventh, is the smoothest form, and

$$b — d — f,$$

which is most like the chord in ordinary use, is of medium quality.

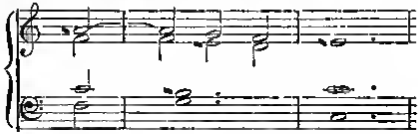
In a passage like the following,



we have the first form above mentioned, i.e. that derived from the scale; it cannot here be modified in any way, since the first chord determines the f and $\setminus a$, and the $\setminus d$ in the second chord is determined by the suspended $\setminus a$.

Where the chord is struck without suspension any form not dissonant of itself may be used.

We have above an example of the constraining effect of suspension; consider now a succession similar to the above, with introduction of the complete chord of the ninth on the dominant; the difficulties thus arising are nearly as great as in any case I know.



If we try to introduce the second of the key in the second chord, it forms a chain of fifths between the dominant and sixth of the key; the one requires it to be d, the other $\setminus d$, it is therefore impossible to introduce the complete chord of the ninth on the dominant when the ninth is suspended as the sixth of the diatonic scale.

Consider next the chord formerly called the 'added sixth,' now usually derived as a chord of the seventh on the supertonic.

$$d - f - \setminus a - c$$

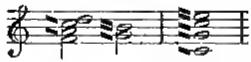
The above would be this chord according to the notes of the diatonic scale, but this is inadmissible on account of the false fifth $d - \setminus a$. It has been usual to avoid this by depressing the second of the key thus,

$$\setminus d - f - \setminus a - c$$

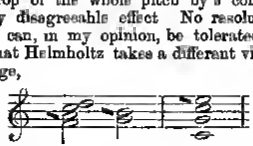
or, considering the chord in the position which gave rise to the name 'added sixth,'

$$f - \setminus a - c - \setminus d$$

in this form the chord presents itself as an agglomeration of consonances, containing only the mild dissonance of the whole tone. Its resolution in this form, with suspension of the second of the key, presents, however, almost insuperable difficulties.



This is the only strict way of effecting the resolution. But it involves a drop of the whole pitch by a comma, which has generally a very disagreeable effect. No resolution depending on a false fifth can, in my opinion, be tolerated, though I am bound to say that Helmholtz takes a different view. He would write the passage,



As before, I say that I would rather stick to equal temperament than face such sounds as these.

If it is really required to employ such passages in connection with perfect consonances, it is in my opinion generally best to sacrifice the thirds, i.e. in the above passage the third $f-\backslash a$ would be changed into the Pythagorean third $f-a$. But nothing is gained by the employment of perfect consonances where such expedients have to be resorted to.

I have endeavoured so far to point out some of the principal difficulties in the harmony of perfect consonances. The best way for the composer to deal with these points will be to avoid them.

Successions of minor thirds admit of easy treatment; the minor third is not an interval susceptible of accurate tuning, and chords containing minor thirds may be arranged in almost any manner; the following are usual forms:—

Augmented Sixth.

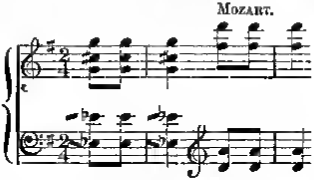
The use of this by the older composers, especially Mozart, is so effective in just intonation that I am unable to believe that this was not within their view.

Referring to Crotch's Table, we easily see that the augmented sixth $/A\flat-F\sharp$ may be represented as an octave less two diatonic semitones (corner to corner, *across* the dotted lines, is a diatonic semitone or a major seventh).

In ratios, two diatonic semitones make $\left(\frac{16}{15}\right)^2=\frac{256}{225}$ and an octave less two diatonic semitones is $2\div\frac{256}{225}=\frac{225}{128}$. But the ratio $\frac{7}{4}=\frac{224}{128}$. Whence—

The augmented sixth differs from the harmonic seventh only by the small interval $\frac{224}{225}$, or about $\frac{1}{8}$ of a comma.

This accounts for the fact that the augmented sixth of just intonation is a very smooth combination.



The Enharmonic Harmonium exhibited on this occasion is the original one which I constructed first. It is not tuned precisely by perfect consonances, but by a rule which approaches so nearly to the tuning of perfect consonances, that the deviations of the tuning from exactness are less in amount than the casual errors which must occur in every instrument in course of time. As I have given a complete account of the tuning in former papers, and in my book on Temperament, I do not propose to enter here into the matter.

No discussion arose on the Paper. A number of illustrations were performed on the 'Enharmonic Organ.'

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