Organ Construction

J. W. Hinton

June 1906

ORGAN CONSTRUCTION

Yours faithfully
J W Hinton.

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BY

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London

THE COMPOSERS' AND AUTHORS' PRESS, LTD.

18, FEATHERSTONE BUILDINGS, HOLBORN

1900

BARNICOTT AND PEARCE
TAUNTON

To my friend

E. H. TURPIN, Mus. Doc.

Hon. Sec., Royal College of Organists;
Warden of Trinity College, London,
etc., etc.

Preface.

In preparing this work my object has been twofold : (1) To state concisely the main principles of organ-building ; (2) to assist organ students, organists, and candidates for diplomas and certificates, by providing answers to the questions upon Organ Construction which have been set by the Royal College of Organists during the years 1888-1898.

Anyone mastering the contents of these pages would, I think, not only be amply furnished with general information upon the subject of Organ Construction, but would also possess a sort of "key," facilitating the study of more elaborate and technical works.

The author's thanks are cordially tendered to all who have assisted him in collecting information. He specially desires to express his gratitude to Dr. J. Warriner and to the Rev. J. B. Croft, M.A., for valuable suggestions received.

J. W. HINTON.

9, Strathblaine Road,
Clapham Junction, S.W.
February 10th, 1900.

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Introductory.

ORGAN-BUILDING was gradually developed in various parts of Europe, but more especially in Germany, England, and France. So late even as the commencement of this century, these countries possessed distinct schools of organ-building, which had naturally grown from the tastes of the people and from the purposes for which they used organs.

Of these the German school claims our most careful attention, on account of its great importance; Germany—Saxony in particular—being the birthplace of the organ as we now understand it.

Over two hundred organ-builders can be counted as having flourished in Saxony alone, between 1359 and 1780, including the Silbermanns, Hildebrand, Gabler, Sommer, and Herbst. It will, therefore, be highly interesting to note the circumstances and surroundings which determined the evolution of the German school of organ-building.

To accompany divine service of a congregational character—the worshippers being of a race both devotional and, almost to a man, possessed of strong musical voices—it is at once evident that organs of considerable magnitude were required. Unfortunately all early attempts to build large organs were doomed to result in failure, either in the quality or quantity of tone; as the then known mechanisms could only bring a limited number of stops under the control of the player. The touch grew proportionately deep and heavy as stops were added, until a point was reached at which playing became impossible, on account of the physical difficulty of pressing down the keys.

The only palliatives then known for this most unsatisfactory state of things were :—

(1). To retain the wind of sufficient pressure but to make the pallets small, only supplying a few of the stops at one time, in effect rendering every stop good, but virtually reducing a large organ to a small one. For instance, in an organ say of forty stops, not more than twenty could be drawn at once ; these chosen in successive batches, varied according to the taste of the organist, but not exceeding the number the pallets would supply.

(2). To lighten the pressure of wind—thus impairing the reed stops, and the treble portion of all the other stops.

When constructing large organs the French chose the former, the Germans the latter, of these alternatives.

The methods of "registering" entailed by the French system just mentioned will be first considered.

Roret's reprint of Dom Bedos' *Facteur d'Orgues* (Paris 1849)* a valuable and exhaustive book, contains a long chapter in which the writer describes what he considers "usual and desirable" stop-combinations. Vol. II, p. 356.

The following are some of the principal ones :—

PEDAL COMBINATIONS. "No pedal flue work is ever to be used with the pedal reeds." (On ne mèle jamais aucune pédale de flûte avec celles de trompettes).

MANUAL COMBINATIONS. "Plein jeu" combination. All the flue stops, together with the Mixtures and Furniture, using Trumpets and Clarions on the pedals as a bass.

To this there is a corollary. A reed (bombarde) added upon the manual would enhance this combination, but this is only possible when there are separate grooves and pallets for the reed, otherwise it would be out of tune, *being robbed of its wind by the foundation stops.*

In describing Combination 3, headed *Pour le duo* (how to play two

* This splendid work (Dom Bedos' original book) containing 137 plates, was published at Paris, 1766-1768.—Hopkins and Rimbault, *The Organ* : London, 1855 : page 9.

independent parts on two separate manuals), Dom Bedos writes as follows :—

Left hand; Great Organ. "All flue stops, the two Twelfths, and the Quarte de Nazard, without the Fifteenth (*sic*), also the two Tierces." This combination is called "Grand jeu de Tierce."

Right hand; Choir Organ. "All flute stops 8ft. the Principal, the two Twelfths, and the Quarte de Nazard." This combination is called "Jeu de Tierce au positif."

Combination 7, *Pour le Cromorne en taille.* How to play a "Cromorne" (Clarinet) solo, is also peculiar; and here, as in the previous combination, the Great Organ is used for the accompaniment, *e.g.* :—

Left hand; Great Organ. All the 8ft. flue stops.

Right hand; Choir Organ. The Cromorne with the Principal. *Pedals.* All the flue stops (if there is a Tierce on the pedals it will be an improvement). ("Cela fera un plus bel effet.")

Enough has, I think, been given to show that all these strange selections of stops were outcomes of the fact that the whole, or "full," organ could never be used at the same time.

Further: as the organ in France had seldom to sustain large masses of voices, it came to be treated merely as a kind of orchestra, intended to embellish the functions of the Roman Catholic Church.* This statement is well within the facts of the case. In all the large Roman Catholic churches of Paris, and of most other French towns, there are two organs: a small one in the choir, upon which a church musician accompanies the choir, and a huge instrument ("Grandes Orgues") at the western end of the edifice. This latter seldom or never takes

* "Jusqu'au XVI. Siècle . . . . on ne se servait pas de cet instrument *pour l'accompagnement des voix* . . . . Ce furent Luther et les autres réformateurs qui introduisirent les premiers l'usage d'accompagner les psaumes . . . .

Les Catholiques, obligés d'employer dans la lutte les mêmes armes que leurs adversaires, adoptèrent dans les mêmes pays (Allemagne, Angleterre, et Pays Bas), l'usage d'accompagner avec l'orgue le Plain Chant et les Cantiques en langue vulgaire . . . . En France, ou les anciens rites se sont conservés intacts, l'orgue a continué *d'alterner avec le chant du choeur.*" M. Danjou, *Revue de Musique Religieuse*: Paris, 1847.

any part in worship music, but at intervals an instrumental display is given upon it by the most brilliant executant the church is able to secure as organist.

The German system being unfavourable to the production of good reeds, the organ-builders of that country neglected this important class of stops, but naturally strove to devise some substitute possible on light wind. They invented that exquisite family of stops known as Gambas, and brought the small wooden pipe work to great perfection.

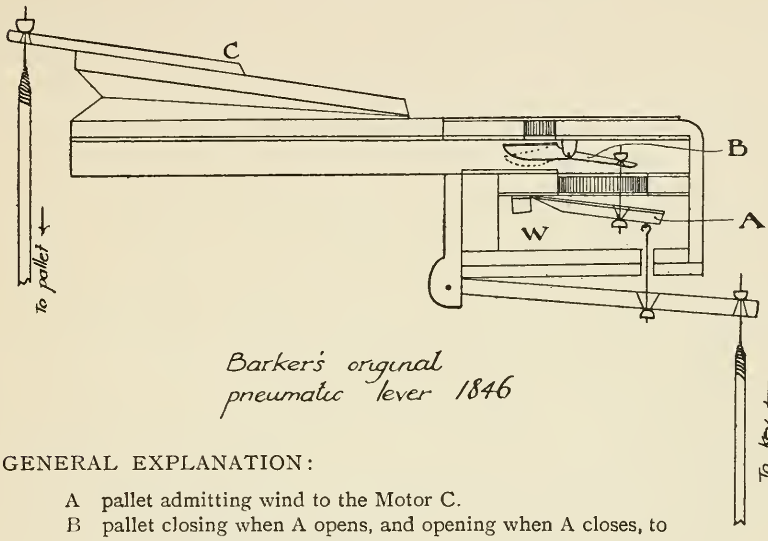
The early English builders followed the German school in all its principal characteristics. As, however, they rarely built organs of a very large size, they were able to combine a slightly higher wind-pressure with many improvements of their own.

Especially important was the discovery of a method for equalising the wind-pressure, by the use of *inverted ribs* in the upper reservoir of organ bellows. This improvement gave steady wind at a constant pressure, a result previously unattainable.

The difficulty which, in France and Germany, brought about the adoption of the different expedients mentioned, was finally overcome by C. S. Barker (b. 1806, d. 1879). Barker's attention was directed to the fact that in the enormous organ at York Minster, by Messrs. Hill, a pressure of several pounds' weight was necessary to bring down each single key. After many fruitless experiments, the principle of the hydraulic press suggested itself to him. Following this up, he devised a mechanism in which the "action" was set in motion by the expansive power of compressed air, the key having only to admit or cut off an exceedingly small quantity of air to effect this result. In a word, the key, instead of remaining a mere crowbar for shifting a cumbersome train of backfalls, rollers, and springs, became, as it were, a valve lever, which a child can work, though the engine thus set in motion exerts a power immensely greater than that required to move the lever.

This glorious discovery, by which was removed the dilemma which had so long baffled the builders of every nation, was offered to Messrs.

Hill, when they were erecting the large organ in Birmingham Town Hall. In spite, however, of practical demonstration, they declined to



Barker's original pneumatic lever 1846

GENERAL EXPLANATION:

A pallet admitting wind to the Motor C.
B pallet closing when A opens, and opening when A closes, to allow the Motor to collapse.
W small chest always full of wind from the bellows.

adopt it. Barker subsequently approached M. Aristide Cavaillé-Coll, the eminent Parisian builder, who applied it to the large organ of St. Denis (1846).

By three English inventions, viz. :—

Jordan's Swell, rendering the organ capable of *expression*;

Flight's Bellows, affording *steady wind*;* and

Barker's Pneumatic Lever, admitting of organs being *built to any size*, the art of the modern builder became broadly eclectic, these discoveries enabling him to combine every effect hitherto only attained in different countries, and under conditions special to each.

* The introduction of Inverted Ribs is generally ascribed to one Cummins, or Commins, a clockmaker, but Flight was the first to work out the idea, and to produce it in a practical form.

Chapter I.

General Notions upon Organ Stops.

By the term "stop" is meant a number of pipes following each other chromatically, and extending over the full compass of the keyboard, or some portion thereof only. Each set, or series, of pipes thus situated is composed of tubes of the same construction producing the same quality of tone throughout; and—as there is a pipe (or sound-producer) to every key—the series aforesaid constitutes a complete instrument or stop. When two stop-handles are drawn there are two instruments simultaneously controllable from the keys, just as would be the case if it were possible to unite two pianos in such a manner that they could be simultaneously played by one performer, on one keyboard.

The German term *Stimme* (or voice) for Stop is an excellent one, as the organist must consider that he is virtually directing a chorus, each stop being a unit. If he draw *one*, it is as though he told an individual to sing alone; if he draw *two* or *three*, it is the same as though he told two or three persons to sing *in unison*.

I certainly think that all separate series of pipes should be termed "voices," according to the German precedent. To call each voice or instrument a Stop is as unphilosophical as to call it a wind-tap, or stop-cock: it only describes a portion of the mechanism necessary to secure the independent action of the "voice" in question.

From an etymological point of view it is, however, quite easy to account for the word "stop." Until about the middle of the fifteenth century each key in an organ controlled a certain pre-arranged

number of pipes—in fact the organ was simply a huge "mixture," sometimes having forty or fifty ranks. When means were devised by which the player could *stop* certain ranks from sounding, thus isolating others he wished to use alone, a new era dawned in the annals of organ-building. The term "stop" recalls the fact that sliders were first used rather to *silence* ranks of pipes than to bring them on, and, in itself, constitutes a record of the causes which led to its invention. Similarly the term "barrel" applied to the body of a gun, reminds us that gun barrels used to be made of wooden staves hooped together like a cask.

Stops (to use the accepted term) are thus classified :

I. Complete stops.
II. Incomplete stops.
III. Short stops.
IV. Divided stops.
V. Compound stops.

Complete stops, are those which extend throughout the entire compass of the manual keyboard, or pedal clavier.

Incomplete stops are stops which—while usually made of complete compass—may, in particular cases, be found commencing at some point above the usual one, thus lacking some low notes.

Short stops, are virtually the same ; but such must not be termed incomplete seeing that they cannot be legitimately completed.

Nearly all orchestral or imitative stops, which are called by the name of an instrument, are incomplete ; as no orchestral instrument has five octaves of compass, as the organ clavier has : *e.g.*, the Flute has no bass, nor yet the Oboe, *when treated orchestrally.* But Oboe treble and Bassoon bass are often conventionally grouped into one, under the name of Oboe, just as Violin and Violoncello are combined under the name of Gamba.

Divided stops are stops drawn in two portions by two stop-handles, one producing the acute, and the other the grave portion of the same series of pipes.

This form of divided stop is not common in modern organs; but where there are incomplete stops, the costly lower notes which they lack are usually supplied by an independent set of closed wooden pipes, which can be drawn to complete any one of the incomplete stops, and is termed Stopped Bass.

Compound stops are those which have two or more pipes to each note, *i.e.*, two or more complete series of pipes are brought on simultaneously. Their nature and use will be found fully described under the head of "Mixtures."

The pipes of which stops are composed, are thus classified:

I. Flue pipes.

II. Reed pipes.

Flue pipes—virtually whistles, of various shapes—are subdivided into
Open pipes, *i.e.*, those having their upper end open;
Stopped pipes, *i.e.*, those in which that end is closed.

Reed pipes—provided with vibrating tongues—are subdivided into Beating reeds, and Free reeds. In beating reeds, the tongue beats *against* the reed; in free reeds, it beats *between* the sides of a slot or groove in the reed, and *does not touch* anything.

The nature and distinctive qualities of each stop will now be described.

The Principal Stops used in Organs.

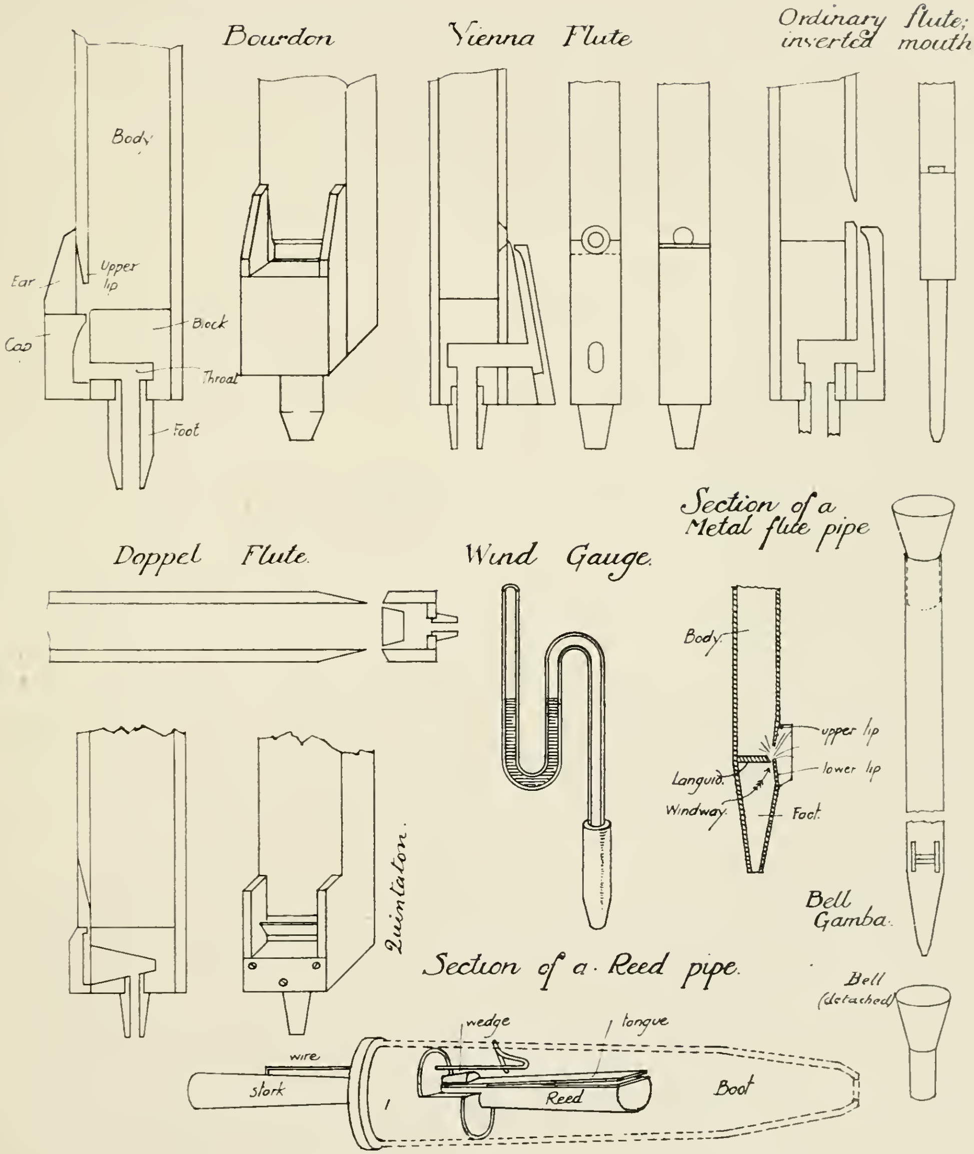
Acoustic Bass; 16ft., a term used to designate the *undertone* supposed to be audibly produced from two notes sounding a perfect fifth; its pitch being one octave below that of the lower note. A 16ft. acoustic resultant is derived from two sets of pipes, respectively of 8ft. and 6ft.* pitch, sounding simultaneously. Acoustics serve to corroborate and strengthen the *bonâ fide* stops already drawn.

Bourdon (Plate I.); 16ft. tone,† a stop composed of large covered

* See page 126.

† By "tone" it is meant to convey that the pitch of the sound emitted on CC is such as would proceed from an open pipe of the length given. Stopped pipes are only about half as long as open pipes, giving the same notes. It is, however, inaccurate to assume that the speaking column of air in

Sections of Wood Pipes.



wood pipes, which is found both on the manuals and pedals.* When two or more exist in the same instrument, they should not be of the same scale. These stops possess the peculiar property of strengthening the tone of stops speaking *an octave higher*, while they only *thicken*—but scarcely increase the power of—stops which are of the same pitch as themselves.

Bassoon ; 8ft. tone. The bass of the Clarinet or Oboe was formerly thus named, being drawn separately. In modern organs the Bassoon is generally carried through as one stop, and the pipes are made of the same shape throughout.

Bombarde ; 16ft. (French), a large reed stop ; it is of metal on manuals, and (generally) of wood on the pedals.

Baar-Pyp Bäer-Pfeife (Plate II.) ; see *Obsolete Stops*, page 33.

Cornopean ; 8ft., a soft, round-toned trumpet—usually placed in the Swell.

Clarion ; 4ft., an octave trumpet. It is best to have the top octave-and-half in flue pipes, the reeds stopping at C^1. Small reed pipes are a nuisance, they are always—*apparently*, or *really*—breaking away from the general pitch ; and, moreover, their tone has no special value.

Clarinet (Plate II) ; Klarinette (German), Clarinette (French), Clarinetto (Italian), 8ft. tone—sometimes spelled Clarionet—a reed stop voiced to give the 8ft. tone quality from a pipe of half-length. This is effected by means of an increased length of reed.

Cremona ; 8ft. tone, "Cromorn," "Krumhorn," and "Cremorne" are varieties of the preceding stop. Very often they are only different

a stopped pipe is half the length of that in an open pipe sounding the same note, as it is slightly *longer*. If a leathered board be applied to the top of an open pipe of any length, and the pitch be noted, it will be found, on removing the board, that the open note is a flat octave to the first note, consequently the open pipe would have to be lengthened before it could give a *true* octave below by being stopped. In the treble notes—as the *scale* of the pipe is greater in proportion to the length—the note produced by covering an open pipe may be as much as a semitone sharp, *e.g.*, C^1 will give about D*b* below.

* French organ builders apply the term bourdon to all stopped pipes, whether of 16, 8, or even of 4ft. pitch. English builders usually follow the German nomenclature, which limits the application of that term to Stopped Diapasons of 16ft. pitch, and of a somewhat burly tone. "Untersatz," and "Sub-bass," are the names applied to covered stops of 32ft. pitch in German and English respectively, while all covered work of a higher pitch than 8ft. is treated as flute-work.

names, given to the Clarinet according to the fashion of the time, or whim of the builder. The bodies of the pipes composing the above stops are cylindrical, and without bells.

Clarabella; 8ft., may be described as a small Open Diapason in wood, voiced "fluty." It is only a treble stop, rarely extending below middle C, the bass being supplied in stopped pipes. A good Clarabella is a great addition to an organ, especially as a solo-stop, but it does not blend well with the other stops, and when used in combination may become a fruitful cause of "sympathy."

Cornet; see page 88.

Cor Anglais (Plate II); 16ft. and 8ft. Free or beating reeds are used according to the fancy of the builder. It is a very beautiful stop, when properly made and regulated. If a free reed, it is generally imported from France.

Corno-di-Bassetto; 8ft., may be described as yet another species of Clarinet. Its tones are made as full and round as possible.

Contra; this prefix applied to any stop, *e.g.*, *Contra*-Fagotto, *Contra*-Gamba, etc., means that the pitch is an octave lower than that which the stop would have were not this prefix added. It is, therefore, synonymous with "double," the pipes being of double length.

Diapason; a word seemingly used without any clear or defined meaning, though its Greek original διαπασων "through all" is plain enough if it could only in some way be connected with what we call the Diapasons in an organ.

The French appropriation of diapason to signify "pitch" would seem more conformable to the Greek original, as uniformity of pitch *must* exist "through all" the stops.

Taking it, however, in its received English acceptation, it means the large 8ft. stops forming the groundwork of the organ.

I think it more logical to call the 8ft. stops (when large, both open and stopped) the Principal, and the Fifteenth, respectively, 8ft., 4ft., and 2ft. diapasons, as they collectively constitute the organ proper; the other stops being only added to "colour" the tone, or for solo

purposes. *Fonds*, or foundation-stops, is the name given in France to the whole class of stops I have grouped as Diapasons. The other stops are classified as "Mutation-stops," or as *Jeux de détail*, *i.e.*, solo stops.

Diapasons (as the term is commonly accepted at present) are :—

(1). *Open Diapason* (Plate II) ; 8ft., and *Double Open Diapason*, 16ft.,* are composed of large-scaled, open metal pipes. CC 8ft. 6in. diameter, Tenor C $3\frac{1}{2}$in., and Middle C $2\frac{1}{8}$in., may be taken as an average scale for Great Organ ; $5\frac{1}{4}$in., 3in., $1\frac{3}{4}$in. (on each C) for that of the Swell, or for the second Open Diapason, where two are placed on the Great Organ soundboard. It is best in the latter case that one of these stops should have longer feet than the other,† as was the invariable practice of the older English builders. The width of the mouth in Open Diapason, and other cylindrical pipes, is usually equal to one-fourth of their circumference. (See page 56.)

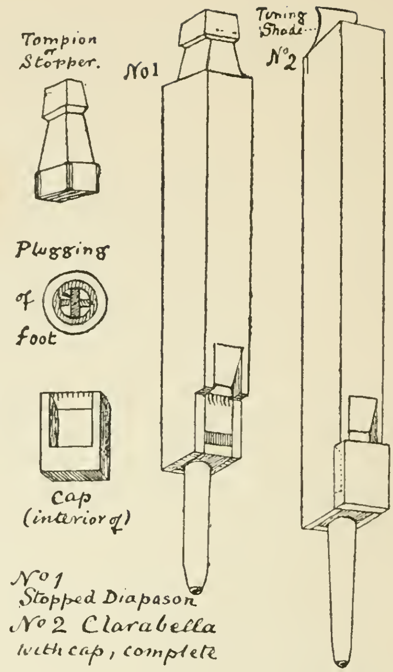
The Large Open Diapason on the Great Organ should always be of "metal" throughout.‡ Zinc, while possessing some special advantages for fronts—in being less susceptible to injuries, and cheaper§—never gives a really *round* and musical tone.

* The 16ft. Open Diapason on the pedals, is usually called Open Diapason 16ft., and is of wood, unless otherwise described.

† This is done to avoid sympathy. It is also well that the two Opens should be separated by several stops placed between them. Harris in his Doncaster organ put the second Open between the two Trumpets, preferring even this (the most undesirable location possible) to risking the production of sympathy between the Opens. Father Smith did the same thing in his organ at Ripon Cathedral.

‡ "Metal," in organ-building phraseology, means a compound of tin and lead, the proportions being indeed variable, but it is never supposed to mean zinc, iron, copper, or anything other than a compound of the ingredients named. "Spotted metal" is in itself a guarantee of excellence which can be recognized by anyone, as a considerable amount of tin must be present in the alloy before the spots will appear.

§ As some indication of the absolute cost of producing metal pipes—and, especially, to show how paltry is the saving effected by using pipes of common metal—the following memorandum may be of interest. A Tenor C Open Diapason or a CC Principal takes about 75lbs. of metal. If in tin, 40lbs. will be sufficient, as the pipes do not require to be so thick. The time of making is the same in either case—five days for a "metal hand." These statements and proportions of course only apply down to the 4ft. pipe, which, however, is practically the largest pipe now made in "metal." Fronts come under a totally different category, and if of good substance and of fair quality, are very costly.



(2). *Stopped Diapason;* 8ft. tone. *Double Diapason;* 16ft. tone. The former is composed of stopped wood pipes of large scale : CC = 4in. x $3\frac{1}{4}$in. (inside measure) is a fair scale. For the latter it is better that the dimensions be reduced considerably. The mouths of Stopped Diapason pipes are usually one-third of their width in height. In the case of Doubles, however, it is sometimes advisable to exceed this measurement. (See page 56.)

Generally speaking, nothing is so vulgar,* or renders organ tone so "muddy," as a large, or coarsely-voiced Stopped Double; † consequently all doubles must be kept very soft. Metal stopped pipes have a tendency to "chirp" before they settle down on the sound intended, an effect not unpleasant in solo passages meant to imitate the flute, but most undesirable in Diapasons. Nevertheless, when skilfully treated, a metal Stopped Double *blends* better with the rest of the stops than a wooden one.

Diaphone; see *Hope-Jones*, page 31.

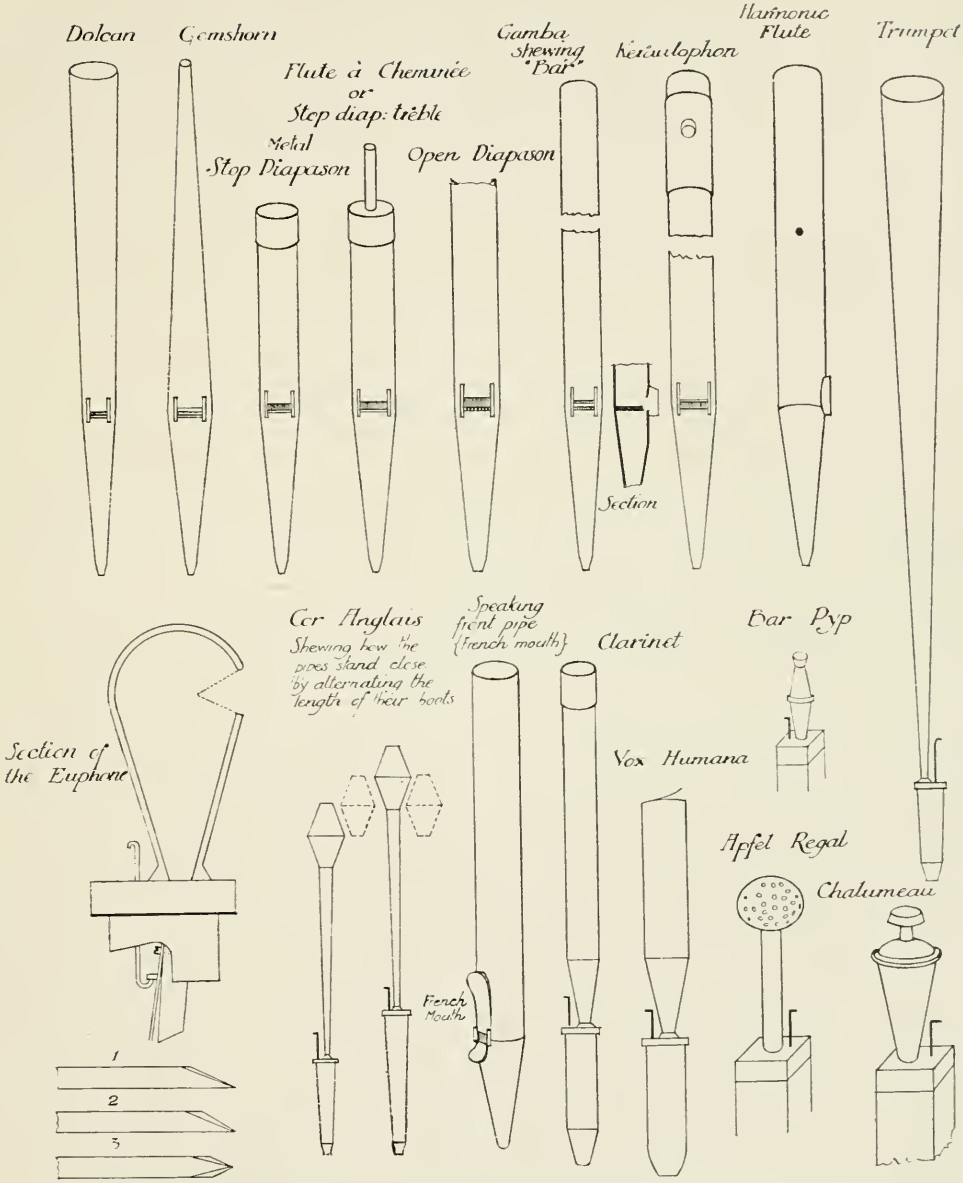
Dolcan (Plate II); 8ft., a stop of delicate intonation, composed of open pipes which are of larger diameter at the top than at the mouth. Dom Bedos, in speaking of this stop, says that it possesses a beautiful

E?
* The harmonics of stopped tubes are C G C *B♭* *D* *F*. Thus as soon as the third one is passed, all those subsequent are discordant. In open pipes these objectionable harmonics do not appear until after the sixth, *e.g.*,

1	2	3	4	5	6	7	8	9	10	11
C	C	G	C	E	G	*B♭*	*C*	*D*	*E*	*F*

† It was formerly the universal practice of English organ builders to increase the diameter of all large stopped pipes at their centres, *e.g.*, if GG were 5in. x $4\frac{3}{4}$in. at the top, it would be $5\frac{1}{4}$in. x 5in. in the centre. By this means great richness and a peculiar ring were imparted. Now, however, the heavy pressures in ordinary use, and the increased power of stops generally require that the stopped wood work be "cut up" to such an extent that the "quality-giving" portion of these pipes is simply cut clean out of them. It is, therefore, no longer essential that the pipes shall be bellied, as no refinement of tone is aimed at—or, indeed, is possible under such conditions—body and thickening power alone being desired.

Plate II.



VARIOUS METAL PIPES

quality of sound (belle qualité de son) but is only rarely found. In some German organs, Dulciana is the name given to stops composed of pipes of this description.

Dulciana; 8ft., a very small Open Diapason, voiced soft and "horny" in quality. Medium scale Tenor C = $2\frac{5}{8}$in. The metal should be thick, planed a little thinner towards the top of the pipes. Below Tenor C, the bass is frequently grooved into the Stopped Diapason. Open zinc pipes make an excellent bass, from the thin, hard tone which that metal gives.

Doublette; 2ft. (1) French for Fifteenth. (2) The name of Doublette is sometimes given by English builders to a two-rank Mixture made up of fifteenth and twenty-second.

Euphone (Plate II.); 8ft. tone, a free reed. On plate II will be found a diagram of the pipes composing this stop. It was first introduced by Sebastian Erard, in the organ built at the Tuileries Palace in 1834. M. Hamel—to whose industry we owe the completion of that gigantic and unique book *(L'Art du Facteur d'Orgues)* so often quoted in these pages—was mainly instrumental in perfecting and popularising free reeds.

Flute; 8ft. and 4ft. tone. Harmonic Flutes, invented by Cavaillé-Coll (Plate II), while somewhat "muddy" in tone quality, are *the* Flutes *par excellence*, and where only one Flute is admissible, it should always be one of this kind. They are preferably made of tin, *without* long ears, as these latter afford too ready a means of tuning at the cost of quality of tone, a facility too tempting to be placed in the hands of careless, or *hurried* tuners.

The harmonic quality in pipes is produced by piercing them nearly in the middle and "winding" them copiously. This causes the column of air contained in the pipe to break up into two equal parts—as a string, when made to give the octave above its fundamental or whole-length note. Consequently all harmonic stops are of double length; *e.g.*, the pipes of the Harmonic Flute, 4ft., are of the same length as those of the Open Diapason, 8ft.

Wald Flutes and *Claribel Flutes* are stops of open wood pipes. Those having mouths of the description known as "inverted,"* and tuned with a metal flap or shade, are the best. They are also often termed Suabe Flutes.

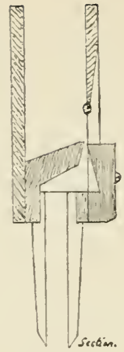
Clarionet Flute; 8ft. tone, a name given to the Stopped Diapason, when a small hole is burned down through the wooden tompion, or stopper, thus brightening the tone by making the pipes semi-stopped in place of entirely stopped.

Gedact Flutes, 8ft. and 4ft., are, as their name implies, composed of stopped pipes. The variety known as "Flute à cheminée" is the most pleasing, as it partakes more of the tone of open pipes.

Doppel Flöte (Plate I); Doiflote or Duifluit, 4ft. or 8ft. This stop is composed of wooden pipes having two mouths, placed, respectively, front and back. The tones are peculiarly charming, both in the case of stopped, as well as of open, pipes. The Doppel Flöte is, however, rarely found. Great delicacy of treatment, and much patience and skill on the part of the voicer, are needed to produce even a moderately good stop of this description; moreover, as the pipes have two mouths, they cannot stand back to back, clear speaking-room *all round them* being absolutely essential. This last condition apparently puts them out of court with the English builders, who never seem able to get sufficient room allowed them for their instruments.

Flauto Traverso, *Flute Traversière*, *Querflote*, *Queerpfeife*, *Piffaro*, 8ft. and 4ft. The terms "Traverso" and "Quer," meaning transverse or cross, were originally used to distinguish flutes into which the player blows crossways, from like instruments provided with a beak or "embouchure." "Piffaro" is probably an onomatopœia,—from the "piff" or slight chiffiness inseparable from all cross-blown instruments; and it is the "piffing" sound which the builders have tried to reproduce in the above stops. Widely different shapes of pipes have been used with equally excellent results.

* See Plate I.



Flute with rounded bar-lip

Flutes have also been made with rounded bar lips as here shewn. A stop of this kind was introduced by Mr. A. Gern, a few years since, and its tones were particularly full and pleasing.

The classical models to be found in Germany, which have been admired and copied by so many generations, are usually of pear or maple wood, sometimes *open*, sometimes *stopped*, and in shape either cylindrical (bored out of solid wood), triangular, tapering, or straight as ordinary wooden pipes. Most of them are really harmonic flutes, being made to overblow, and thus sound at half-length pitch. In some cases this was done by merely keeping the mouths very low, all accessories being suitably adjusted. In others, an inverted mouth was cut half-way up the pipe, the wind (brought up by a long cap, or otherwise), being thrown into the middle of the pipe. This form was invented by Müller of Breslau, and was subsequently used by Maelzel in his Panharmonicon.

The basses of these stops were usually composed of pipes of the Portunal shape.

While tones of exceptional purity and beauty have been obtained from Querflotes, several drawbacks have tended to limit their introduction ; firstly, their great expense—being practically works of art ; secondly, the weakness of their tones, which renders them unfit for large edifices ; thirdly, the objections common to all small wooden pipes (see page 99).

Cavaille's rough-and-ready method of obtaining harmonics, of any desired degree of power, from *metal* pipes has therefore become universally adopted, and the Querflote, except as a fancy stop, and under exceptional circumstances, may be considered to be practically obsolete.

Vienna Flute (Plate I). The tones of this stop also closely imitate those produced by a flute player. The cap of each pipe is cut through diagonally, and a small windway is excavated in the outer

part. Then this part is re-applied and glued on. The wind is thus sent into the little hole which constitutes the mouth of the pipe *at an angle*, just as a flute player blows into his flute.

Wooden flute pipes, which are made triangular in section, or V-shaped, take but little room, as they can stand in *one single line*, thus—△▽△▽△

When there are several stops of the same kind placed upon different manuals, it is much to be desired that they should not produce mere repetitions of the same tone, but should possess some slight individuality or distinction. To have every Flute stop in an organ of the harmonic description, is, I think, a mistake, as the tones of these stops can only differ in power, not in absolute quality. It would seem a pity that some of the above German Flutes are so seldom introduced into English organs. Of course I speak of Flutes which are really such as the drawstop knob professes them to be.

The practice of giving outlandish names to stops of the most simple, homely kind, has done no little harm, and has led organists to imagine that they were acquainted with stops which in reality they never had heard, and which the builders of the organs possessing these misleading stop-knobs, may have been absolutely unable to construct.

Fifteenth; 2ft. metal, a Diapason tuned two octaves above the "great" diapason of 8ft.

Fagot; Fagotto, see *Bassoon.*

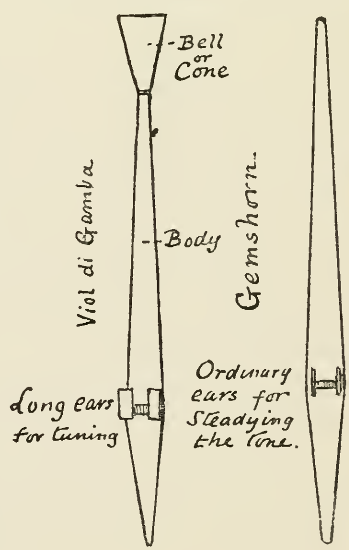
Fugara; 8ft., a stop frequently found in foreign organs, sometimes made in wood, but oftener in metal. When of wood, the pipes are triangular or prismatic in shape. The tone of this stop resembles that of the Gamba, but is of a sweeter and "quieter" quality. The Fugara, while soft, has much of the assertive and decided character which is so marked in all stops of the Gemshorn family.

Gedact; 8ft. tone. German. Gedact (gedect) in German means "covered," and is therefore synonymous with the terms *Stopped* in English, and *bouché* in French, applied to stops. Many builders *call* their Stopped Diapasons "Gedacts:" the true Gedact, however, is

of very small scale, having its mouth cut up nearly semicircularly, and is copiously winded. When nicely voiced, the hollow tone of this stop is useful for special effects. Stopped pipes, below Tenor C, should always be of wood.

Gamba (Plate II); 16ft., 8ft., and 4ft. German. These stops furnish a distinct and valuable tone-colour, which should exist in every organ, however small. They are voiced to imitate various stringed instruments. The abnormity *called* a German Gamba, composed of pipes *without ears* and slow of speech, is happily now rarely met with. Gambas are best made in spotted metal or tin. Gambas of large scale, rendered more pungent and pervading in tone by the addition of a bell (similar to an ordinary funnel) inserted at the top of the pipes commonly receive the name of *Bell Gambas* (Plate I).

Gemshorn (Plate II); 8ft. and 4ft. The pipes of this stop are much smaller at the top than at the mouth, and produce a bright, clear tone, of incisive quality. The Flageolet (2ft.) is sometimes thus made, and, indeed, the Gemshorn shape of pipe can be freely used for various stops, when the object in view is to secure a bright tone, combined with the minimum of power. Moreover, the Gemshorn family of stops is intended to supply a tone partaking of the characteristics respectively peculiar to both open and stopped pipes, thus helping to unite these two classes. This is effected by making the pipes taper towards the top, thus causing them to be virtually half-stopped, the diameter of the upper end being only one-third or one-quarter of that at the mouth.



When a cone is added to the Gemshorn it is immediately changed into a Gamba of great power and beauty of tone. This shape was much in vogue for the Viol-di-Gamba a few years since, but is now seldom used;

probably because it is a very troublesome one to make, and to voice. Moreover, it is almost impossible to "scale" these tubes to such a nicety, that the bells shall be all perfectly proportionate to the bodies, and that the ears shall all stand in the same position when the stop is put into tune. Now, even if this is successfully accomplished *on the voicing machine*, some notes will need further regulating when the stop is put on its own wind in the organ, and—as must be the case with ANY stop—some notes will eventually go out of tune. It then is difficult to restore these notes to their proper pitch and power, as any alteration of the ears changes *the quality of tone* and the absolute power of a note, *long before* any perceptible difference of pitch is effected.

Hence it will be seen that to tune this, or any other stop which is provided with no other tuning facility than long ears, the tuner must in some cases re-voice, as well as tune—two perfectly distinct operations, which cannot well be conducted at the same time. (See page 41, concerning "handling" pipes; also remarks *re* Harmonic Flute, page 13).

Horn; see *Trumpet.* The Horn closely resembles the Trumpet, but is generally much larger in scale, and fuller in tone. It was first introduced by Bridge, in his organ at St. Ann's, Limehouse.

Keraulophon (Plate II); 8ft., a species of soft, full-toned Gamba. For the purpose of tuning, the pipes are provided with slides moving after the manner of a telescope.

Larigot; Octave 12th, see *Mixture* (19th), corroborates and strengthens the 4ft. tones.

Lieblich; a prefix meaning lovely or sweet. Lieblich-Gedact, Lieblich-Flute, etc.

Montre; 16ft. or 8ft. The term Montre* is used in France to

* From "Montre" a shop front (Fr.). Similarly Chamade (Trompette-à-Chamade)—from the Italian word *chiamata*, a call or flourish on the trumpet—is a term which refers to the *position* of certain pipes, and not to their quality of tone. "Trompette-à-Chamade," means a Trumpet or Tuba placed *horizontally*, so as to blare out directly at the audience. The English equivalent is "Fan Trumpet."

designate the show front of speaking pipes. As these are usually derived from the Open Diapason, Montre came to mean an Open Diapason, part of which is in the speaking front: otherwise the ordinary Open Diapason is called *Flute de huit* by French builders.

Mutation Stops; every stop speaking a note other than the one implied by the key struck (or some octave of it), is a *Mutation Stop: e.g.*, the Twelfth, speaking G on the C key, is a Mutation Stop. This is the *old* and the *only* true meaning of the term.

Mixtures; stops having two or more ranks of pipes (tuned to the intervals of the common chord) on each note, are called by the generic term of Mixture. The most usual varieties are, Mixture II Ranks, and Sesquialtera, V, IV, or III Ranks.

A five-rank Mixture would commence thus on the CC note: 17th, 19th, 22nd, 26th, 29th; but from the fact that it would be impossible to continue such small pipes up to a scale of five octaves they would be repeated in various places; *i.e.*, the pipes used upon C^1 would in some cases be of the same length as those on Middle C. This will be made clearer by the following plan of a four-rank Sesquialtera:—

First break, CC to fiddle G . .	19th, 22nd, 26th, 29th.
Second break, thence to Middle C	15th, 19th, 22nd, 26th.
Third break, to C above . . .	12th, 15th, 19th, 22nd.
Thence to top	1st, 8th, 12th, 15th.

A three-rank would be:—

First break . .	17th, 19th, 22nd, or 12th, 19th, 22nd.
Second break .	17th, 12th, 22nd, or 15th, 19th, 22nd.
Third break . .	17th, 12th, 15th, or 19th, 12th, 15th.
Thence to top .	8th, 12th, 15th, or 12th, 8th, 15th.

A two-rank:—

CC to middle C . . .	26th, 29th.
Thence to next C . .	19th, 22nd.
Thence to top . . .	12th, 15th.

A very useful Two-rank Mixture may be made up as follows :—

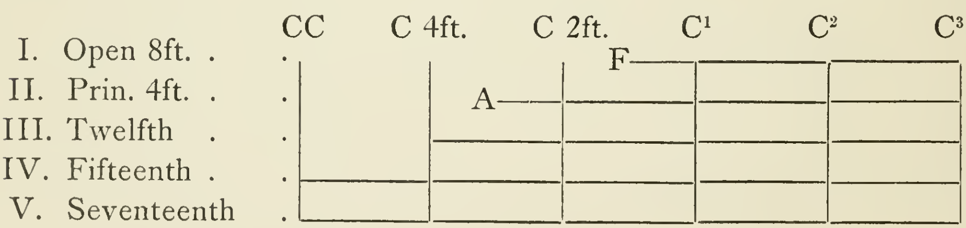
CC to Fiddle G	19th, 22nd.
To 1ft. C	12th, 22nd.
To top	12th, 15th.

From these schemes for various Mixtures it will be seen that it is customary in England to break small ranks into larger ones as the scale ascends ; also that the Twelfth is invariably the largest rank used in the first break ; *e.g.*, between CC and Fiddle G.

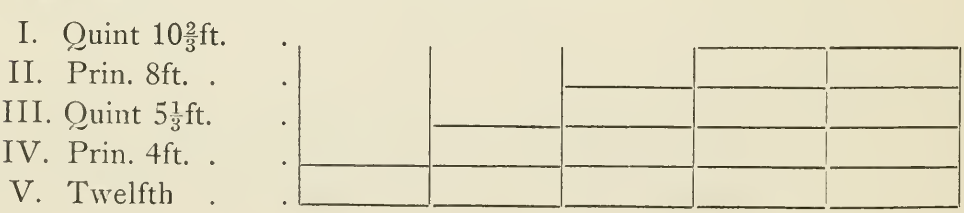
It would seem rational, if such intervals as the 17th, 19th, and 22nd are to be admitted, that they should exist in the lower octaves, where they produce harmonious and *intelligible* harmonic combinations.

M. Cavaillé-Coll, the eminent Parisian builder, has, however, proceeded upon a totally different system, as the following diagram of the Mixtures in his large organ erected at Nôtre Dame, Paris, in 1868, will show.

Grand Cornet. I.

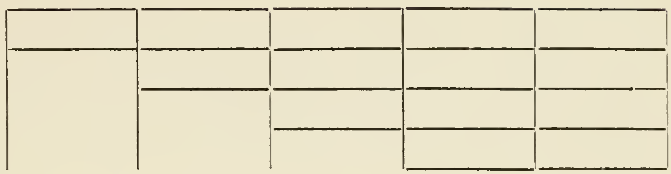


Fourniture. II.



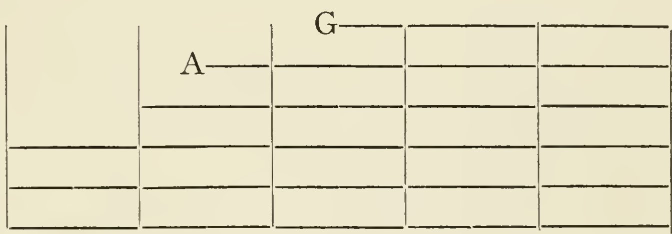
Cymbale. III.

I. Twelfth . .
II. Fifteenth . .
III. Seventeenth .
IV. Nineteenth .
V. Twenty-second .



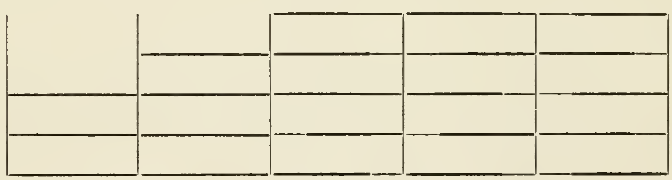
Plein Jeu Harmonique. IV.

I. Closed 16ft. .
II. Open 8ft. . .
III. Quint $5\frac{1}{3}$ft. .
IV. Prin. 4ft. . .
V. Grosse Tierce .
VI. Twelfth . .



Swell Cornet. V.

I. Open 8ft. . .
II. Prin. 4ft. . .
III. Twelfth . .
IV. Fifteenth . .
V. (17th) Tierce .



This table is an exact copy of the original scheme for the Mixtures to be placed in the organ of Nôtre Dame, from the original in M. Cavaillé-Coll's writing. Subsequently slight modifications were made by the addition of ranks giving the flat 7th—*e.g.*, fourteenth and twenty-first. The harsh discord thus introduced did not seem to me to give any adequate result when I heard these Mixtures.

It is worthy of note that these 14th and 21st are tuned *perfect*, in the same manner as the Twelfth and other mutation stops in the organ; and thus, while described as flat sevenths, they are in reality a different interval; being Tartini's "ZA." Perronet Thompson* thus explains the formation of this interval.

* Perronet Thompson's *Enharmonic Organ*, p. 69. Effingham Wilson, London.

"The first time the subject was introduced to the writer was by an intelligent workman in the employ of Messrs. Robson, the organ builders, who stated that he had observed that on sounding the interval of a minor seventh, on a tempered instrument, there was what he called a "Wolf," but that on further flattening the seventh the wolf ceased. This proved to be Tartini's "ZA," an interval in which there are no beats, any more than in a perfect fifth, or other perfect interval."

In another place Perronet Thompson disposes of Tartini's claim—that "ZA" should be included as a separate note, increasing the number of sounds into which the octave is divided—in words to the following effect. "It (ZA) is a wheel, but not a wheel which will fit in with the previously constructed parts of the machine, and therefore it must be left on one side."

The introduction of the 14th as a rank in Mixtures is probably due to Dr. Gauntlett, and was first tried by him in the organ at St. Olave's, Southwark. It will be elsewhere recorded that the application of electricity to the organ was also discovered by the learned doctor, being only one of a great many other inventions of which he furnished the embryo.*

Mixtures are best made in spotted metal, with low mouths, to avoid a "fluty" tone. The Twelfth, however, as a separate stop is perhaps more useful in ordinary metal, as it then has more weight and less obtrusiveness.

Musette; 8ft., a free reed, closely akin to the Cor Anglais in quality and general structure.

Nazard; 3ft., French for Twelfth.

Nason (English); a 4ft. Stopped Diapason. Obsolete. There is

* Dr. Gauntlett, who did more than any man to raise, both the craft of the organ builders, and the skill of the organ players of his generation, does not seem to have been a personally popular man, and many who improved on his ideas omitted to acknowledge the source they derived them from. If it were possible, after so many years, to tabulate and classify his researches and inventions a most interesting and valuable book would result.

an Octave Nason, called Lieblich Gedact, 2ft., in the fine organ at Ripon Cathedral, and it is stated that it is "stopped up to the top note."

Oboe; 8ft., a delicate reed stop voiced in imitation of the hautboy. If only one reed is placed in an organ, this is the most usual one. The Orchestral Oboe has a slot under the bell which thins the tone down, and renders it more imitative.

Principal; a 4ft. Diapason. It should be of metal *throughout*, not of wood or zinc in the bass. On its quality greatly depends the character of tone of the whole full-organ.

Pausanne, *Posaune*, see *Trumpet.*

Piccolo; 2ft., an octave flute of wood or metal, generally of the former material when not harmonic. The Harmonic Piccolo (perhaps the most useful variety), is usually harmonic as far as Tenor C, breaking into a Fifteenth Bass.

Portunal; 8ft., a Clarabella, the pipes of which are a little larger at the top than at the mouth. It is rarely used, perhaps for the same reason as the Doppel Flute—which see.

Quint; 6ft.,* or twelfth to the 16ft. diapasons, is generally a pedal stop. The combination of this stop with the 8ft. stops produces a confused noise, in which the "Acoustic" 16ft. *undertone* is suggested. The Quint would be worse than useless if there were no pedal stops speaking 16ft. drawn in addition. The Quint should (as its "relatives" the twelfth and nineteenth) be voiced much softer than the diapasons, and must be tuned a *perfect* fifth to them. Hence the quint effect, resulting from couplers acting upon foundation stops, (which, of course, are tuned in *equal* temperament,) can never be wholly satisfactory.

Quintaton (Plate I), *Quintadena*, *etc.;* 16ft. and 8ft. are stops of *slightly over-blown* pipes, so adjusted that the fifth or twelfth shall be prominent in their speech.

Rohr Flute; 8ft. A kind of metal Stopped Diapason of delicate

* See page 8.

and reedy tone. The pipe stoppers in the treble portion of this stop are always perforated, or provided with chimneys.

Salicional. (Latin, *Salicetum—Salicis fistula.* Anglicé, *Willow-flute*). 8ft. A small Open Diapason of pleasing quality, voiced to speak somewhat as the Quintaton. It is a very useful addition to the choir organ, and should not be unduly soft, as it is then impossible to retain the Quintaton quality. Plain metal of good substance is better than tin or spotted metal for this stop. Salicionals are not common in English organs, but *the name* "Salicional" is applied by some English builders to a kind of Echo Dulciana.

Sesquialtera. See *Mixture.* The names of compound stops are very loosely used by modern builders. Their exact description is as follows :—Sesquialtera (sixth), G, E ; "Mixture," G° C^1 G^1 C^2 G^2 C^3. Other kinds of Mixtures are Tertian (third), E^1 G^1 ; Quarte (fourth), G° C^1 (this is the usual English 2-rank mixture) ; Scharf (Mixture, with Seventeenth added), *e.g.*, G^1 C^2 E^2 G^2 C^3, the three upper ranks of which correspond with the English Sesquialtera. This tablature gives the real notes on CC in each stop.

Trumpet (Plate II) ; an 8ft. reed stop of powerful and penetrating tone, usually placed only upon the Great Organ, a rounder-toned reed (Horn or Cornopean) answering better when placed inside a swell box.

Harmonic trumpets are of double length, and are made harmonic in the same way as the Harmonic Flute—which see.

Twelfth ; 3ft.,* a mutation stop, speaking a twelfth above the Open Diapason. This really valuable stop is too often omitted in modern organs. It affords a connecting link, binding the various octave tones closer together, and imparting a peculiar grip or firmness to the whole. Being tuned a *perfect* fifth to the Principal, its union with that stop suggests an 8ft. undertone. Thus the 8ft. stops are obviously strengthened and corroborated.

Trombone, *Tromba ;* 16ft. and 8ft. See *Bombarde and Trumpet.*

* See page 19.

Tuba ; 8ft., the most powerful reed stop in the organ. It is usually harmonic and on a specially heavy pressure of wind—nine to twelve inches, or even more—according to the size of the edifice it is required to fill.

Tierce. Obsolete. See *Seventeenth* in *Mixture.* Formerly there were two Tierces used, Grosse Tierce, or Tenth, being the third of the Principal, and Petite Tierce, or Seventeenth, being the third of the Fifteenth.

Unda Maris. A Stopped Diapason tuned sharp to the general pitch of the organ, as the Voix Célèstes. Dom Bedos describes an ancient variety of Unda Maris called *Biffara*, consisting of wooden pipes with two mouths. The top of the block was usually cut so as to describe an angle of about forty-five degrees *on the side*, thus placing one of the mouths *higher* than the other by nearly half the diameter of the pipe.* An undulation similar to that obtained from the Unda Maris, when joined with another stop, was thus produced from one pipe only.

Viol, *Viola.* These are prefixes used before the name of a stop to denote that it is voiced in imitation of a *stringed* instrument. The principal varieties are the following :—Viol-di-Gamba, Viol-d'Amour, Violon, Violone.

Violoncello. See *Gamba.*

Violin Diapason, *Geigen-Principal ;* 8ft. A diapason voiced in imitation of the Gamba. The Horn Diapason used by some builders is a similar stop, but usually of larger scale : its tone being very full and pervading.

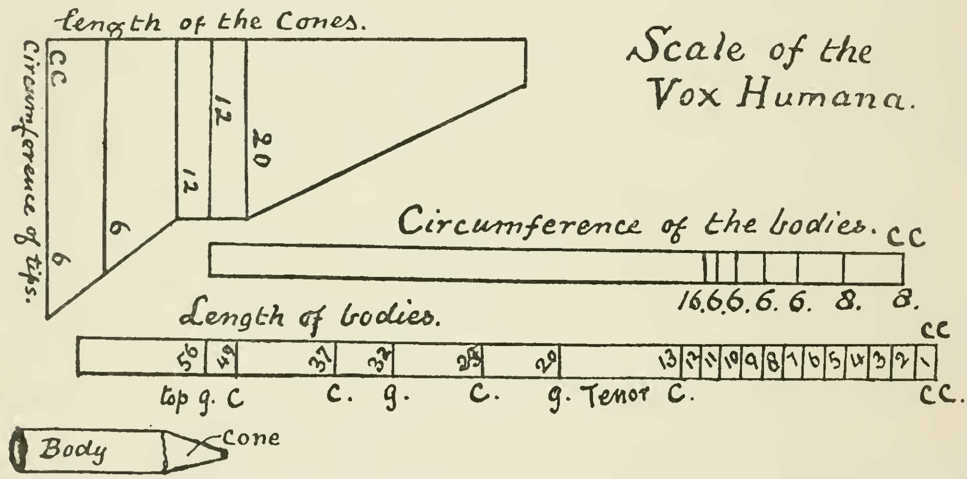
Vox Humana (Plate II) *;* 8ft. A stop for many years banished from England, owing to the fact that it was impossible to obtain its

* Notwithstanding the extreme accuracy which characterises the learned Benedictine's statements generally, I give this under reserve. I have never succeeded in constructing any single pipe which would produce the result described, although I have followed the direction most carefully. At the same time, considering that *ordinary* pipes sometimes "throb," it is not impossible that a method was discovered for systematically producing a result known to us as a fortuitous occurrence ; only removable by empirically trying a variety of expedients, *e.g.*, by "bearding," "barring," "shading," or by putting a piece of tracker into the windway.

true character upon the light wind-pressures which were formerly usual. When used as an accompaniment, its tones are invaluable as a sort of neutral background for showing off various other stops in solo effects.

The scale to which the Vox Humana pipes are made appears to be purely arbitrary, hardly any two builders agreeing upon this point. CC may be of any length, from five-and-half inches to twelve or fourteen inches. I once made a very successful Vox Humana to the scale here given, which I obtained from the late J. B. Stoltz, the Parisian organ builder.

The Stopped Diapason 8ft. is always drawn with this stop, and the Tremulant is indispensable.



TO REDRAW AS A WORKING DRAWING { Make CC body 6 inches long. And all other measures proportionate.

Voix Célèstes ; A very beautiful stop* gradually finding its way into English organs. The pipes (Gamba or Salicional in scale and voicing) are tuned a few beats sharper than the general pitch of the instrument. It is necessary that there be *another* stop of the same scale which is always drawn with the Voix Célèstes. A common

* The Voix Célèstes were first introduced into this country by Hill in the Panopticon Organ, Leicester Square (1853). It was sometimes called "Voix Lumineuse" in France.

mistake is that of making these stops beat too slowly. Perhaps the nicest Voix Célèstes effect is that produced by a Dulciana beating sharp against a soft Gamba—not the combination of two Gambas, or of two Dulcianas.

Tenor C is the downward limit of the sharp rank. Below this the beats get too slow. It is for a similar reason that the lowest tone of the organ is fixed at CCCC 32ft., lower sounds than this lacking continuity, and only coming on by throbs.

Ventils. Ventil is the name given to the system of Composition Pedals used by French and Belgian organ-builders. They act by cutting off or admitting wind to sound-boards, or portions of sound-boards governing certain groups of stops ; *e.g.*, if three stops Trumpet, Clarion, and Oboe, were on a separate chest, they would not speak *(even if drawn)* unless the Ventil were opened. If this were done, all the three, *or only as many as had been previously drawn*, would speak. By these means combinations less stereotyped than those of the Composition Pedals are possible. Walker's "Selective Pistons,"* Lewis's "Key-touches," as well as other thumb pistons, and studs used by many leading builders, together with Mr. Casson's system of pedal "helps" have, however, now revolutionised this department of organ construction. Ventils—as combination producers—are completely out of date ; still, a comparatively modern instance of them occurs in Mitchell and Thynne's large organ erected at Tewkesbury Abbey in 1887.

Composition and Ventil movements have never found much favour in Germany.

Stop Combinations.

The organ has pre-eminently its *own* legitimate effects, which must of course be those mainly drawn upon. But further than this it has some claim to be considered an orchestral instrument. Again, while

* Messrs. J. W. Walker and Sons' patent, 1895. Introduced into their noble instrument at St. Matthew's, Northampton, and other large organs.

most of these orchestral effects are, so to speak, peculiar to itself, a few others are purely imitative.

For sustaining voices nothing is better than the diapasons with, or without, the Principal. The Stopped Diapason alone is hardly ever to be used for this purpose, as it invariably causes singers to flatten in pitch. Much the same occurs with the Clarabella and the Harmonic stops in general; in a word, of every stop speaking as it were in a "falsetto" register: moreover, all manual doubles have the same tendency.

The effect of the diapasons, far from being enhanced, is marred by the addition of gambas, as the smoothness of the diapasons is destroyed.

Similarly the tone of the reeds, if intended to be "orchestral," is marred by the addition of mixtures. In fact, reeds tell best when added to the organ *Full to Principal* only.

In the case of a large organ, the imitative combinations obtainable are fairly numerous, a few of which may be given as typical.

Oboe; stop of that name *alone*, if sufficiently well voiced and regulated, or with Double Stopped Diapason. Accompany on Choir Dulciana.

Bassoon; stop of that name, or Clarinet (if to CC), with, or without Stopped Diapason. In some cases Bass Clarinet and Gamba produce an excellent effect.

Flute; Flutes 4ft. and 8ft. Accompany on any soft 8ft. stop, preferably of reedy tone, or with the Vox Humana in Swell. The accompaniment, in this case, is best made to *surround* the Flute as it were, *e.g.*, play bass on Pedals coupled to Swell, and take chords high, so that the Flute passage goes *over and under* the upper accompaniment. This is the proper treatment of Vox Humana accompaniment generally. In *slow* passages the Tremulant can be used with Flute stops.

Piccolo; Piccolo, or Piccolo and Double, or Fifteenth and Double.

Trumpet; Trumpet and Stopped Diapason.

Violin; Both hands on Gamba, Pedal Open Diapason.

Pan Pipes; Clarinet and Fifteenth.

Bell Effects (Iterated single note); Double Diapason 16ft., Stopped Diapason 8ft., and Twelfth. *Scale Passages;* Mixture (or Twelfth) and Double Diapason.

The following table will show at a glance the *order* in which the various classes of stops must be drawn.

(*a*) 1. 8ft. stops.
2. 4ft. stops.
3. 2ft. stops.
4. 3ft. (the Twelfth) gives brilliancy to the 2ft. stops. It must never be drawn without the 2ft. stops to cover it.

Now may be added groups *b* or *c*.

(*b*) Double Diapason 16ft.
Reeds, with or without the Double Diapason.

(*c*) Mixture work with or without Double Diapason.

Unless there be a great number of 8ft. stops, the addition of the Double Diapason or Double Open (Manual 16ft.) to the 8ft. *alone* is usually unsatisfactory.

The Double Dulciana (16ft)—introduced by Holdich—is a most delicious stop in soft combinations. Unhappily, as it adds nothing to the full organ, and costs as much as doubles which do, it is an expensive luxury rarely found. Much the same may be said of the Contra-Hautboy, or 16ft Oboe. There is a fine specimen of this stop in the organ at Holy Trinity Church, Tulse Hill, voiced by Mr. Herbert Norman, whose artistic treatment of both reed and flue work is largely admired.

I cannot better close this very brief summary of stop combinations, than by quoting the following passage from an excellent work dealing with organs and organ playing, by Mr. J. Matthews, of Guernsey.*

"Besides the orthodox combinations applicable to every organ, the advanced student will frequently find on individual instruments cer-

* *Handbook of the Organ*, by J. Matthews, p. 81. Augener and Co.

tain combinations available for occasional use, which are apparently outside the prescribed rules.

"The acoustic properties of a building, or the voicing of particular stops and their relative power, will account for certain combinations blending well on one organ, whereas in another they would be quite inadmissible.

"By a quick comprehension of every resource afforded by each particular instrument, experienced players will often get more variety of a two-manual organ, than others equally skilful, it may be, as regards technique . . . . from three manuals." From another point of view, the same thought must have struck many persons in hearing Mr. G. M. Holdich, and other organ builders who play, 'showing off their organs.'

Organ students may depend that it will pay them to fully understand the anatomy of the organ, and to endeavour to treat each organ with intelligent appreciation of its capabilities, not according to routine or conventional rules.

An Explanation of Mr. R. Hope-Jones's Special Stops.

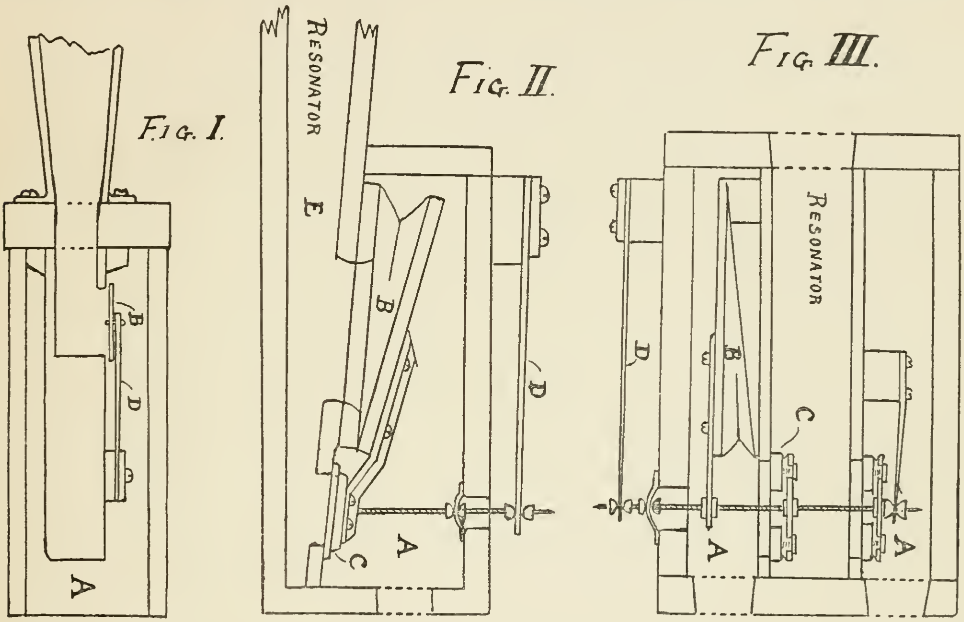
In Mr. Hope-Jones' organs a new method of producing tone, known as the Diaphone, is largely introduced. The Diaphone may be defined as consisting of three parts.

1. A *Valve*, moved by
2. A *Motor*, and governed by
3. A *Resonator*.

Diaphones speak well on any wind pressure from one inch upwards. They are capable of producing enormous volume of sound, and various qualities of tone may be arranged for. It is intended here to point out three or four of the leading types.

Figure 2 represents a Diaphonic Violone. The Box (A) is supplied with wind under pressure. This pressure acts upon the Motor (B), causing it close and thereby open the Valve (C) against the tension of

the Spring (D). A puff of the compressed air from the box (A) now rushes through the valve (C) into the Resonator or pipe. Here it encounters the inertia of the column of air contained in the resonator, and the pressure at its base (E) in consequence rises. This pressure



acts upon the inner surface of the motor (B) and therefore allows the spring (D) to close the valve (C). By this time the pulse of air has shot up the resonator, or pipe, in the form of a sound-wave, and a rarefaction at E results. The compressed air in the chamber (A) again acts upon the outer surface of the motor (B), and the cycle of operations is then repeated.

As there is a direct connection between the base of the resonator (E) and the inside of the motor (B), the period of vibration in the resonator, or pipe, determines the speed of vibration of the motor and of the attached valve (C). If the pipe be lengthened the speed of vibration will be reduced, and a lower note will be the result.

Figure 3 represents a Diaphone of a more powerful form. Wind under pressure is supplied to the box (A, A) : it acts upon the outer

surface of the motor (B) and causes this motor to collapse. In collapsing, the motor opens the Compound Spring Valves (C, C) and allows a great volume of air suddenly to pass into the foot of the resonator. The pressure then rises within the motor (B), and the spring (D) closes the compound spring valves (C, C). The cycle of operations is then repeated. The tones produced from this form of Diaphone are of very great power, though full and round in quality.

Figure 1 is a simple form of Diaphone which can also be called a valvular reed. It partakes both of the nature of the Diaphone and of that of the reed. With careful voicing, many varieties of tones may be obtained from it, some resembling the quality of flue pipes more than that of reeds. In this case, also, the length of the resonator has a great deal to do with determining the pitch of the note. The box (A) is supplied with compressed air. It acts upon the back of the valve (B). The centre portion of this valve in reality takes the place of the motor in the Diaphones previously described, the edges of the disc only act in the capacity of a valve.

The compressed air upon the back of the valve or motor (B) drives it against its seat, and so prevents the air which had escaped round the edges of this valve from continuing to flow into the resonator. When the sound-wave or pulse in the resonator is changed in phase it acts upon the inner surface of the motor or valve (B), and so allows of the spring (D) returning the valve or motor to its normal position.

There is nothing to prevent Diaphones being voiced on very high pressures of wind, as Mr. Hope-Jones states that it is easy to produce diapason tone from Diaphones at any pressure of wind. They should therefore allow of the balance between the flue and reed qualities of tone being maintained in the largest instruments of this kind. Moreover, the pitch of the Diaphone is not altered by any change of wind pressure, an attribute which it has in common with harmoniums and other free-reed organs.

Mr. Hope-Jones developes the tone of his organs on somewhat novel lines. He bases the structure upon the family of stops he

terms "Tibias." These stops are intended to produce almost pure foundation tone, devoid of upper partials; which, indeed, is the aim of every good voicer in producing diapasons in the ordinary way. Tone of this kind is of great weight and imparts massiveness to the other foundation work. He seldom uses Mixtures, and almost invariably employs, instead, solo stops of curious qualities of tone which are chiefly remarkable in that some one or other of the upper partial tones is averred to be developed. The most frequently used of these stops are the Quintadena and Tiercina and their relatives the Quintaton and Tiercaton. His String Stops are unusually rich in upper partial tones—the Viol d'Orchestre pipes measuring only $1\frac{1}{16}$" in diameter for the 8ft. note. The Double English Horn, which is a 16ft. reed stop, is constructed with bells at the top. The Muted Viol, Phoneuma, and Hediaphone are other specialties.

These specimens have been selected from several which have been kindly placed at the author's disposal by Mr. Hope-Jones, and may be considered typical; some other patterns, however, are in use, which differ slightly in their details.

Particulars concerning various Obsolete Stops seldom found in Modern Organs.

Apfel Regal (see Plate II); sometimes called Knop-Regal or Knoch-Regal, a 4ft. or 8ft. reed, the tones of which were very subdued and distant in effect.

Avicinium (Aviary) consisted in an arrangement by which a few small pipes were bent down so that their ends were immersed in a little trough full of water, thus giving an effect similar to the warbling of birds.

Bär-Pyp; Baer-pfeife, Behr-pipe, a reed stop of soft intonation, made to 16, 8, and 4ft. pitches (see Plate II). The representation there given is designed from Praetorius' work on Organs. Instances—

Lubeck, Churches of St. Mary, St. Peter, Notre Dame ; Lunebourg, Church of St. Lambert, and others.

Block-Flute ; 2ft., a large-scaled Fifteenth (obsolete).

Chalumeau ; Schalmei, Chalmey, or Shalomo (see plate II). An 8ft. or 4ft. reed stop. Instances—Cathedral of Merseburg, Christchurch, Herschbourg, St. Michael's, Hamburg, etc.

Doeff ; this name is sometimes used by German builders to express Principal.

Flaut-Hemiol ; 8ft. A species of stop, which, commencing at CC as a stringy Gamba, gradually lost this reediness as it continued upwards, eventually becoming fluty in the upper octaves.

A similar gradation is observable in Hope-Jones' Diaphonic reeds, and, to some extent, in all orchestral reed instruments.

*Gedact Bommer ;** 4ft. stopped pipes, producing the effect of a soft Twelfth. Instance—St. Peter's, Goerlitz.

Hellpfeife ; Hellpipe, Hellpyp, a very bright-toned flute ("hell"—German for clear)—common in German organs.

Vox Angelica ; Stümme, the celebrated builder of organs at Frankfort, Maintz, Boehenheim, and other places, introduced a 4ft.

* Also spelt Pommer or Brummer, Pommer being the ancient German name for the Oboe, and Bass Pommer that for the Bassoon. It would seem doubtful whether Bommer is a corruption of Bombard, and, again, whether Pommer is a further corruption of Bommer—as has been suggested by some distinguished authorities upon the subject.

The term Bombard(e)—now confined to powerful 32ft. or 16ft. Pedal Organ reeds—appears to have been for centuries applied to the sounding medium (either instrument or organ stop) which for the time being was capable of producing the most imposing and thrilling tones.

According to M. Littré (*Dictionnaire de la langue Française*) Bombarde is derived from "Bombarda" (middle-age Latin), a machine to hurl huge stones in times of siege, or, from the same word, which, long after the invention of gunpowder, was applied to cannons charged with stones, in lieu of bullets or shells. Of the value of this derivation we have further confirmation in the verb to bombard which is common to most European languages. We may also recall Figaro's song in "Le nozze di Figaro" (non piu andrai) where he sings, "di bombardi, di canone." It is presumable that the late Mr. Thynne had not heard of this stop or made any study of the German wood flutes generally, since he claimed to have invented the application of the harmonic principle to stopped pipes (Elliston's *Organs and Tuning*, p 81). A prominent item among his specialties was a stop, or (to quote his own modest term) a "tone picture," produced from stopped harmonic pipes.

"In stopped organ pipes the tones of which only consist of the first and third partials, the twelfth is the only interval defined by the coincidence of the partials—the other intervals, even the octave, being guarded." T. F. Harris, *Handbook of Acoustics*, 1891.

Vox Humana under this title. English builders apply the same name to a sort of Voix Célèstes, which beats flat to the main pitch of the organ.

Schreier; Schreipfeife, Schryki (German)—sharp mixtures or Furnitures (" shriekers.")

Vox Retusa; an Echo Dulciana of the softest possible quality of tone.

Vox Vinolata; " drunken voice "—evidently from the Latin, vinolatus, " drunk." Instance—High Church, Lund, Sweden.

Vox Stellarum, Cymbel-Stern, Etoile sonore ; mechanical arrangements by which a star of hollow metal, containing tiny bells, was made to oscillate.

Glockenspiel; a set of bells or metallic plates struck by hammers much after the manner of the percussion action in harmoniums. It was usually a treble stop, commencing at Middle C, but at St. Michael's Church, Ohrdruff, it extends through the entire compass of the clavier. Some modern organs contain Glockenspiels. The effect produced is seldom satisfactory, as the bells or plates are always out of tune with the main body of the organ, except when the thermometer registers exactly the same degree of temperature as when they were originally tuned.

Zink, *Zinken;* 4 and 2ft. A name used by many of the older German organ-builders to denote a kind of Clarion. Happily they were innocent of using zinc as a material for pipes, so the term does not refer to the substance of which the stops were constructed.

Chapter ii.

Picking Out and Rough Tuning:

A FEW DIRECTIONS FOR THE REMOVAL OF GRAVE DISCREPANCIES OF PITCH.

Flue Pipes.

Generally, if the discrepancy of pitch is more than a slight waver, or if the quality of a note is very dissimilar to that of the neighbouring ones, the pipe is either choked up with dirt, or else dirt, which was in it when last tuned, has blown out. In either case the pipe must be *regulated—i.e.*, brought to match its neighbours in quality and in power—before it can be tuned.

Pipes blowing their octave, or their fifth, may be brought back to their pitch by slightly closing the foot, or by pressing in the upper lip. Very often this defect arises from the pipe having been driven down in the mouth by a heavy-handed or hasty tuner. If so, straighten the pipe by rolling it on a board, applying pressure very gently. Set the mouth with a bit of flat wood shaped like a wedge (not an ordinary steel knife) and tune with great care.

Sympathy. If any pipe, correctly in tune with its own octave in the same stop, wavers, when used in conjunction with another stop, there is *Sympathy*. Try if turning one, or both, of the offending pipes will cure this; otherwise never on any account turn a pipe to speak in a different direction from that in which it was "planted" by the builder.

2. Next find out if any of the bass notes "rob" (see page 52). If

so, do not tune the Mixture, Twelfth, or Fifteenth basses to the Principal, but tune them to the organ with all diapasons up to the Principal. By this device robbing (unless of a very serious character) will be practically concealed.

3. Do not on any account touch any pipe which serves as a common bass to two stops, unless it is very much out of tune. If so, draw *the two stops* that have it in common, and tune, leaving it a trifle sharp. It then will not be offensively flat when speaking on one stop only. (See "Neutral Ground" page 48).

The following standards of pitch are those most usual :—

Society of Arts	C = 530	vibrations per sec.
Philharmonic	C = 540	,, ,, ,,
French pitch	C = 517	,, ,, ,,
	A = 439	at 68° Fahr.—"Diapason Normal"

Reed Pipes.

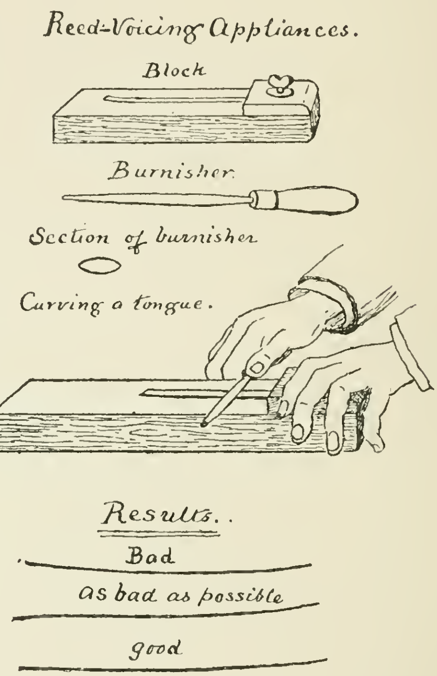
Reed stops rarely remain in tune long, thus requiring frequent attention. In the case of organs in remote places, or of such as are not under the *regular* care of a builder, organists must be content only to use the reeds for a short time after the periodical visit of the tuner, unless they are able, at least, to "knock them into tune," whenever they become unbearable.

On referring to the section of a reed pipe, on Plate I, it will be seen that the speech of reed pipes is produced by a tongue beating against a hollow barrel (or so-called "reed"). The pitch of the sound is modified by a wire, which lengthens or shortens the vibrating portion of the tongue.

When the wire is knocked upwards—this is done by hitting up the crook which is provided for that purpose—the tongue is lengthened, and consequently the pitch is flattened. The contrary will ensue if the wire is depressed by hitting it downwards—as in driving a nail.

In order that the tyro may be able to diagnose the causes of defects in the speech of reed pipes, I shall now lay down three axioms ; and a few inferences, drawn from them, may not be misplaced or unnecessary.

I. A tongue, or vibrator, cannot be absolutely straight : it would not speak at all.



II. The less curved a tongue is, the more prompt its speech will be.

III. The more curved, the slower its speech, but the gain of power is enormous, as the *amplitude* of vibration is thus increased.

The whole *technique*, either of voicing a reed stop, or of adjusting any one pipe, lies in the power of curving the tongues to a microscopic nicety.

We will now apply the three principles to ordinary cases.

From I, we find that if a note is silent (absolutely) it is probably because the reed is not sufficiently curved. At the same time, and once for all, I presuppose that both reed and barrel are scrupulously clean, and that there is no obstruction in the pipe, such as cobwebs, plaster from the ceiling, a dead bird, a mouse, candle-grease, or anything else.

From II, if a note is weak, the tongue requires to be more curved.

From III, if a note is slow of speech, or too loud, the tongue must be straightened.

If a note is silent, but wind can be heard rushing through the pipe, the tongue curve is so exaggerated that the tongue will not touch the barrel ; consequently it must be straightened.

The following synopsis may be useful :—

Condition of the reed.	*Effect.*
Straight tongue.	Silence
Insufficiently curved tongue.	Weak and rattling sound.
Here follow a variety of possible and desirable curves.	Satisfactory tone.
Tongue too much curved	Slowness of speech, with loudness of tone.
Tongue curve exaggerated (final result)	Silence.

Tongues which are twisted (or "buckled," to use the technical term), even though it be only in an infinitesimal degree, will either refuse to give the note desired, or will produce most extraordinary and unexpected sounds. They must be thrown aside and replaced by new ones.

The most minute attention to details, and *absolute cleanliness*, are necessary. Reed pipes must never be blown with the mouth. And, generally speaking, so much skill and experience are necessary whenever anything beyond mere tuning is attempted, that it is questionable whether it is wise for any non-professional person to attempt more.

Hamel (Marie Pierre, b. 1786, d. 1870), in *l'Art du Facteur d' Orgues*, vol. ii, page 355, paragraph 1258, after telling organists how to repair and tune their own organs, thus expresses his fear that the knowledge he has imparted may prove dangerous, by causing them to destroy, rather than to preserve, their instruments.

" Je crains beaucoup d'avoir fait plus de mal que de bien. On est très convaincu que si on ne parlait qu'a des organistes sages et prudents, il n'y aurait rien a risquer ; mais comme on est forcé de dire devant tous ce que l'on a jugé convenable, il est bien a craindre qu'il n'y en ait plusieurs qui en feront un mauvais usage. Un organiste imprudent (il en est toujours quelques-uns) ravagera son orgue au lieu de l'entretenir. Il vaudrait autant livrer un orgue a la mercie des rats, qu'a légerèté d'un tel organiste. Il ne faut donc pas être surpris

si les ouvriers facteur d'Orgues font toujours cette injurieuse comparaison, et s'ils en ont fait une espèce de proverbe."

Rough Tuning.

Hitherto I have only spoken of the palliative treatment of individual notes—"picking out."

Should the organist, however, be compelled to "care for" his organ, when skilled aid is not forthcoming, the following method of procedure is convenient for a rough tuning.

Take the Principal, and where any note is much out, compare it with *its other octaves* in the same stop. Bring the offending note into tune with them. Do not use the fingers to pinch the pipes.* Having thus got *approximate* bearings, tune every stop individually to the Principal, note for note, from fiddle G up two octaves.

Tune the basses, and treble top notes of each stop in octaves to itself, from the part tuned to the Principal, occasionally, if need be, proving by drawing the Principal.

A few words of advice as to what must *not* be done may also not be out of place.

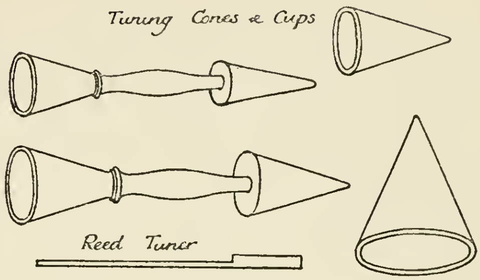
Do not attempt to lay new *bearings* (see page 41) unless previously well experienced. When an amateur starts gaily with fifths and fourths to lay bearings, it is like declaring war on the whole organ—without having first counted the cost.

Do not attempt to modify the pitch, or to change unequal to equal temperament.

Above all things do not *sharpen* the pitch : even if the pitch is raised by a competent organ-hand it is not usually a wise proceeding, the immediate consequence being the utter ruining of the reed stops. Remember that any change of pitch practically *means revoicing as well.*

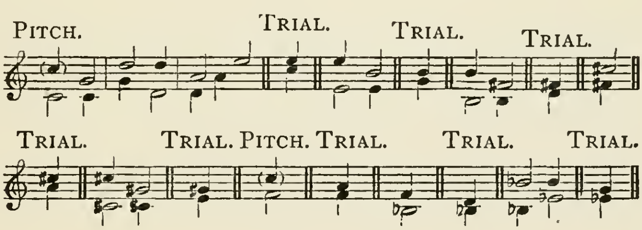
* Two brass cones—a "bearing" cone and a "mixture" cone, are *indispensable*—but of course it is desirable to have the complete set.

Never handle metal pipes if it can be avoided. Should it, however, be inevitable, they must be allowed a considerable time to cool before they can be tuned. Brass tuning cones are the best for general use, as they do not injure the pipes so much as wooden ones. This may seem a paradox, but on reflection it will be readily



perceived that a sharp blow from a heavy cone, judiciously delivered, hurts the pipe far less than repeatedly hitting and pressing it with a wooden one. Wooden cones are a great boon to tuners who have to carry their tuning kit with them, as the *weight* of a set of brass cones is not inconsiderable. Wooden cones answer well for some stops of thin metal, and for the smaller Mixture pipes.

Scheme for Laying the Bearings.



Method of using the trials. No perceptible beat must be heard in the third C-E. When such beating is present, shade the C slightly, with the cone—which will, of course, have the effect of flattening that note : if by doing this the beats are removed and the resulting third sounds pleasant, it is evident the E, the last note tuned, is too flat. If, on the contrary, shading C makes the third sound worse, E is evidently too sharp. Now seeing that E is not tuned from the pitch note, but is the result of tuning four fifths successively, it is evident

that the discrepancy must be equally divided between these previous four fifths.

If E is too flat, the previous fifths have *all* been made a little too flat, and the offensive third C-E is a cumulative result.

If E is too sharp, the previous fifths have not been flattened enough.

In either case it will be necessary to go back to the commencement, and to *slightly* sharpen, or flatten, *all* the fifths so as to arrive at a satisfactory third. All the other fifths are easy to tune, as there is a trial for each. Lastly, try all the fifths diatonically, C-G, D-A, E-B, etc., and endeavour to get them all to match exactly in character and "colour."

Before leaving this part of my subject, I may mention a few casualties admitting of simple remedies.

Ciphers. The continuous sounding of a note, which refuses to stop though the finger be taken off the key, is an accident common even in the best-cared-for organs. The following methods of stopping a cipher should be tried in the order given :—

1. Strike the key sharply.
2. Rub it against those adjacent on each side.
3. Slacken the button on wire leading to pallet (very little).
4. Open the chest and see if there is any dirt, or the wedge of a reed pipe on the pallet. Possibly the pallet is held tight by the steady-pins on each side. Remove dirt, or bend the pins to let the pallet have a little play, as the case may be.

It is a good plan to keep a few tools and sundries inside the organ. The following are the most indispensable :—

Tools. One or more screwdrivers, cutting-pliers, hammer, and chisel. A "pad" tool, containing the usual selection of diminutive instruments, is also useful.

Sundries. Buttons, cloth, tapped wires, binding wire, carpet thread, liquid glue, sundry nails and screws, and, especially, a few *tallow* candles. These latter both serve as lubricants, and for lighting purposes. No composite or wax candles should ever be used about

or inside an organ, as drops of grease from them set hard enough to clog and impede the motion of any small action work they may fall upon, besides being very difficult to remove.

Buttons tight. Do not use force, or the wire will probably snap off, but pinch them flat with pliers, first one way, then at right angles to the same. After this they will turn quite easily.

A common cause of sticking or ciphering, is the friction of the serrated part of tapped wires in the holes of the squares or backfalls through which they pass. This Mr. Wedlake has successfully obviated by the use of a small shield—or tube—covering and extending beyond the tapped portion of the wire. This rises or falls as the button is turned. Some years ago, but without any previous knowledge of this system, the writer obtained the same result by using short pieces of clay pipe stems, and pianoforte *damper wires* in lieu of "taps."

Drawing Tight Screws. Do not wait till the head is split, or the nick is chafed away, by frantic efforts to start the screw. Heat a *large* poker, or other iron, red hot, and hold the point against the head of the screw: if necessary take several heats till the screw is hot right down to the point. Next put the screw-driver into the nick of the screw and give a sharp blow with the hammer: then apply strength to turn. No screw must be tight in the *collar*, *i.e.* the part where there is no thread.

On Plate VII will be found an illustration of how to glue on a pallet in a sound-board without taking the latter to pieces. A "shoe," or piece of wood cut to support both pallet and the leather tail of the same, is accurately fitted. The pallet tail is then glued in the ordinary manner, and the shoe is wedged up, as shown, thus securing the pallet until the glue is hard enough to retain it.

This is a very delicate operation, and one which can hardly be recommended to the amateur—unless perhaps if abroad, and thus completely cut off from skilled aid.

Chapter iii.

Close Tuning.

Before starting it is essential that many preparations be made and that the action generally be looked at. See that the stops draw out properly. If you have any doubt that some hang, or are obstructed by the fans of the Composition Pedals, disconnect the trace-rods and move the slider at the chest.

Note if the touch has dropped ; if so, raise it, in order that the pallets may act fairly.

See that the bellows regulators are all right, and that the weights have not been shifted so as to cause any irregularity in the working of the bellows.

Take out the swell shutters, *but only as few as possible, and do not unnecessarily remove any panels, or indeed disturb anything which need not be disturbed.* Do all this *overnight.*

Leave the reed work till the last, and get all heavy hammering of stoppers and cupping of large pipes done at an early stage, so as not to shake the more sensitive work.

Do not allow any sweeping to be done in the church ; and, if possible—by the use of gas in winter, or otherwise—obtain a mean temperature of about 60°.

Both reeds and flue work should be *regulated*, when practicable, *the day before* the thorough tuning commences.

Regulation. A few words on regulating may not be out of place here. Regulation is *the* one thing, the matter paramount in respect not only of organs but of every musical instrument.

A well-regulated organ is always pleasant to listen to, as the mere fact of absolute equality and uniformity will make almost any succession of sounds agreeable, no matter whether their tone be bad or good intrinsically.

After a few tunings an ill-regulated organ soon begins to deteriorate, even though it may originally have been of the best possible construction.

It is tuners who wear out organs, and the harm is done by tuning pipes not properly regulated, and therefore not in a fit condition to be tuned.

Instruments wear out, or rather are destroyed, in this manner. Regular *tunings* do not keep an instrument in order: they merely keep it usable. Unless an organ is cleaned frequently and thoroughly, each tuning is a nail in its coffin.*

Players, no matter how unskilful, seldom or never injure organs.

After the organ has been regulated, the next step consists in "laying the bearings;" *i.e.*, determining the pitch of every note in the octave. The Principal is the stop selected for this purpose, and, in this country, C[1] above middle C is usually the starting point. On the Continent, A is generally preferred.

When this C is at the required pitch (taken from a fork, or other organ-pipe) tune the octave below a perfect octave. Then work upon the following scheme, leaving the fifths a little flat, but keeping the octaves perfect.

N.B.—It is not necessary to tune the notes on the bass stave, but they are convenient for reference and comparison.

* It is almost hopeless to make the average musician or general public realise this. It is a thankless thing for the tuner to point out the necessity of cleaning an organ, as he is at once suspected of trying "to make a job," and is always met with some indignant or sneering remark—"Oh,

As soon as E is tuned, try if it makes an acceptable third with C and G. See also scheme on page 41, which is, perhaps, the best one and should be first studied.

The whole art of laying bearings consists in knowing how much the fifths must be flattened, and in making them all alike. This is best learnt on an old piano, and afterwards upon the Stopped Diapason, as metal pipes may be damaged irretrievably in experimenting.

There is another way of laying the bearings, now more generally in vogue, *viz.*, tuning by fifths and fourths. Here the student has to learn two things, as against one only in the previous schemes. The fifths must be a little flat (as before) and the fourths must be left sharp to the same extent.

PITCH. TEST.

I need hardly say that *absolutely steady* wind is needed while tuning. The bellows should be kept half full during the whole time, and the slightest jerk of the handle must be avoided.

Tuning is much facilitated by previously equalising the power of all the notes. It is very ~~different~~ difficult to tune a loud note from a weak one, or *vice versa*.

After the bearings have been laid in either of the ways given, a few octaves are tuned, and they are tested, by playing chords. Finally all the notes of the stop are tuned in octaves from the bearings, or fixed sounds obtained in the first instance.

The best possible time for tuning is when the thermometer is about halfway between the extremes of temperature, as indicated by a self-registering thermometer kept in the organ. It is probable that a similar condition of the barometer is also favourable.

so there are repairs wanted already: Mr. Smith's and Mr. Jones' organs have stood well without any repairs," etc. The organ-builder—who of course is only human—soon discovers the folly of obtruding advice, realising that, after all, letting the organ go to ruin will make good for trade, and that—even if he lose *that* job—he will, probably, be called in to rebuild some other builder's job, lost by the latter in the same way.

In tuning acute octaves the ear is apt to be satisfied while they are still too flat. The small notes of the Fifteenth are especially trying. When there is any doubt, prove, by testing the note with its fifth below—the fifth being (in that region) the most recognisable interval. In tuning stops of very low pitch, it is best to go gradually downwards : the ear thus becomes as it were educated to the work. Even so, however, the tuning of very low sounds is done more by judgement than by ear ; *i.e.* the pipes are shaded either at the top or at the mouth, and notice is taken whether this aggravates or diminishes the discordant beats. If it makes the beats stronger (aggravates) the pipe is too flat, if the contrary, the pipe is too sharp.

The tuning of stops of delicate pitch and intonation is always troublesome, as other stops of large calibre* "draw" them. *E.g.*, it is quite possible for a Dulciana note to be as much as a comma flat or sharp when sounded alone, but if an Open Diapason note of the same pitch be added, the large pipe will draw the small one temporarily in tune, so that no wave is perceptible. The difficulty is that there are no small-scaled stops, already tuned, to tune from. Great care must be exercised in getting the pitch of the first few fifths accurate. Complete bearings must be laid separately in each of these stops—or they may be tuned from the Twelfth, and proved with the Stopped Diapason—the latter having been previously tuned to the Principal. This test will prove a double purpose, by likewise making combinations of the Stopped Diapason with other soft stops particularly sweet.

I once asked a very clever tuner, "How do you succeed in getting such smoothness of tone, and in seemingly pleasing all classes of players?" His reply was, "I first try to find out what style of pieces the organist plays. If need be, I look over all the music I can see about, and I form my conclusions. Then I judge what combination

* It is important to note that only sounds at the octave or unison "draw." That is why fifths are more easily tuned than (true) octaves or unisons. For this reason the Twelfth is useful to tune small-scaled stops from, and to "prove" large-scaled ones by.

of stops he likes." Would that all tuners possessed the same amount of brains!

Neutral Ground. Every pipe sounding the octave to another pipe possesses what is termed "neutral ground" between the point (either above or below) where a sharp beat arises from undue sharpening, and a flat beat from undue flattening.

On CC of the Open Diapason there are nearly two commas of neutral ground, *representing about an inch of length in the pipe.*

It is in dealing judiciously with this quantity that brains, and real *art* in tuning, come in. No amount of mathematics, monochords, pendulums, or the like, will produce anything but a theoretically correct result. Some persons grasp this readily, and by cross-tuning attain a sweetness and cohesion of tone completely beyond the capacity of the mere routine tuner who, again, is invariably better than the theoretical "crank" who approaches his work with a mind filled with algebraical formulas.

The most elementary application of the principle of neutral ground obtains in tuning the bass notes of borrowed stops (page 37). Indeed, but for the existence of neutral ground borrowing would be impossible.

When there are two large unison stops, say, two Open Diapasons, each must be separately tuned to the Principal. If we tune one Open to the Principal, and the other Open to the first, we are not sure of getting the pitch of the latter as it were to *the exact centre* of the neutral ground; and it may be only so barely within one of the limits as to cause beats with other smaller pipes of similar calibre.

Small pipes are sensitive to large, being temporarily drawn into tune by them; but large are not generally sensitive to one another.

Before commencing to tune, it is a good plan to make a mark exactly midway between the "Full" and "Empty" marks on the tell-tale board, directing the blower to keep the tell-tale exactly to this point, *blowing slowly and steadily.*

If the wind be naturally unsteady, it is often necessary to tell the

blower to fill the bellows up, and to refrain from blowing while the more susceptible notes are being tuned.

Small and sensitive pipes sometimes can only be adjusted in this manner, as the pumping of the feeders throws them on and off.

Further, it is a good plan to draw several stops together, testing them in various ways.

When any beat or waver appears, its cause must be sought. Generally, enough "neutral ground" will exist in either or both of the offending pipes to render the removal of the waver possible, by imperceptibly sharpening or flattening one of the pipes concerned, without disturbing the bearings of the stops—which, it is needless to say, must be most strictly respected. By these means, waverings, due to the fact that some pipes are not tuned right *into the centre* of their neutral ground, so to speak, or to "sympathy," may be removed or palliated.

Finally, the organ (full without reeds and mixtures) must be tried in double octaves; but as Robbings* now possibly begin to assert themselves, it is best to avoid meddling with any pipe, until quite sure that the wavering is not due to this cause—which can only be, at best, palliated.

The tuner may now wipe his cones—which should always be oiled by rubbing them with a greasy rag before use—and proceed to collect his belongings.

* See pages 52, 78.

Chapter iv.

New Organs and Reconstructions.

Every application of public money naturally calls for a guarantee which shall be sufficient for the satisfaction both of those who have subscribed, as well as for those who are responsible for their stewardship in the matter.

Failing the assistance of a disinterested expert, a few hints upon the methods of testing a new organ may be useful to some readers.

Tests which may be applied to New Organs as a guarantee of their soundness.

Building Frame. 1. The general frame-work supporting the soundboards, bellows, and other essential parts of the organ, should be built upon a horizontal frame (sole frame) to insure against the danger of one corner, or side, of the organ moving or sinking. Such a deflection, though often imperceptible to the ordinary observer, is a certain cause of serious mischief. When, however, the organ is on a ground floor, boarded on *strong* joists, or paved with *large* flags, the sole frame *may* be dispensed with ; even so, however, it is always an advantage.

Swell Box. This should be firmly fixed : it must not vibrate or shake when the louvres slam. Its sides should be not less than $1\frac{1}{4}$ inches thick.

Bellows. These must be of *ample* capacity. Given the (ordinary)

rise of ten inches, about 2ft. to 2ft. 6ins. square (superficial measure) on the top represents wind for a 4ft. stop, or—averaging great and small—may be taken as the measure of each stop. There should be plenty of valves in the feeders to avoid the sucking noise which is otherwise heard, and to prevent the blower's power being greatly overtaxed with no adequate result.

The top of the bellows should be provided with panels *screwed on*, so as to be easily removed when it is necessary to clean the pallets, or to replace the cords of the safety-valves.

Examine also in respect of the following :

1. That the angle described by the ribs when fully open is not greater than 75 deg., or, roughly speaking, that it is *much less than square* (90 deg.)

2. That the bellows rises *level*, not one corner (or side) before the one opposite.

3. See that the feeders (small bellows directly moved by the handle) open freely, are not hinge-bound, and do not creak, or make a pumping noise audible outside the case.

4. If possible require *metal* weight on the bellows : the paltry saving effected by using stones or bricks cannot be too much condemned.

5. See that the *waste* (or "exhaust") *valve* opens outwards in the top of the bellows.

Draw Stops must be perfectly silent in their working. When they are pushed home a smart shock must be felt, and again when they are pulled out to their full extent. They must not admit of being forced in, or dragged out beyond these limits, even though they may return to their proper position. Such springing, as it is termed, is totally inadmissible.

Ordinary trunnel drawstop action is shown on Plate V. When the stop-handle A is drawn, the trunnel B turns, and pulls the trace-rod C, which, by moving the lever D, works the slider E, E.

On the same plate are represented the following Manual Couplers:—

Robson's Ram coupler, Kirtland's coupler; both these act by sliding from left to right.

Ordinary Tumbler coupler. Here the stock A does not slide—as in the two previous forms—but *turns* on a centre. When the little tumblers (T) are perpendicular, the coupler is on. When they are horizontal, it is off.

It is a paltry and unworthy saving to put the lower octave of the Swell Open Diapason outside the swell-box. The effect is most undesirable, being nearly as objectionable as that produced from a Tenor C Swell continued with a bass from the Choir or Great Organ. Indeed a Tenor C Open Diapason, grooved into the Stopped Diapason's twelve lower notes, is far better.

Tests at the Keys.

Robbing. 1. To discover robbings, draw the Principal (say on lowest C on the manual) and add successively all the 8ft. and 16ft. stops on the same row of keys. See if the pitch flattens, if so, note the same as a Robbing.

2. Now draw all the stops (on the row of keys being tried) and suddenly push off all except the Principal and Fifteenth. Note if the pitch appears to sharpen. Supposing that these defects (flattening and sharpening) exist, and that a slight deepening of the touch does not remove them (though this at best is unsatisfactory), the organ will never be in perfect tune, as the pallets are too small, or the bars are too shallow.

Running. Next draw the Gamba (or Fifteenth, if there be no Gamba) and play slowly major thirds in *every* note (C-E, D♭-F, D-F♯, etc.). Then play major thirds and fifths in the same way (C-E-G) (D♭-F-A♭, etc.).

If some of these chords have a different effect, suggesting the blending of notes, other than those pressed down, there are Runnings; that is the wind runs into pipes not intended then to sound. It now

remains to find where these runnings are. Try the defective combinations of notes in some other stop (say in the Principal). If they exist there too, the chest is radically defective, but if runnings exist only in one stop, or in different places in different stops, it is a comparatively trifling defect, which I shall call runnings of the second order, as distinguished from the first. These latter can be easily remedied by re-levelling the upper boards and deepening the scoring.

Tone. Remember that every pipe in each stop should match in tone. Absolute excellence of tone in a stop is less a desideratum than perfect equality throughout.

It is much to be desired that the pipes of the various stops should be regulated in the place where they are to stand ; *i.e.* should go from the voicing machine to the church direct, and there be regulated.

This would be a little more expensive, and necessitates some delay, but absolute fitness of tone for the edifice is only guessed at by any other means. In most of the large organs on the Continent this process has taken months, in some cases years. But the hapless English builder has generally to run up his organ in a few weeks or months, finish it in his shop (which differs from the place in which the instrument is to stand, not only in its normal acoustic properties, but by being in itself continually subject to variations when more or less crowded with work) ; then the whole thing is torn down, hurried off, and men work night and day to throw it together. Under these circumstances, if it does suit the building, the builder can only be said to have made a lucky guess. Surely an organ deserves a little fair play in this respect.

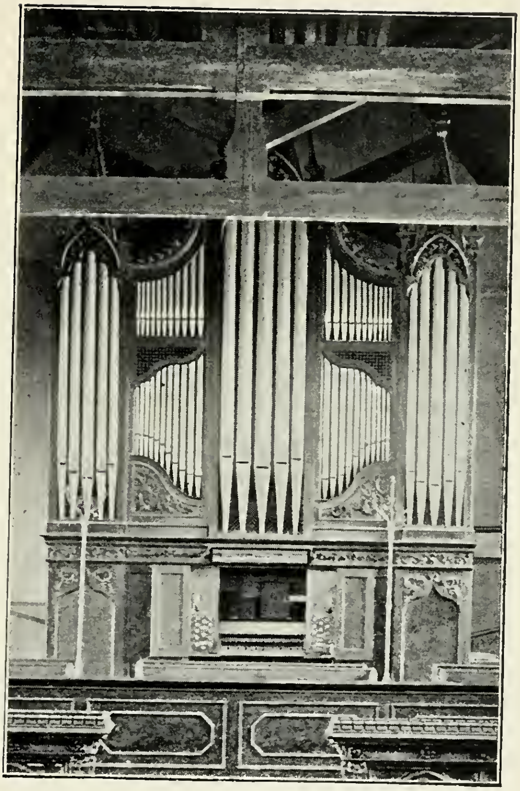
Possibilities of Alteration and Reconstruction of old Organs.

There was a time, not many years distant, when the number of old GG organs existing (many of which contained pipe work of great excellence) would have afforded reasonable excuse for a long chapter

upon this fascinating subject. As a matter of fact such organs have now virtually disappeared, and the few that remain scarcely justify a writer in devoting space to their possibilities. It is with organs, as with every other industrial product. Formerly coats made by high-class tailors could be turned. Now, when the seams of coats are not intentionally spoiled to prevent this, the material itself is seldom good enough. Moreover, even in the case of instruments by thoroughly first-class builders, the modern organ is such an ephemeral thing, made up of toy-like motors, magnets, and wires, and one whose fashion changes so quickly, that—to follow up my simile—it is better to buy another garment, than to have an old one, already shewing signs of wear, remade according to a new fashion. The old slider and pallet sound board, when well made, is practically everlasting ; but it is quite different in the case of the intricate (and of necessity fragile and perishable) work of which modern organs are composed. Lastly, age does not appear to improve modern pipes to the extent (probably from the higher pressures of wind now used,) it did those of the old school of builders. For all these reasons it is better to order a new organ than to rebuild a comparatively modern one, and greater satisfaction is sure to ensue both to organist and organ-builder.

An instance of the survival and judicious restoration of an old organ is presented at Dulwich College Chapel (Plate III). Details of this interesting instrument will be found under the Description of Plates, page 106.

Plate III.



THE ORGAN
IN CHRIST'S CHAPEL OF ALLEYN'S COLLEGE OF GOD'S GIFT,
AT DULWICH.

ORIGINALLY BUILT BY GEORGE ENGLAND THE ELDER, 1760.

Chapter v.

Scales of the Various Stops.

All scale measurements (*i.e.* diameter of the pipes) are *relative*, and depend upon various contingencies. It is, indeed, in the selection and combination of various scales that the experienced organ-builder will ever hold an advantage completely beyond the grasp of the amateur, or even of the average organ-workman.

It would therefore seem useless to give detailed measurements; but as pipes are sometimes made so small that they can never stand in tune, and that the least particle of dust throws them off in their speech, I here suggest a *minimum* scale in the case of the principal stops. It does not, however, follow that the larger a stop is, the better it is; beyond a certain limit pipes become "tubby" and lose the "ring" which should exist in every individual note. See page 144. Further, and separately, these measures must be considered as referring to stops of usual construction only, and not to Hope-Jones' and other builders' specialities for the production of orchestral effects.

Flue Pipes, diameter at CC :—

Open Diapason, CC $4\frac{3}{4}$in., Tenor C $2\frac{7}{8}$in., 2ft. C $1\frac{5}{8}$in., 1ft. C $\frac{15}{16}$in.

Principal, one pipe smaller; *e.g.*, CC the size of Open Tenor C♯.

Fifteenth, three notes smaller than Open; *e.g.*, CC the size of Middle D♯ in Open Diapason.

Dulciana CC $3\frac{5}{8}$in., Tenor C $2\frac{1}{8}$in., 2ft. C $1\frac{3}{16}$in., 1ft. C $\frac{13}{16}$in.

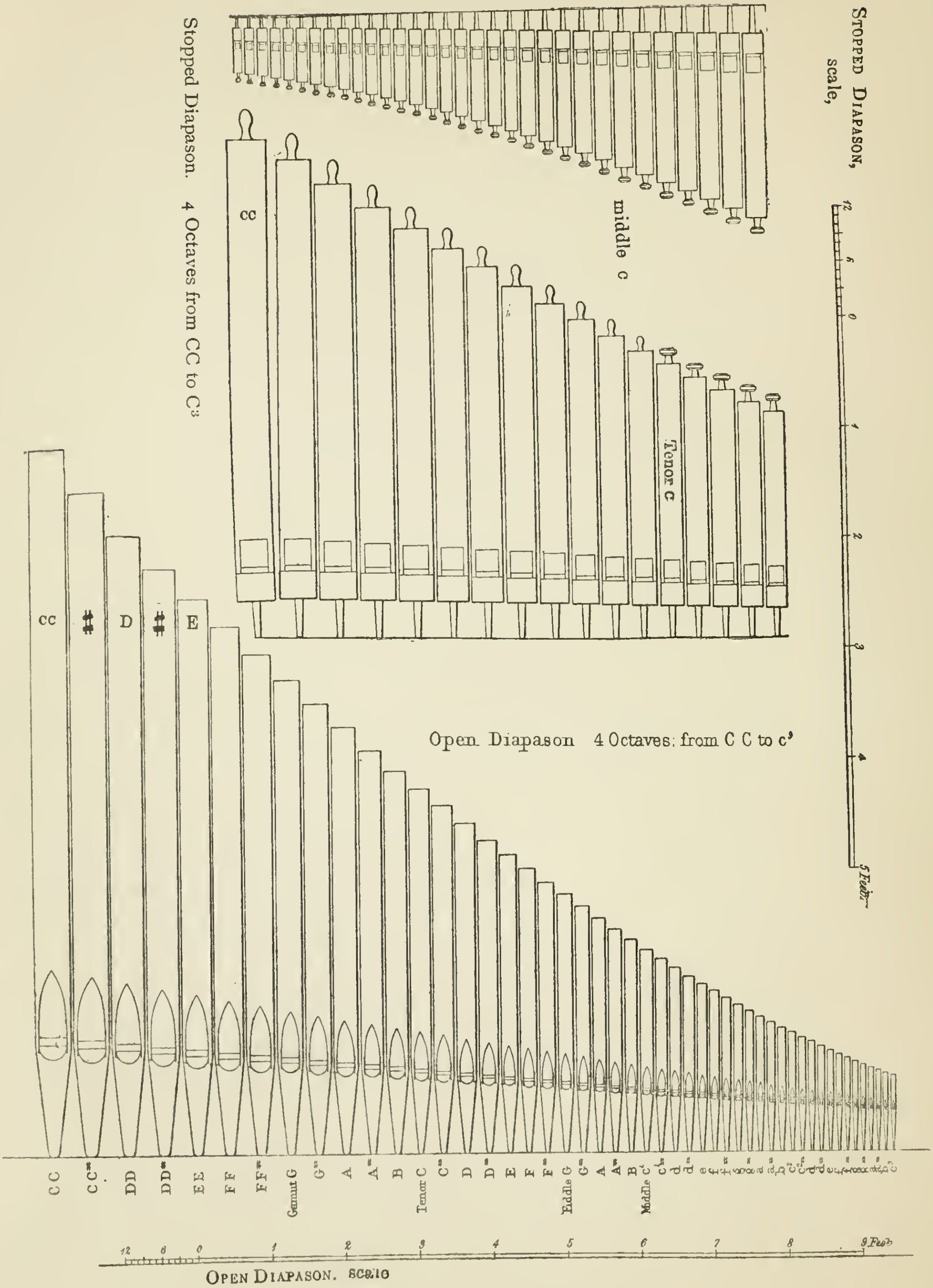
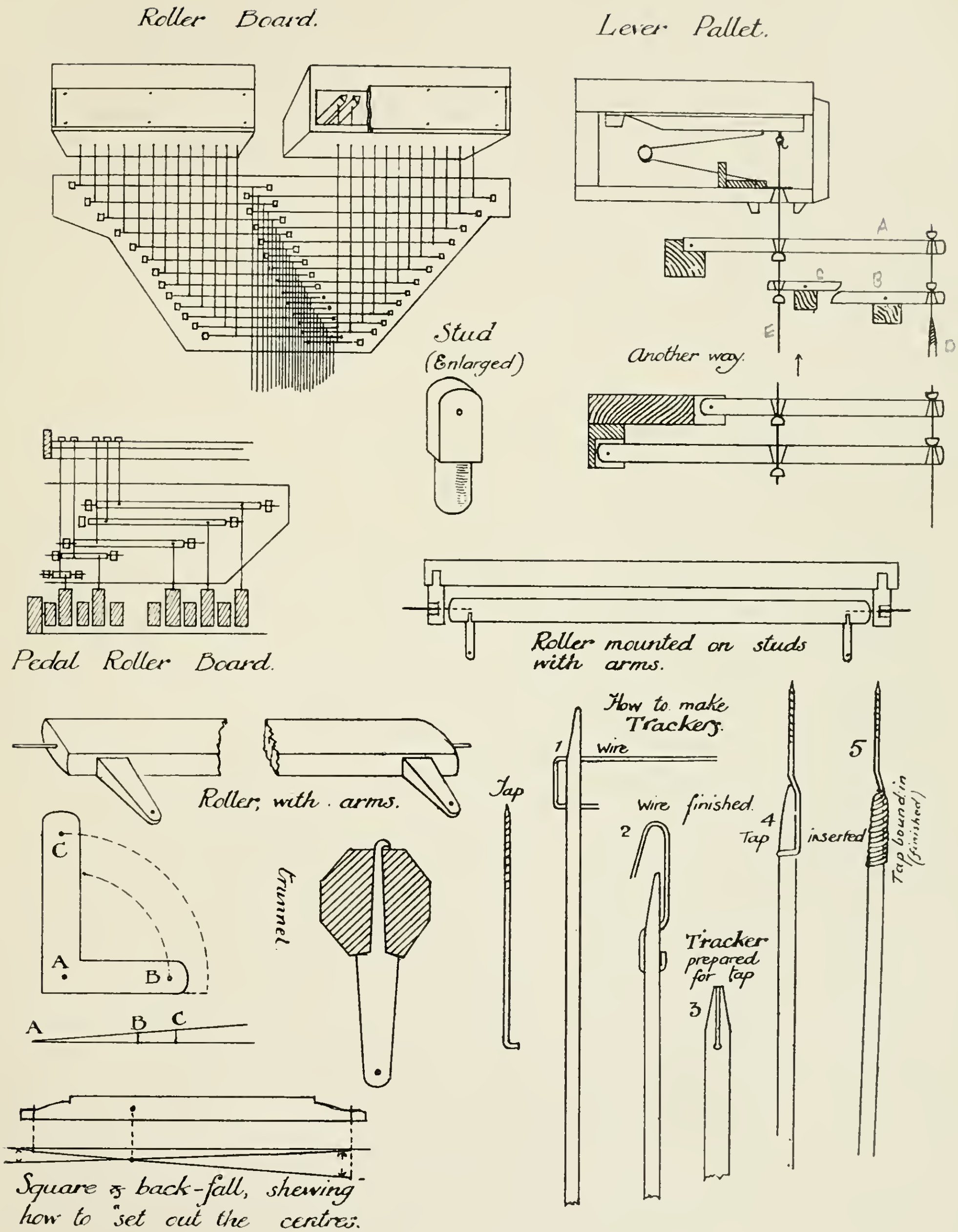

Stopped Diapason. 4 Octaves from CC to C3
Stopped Diapason, scale,
CC
middle c
Tenor C
Open Diapason 4 Octaves: from C C to c3
CC
D
E
CC
DD
EE
FF
Gamut G
A
B
Tenor C
D
E
F
Middle G
A
B
Middle c
Open Diapason. scale

Plate IV.



Roller Board.
Lever Pallet.
A
C
B
E
D
Another way.
Stud
(Enlarged)
Pedal Roller Board.
Roller mounted on studs with arms.
Roller, with arms.
Tap
How to make Trackers.
1
Wire
Wire finished.
2
4
Tap inserted
5
Tap bound in (finished)
Tracker prepared for tap
3
C
A
B
Grunnel.
A
B
C
Square & back-fall, shewing how to set out the centres.

Length of feet. The length of the foot does not influence the *pitch* of the speaking portion of the pipe. In metal pipes, however, it slightly modifies the *quality* of tone. As a rule, the longer the foot the clearer the tone, especially in the middle part of a stop.

In designing organ fronts, attention should be paid to the relative proportion of lengths of foot and diameter in show pipes. There are three systems: (1) foot length *increasing* as scale diminishes, (2) *uniform* length of feet, (3) feet *proportionate* to diameter (as in inside work).

Reed Pipes, Diameter at CC :—

Cornopean or Horn 5in.

Trumpet $4\frac{1}{4}$in.

Clarion about two notes smaller than Trumpet on tenor C.

Clarinet about $1\frac{1}{2}$ to 2 inches.

Vox Humana about $1\frac{1}{2}$ to 2 inches.

The degrees of intensity (weight) of the wind used practically determines the scales. Small scales are at a disadvantage on heavy wind, and large scales will not speak properly on very light wind.

The diameter of organ pipes is in INVERSE PROPORTION to their length, *e.g.*, CCCC (length 32ft.) has a diameter = to one-twentieth of its length. At top G on the Fifteenth (length $\frac{3}{4}$in.) the diameter of the pipe will have increased to one-fifth of its length at least.

The establishing of these scales, as they are called—that is, the determining the proportion of gradual increase (or decrease) in the diameters of pipes—has considerably exercised many scientific organ constructors; but the lengthy tables of Herr Töpfer and Herr Zeiger apparently exhaust the subject of scale variations in all its bearings. To the amateur organ-builder it may not be uninteresting to possess the rule of thumb method adopted by many organ workmen, who never heard of Töpfer or Zeiger, and which, indeed, answers practically as well.

First determine a diameter for CC, which in this case we will assume to be $5\frac{1}{3}$ inches. Then make the diameter of the fourths and octaves in like manner proportionate to their lengths, *e.g.*

Lower two Octaves.

	CC	FF	Tenor C	F	Mid C	
Proportional diameter of certain notes . .	$5\frac{1}{3}$ins.	4	$2\frac{2}{3}$	2	$1\frac{1}{3}$	From these fixed measures it is easy to graduate the intermediate pipes.
To get the increase of scale we add $\frac{2}{3}$ of an inch to each . . .	$\frac{2}{3}$ins.	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	
This gives ordinary diapason scale in bass	6ins.	$4\frac{2}{3}$	$3\frac{1}{3}$	$2\frac{2}{3}$	2	

Upper Octaves.

	Mid C	f	c′	f′	c″	g″
Proportional diameter . .	1.8	1.35	.99	.675	.45	.3
Add to each .2 . . .	.2	.2	.2	.2	.2	.2
Gives ordinary Open Diapason scale in the treble . . .	2	1.55	1.1	.875	.65	.5

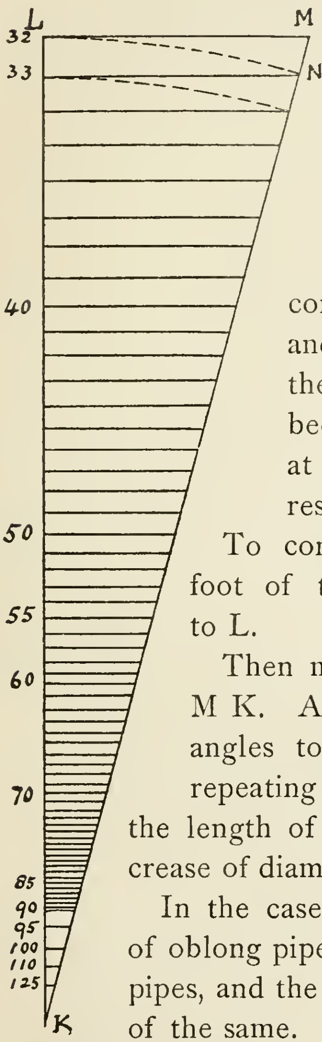
In the case of metal pipes these diameters can be converted into circumferences by multiplying by 22 and dividing by 7. This gives the width of the sheets* of metal before they are rolled into pipes. Once a scale is truly formed, any other scale can be derived from it. Let CC D E F G A B C D E F be an Open Diapason scale. Then—

C D (two pipes smaller) is a smaller Open Diapason scale
C (four pipes smaller) Principal and Fifteenth scale.
C D (7 pipes smaller) Gamba or Dulciana scale, etc., etc.

* It should be noted that organ workmen usually describe the Open Diapason as being of 13, 14, or 16in. scale. By this they mean that the Gamut G pipe (lowest G on the manual) is made of a sheet of metal 13, 14, or 16 inches wide (which, in the case of 13 inches, gives 4 inches diameter, nearly). The practice of measuring the G and of using it as a standard appears to have survived from the times when GG was the usual terminal note—as CC is at present.

N.B. Though this information might seem so purely technical as to be redundant in a work of this kind, the question "What is an Open Diapason of 14in. scale?" has been given by the R.C.O. both in 1883, and subsequently.

Thus we can diminish the scale by starting at *any* degree above, as in foregoing examples.



Scale for both Metal and Wooden Pipes.

The accompanying Diagram is that of a scale in which the diameters of the pipes halve every seventeenth note. To work from this, make the line L M $2\frac{7}{8}$ inches and the line M K $9\frac{6}{8}$ inches, set the *proportional* compasses so that the small end gives L M $= 2\frac{7}{8}$, and the long end 6 inches—or whatever may be the desired scale for CC. Once they have thus been set, the size of all the pipes can be found at the long ends by setting the short ends to the respective lines in this figure.

To construct the accompanying figure, place one foot of the *compasses* at K and extend the other to L.

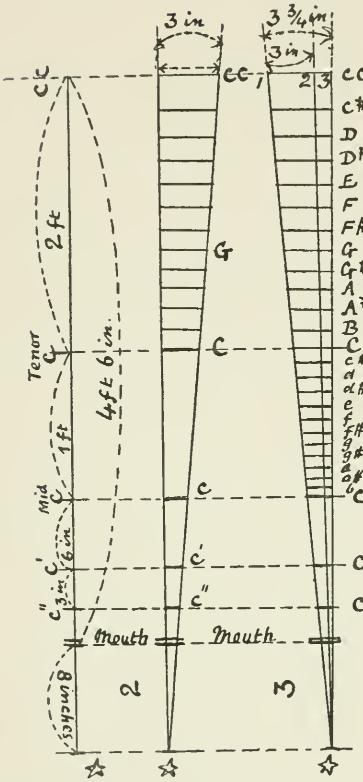
Then move the point at L until it touches the line M K. At the point of contact (N) draw a line at right angles to L K, and therefore parallel to L M. By repeating this process the graduated scale is obtained, the length of each line representing the proportional decrease of diameter in the pipes.

In the case of wood stops, which are usually composed of oblong pipes, use the scale as given for the depths of the pipes, and the scale starting at 35 or 36 to express the width of the same.

This scale diagram can be used either for constructing a whole stop, or for accurately dividing the difference in scale between given notes.

Draw this line first, dividing as here shewn.

Construct figures (2, 3), from measures on line 1.



PRACTICAL WORKING SCALE FOR WOOD PIPES.
Divide each section into twelve parts.

(2) gives scale for perfectly square wooden pipes—some flutes are so made.
(3) gives the complete scale of a stopped diapason to CC. 56 notes.

Scale for Wooden Pipes.

To use the Scales, in figures 2 or 3, measure from the upper of the two lines marked "Mouth" along the right hand line up to the cross line bearing the name of the note desired. This gives full speaking length. In figure 3, the whole length of the cross line will give the depth of the pipe (1—3) : the length between lines 1 and 2, width of the pipe —inside measure in each case. If the scale of a 16ft. Bourdon be required ; add 4ft. more at the top by producing the lines, and divide as before in 12 parts :* this will give scale from CC to CCC. *(See dotted lines.)*

Blocks. The first twelve blocks, commencing at CC, will be $4\frac{1}{2}$ins. long, the next twelve, $3\frac{1}{2}$ins., the next twelve, $2\frac{3}{4}$ins. ; and the rest about $2\frac{1}{4}$ins.

Practical Hints on Voicing.

Voicing is the operation by which various qualities of tone are produced from speaking pipes.

If we for the moment put aside the question of shape in organ

* The division of the octave in twelve parts, approximately graduated by the eye, is, of course, not strictly scientific, but this scheme—which is that used by most workmen—answers perfectly. We commence by making the CC longer than it need be, and the slight excess of length in each pipe is not much more than is required for squaring and trimming it off neatly.

pipes we may broadly say that pipes differ in tone according to the manner in which they are "nicked," and "cut up."

Voicing is therefore mainly a matter of nicking and of cutting up.

Nicks are made in the front edge of the "languid" in metal pipes, and in the "block" of wooden ones, as may be seen if any pipes be examined.

These nicks may be coarse, *i.e.*, deep and wide-spaced, or fine, and, consequently, more numerous. An Open Diapason will be coarsely nicked to render the tone bold : a Dulciana, or Gamba, must be finely nicked to render the tone delicate and mellow. Nicking of metal pipes is done with nickers or knives specially shaped at the points so as to nick both languid and lip at the same time. Nicking of wood pipes is done with small half-round and triangular files. Great care must be taken to clear away any burr or splinters. Many German builders black-lead the blocks to ensure absolute smoothness.

Deep-nicking not only steadies the tone of a pipe, but appears to have the property of causing pipes to blend with other similarly-nicked ones.

On the contrary, pipes nicked but very lightly, or not at all, while they may give a pleasing quality of tone when sounded alone—never blend, and therefore can only be used for certain solo-stops.

Metal Pipes. The following general table will illustrate the principle of voicing metal pipes.

Nicking.	Diameter of wind-hole.	Height of mouth. (Cutting up).
CC Nicks. $\frac{1}{16}$in. or more deep, $\frac{1}{8}$ apart, both in languid and lower lip.	$\frac{1}{3}$in. to $\frac{1}{2}$in.	$\frac{1}{4}$ of width of the mouth (or more, according to pressure of wind used.)
Do not nick the lip, but only the languid in the case of very small pipes.	Diminish these measures progressively.	Continue to top. N.B.—The height of mouth may be diminished slightly in the upper notes, if a tendency to "tubbiness" and windiness is noticeable.

Defects of speech :

"Chiffing." Causes. (1) Nicks too shallow, (2) loose languid.

Windiness. ,, (1) Nick too deep (2) mouth "crippled," *i.e.*, incorrectly nicked, or spoiled, (3) pipe-foot too short, (4) mouth cut up too high.

Overblowing—*i.e.*, speaking some harmonic in place of the note intended. Causes. (1) languid not high enough, (2) upper lip too forward, or convex, (3) lower lip not straight, (4) wind-hole too large. A thin, soft, quiet tone is produced in small-scale stops by keeping the languid as high as possible, and by bevelling the outer side of the upper lip.

To make making the tuning slots in the right places in pipes. Leave the pipes a semitone flat (*e.g.*, tune C to B), then set the compasses to the diameter of the pipe, mark the same distance down from the top of the pipe ; this will give the top of the slot, which must be cut *downwards* from this point.

Nicking knives. (See Plate II.) 1 and 2 are single nickers. 3, serves to nick both languid and underlip simultaneously.

Wood Pipes. Wood pipes, as they leave the maker's hands, usually have their ears extending down below the block. These ears must be cut back so that when the cap is applied it shall stand only a little below the level of the block. On CC 4ft. Stopped Diapason, the cap should stand down about $\frac{1}{8}$—the distance being, of course, diminished as the pipes get smaller.

After the caps are fitted, proceed to round the edge of the block, *very slightly*—using a worn file. The nicks can then be made with the edge of a half-round file.

The wind-way in the cap is then made, and other nicks are filed, corresponding in number and depth with those in the block.

All fibres and chips must be very carefully removed, and the pipe can be tried on its wind. To regulate the supply of wind through the wind-hole in the foot, wedges of wood are driven in until it is reduced to the required size.

The mouths are cut up from $\frac{1}{4}$ to $\frac{1}{3}$ according to the quality of tone required.

Arching the mouth gives greater power, provided that the wind "reaches" well—*i.e.* is copious—but delicacy of tone is destroyed thereby.

Some hints on the speech of reed pipes will be found on page 38.

To treat of reed voicing would carry me beyond the scope of this work. Generally speaking no one can turn out even a barely endurable reed except such professional voicers as devote all their time, or most of it, to reed-work specially.

Glossary of Technical Terms.

Abrégè (French). A Roller.

Action. All parts that move or transmit motion.

Anches (French). Reeds.

Backfall (J*). Wooden levers centred near the middle, which transmit motion from keys or stop-knobs.

Bars. The partitions which separate the sound-board into channels, each governed by a pallet.

Bay-Leaf (D). The pointed variety of upper lip in show pipes.

Beard. A slip of metal or wood fixed horizontally under the mouth of a pipe, its effect is to render the tone more grave and solemn in character. It is in many instances impossible to produce a steady and continuous note from small scale pipes unless they are bearded, but in full scaled pipes, beards are usually harmful, or at least useless.

When a very bright tone is desired in the case of wooden pipes, the lower lip is usually reduced to a thin edge, as the top of the cap of an ordinary wood pipe is in itself a kind of beard, which is destructive of brightness of tone.

* The letters refer to the folding diagram.

Bearers. The slips of wood between the slides, which bear the weight of the upper boards.

Bleeding. An operation which consist in pricking the parchment or American cloth which covers the underside of the sound-board grooves—thereby neutralising "runnings," by allowing the small quantity of air which causes them to escape freely.

Block. The solid piece of wood which closes the bottom of a wood-pipe, and acts at the same time as a "languid."

Boot (E). A kind of elongated thimble-shaped case, which contains the mechanism of the reed pipes, and which stands on the sound-board.

Butterfly-crank, or square. A term designating V-shaped cranks used to convey action to an obtuse angle, as in the case of the stop handles when set to draw at an angle of 45 degrees, etc.

Borrowing. Arranging a certain number of pipes so as to be common to two or more stops.

Building-Frame. The framework which supports the sound-board, bellows, and other heavy portions of an organ.

Buttons. Small leather nuts used for regulating the touch by shortening or lengthening the trackers.

Cipher (French : Cornement (S), Corner (V). German : Ausstossen, Abheulen). See page 42.

Cleat (Plate VII). A wooden hook : wood pipes below 4ft. are always secured to a rack, or other fixing, by a cleat.

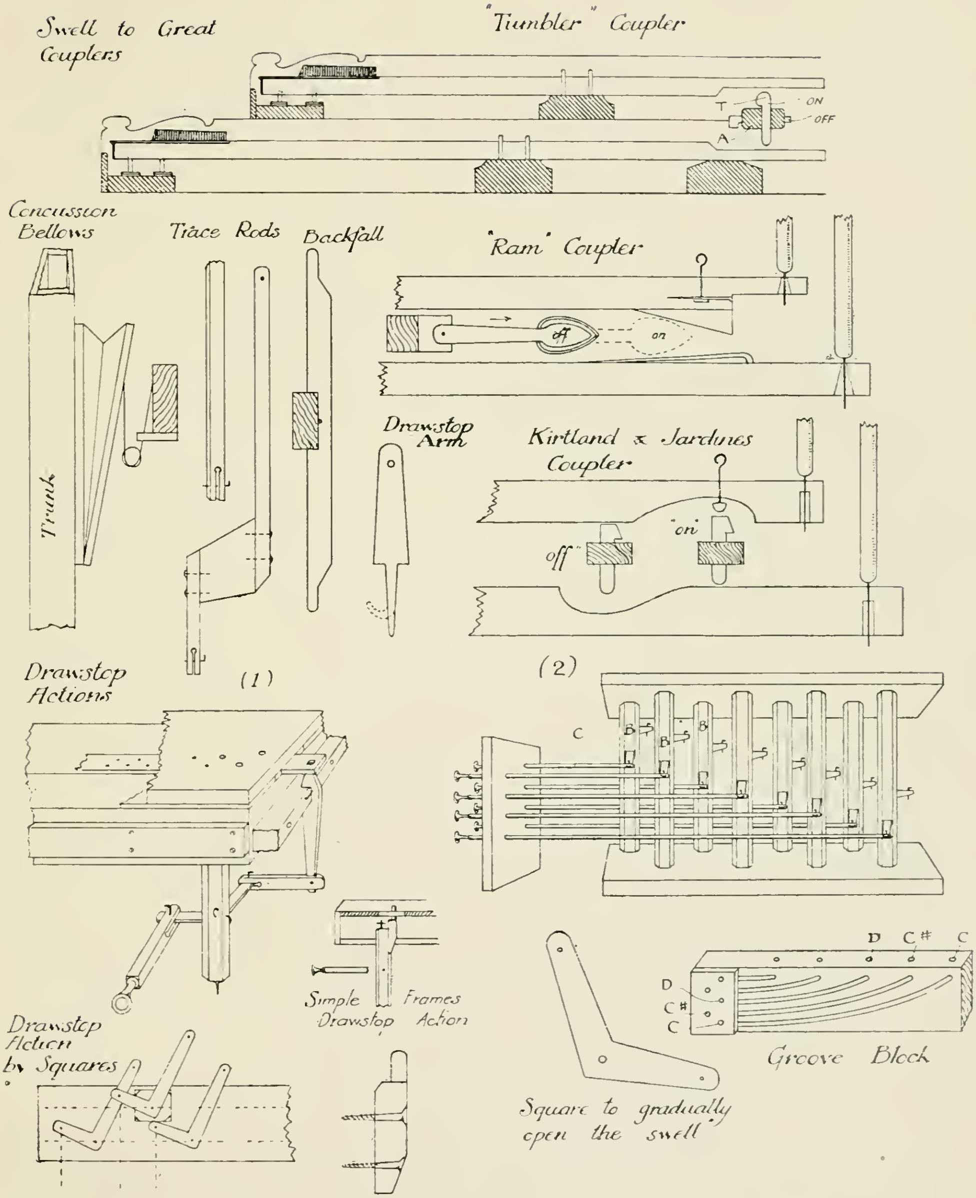
Cloth. Small wads of cloth, used with buttons to prevent rattling.

Concussion bellows. A floating bellows calculated to counteract and nullify jerkiness in blowing. See Plate V.

Console (Plate VI). A structure, in outward appearance resembling a large harmonium, in which are grouped together the keys, pedals, and drawstops of an organ when they stand apart from the main body of the instrument. Consoles are generally so arranged that the player shall face his choir or audience.

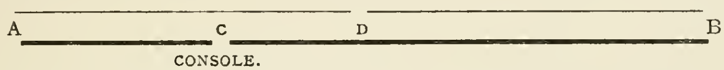
Tracker, and still more tubular, action will suffice to admit of re-

Plate V.



Swell to Great Couplers
"Tumbler" Coupler
T
ON
OFF
A
Concussion Bellows
Trunk
Trace Rods
Backfall
"Ram" Coupler
off
on
Drawstop Arm
Kirtland & Jardines Coupler
"on"
off"
(1)
(2)
Drawstop Actions
C
B
B
B
Simple Frames Drawstop Action
D
C#
C
D
C#
C
Groove Block
Drawstop Action by Squares
Square to gradually open the swell

moving the console a considerable distance from the organ. With electric action there is practically no limit to the distance, but while the pipes may (and often do) speak as promptly from the key as in the smallest sticker organ, the sound cannot be hurried in the same way, but takes a time (defined by the laws of the velocity of sound in air generally) to travel back to the console.



If two organs, A and B, were played from a console at C, the emission of sound would appear simultaneous to a hearer at D (mid-way), but if only a few yards nearer to A he would hear A first, and a repetition note from B. The contrary would occur if he were nearer to B. Generally speaking, such instruments could only be played alternately, but not simultaneously, and it is evident that a very long movement may become a disadvantage rather than otherwise.

The organ provided with a console, shewn in the illustration, is an instrument of two manuals and pedal, containing nineteen speaking stops, built by Mr. A. Gern, for the Earl of Home.

Conveyance (F). A metal pipe which does not sound, but conveys wind to one that does.

Cow-heel, or Cow-heel Crank. Terms applied to cranks made to an obtuse angle to connect motions nearly, but not quite, parallel. See plate V, where a cow-heel square is shewn, as used for rendering the opening of the swell shutters gradual—the forces transmitted being in that case at right angles.

Divided pallet, or cut pallet. A pallet cut so that a small portion of it opens before the main body of the pallet. See plate VII.

Double pallet. Two pallets to one note.

Double touch. A means of obtaining two sets of sounds from a key, according as it is wholly or partially depressed.*

* Introduced by Mr. H. Wedlake in the remarkable pneumatic organ built by him in 1863 for H. A. Hankey, Esq., Queen Anne's Mansions, which contained four manuals, five octaves (CC to C'''), pedal clavier, thirty-two notes (CCC to G), sixty-five sounding stops, twenty-six couplers. Special

Duplication. A term evidently devised to avoid the unjust stigma which in the minds of imperfectly informed persons often attaches to such words as "borrowing," "grooving," etc. Duplication expresses the result achieved; borrowing, the means by which that result is attained. Some most valuable systems of this kind have been introduced by Mr. Casson, Messrs. Brindley and Foster, and Mons. C. Annessens.

Feeders (A). The small bellows (actuated by the handle) which supply the main reservoir.

French Feeders. Feeders similar to an accordion. Sometimes the top and bottom boards are fixed, and the middle board alone moves, throwing wind both ways. Where practicable they are the best form of feeder. (See Plate VIII, fig. 3.)

Free reeds. The vibrator does not strike anything—example, harmonium reeds.

Front or face board (R). Board in front of chest. By removing it access is obtained to pallets.

Groove (G) (to groove off). Grooves are channels excavated in the upper boards acting as "conveyances."

Gussets. The leather at the four corners of the bellows.

Jamb (draw-stop). The *perpendicular* board through which the stops protrude.

features in this organ were (1) three pedal couplers to swell manual, *viz.*, unison swell to pedal, octave swell to pedal, super-octave swell to pedal. By using the octave and super-octave couplers the "Carillons" (which commenced on tenor C) could be played in unison or octaves, thus producing a novel and beautiful combination with the pipe stops. (2) The Stringendo Coupler was an invention of Mr. Wedlake's. It was composed of an escapement movement, which plucked the action of the swell manual, thus giving the effect of strings (*Pizzicato*) to that organ, the sounds of the great organ being at the same time retained. (3) The entire pedal organ could be transferred (by drawing stop 91) to the choir manual, the lower CCCC commencing on tenor C key. (4) Large pedal organ of twelve stops, including 32ft. Open Diapason (wood) and 32ft. reed Contra-Bombarde. There was an ingenious arrangement (stops 64, 65) whereby a grand piano was brought under the control of the organ pedals.

Mr. Wedlake, in the manual and orchestral organ built for the late J. H. Van Ryn, Esq. (Plate XIV), has so arranged his system of couplers, that while the swell is provided with super and sub-octave couplers on itself, which naturally are available from the great organ keys through the unison swell to great coupler; they can also be made use of from the great organ keys *without sounding the swell to great unison* (although that coupler, which must be drawn to effect connection between the manuals, remains out), a special valve being actuated for the purpose of temporarily silencing it.

Impost (P). Base on which the speaking front pipes stand.

Key slip. A strip of wood (often bearing maker's name) *between* the manuals.

Languid. A horizontal disc of metal, which closes the foot (or conical part) of a metal speaking pipe, and, *nearly* meeting the lower lip, directs the wind against the upper lip, thus producing sound. See diagram.

Louvre (Y). A swell shutter.

*Metechotic.** Brindley and Foster's term for a system by which certain stops of pipes are made to serve on two or more manuals.

Mop. A miniature mop made with wire and any soft material, used in tuning the mixtures to silence certain notes, and thus isolate the one upon which the tuner is engaged. Sometimes little pieces of paper are put into the mouths instead.

Nicking. The saw-like edge of the languid. The object of nicking is to steady the tone, and to cause it to *blend* with other notes. See page 61.

Pallet (N). The valve which admits wind into the channels.

Lever Pallet (see Plate IV). When the tracker D is pulled, the lever A begins to open the pallet. (It will be noticed that from the great amount of leverage a slight amount of pressure on D will exert great power on the wire E). The points of the levers B and C do not quite touch, so it is not until A has already opend the pallet, that these latter come into action, and throw it full open, which they do with ease, as the suction has been already overcome by the powerful lever A.

Passage boards. The "gangways" or passages by which access is gained to the different parts of an organ.

* M. Merklin has also used a similar arrangement. It was unjustly condemned by most of the leading French organists, but strongly favoured by the late E. Batiste. Mr. Casson, also, has another way of effecting the same thing. In fact, the rendering a stop of pipes available on several keyboards and on the pedals too, is not difficult. *What is difficult*, is to evade the (often unjust) stigma which attaches to the word "borrowing." Some builders use the euphemism "transmission;" others tax their ingenuity to coin most extraordinary words and names.

Pipes stand on their wind when neither "grooved" nor "conveyanced" off.

Pipe metal, commonly called "Metal," is composed of tin and lead. The following are the proportions employed by various builders:—Father Smith—tin, three-fourths; lead, one-fourth. Cavaillé-Coll and Schultze used nearly the same proportions, the former using nearly pure tin for most of his stops.

The older French organ builders called "metal" "etoffe" (or stuff) to distinguish it from pure tin, which material was used for all the principal stops, the use of "etoffe" being confined to stopped metal pipes.

Spotted metal is obtained by mixing about thirty parts of tin to seventy lead. This will give ordinary spotted metal ("metal saumonné" as the French call it) but more tin and considerable accuracy in the proportions is needed to get the spots to "rise" as the metal cools, and thus secure first-class spotted metal.

Positif. Ruck-positif. Terms used in France and Germany to denote the choir organ. Mr. Casson has recently adopted the name "Positive" for the highly ingenious and effective one-manual organ he has introduced and which ought to find its way into every place of worship where that nineteenth-century abomination—the American organ—is to be seen.

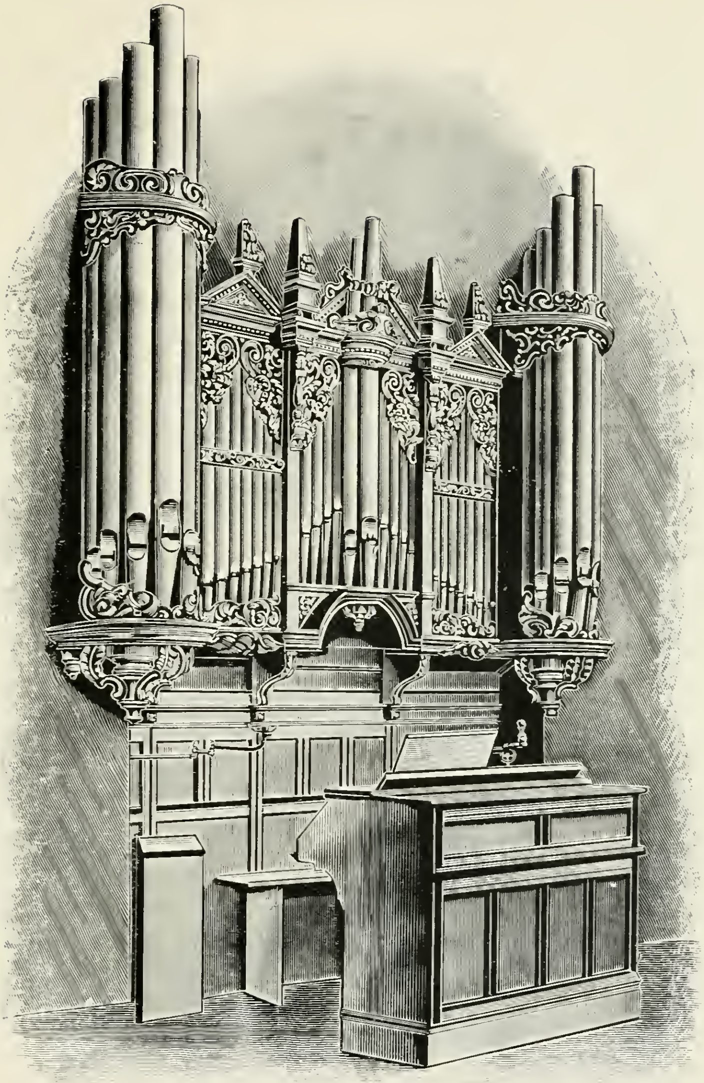
Pull-down (M). The wire passing through the bottom of wind-chest (K) (purse board) and hooking on to an eye in the pallet.

Rack-board (X). The board about seven inches above the sound-board through which pass the pipe feet.

Rack Pillars (W). The small uprights which support the rack-board.

Register (V). A comb or perforated slip through which trackers or long trace rods are passed. Its object being to keep them apart, and to prevent them from flapping about, thus causing noise—or even the iteration of a note after the finger has left the key.

Ribs of a Bellows (O). The boards which fold up.



ORGAN WITH SEPARATE CONSOLE.

Erected by A. Gern, in Douglas Castle Chapel, Lanark, N.B., for the Earl of Home.

Rollers, Plate IV. Cylindrical or eliptical rods turning on pins at each end, used for conveying motion *laterally*.

Roller Arms. Arms projecting at each end of the roller to which trackers or stickers are connected.

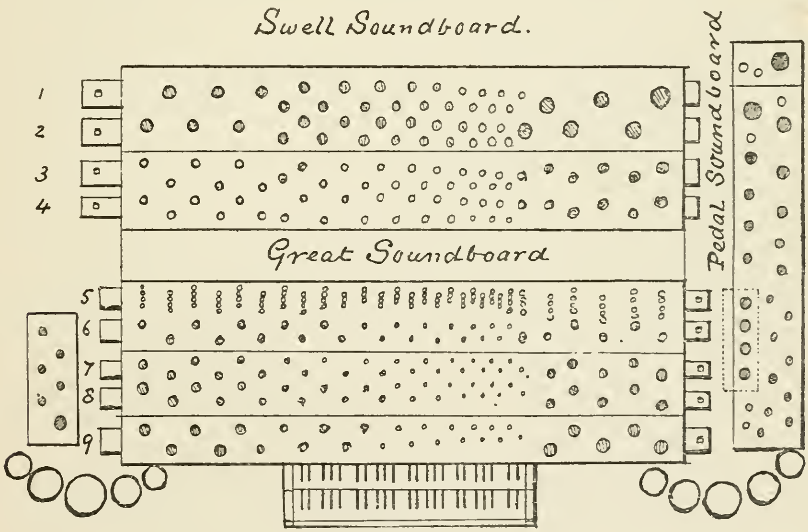
Schwebung, *Englische-Schwebung* (German). Tremulant.

Schnarrwerk (German). Reeds.

Slide or Slider (T). The slip of wood which covers and uncovers the holes in the soundboard.

Slot (H). An oblong hole.

Soundboard. The Soundboard is virtually the heart of the organ, or nucleus around which all the other parts are collected. The principal components of a soundboard are the *Windchest* (or the box containing the wind supplied from the bellows, and in which are situ-



PLAN.

ated the *Pallets*) ; transverse *Grooves* (one of which is allotted to each key) ; and *Slides* or *Sliders* (which govern the various ranks of pipes, by bringing them under the control of the drawstop handles), together with various fixtures ancillary to the same. By referring to the frontispiece, in which the several soundboards—Great, Swell, Choir,

Pedal—are shown in section, the action of the various parts will be clear. The references to the soundboards are indicated by the letters K, N, R, S, T, U. Soundboards without sliders, and the differential points of pneumatic soundboards, are shown on Plates VII, VIII, XI.

Square (C). A kind of crank (similar to those used for bells). Transmits motion at right angles.

Steady Pins. Pins on each side of the pallet, to keep it over its hole.

Sticker (I). A light cylindrical rod which communicates motion by pushing.

Stock (B). The beam of wood to which "back-falls" or squares are attached.

Stud, Plate IV. The little pegs at each end of a Roller, forming the supports for the centre pins upon which the roller turns. The term Stud is also used for certain forms of Key-touches or thumb pistons pressed by the player.

Table (S). The upper surface of the sound-board upon which the slides and bearers are placed.

Taps. Screw-wires terminating trackers, serving to regulate the action. Plate IV.

Thumper. A leaded and felted bar of wood placed on the top of the keys to prevent them jumping off the pins when they rise.

Tirasse (French). The action connecting a manual to the pedals when there are no independent and pipes to the latter.

Trace-Rod. Rods which connect the various parts of the drawstop action. See Plate V.

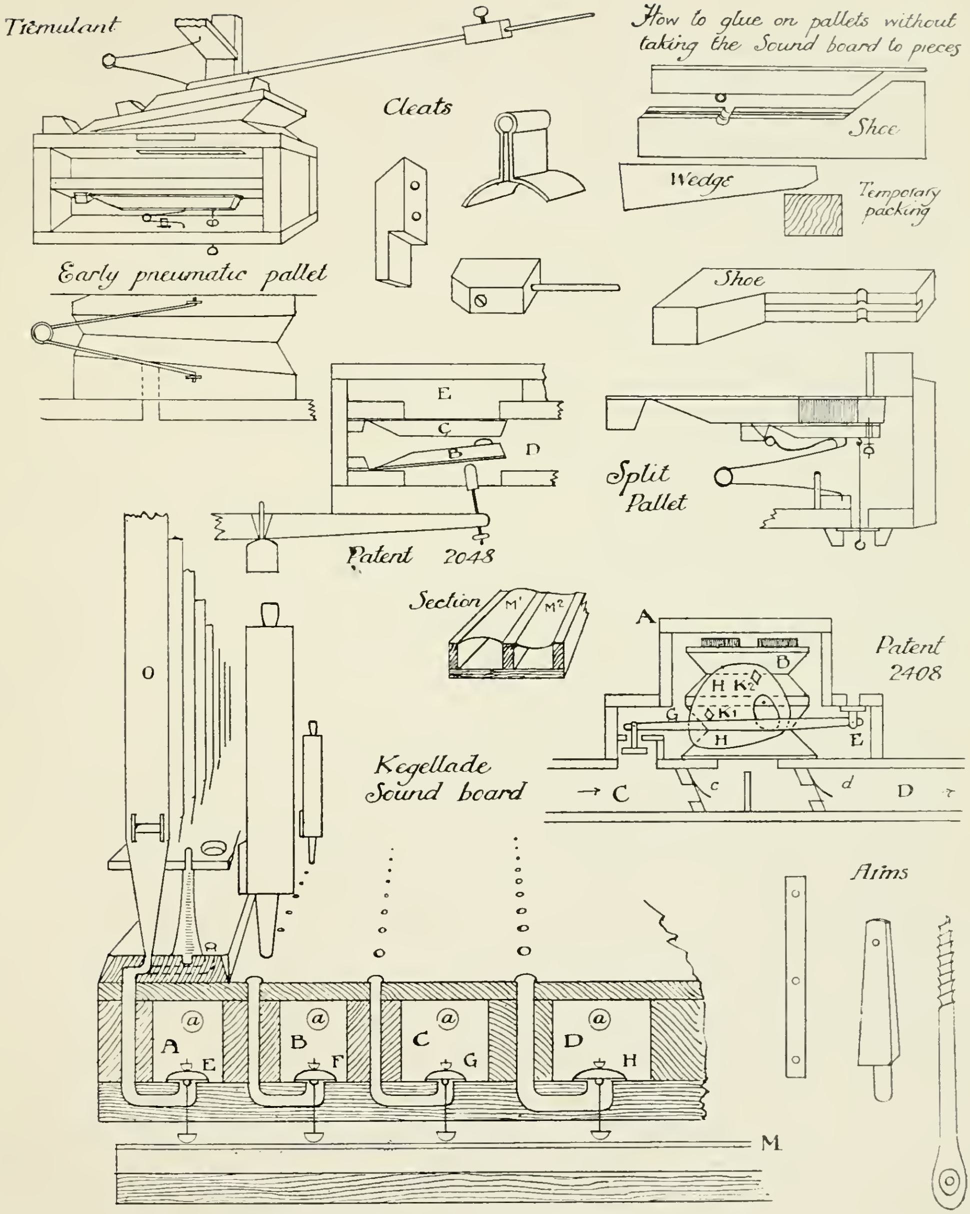
Tracker (L). A light rod which *pulls.*

Tremulant, Plate VII. A small "fluttering" bellows which, when set in motion, caused the undulation in the tone of the organ. The early builders called it "ye shaking stoppe." Its effect is neutralised by the "Concussion bellows," which letter should be put out of gear when the tremulant is drawn.

Trunnel or *Trundle.* The large "rollers" used in drawstop action.

Tubular Pneumatics. In this action "pallets" are often done

Plate VII.


Tremulant
How to glue on pallets without taking the Sound board to pieces
Shoe
Wedge
Temporary packing
Cleats
Early pneumatic pallet
Shoe
E
C
B
D
Split Pallet
Patent 2048
Section
M'
M²
A
B
H
K2
K1
G
E
Patent 2408
→ C
c
d
D
Kegellade Sound board
O
A
E
B
F
C
G
D
H
M
Arms

away with, being replaced by tiny bellows, the tops of which, when inflated, close up the aperture under the groove.

When the wind inflating them is cut off, they drop, thus causing the pipes to speak. The wind is supplied and cut off by a double pallet, or disc arrangement, near the keys ; and the connection is effected by long tubes, like small sized gas-piping, thus doing away with trackers, levers, stickers, and squares. Sometimes the small bellows act as motors and pull down the pallets. Plates VIII, IX.

Tubular pneumatics, generally, give very plump wind to the pipes, but are inclined to be slow, and imperfect in repetition and attack.

Precisely the same action (but on a larger scale), is used to move the drawstops and composition movements, and is actuated by "studs" and similar contrivances in the key slip between the keys.

Upper Board (U). The uppermost board of the wind-chest, that upon which the pipes stand.

Vergette (French). A Tracker.

Voicing. The art of producing the tone desired from pipes ; by defining the amount of wind admitted, and by establishing regular proportions in the relation of the sizes of mouth, wind-way, width of nicking, etc.

Voicing Machine. A small soundboard, provided with keyboard and foot-blowing bellows, used for voicing pipes upon. There is generally a Principal stop permanently located upon this soundboard, to which the pipes are tuned after being voiced.

Weight of Wind. Ascertaining the pressure of wind by means of the Wind Gauge, the difference in height of the two surfaces expressed in inches gives what is called the "weight of wind."

Wind-bar (Q). The heavy transverse beam closing the back of the wind chest. Its purpose is to carry the weight of the pipes.

Wind Chest. See *Soundboard.*

Wind-Trunk. A large rectangular wooden tube which conveys the wind from the bellows to the soundboards. Plate VIII.

Windway. The space between the "languid" and the lower lip in pipes.

Method of Finding the Exact Length of Speaking Pipes.

In the questions of the College of Organists it is frequently required to find the *length of a pipe* sounding a given note, or to state *the note* which will be produced by a pipe of given length.

As these questions cannot be answered without complete data being given, I shall show the *method of stating* such questions properly, and of working out the answers.

In this table let T = tonic or given note (which of course can be any sound), and, for simplicity, in the present example let C′ = T. Its *length* must also be given, or ascertained experimentally: we will here assume that the pipe producing T is 12 inches in length.

$\frac{3}{4}$ of C′ gives the fourth therefore	F = 9 inches	If we assume that D=T we get $\frac{3}{4}$ of D=G=9ins.
$\frac{2}{3}$ of C′ ,, ,, fifth ,, ...	G = 8 inches	A
$\frac{4}{3}$ of G ,, ,, fourth below ...	D — the other lengths to be obtained similarly.	E
$\frac{2}{3}$ of D ,, ,, fifth above ...	A	B
$\frac{4}{3}$ of A ,, ,, fourth below ...	E	F♯
$\frac{2}{3}$ of E ,, ,, fifth ,, ...	B	C♯
$\frac{3}{4}$ of F ,, ,, fourth ,, ...	B♭	C♮
$\frac{3}{2}$ of B ,, ,, fifth ,, ...	E♭	F♮
$\frac{3}{4}$ of E ,, ,, fourth ,, ...	A♭	B♭
$\frac{3}{2}$ of A ,, ,, fifth ,, ...	D♭	E♭
$\frac{3}{4}$ of D ,, ,, fourth ,, ...	G♭	A♭

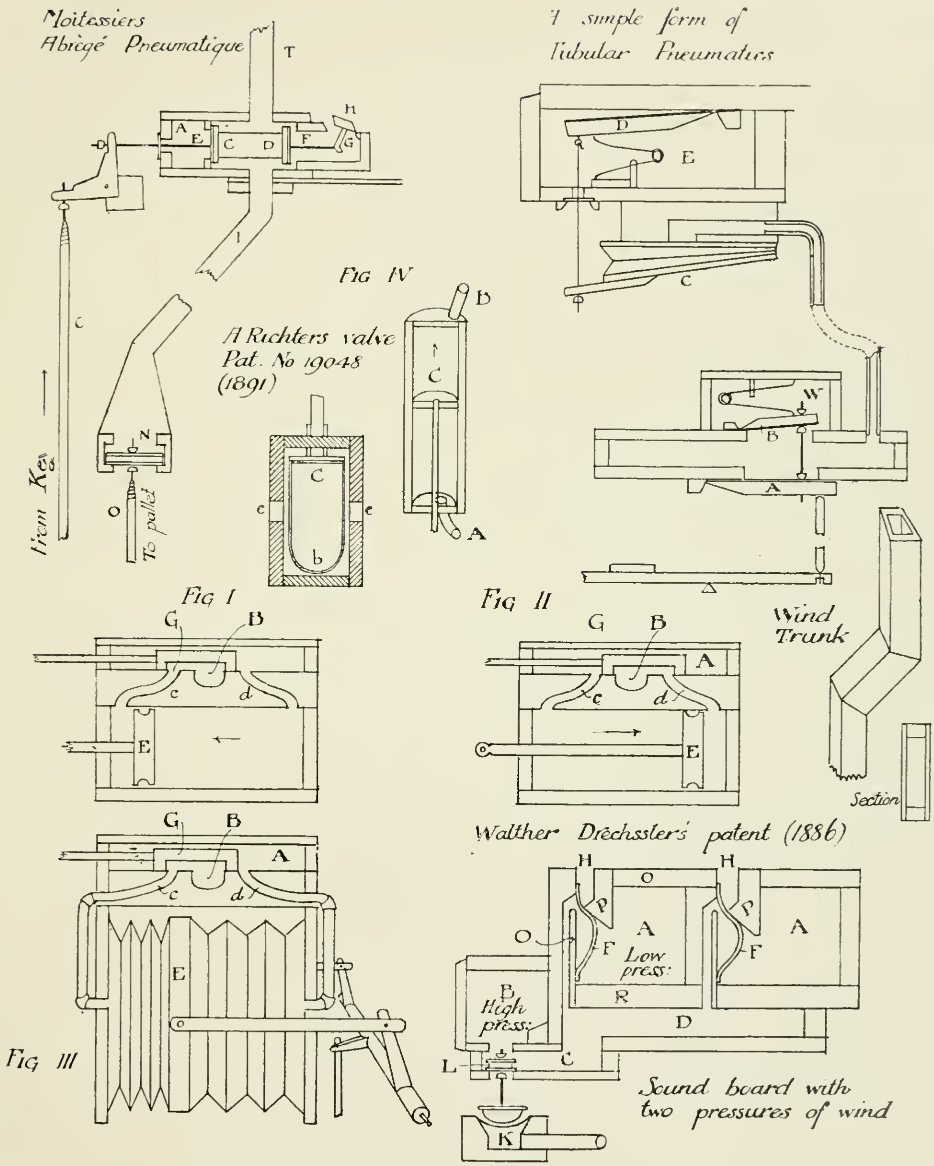
Further than this it must be assumed that the notes are all scaled proportionately. It is impossible to say within a semitone what note a pipe of any given length will sound unless both its diameter is given, and also the pressure of wind it is to speak upon.

The following facts concerning the pitch of speaking pipes may be of interest.

Wooden pipes can be made sharper by being planned thinner.

The pitch of large wooden pipes may remain unaltered when their sides are reduced in thickness, but less wind will be required.

Plate VIII.


Moitessiers
Abrégé Pneumatique
T
A
E
C
D
F
G
H
I
c
From Key
N
O
To pallet
FIG IV
A Richters valve
Pat. No 19048
(1891)
C
e
b
B
C
A
A simple form of
Tubular Pneumatics
D
E
C
W
B
A
Wind
Trunk
Section
FIG I
G
B
c
d
E
FIG II
G
B
A
c
d
E
FIG III
G
B
A
c
d
E
Walther Drechssler's patent (1886)
H
O
H
P
A
P
A
O
F
Low
press:
F
R
B
High
press:
D
L
C
K
Sound board with
two pressures of wind

On the contrary, small wooden pipes when planed very thin, will generally demand more wind to enable them to sound at all.

An open pipe can be made to speak until it is shortened to a length equal to twice its diameter—the wind hole being enlarged, and the mouth suitably lowered in proportion.

It can also be lengthened to a length equal to 32 diameters—the wind hole being reduced and the mouth cut up.

This gives about three octaves and a semitone between the extremes of pitch produced. Should such an experiment be tried, it will be noted that, for every piece successively cut off, reducing the pipe 32 diameters long to 2 diameters, a different *quality* of tone results—thus illustrating the effect of *different scales* in pipework generally. In this experiment, a constant pressure of 3 inches or 3½ is assumed, but if the pressure is reduced to 1 inch for the long pipe and gradually increased to say 5 inches, more than four octaves can be produced—as the pipe may be 40 diameters long, or more, to start with.

When a pipe is shortened the vibrations do not vary inversely as the length—that is absolutely—as writers on acoustics tell us. The fact of shortening a pipe makes it *relatively of larger scale*, and thus a new factor is introduced, causing the vibration numbers to diminish less rapidly than theoreticians affirm, as the shortening is counteracted in some degree by the corresponding increase of scale (or diameter) of the tube, which becomes very great as the tube nears the length at which it ceases to speak (two diameters). A similar phenomenon may be noted in the upper or topmost notes of the piano, where the ratio of the diameter of the wire to its length increases so rapidly.

The reader will note the absurdity of such flippant questions as "What note will an open pipe 18 inches long speak?—no diameter, pressure of wind, or particulars as to thickness of the tube, being given.

Markings used to define the pitch of pipes, for the five C's which the organ manual of fifty-six notes (CC to G) comprises.

ENGLISH.

CC, or "Double C."	Tenor C.	Middle C.	One foot C.	Six inch C.

GERMAN.

	CC	C	c^1	c^2	c^3
or this					
	$C_{''}$	$C_{'}$	c	c′	c″

Also the following, which seems to be the original rule of thumb method adopted by all the early builders :—

PEDAL.		MANUAL.					
$\underline{\underline{\underline{C}}}$ 32 ft.	$\underline{\underline{C}}$ 16 ft.	$\underline{C}$ 8 ft.	c 4 ft.	c $\overline{2}$ ft.	c $\overline{\overline{1}}$ ft.	c $\overline{\overline{\overline{6}}}$ ins.	c $\overline{\overline{\overline{\overline{3}}}}$ in.

This latter tablature is, however, to be deprecated, as the small pipes of the mixtures are often marked in the same way (*i.e.*, by dashes above) to show to *which rank* of the Mixture they belong, quite irrespective of their pitch.

Chapter VI.

Answers to Questions in Organ Construction set at the Royal College of Organists' Examinations,* from 1888 to 1898 inclusive.

Associateship, July 1888.

6. *Question:* Say to what note (key) a pipe 16 inches long will belong?

Answer: If worked as a question of acoustics, consider 16 inches as $\frac{4}{3}$ of a foot and the foot as $\frac{1}{8}$ of CC 8ft. The experimental, and therefore correct, solution will, however, not exactly correspond. This may be found by actually measuring, and noting the pitch of pipes 16 inches long. See converse of this question, Associateship, January, 1890, No. 1.

9. *Question:* Give some account of Green, the organ-builder, with approximate dates. Mention some examples of his work?

Answer: Samuel Green was born 1740, died at Isleworth, September 14th, 1796. Notable organs: Cathedrals—Canterbury, 1784; Wells, Lichfield, 1789; Salisbury, 1792; Rochester, 1793; Bangor, 1779 (?); Cashel, 1786. London Churches—St. Katharine's, London

* When no answer is given to a question it is from one of the following reasons:—

1. (*a*). The answer required is a specification, or a lengthy list of stops with a diagram.
2. (b). The candidate is required to *draw* something.

All questions on acoustics are not answered. They do not come within the scope of this work, any more than do questions on Counterpoint, or Musical History.

Question 1 (July 1888) (*a*), and question 1 (January 1890) (*b*), are the only exceptions I have made, and for the following reasons:—

(*a*). The answer is intended to be typical.

(*b*). To answer the query from an "Organ Construction" point of view would require at least two pages of very involved explanation, together with a diagram, and could be of no service to students.

Docks, 1778; St. Botolph, Aldersgate; St. Michael's, Cornhill; Freemasons' Hall, etc. No builder has ever excelled Green for sweetness and charm of tone. He was an enthusiast in his calling, and it is sad to record that he died in great poverty.

Fellowship, January, 1889.

1. *Question:* Who was the inventor of the "Swell," and in what organ was the "Swell" first introduced?

Answer: See "Jordan" (Fellowship, 1896).

2. *Question:* Explain nature and advantage of the "inverted ribs" in Organ bellows.

Answer: Bellows were first made with "plain" ribs hinged to the outward edges of the bellows' frames, as will be seen in the following diagram:

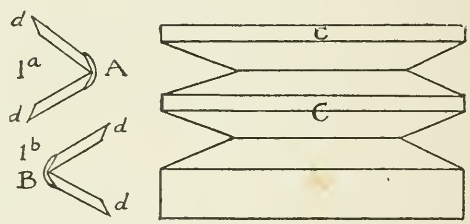
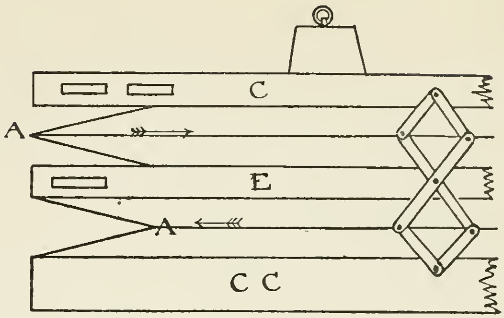


Figure 1.

Now if a piece of card bent to resemble the folds (A and B), be held lightly between the finger and thumb of the left hand, it will be found that any pressure applied to the points A. or B. will have a tendency to force open the fingers of the left hand, and that this force increases very rapidly as the card assumes the shape of figure 1^a. Consequently the force of the wind in a bellows, such as that drawn, will tend to open the ribs and *make them lever up* the top of the bellows. This leverage subtracts weight from the weight on the top of the bellows, which, until this leverage came into play, was lifted entirely by the density of the wind, consequently the air becomes less compressed in proportion as the lifting power becomes a *joint process*, not entirely done by the air density, but partly by the leverage which supervenes as the "plain" ribs open.

Figure 2.



In figure 2 we have the modern bellows in which inverted ribs are combined with plain ribs. Now if pressure be applied to the points A A from the interior of the bellows, it is evident that, in the case of the upper or inverted ribs, it will tend to collapse the folds and *to pull together* the two boards C E. In the case of the lower or plain ribs, pressure similarly applied will (as previously explained) tend to *push E away* from C C.

We therefore have two forces acting in contrary directions, which can be made to mutually destroy one another; and when this result is attained, the density of the wind remains the same, as this density is the direct result of the amount of compression exercised by the weight placed on the bellows, unqualified by any leverage or other mechanical action reducing the degree of density required to sustain the weight. In order to ensure that all the folds should open at the same time, and proportionately, Regulators or Counterpoises are needed. These are parallelograms (D D folding diagram). It will be seen that the boards C, E, and C C, will always be equidistant, and further that the *lifting* and the *collapsing* powers are thus balanced one against the other.

3. *Question:* Explain the object and nature of a Relief Pallet.

Answer: The *Relief*, or more properly *Waste* Pallet, is a pallet which opens automatically when the bellows is full, exactly as the safety-valve of a steam-engine. If it were absent the density of the wind might be increased by the blower pumping in more air when the bellows is already full—and indeed the bellows might eventually burst. The first result would mar the music, by causing the pipes to screech horribly, and the second would, of course, be still more serious.

ASSOCIATESHIP, July, 1889.

7. *Question:* Describe the shape and structure of the following organ pipes: Open Diapason, Harmonic Flute, Oboe, and Cremona. See Plate II, and folding diagram.

8. *Question:* Describe the various kinds of mechanism used for coupling Swell to Great.

Answer. 1. Tumbler Couplers. See Plate V.

2. Ram Couplers (Robson's).

Drum Couplers (a variety of "ram.")

These are small leathered pieces of wood shaped like a spoon, held horizontally and edgeways, which are thrust ("rammed" between the Great and Swell Keys, causing the lower set of keys (Great) to lift the upper (or Swell) keys. See plate V.

3. There are many species of Backfall Couplers, and as less friction results from them than from any other kind they are, generally, the lightest and best couplers made. (See folding diagram).

ASSOCIATESHIP, January, 1890.

1. *Question:* What is the approximate length of CC♯ on the Open Diapason 8ft.?

Answer: If the length of CC=8ft.=96in. CC♯ will have a length equal to 96 x $\frac{15}{16}$=90, therefore CC♯=7ft. 6in.

N.B.—$\frac{15}{16}$ is the vibration fraction of a semitone.

That every calculation based on the length only of a pipe, disregarding its diameter, must be very "approximate" indeed—or rather quite worthless—may be inferred from the fact that if an Open Diapason of 2.2in. diameter and a Dulciana of 1.3in. diameter are tuned in unison to Middle C their respective speaking lengths will be found to be $22\frac{3}{4}$in. and $23\frac{5}{8}$. The contrary obtains of conical pipes. At mid. C, the Horn (a large scale stop) is $\frac{3}{4}$in. longer than the Oboe.

2. *Question:* Explain the cause of "runnings" in organs, and say how you would proceed to discover this fault.

Answer : See page 52.

3. *Question :* What do you understand by the expression "A Pair of Organs?"

Answer : An organ provided with more pipes than one. Illustration of term : "A pair of steps," a "pair of stairs." The expression is archaic. (In French we have a trace of the term in "Les Grandes Orgues" ("Organs.") Again, "Facteur de grandes orgues" means simply "organ-builder," not "maker of *large* organs.")

FELLOWSHIP, July, 1890.

4. *Question :* Supposing an organ of one manual (not pneumatic) with the bellows at work—why is the touch lighter with no stops drawn than when they are out ?

Answer : Because there is no suction tending to draw the pallet.

5. *Question :* Which register varies most with changes of temperature, an Open Diapason, or a Tuba of twelve-inch pressure ?

Answer : The Open Diapason. The Tuba, however, *appears* to change most because it goes away from the initial pitch in an opposite direction to the whole body of the organ stops, including the Open Diapason. All these latter *sharpen*, while the Tuba *flattens.*

The consideration of the wind pressure (12 inches or any other) is unimportant. The pitch of metal *flue* pipes *sharpens*, as the final result of *complex actions* of heat. While tending to flatten the pitch by slightly expanding and lengthening the tubes, heat acts still more upon the air, and so rarefies it that the degree of sharpening thus produced completely overrules the trifling flattening caused by the expansion of the tubes themselves. Exactly the reverse takes place in reed pipes. So far as their tubes are concerned the phenomena are the same as in the previous case, but the infinitesimal lengthening of the brass tongues so flattens the notes emitted by them that even the complex sharpening of the tubes does not suffice to retain the note at its initial pitch, and, as a final result, the tongues overruling the tubes, the notes flatten.

6. *Question:* Why do organ-builders place stops of a similar character as far apart as possible on a sound-board?

Answer: To avoid "Sympathy." See pages 10, 36, 47, 48.

7. *Question:* If a Stopped Diapason pipe is forced beyond its fundamental tone, what sound is produced?

Answer: See harmonics of stopped pipes, page 12.

Associateship, July, 1890.

9. *Question:* Explain the function of "Pallets" and of "Ventils" in organ-building.

Answer: See Glossary of Terms, also Index.

Associateship, January, 1891.

4. *Question:* What is really the *stop** controlled by the draw-stop action.

Answer: The slide which "*stops*" and "unstops" the holes admitting wind to the pipes.

5, 6. *Question:* What is peculiar about the top octave of the Clarion? How is the beating of the Voix Celestes produced? Describe the Larigot, Tierce, Doublette and Mounted Cornet.

Answer: The Mounted Cornet was a mixture raised high above the other stops on a speaking-block. It is obsolete. See page 88.

Fellowship, January, 1891.

1. *Question:* Give a short account of the improvements made from time to time in the construction of organ bellows, and in the method of blowing.

Answer: Chronologically thus—(1) Diagonal Bellows; (2) Diagonal Reservoir, with Diagonal Feeder; (3) Horizontal Reservoir, with

* See Chapter I, where this confusion of terms is explained. Also Appendix.

Feeders; (4) *Horizontal Reservoir, with Inverted Ribs*, Feeders, either diagonal or accordion-shaped (French). Blowing—(1) Manual Power; (2) Water; (3) Gas; (4) Electricity. See references to "bellows" *passim*.

2. *Question:* Give a short history of the Swell Organ.

Answer: Chronological order—(1) Echo Organ, *viz.*, stops placed in a *closed* box; (2) Jordan's "Nag's Head Swell," 1712 *(circa)*, in which one side of the box lifted up like a sash window, thus giving a *crescendo;* (3) Avery's Venetian Swell, still used.

Question: Show growth of compass (Swell Organ).

Answer: *Middle C*—instance, Green's Organ, Salisbury Cathedral, built 1792. *Fiddle G*—instance, St. Margaret's, Westminster, by Avery, 1804. *Tenor F*—instance, St. Clement Danes. *Gamut G*—St. John's, Waterloo Road, 1824 (Bishop). *FF*—Greenwich Hospital. These instances, however, cannot be taken as a chronological record. All the incomplete compasses *appear to have existed contemporaneously*.

3. Compare or contrast, the respective meanings of the terms Sound-Board as applied (1) to the Organ, (2) to the Piano.

Answer: (1) The Organ. See Soundboard in Glossary of Terms. (2) Piano. It is a sounding board or resonator (similar to the belly of a violin) which reinforces the sound of the vibrating strings.

Associateship, July, 1891.

4. *Question:* What is the result of playing upon the Full Swell for any considerable time with the box closed?

Answer: The air inside the box becomes condensed, as there is not a ready outlet for the increased amount pumped in by the bellows. The pitch may be perceptibly affected by this condensation.

To obviate condensation of air in the Swell box, and with a view to enhance the *crescendo* power obtainable, some of the older builders constructed Swell boxes provided with a tube or trunk leading out of

the top of the box to the church tower, or out through a window. The lower extremity of the tube was closed by a large pallet or door which opened when the louvres closed, and closed as the louvres opened.

A notable instance of this system existed at St. Martin's-in-the-Fields, in the organ built by Robt. Gray, circa 1800.

6. *Question:* Why is it usual to line the inside of a Swell-box with thick brown paper?

Answer: (a) One thickness of paper, with the glue necessary to make it adhere, is equivalent to fully a quarter of an inch of wood in rendering the sides of the box impervious to sound.

(b) The smoothness of a paper surface, well sized with glue, tends to equalize the distribution of tone.

Some German organ-builders lacquer the insides of metal pipes for a similar reason.

Fellowship, June, 1892.

Question: (1) Give the actual sounds, etc., produced by various stops (diagram needed).

Answer: See Chapter I, wherein all these stops are explained.

2. *Question:* Describe the Anemometer.

Answer: The instrument thus designated, is called in plain English a "wind-gauge" (Plate I). It consists of a glass tube bent into the shape of a double syphon, one end of which is fitted into a wooden pipe-foot (see diagram). When used the pipe-foot is inserted into the upper board as an ordinary speaking-pipe, and a little water is poured into the top, which at once finds its level in the two arms of the loop. When wind is admitted the pressure drives the water down in one loop and raises it proportionately in the other. The difference in height of these surfaces (expressed in inches) gives what is called "the weight of wind." The Anemometer was invented by Christian Förner, organ-builder at Vetin-sur-la-Sâle, circa 1680.

3. Describe the difference between diagonal and horizontal Organ Bellows. State which supplies the most wind, and why?

Answer: The diagonal bellows is hinged at one end, as an ordinary house bellows. The horizontal opens all over, like a concertina bellows.

Since the diagonal line bisects all squares and parallelograms equally it is obvious that a horizontal bellows gives twice the amount of wind obtainable from a diagonal bellows of the same area.

Associateship, January, 1892.

1. *Question:* Describe the "Pyramidon" stop, and name its inventor?

Answer: The Pyramidon is composed of stopped pipes so shaped that the top measures across four times as much as the bottom, the contour being that of an *inverted* pyramid. Very grave tones are produced from these small "boxes," *e.g.*, the CCC 16ft. tone has been obtained from a Pyramidon, 2ft. 9in. high. The Pyramidon was invented by Sir F. A. G. Ouseley, and first constructed by Mr. Flight.*

2. *Question:* State who was the inventor of the Concussion Valve (*sic*), and describe its use.

Answer: See "Concussion *Bellows*." Bishop is said to have invented them.

3. *Question:* State the difference between "single" and "double" acting composition pedals. Who was the inventor of the latter?

Answer: "Single" Composition Pedals produce or remove *certain stops;* "Double" (by the use of *one* pedal only) always reproduce a *given selection* of stops, by thrusting out such as may not be drawn, and by putting in all others which may be out, but are not included in the selection. Bishop invented the latter species of Composition pedal. See also Wedlake, page 120.

* Mr Flight here mentioned, the last of the family of eminent organ-builders of that name, died in 1890, at Strathblaine Road, Clapham Junction, a few doors from where I am now writing these lines.—J. W. H.

FELLOWSHIP, July, 1892.

2. *Question :* How are the shutters of the Swell-box placed—(1), when the Organ has the ordinary form of Swell Pedal ; (2), when it has the Balanced Swell Pedal ? *

Answer : (1) The shutters, or louvres, are *horizontal.*
(2) They are *vertical.*

ASSOCIATESHIP, July, 1892.

1. *Question :* How does heat affect the pitch of metal flue pipes ?

2. *Answer :* It causes them to sharpen. See also Fellowship, 1890.

2. *Question :* What notes do the Open Diapason pipes of 18, and 16 inches speak ?

Answer : Sufficient data are not given. See remarks on page 78.

3. *Question :* Is there any disadvantage in having the bellows a long way from the sound-board ? If so, state what, and how it may be remedied.

Answer : It is a great disadvantage, as the wind loses its pressure unless the trunks are very large. This can be remedied by placing a *second* bellows, or reservoir, close to the sound-board.

FELLOWSHIP, Jan. 1893.

2. *Question :* In arranging the rows of pipes in a Swell-box, what is, generally, the order observed in placing them ?

Answer : The 16ft. stops—either open, or closed—are placed at the back, then 8ft., 4ft., 2ft. and mixtures—so that the tuner *may not have to reach over* a long pipe to get at a short one—then reeds (in front) being pipes which must be got at laterally with the tuning knife,

* The " Balance Swell Pedal " is a contrivance admitting of the Swell shutters being left stationary at any angle. There are many grave drawbacks to this plan. The shutters generally fail to close tightly; indeed, are never *properly* closed. It is very hard to obtain a " Sforzando " effect. The rocking pedal (balanced pedal) is usually in the centre of the Knee board, thus hampering the organist when he endeavours to pedal, using the Swell at the same time. The advantages claimed for the Balance Swell appear to be principally imaginary.

and also because they speak best just over the pallets, thus receiving the first impact or "flush" of wind. Similarly on the Great Organ—the reeds being over the pallets, then the shortest stops—the longest being next to the speaking front.

Associateship, Jan. 1893.

Question : 1. Describe the "Salicional" and "Dulciana" stops. Are they diminutives of the Open Diapason?

2. What is the object of the introduction of the Quint stop into the Pedal Organ?

Answer : (1), (2). See description of these stops, under their respective names. Chap. I.

Associateship, July 1893.

Question ; 1. Describe the Harmonic flute and name the inventor.

3. Classify and describe the following registers, "Keraulophon," "Contra Fagotto," "Vox Humana."

Answer : (1), (2). See description of stops in Chap. I.

Fellowship, July 1893.

2. *Question* : Name the advantages gained in the case of a large organ by wind supply at different pressures.

Answer : Reeds and large-scaled pipes need heavy wind—small and delicate stops, light wind; consequently each class is better served than if there were but one pressure.

Fellowship, Jan. 1894.

1. *Question :* State your opinion with regard to the decreased employment of Mixtures, and other Mutation stops, by modern organists.

Answer : This is a matter for an essay rather than for an answer. Mixtures are less common than formerly (1) because the higher pressures of wind now used give more brilliancy of tone, and mixtures do

not therefore seem to be so indispensable for that purpose. (2) Organists do not favour the "full chord" style of former days, but prefer to play, carefully preserving the contrapuntal outlines of the parts, not smothering them with every concordant note within easy reach of the fingers, as was the old practice. (3) Mixtures themselves are not, now, usually things of beauty. Some of Green's, England's, and Avery's mixtures were simply exquisite; though, of course, the conditions which rendered that kind of voicing possible involved many serious drawbacks in the *general* possibilities of organ-tone, especially in the case of reed-pipes.

ASSOCIATESHIP, January, 1894.

1. *Question:* Who invented the Keraulophon?

Answer: Messrs. Gray and Davison first introduced this stop in their organ at St. Paul's, Wilton Place, in 1843.

2. *Question:* What is the length of pipe respectively upon Fiddle G (*a*) Open Diapason, (*b*) Fifteenth?

Answer: If the G (Open Diapason) is assumed to be 3 feet, the same G on a 2-foot stop will be $\frac{1}{4}$, *e.g.*, 9 inches. See remarks on Quint. See page 23.

3. *Question:* Briefly explain the action and use of a roller board.

Answer: to convey motion laterally. Example: the CC sharp pipe is on the extreme right of the organ, the CC sharp key on the extreme left. A roller, one arm of which comes under the pipe, and the other over the key, effects this lateral transmission. See plate IV.

FELLOWSHIP, July, 1894.

2. *Question:* Who invented Concussion valves?

Answer: See January, 1892; also plate V.

3. *Question:* What is the difference between "Sesquialtera" and "Mixture" stops?

Answer: The latter is a generic term, the former a distinct appellation of a species. In practice the term Mixture is applied to stops

consisting of the *more acute ranks* included in the Sesquialtera, when this latter has four or five ranks. See detailed explanation under "Sesquialtera" (pages 19, 24).

4. *Question :* In a large organ what pressure of wind would you suggest for the different manuals and pedal organ ?

Answer : Great and Swell, $3\frac{1}{2}$; reeds, $4\frac{1}{2}$; pedals and choir, $2\frac{1}{2}$; the pneumatics being actuated by the $4\frac{1}{2}$-inch wind.*

ASSOCIATESHIP, July, 1894.

1. *Question :* Classify the following stops : Doublette, Gemshorn, etc.

Answer : See Chapter II.

2. *Question :* What causes the defect known as "running ?"

Answer : See Chapter IV, page 52, and Question 2, Associateship January 1890.

3. *Question :* What are the principles which govern the difference of character of Great Organ and Choir Organ stops ?"

Answer : The Choir stops are of more delicate intonation, and usually of smaller scale. Where the names of certain Choir Organ stops are duplicates of similar ones on the Great Organ, the stops which they designate may be considered as "echoes" to those on the Great Organ. Great Organ stops should be bold ; Choir Organ stops, soft and subdued.

FELLOWSHIP, January, 1895.

1. *Question :* Describe the mechanism of any forms of Coupler you are acquainted with.

Answer : For "Tumbler" and "Ram" Couplers see Plate V. For "Lever" couplers see folding diagram. Where space admits of them Lever couplers are generally to be preferred.

* Willis has used the following pressures in the organ at St. Paul's Cathedral :—Swell and great, generally $3\frac{1}{2}''$; Reeds, $6''$; Choir and Pedal Violone, $2\frac{1}{2}''$; Solo organ reeds, $3\frac{1}{2}''$; Tuba, 17in. in treble, 14 in bass ; Great organ Open Diapason, $5''$; Bombarde, 16ft., on pedals, 18in. See also page 123, where the subject is further explained.

2. *Question :* A celebrated stop in old organs was the Cornet. Describe it.

Answer : The Cornet was a compound stop of from five to fourteen ranks. It was composed of large-scaled pipes very loudly-voiced, and seldom extended below Middle C. The composition of a Cornet was usually the following :—1. Stopped diapason in metal ; 2. Principal ; 3. Fifteenth ; 4. Twelfth ; 5. Tierce (or 17th). The *Mounted* Cornet was a stop of the same nature, elevated on a speaking block high above the other stops, thus securing still greater prominence of tone. The Cornet was used for "giving out" psalm tunes, and for a peculiarly detestable form of voluntary, now, happily, obsolete.

In some organs all the stops (above those of 8ft. pitch) were drawn on one slide, *e.g.*, at St. George's, Ratcliff Highway, where Principal, Fifteenth, Twelfth, and Seventeenth were called "Cornet," much in the same way that Messrs. Bevington, until comparatively recently, continued to draw the Twelfth with the Fifteenth.

During the last century, Cornet came to mean a 3-rank mixture—12th, 15th, and 17th. The fact of the 17th, or Tierce, *being the highest rank* was the distinctive—and objectionable—feature in all Cornets. Later again, it became customary to cut the Sesquialtera at Middle C, the treble portion being called Cornet.

In France and Germany, Cornets are still to be found in many organs. The pipes are always of huge scale, and their tone is often almost bell-like. They are retained in order to help out the reeds, which always have a tendency to get weak above the middle of their compass, except when the treble organ is winded more heavily than the bass, as in some modern instruments.

The Cornet in Germany often extended to Tenor C.

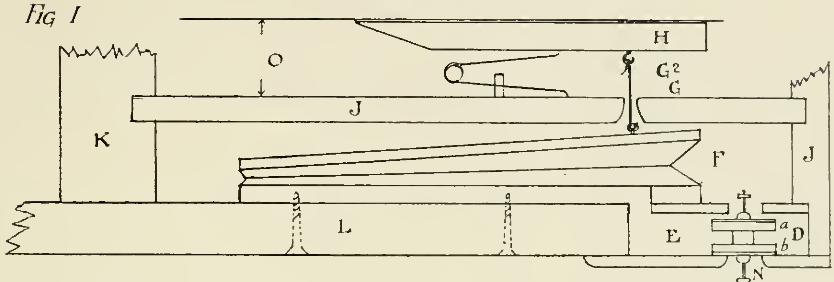
ASSOCIATESHIP, January, 1895.

2. *Question :* If you had occasion to tune a note on one of the reed stops in your organ, how would you set to work ?

Answer : See Chapter II.

A. Gern 1895

Fig I



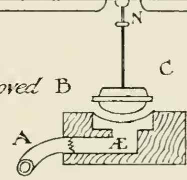


Fig II Fac Simile of Mr Barkers original drawing of his improved Pneumatic lever (1850)

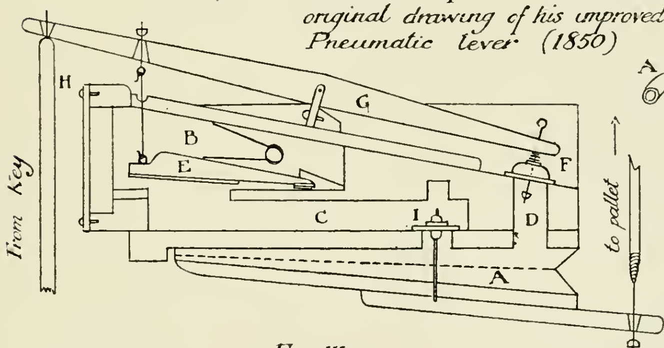


Fig III

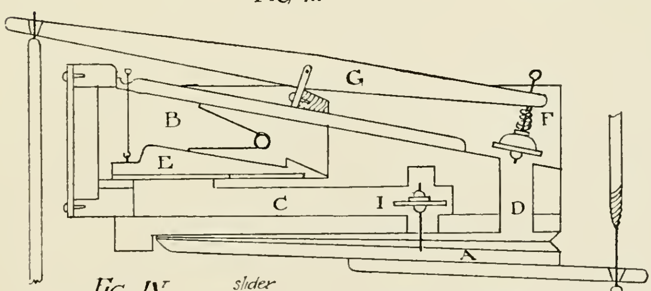
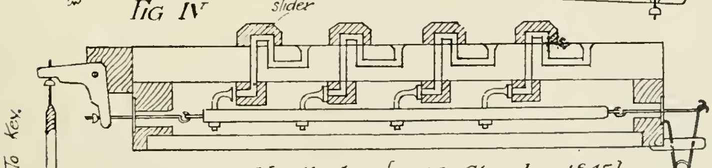
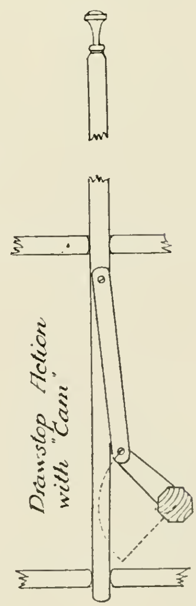


Fig IV



Kegellade {M. M. Claude 1845}



Drawstop Action with "Cam"

3. *Question:* What was the origin of the introduction of the Swell-box? (*sic*). At what time and by whom was it introduced?

Answer: The use of a box enclosing certain stops is very ancient, and was intended to produce an "echo" effect.

About 1712 Jordan introduced mechanism by which one of the sides of the box could be opened by sliding it upwards, giving a *crescendo*.

This was the first form of the Swell (Nag's Head).

The Swell-box (*sic*) was never introduced *as such*, but the improvement of making the already existing "echo" boxes capable of producing a *crescendo* (or swell) originally due to Jordan, was further perfected by Avery, to whom we owe the Swell as now used.

Examination for Fellowship, July, 1895.

1. *Question:* Describe clearly the pneumatic lever.

Answer: Pneumatic lever actions (Plate IX) as made by different organ-builders vary slightly in detail. The main lines, however, in which all agree are the following.

(1) Corresponding to each key there is a small bellows ($2\frac{1}{2}$ inches by 8, or larger), of the diagonal species. (2) At the end which rises there is a small lug or arm which draws up a tracker (or trackers) and opens one, or moxe, pallets. The key only acts upon a tiny pallet, which admits wind into the little bellows aforesaid; consequently the touch can be exceedingly light. When the key is released the small bellows instantly collapses, and is *ready to respond* to the next key impulse.

The *principle* of all pneumatic actions is, briefly, to derive the power necessary to drag down the pallets *from the bellows*, not from the muscular exertion of the organist's fingers. These latter only supply the trifling force necessary to start the "machinery" exactly as a single man, by opening a valve, can start a huge ocean steamship.

The Pneumatic Lever was invented by Charles Speckman Barker, 1830. Barker in his youth was a chemist's assistant at Bath, but most

of his life was spent in Paris. During his sojourn there he was, successively, a voicer with Cavaillé-Coll, manager of the firm of Ducroquet & Cie (the grand organ at St. Eustache—the finest, and *best-balanced* organ in Paris—being built by Ducroquet under his management) and finally he went into partnership with Verschneider (Verschneider and Barker, facteurs d'orgues). At the outbreak of the Franco-German war, 1870, Barker migrated to Dublin, where he built several organs. Having, however, no proper staff of workmen, and being rather an inventor and a dreamer than a practical man, the results were most unworthy, and have since been "improved away." In 1868 Barker patented the electric action for organs, and disposed of it to Messrs. Bryceson. This remarkable man died in very straitened circumstances.

Associateship, July, 1895.

2. *Question:* Enumerate the different parts of (*a*) a Flue pipe; (*b*) a Reed pipe.

Answer: (*a*) the foot, the languid, the upper and lower lips, the ears, the body; (*b*) the boot, the block, the reed, the tongue, the wire (or spring), the stork, the tube (or body).

N.B.—The parts are named in order from the bottom upwards. See Plate II.

Fellowship, January, 1896.

1. *Question:* Describe the following actions and name the inventor of each: (*a*) Composition pedals; (*b*) Thumb pistons; (*c*) Ventils as chiefly met in French organs.

Answer: (*a*) Probably invented by Bishop; (*b*) invented by Willis; (*c*) invented by Cavaillé-Coll? See "Composition pedals."

N.B.—It is more than doubtful whether these builders did "invent" these specialities, as instances or prototypes of all of them are continually being discovered in old organs. It was however necessary to answer the question according to the *assumption* it contains—I should

prefer to say that these "actions" were *introduced* by the builders named.

Associateship, January, 1896.

1. *Question:* Give a short description of some of the more recently invented mechanisms that differ from the old tracker action.

Answer: (L) Pneumatic lever, see Fellowship examination, July, 1895. (2) Tubular pneumatic (see page 110). (3) Various electric systems acting either on "L" or "2"—*no electric system is independent of the aid of pneumatic action.*

2. *Question:* Name the inventors of the (*a*) Dulciana; (*b*) Keraulophon; (*c*) Harmonic flute.

Answer: (*a*) Snetzler; (*b*) Gray and Davison; (*c*) Cavaillé-Coll.

Fellowship Examination, July, 1896.

1. *Question:* Give the names and approximate dates of some of the chief early Organ Builders; state any interesting facts you may know about their careers.*

Answer: Bernhardt Schmidt (otherwise Bernard Smith, as he usually signed his name—otherwise "Father" Smith) came to England about the time of the Restoration. Smith had learned his calling under Johann Christian Former of Wetten (near Hallé, in Germany). His principal organs were: Chapel Royal, 1660; Westminster Abbey, 1662; St. Giles-in-the-Fields, 1671; St. Margaret's, Westminster (of which church he was also organist); St. Peter's, Cornhill, 1681; St. Mary, Woolnoth, 1681; The Temple Church, 1682; St. Mary-at-Hill, Billingsgate, 1693; St. Paul's Cathedral, 1687; Hampton Court Palace Chapel; St. Clement Danes; St. Catherine Cree; St. Olaves, Southwark; and many provincial organs. Smith died about 1708, but the entry of his death has not been found in any register.

* A short biographical notice of French Organ Builders will be found in the Appendix, furnishing information both interesting, and possibly useful for examination purposes.

Smith's nephews, Gerard and Christian—organs All Hallows, Broad Street, 1717 ; Little Stanmore Church, 1720 ; St. George's, Hanover Square.

Renatus Harris, the rival of Bernhardt Schmidt, and who, of the two, appears to have been the greater "artist" in his calling, was born in France. As in the case of Smith, we have no record of his birth. He died in 1715, shortly after finishing the organ of St. Mary's, Whitechapel.

Principal Organs : St. Sepulchre, 1670 ; St. Botolph, Aldgate, 1676 ; St. Dunstan, Stepney, 1676 ; St. Giles, Cripplegate, 1680 ; All Hallows, Barking, 1680 ; Lambeth Old Church, 1680 ; St. Lawrance, Jewry, 1687 ; St. James, Piccadilly, 1687 ; Christchurch, Newgate Street, 1690 ; St. Andrew, Undershaft, 1696. Cathedrals : Chichester, Winchester, Bristol, St. Patrick's and Christ Church, Dublin, Norwich, Salisbury, etc., etc.

Successors : Harris (John), and Byfield. John Harris was the son of Renatus. Christopher Schreider, one of Father Schmidt's workmen, and eventually his son-in-Law. Of these builders' work the organ erected in Westminster, 1730, by Schreider, seems to have been the best.

Thomas Schwarbrook was originally one of Harris's skilled artificers. He built many noble organs in the midlands. Of these the principal ones were St. Chad's, Shrewsbury, 1716 ; Trinity Church, Coventry, 1732 ; St. Michael's, Coventry, 1733 (his masterpiece) Magdalen College, Oxford, Lichfield Cathedral, etc.

Jordan (Abraham) the inventor of the Swell. Principal Organs, St. Michael's, Paternoster Row, 1700 ; St. Magnus, London Bridge (the first organ in which *the Swell was introduced*), 1712 ; St. Dunstan's, Fleet Street ; St. Luke's, Old Street ; St. Paul's, Shadwell, etc.

Bridge (Richard) St. Bartholomew the Great, 1729 ; Christchurch, Spitalfields, 1730 ; St. George's-in-the-East, 1733 ; St. Ann's, Limehouse, 1741 ; St. Paul's, Deptford.

John Snetzler. John Snetzler was born at Passau, Germany, circa

1710, where he acquired considerable celebrity. Eventually he was persuaded to settle in England. After having built many noble organs in this country, and having saved a fair competence, he returned to Germany. It appears, however, that he found the lager sorry stuff, having been so long used to London stout. He accordingly came back to London for the good of his health, and the comfort of his declining years. There is no record of his death.

Principal organs—Finchley Church, 1749; *St. Margaret's*, Lynn Regis, Norfolk,* 1754 (This organ cost £700, and was built under the direction of Dr. Burney, who had it is said, originally induced Snetzler to come over to this country). Another interesting specimen existed until recently at Sheffield, viz., the Snetzler organ formerly in St. Paul's Church. As left by that builder, it contained the following stops :—

Great.	Choir.	Swell.
(GG, short oct. to E.	(GG to E, short octs.)	(to fiddle G, Bass conveyed from choir organ)
Open Diapason ,, ,,	Stopped Diapason ,,	Open Diapason
Stopped Diapason ,,	Principal ,, ,,	Cornet, 4 ranks.
Principal ,, ,,	Flute ,, ,,	Oboe
Twelfth ,, ,,	Fifteenth ,, ,,	
Fifteenth ,, ,,		
Sesquialtera ,, ,,		
Cornet ,, ,,		
Trumpet ,, ,,		

During the present century it was enlarged by Lincoln, who added pedals and made a new Swell sound-board, adding to the original three stops a Stopped Diapason and Trumpet. At a later date, Jones, of Sheffield, added unison pedal pipes GG to D; substituted a Dulciana to gamut G in place of the fifteenth in the choir organ; and supplied various couplers.

* The "Dulciana" stop was invented by Snetzler, who first used it in this organ, which also included a Double Diapason 16ft. tone on the Manual—this is the earliest instance we have of the introduction of Manual Doubles in England.

Also St. Peter's College, Cambridge ; The German Lutheran Chapel, Savoy—which was the first organ (in England) provided with pedals—and the German Calvinistic Church, Savoy, which was given to that church by the builder.

Other notable builders of the 18th century*—

John Byfield, junr., died 1774. Organs at St. Botolph's, Bishopsgate ; Christchurch Cathedral, Dublin ; Magdalen College, Oxford ; The Theatre, Oxford ; St. John's College, Oxford, etc.

Messrs. Crang and Hancock, principally noted for alteration and revoicing of the reeds in the "old" organs of their day. Hancock was celebrated as a reed voicer. They conjointly built the organ of St. John's, Horsleydown, 1770.

John Avery, a very prominent artist in his calling. Little is known about him—is said to have been a very gay and dissipated man—died 1808. Many improvements (alluded to elsewhere in this work) were made by him. Notable organs :—Croydon Parish Church, 1794 (his masterpiece), St. Stephen's, Coleman Street., St. Margaret's, Westminster, 1804 ; Christchurch, Bath, 1800 ; King's College Chapel, Cambridge, 1804 ; Carlisle Cathedral, 1804, etc.

George England. Very great excellence marked the work of this builder. The following are a few of his organs :—St. Stephen's Walbrook, 1760 ; St. Matthew's, Poultry ; St. Mary's, Aldermanbury ; The Chapel of Dulwich College (which still remains largely as he left it). See page 106. Plate III.

George Pike England, son of the above. Most of this builder's organs were erected in the Midland and Northern Counties. Excellent specimens were the following : Parish Church, Sheffield ; St. Philip's, Birmingham ; High Church, Lancaster ; Stourbridge Church. In London he built : St. Margaret's, Lothbury ; the Sardinian Chapel ; St. James's, Clerkenwell ; Fetter Lane Chapel ; and a few others.

* In compiling these principal facts connected with the "chief early organ-builders" I am largely indebted to Dr. Hopkins' unique and masterly work "The Organ."

2. *Question :* Why are some stops slower of speech than others? Give the names of some.

Answer : All small scale pipes producing, or intended to produce, fundamental tones, are slower of speech than large ones. A narrow column of air readily breaks off into harmonics, so if the fundamental is to be produced, it must be by *coaxing* it on slowly—this takes an appreciable time.

N.B.—Now, bars across the mouth and "beards" have greatly remedied this—no absolutely slow stop being admitted; but at the same time very small scaled stops never possess any *weight of tone*—or to put it in plainer words—real organ character.

Stops apt to be slow—Dulcianas, Gambas, Lieblich Bourdon. An obvious example was the old "German" Gamba (*sic*) so much used by the Robsons. It gave great power (being cut up very high) but could not be played without some other stop being used to "bring on" its notes.

3. *Question :* Give a list of the principal stops in German and French organs, with their English equivalents.

Answer :

German.	*French.*	*English.*
Principal, 16, 8.	Montre, 16, 8 Flute, 16, 8	Open diapason, 16, 8
Octav 4, Prestant, 4	Prestant 4	Principal 4
Gedact, Still Gedact 8	Bourdon 8	Stopped diapason 8
Octav 2, Quinta-decima 2	Doublette 2	Fifteenth 2
Scharf Mixtur.	Plein-jeu	Sesquialtera
Cymbel	Cymballe, Fourniture	Furniture
Bordun or Untersatz 16, 32.	Bourdon 16 Sousbasse 32	Bourdon 16 Sub-Bourdon 32

In the case of solo stops the names do not much vary, except in their terminology, which must be that of each language, *e.g.*, Clarinet,

Clarinette (Fr.) Clarinetto (It.) An ordinary French-English or German-English dictionary will usually give them, as they are names of orchestral instruments.

ASSOCIATESHIP, January, 1897.

1. *Question:* What is the pitch of a note on the Open Diapason 8ft., the length of pipe of which is 1ft. 6in.?

Answer: See Question II, Associateship, July, 1892, also Associateship, January, 1890. Neither question can be correctly answered without more data. Even if worked out mathematically from the length 8ft. CC Open Diapason (which is a wrong data as before explained) the pitch may vary as much as a semitone, or even more, according to the *scale* of the pipe and the wind pressure used.

2. *Question:* Explain the difference between equal temperament and just temperament?

Answer: Equal temperament consists in modifying the true intervals of the scale so that they may both form acceptable intervals between themselves, and with respect to tonics other than the first scale sound assumed.

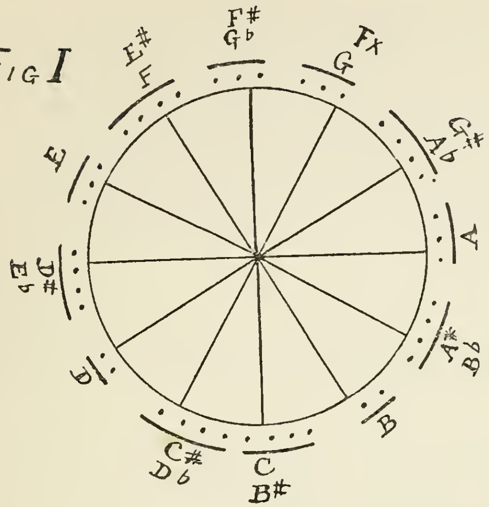
The result is imperfection in all keys, but absolute harshness in none. This system has definitely superseded the unequal temperament system by which a few keys were made better at the expense of others.*

Assuming that the octave is divided into forty parts (although of course there is no reason why it should be so divided), the following diagrams—for which I am indebted to Perronet Thomson's "Principles of Just Intonation"—will illustrate both the method of obtaining equal temperament and likewise the true division of the octave when considered without any relation to other keys.

* So late as 1853, Messrs. Hill & Co., when building the magnificent organ which was placed in the "Panopticon," Leicester Square, added to their description of the same the following words: "All the musical scales have alike been rendered available to the performer, by the adoption of the admirable system of *equal temperament.*"

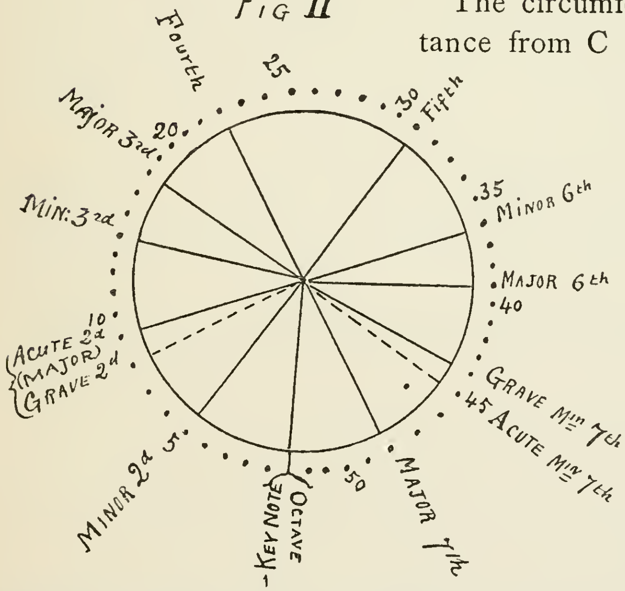
It was not until 1867 that the organ in St. George's Hall, Liverpool, was changed from unequal to equal temperament, an improvement which Mr. Best had long unsuccessfully advocated.

Fig I



The circumference represents the distance between C and its octave, and in this figure is divided into 12 parts, each representing a semitone, according to the practice known as equal temperament. It will be seen that each section does duty for several sounds which really differ one from the other. Thus Enharmonic changes are made possible.

Fig II



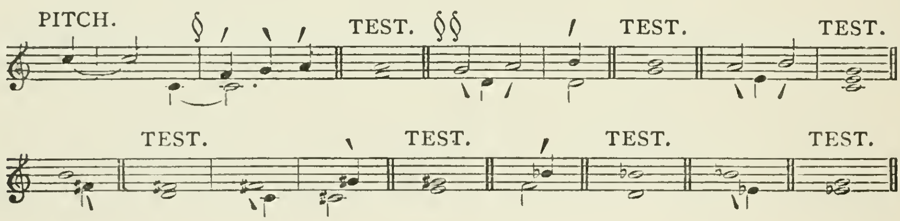
The circumference denoting the distance from C to its octave, as in the previous illustration, the relative position of all the intervals of the scale of C are shewn. *These intervals* are "true," and not "tempered," so as to do duty for other intervals of sound. By measuring with a compass it is easy which intervals are augmented or diminished by temperament in Fig. 1, and to what extent they differ from the (true) intervals in Fig. 2.

While dealing with "temperament" a few words upon unequal temperament may be interesting. Its long survival seems partly to have resulted from the fact that ecclesiastical musicians—it matters not whether originally by choice or necessity—from the sixteenth and

seventeenth centuries onward, seldom wrote music in any key having more than one or two sharps or flats in the signature : and they continued this habit long after secular music was freely written in all keys. The organ was then tempered so as to favour the tonic, dominant, and sub-dominant, harmonies of the few scales principally used. Dr. Hopkins shows this most concisely in the following table (from his work, "The Organ.")

Five keys were tempered so as to form nearly perfect thirds to the small black notes added above or below, of course endowing them at the expense of the others whose thirds were thereby impoverished.

Dr. Hopkins also gives a scheme for laying the bearings of unequal temperament, which may be consulted with advantage. The following scheme, abridged from the late B. Flight's "Practical Tuner" (Novello & Co.), is also exceedingly interesting.



FELLOWSHIP, January, 1897.

3. *Question :* How are are organ pipes affected by heat?

Answer : See 5 Fellowship, July, 1880.

Generally, we may assume that with heat (*a*) Reeds flatten very slightly ; (*b*) metal flue-work sharpens much ; (*c*) wood-work is sharp-

§ These accents (acute, grave, acute) mean that the notes over which they are placed are to be thus modified. In this case C–F is a sharp fourth, C–G a flattened fifth, one interval being the exact complement of the other, *e.g.*, C–F and F–C (F–C being tuned as C–G) would make a perfect octave. The interval C–F being too large by the same quantity that F–C is too small.

§§ "D" is tuned sharp to G and flat to A. Similarly E later on.

ened in the upper notes, but unaffected in the bass or tenor. For this reason Cavaillé-Coll, Willis, and others, avoid *small* wooden stops. Cavaillé never makes wood pipes shorter than two feet in length.

The above may be considered as describing what takes place when the *whole of the organ* is subjected to the influence of heat.

In practice, however, this seldom occurs, as some parts become heated, while others are still practically unaffected. Again, if the bellows chamber remains cool, or if the wind trunks (especially metal ones) run through a cold passage, or by an open window, the cold air pumped into the warm pipes will cause all kinds of variations in their speech and pitch.

It may, I think, not be too sweeping an assertion to say, that no organ in an organ chamber is *ever really in tune all throughout*, *at the same time*, as the changes of heat and cold can hardly reach the whole instrument quickly enough to act *uniformly* upon it.

Early History of the Organ.

A few dates for Examination purposes.

VIII Century. 757. Organ sent by the Emperor Constantine to Pepin, father of Charlemange ; ultimately placed in the Church of St. Corneille at Compiegne, France. (Seidel. "Die Orgel und ihr bau," Breslau, 1843).

X Century. 961. Organ at Winchester Cathedral : St. Dunstan, of organ-building and bell-casting fame, died 988. Organs existed at Erfurt, Madgeburg, in 994. (Praetorius. "Syntagma Musica" and "Theatrum Instrumentorum," Wolfenbuttel, 1620).

XI Century. Number of keys in the organ at Madgeburg Cathedral extended to 16. (Praetorius).

Curious treatise on organ-building by the monk Theophilus ; first brought to light by Dr. Rimbault (Hopkins and Rimbault's "The Organ," London, 1855).

The XII and XIII Centuries are practically blank of records,

but we may gather that Regals or portative organs came into use during that period.

The term Regal seems to have been derived from the Italian word "Rigabello."*

Regals, or Regalls, as they were called in England, were still used in the sixteenth century, and so late as 1767 one Bernard Gates, an officer of the Chapel Royal, St. James's, was styled Tuner of the Regalls.†

XIV Century. Keyboards were made smaller and lighter, so as to be played with the fingers, in place of being punched with the fists, as previously. In 1359, Semitones were introduced. The octave was first divided into twelve sounds, in the organ at Halberstadt Cathedral, built by Nicholas Faber. Pedals came into use. Some claim that they were invented by Bernhardt, organist to the Doge of Venice, circa 1475. Dr. Hopkins thinks that pedals were used at a considerably earlier date.

Dom Bedos would refer them to the twelfth century.

XVI Century. 1570. Bellows ribs were invented by Johann Lobsinger, of Nuremberg—moderately steady wind being thus secured.

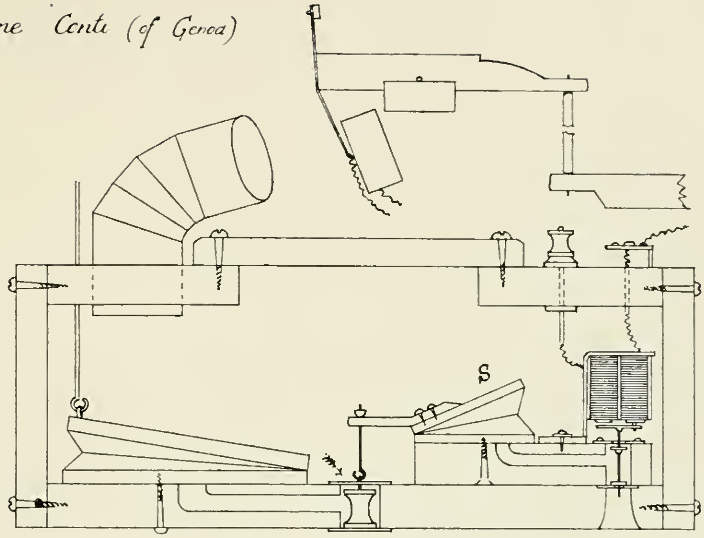
XIX Century. Gauntlett (Dr.), Henry John (see page 22). Born at Wellington, Salop, 1806 ; son of the Rev. H. Gauntlett ; articled to a solicitor, 1826 ; Organist of St. Olave's Southwark, 1827-47 ; gave up the law, 1842 ; Mus.D., Lambeth, 1843 ; commenced his campaign against the old GG organs, circa 1835, and lived to see them practically extinct before his demise (1876). Dr. Gauntlett was the great apostle of the CC compass in this country. Dr. Samuel Sebastian Wesley (son of the great Samuel Wesley, who first made Bach's works known in England) was his chief antagonist in this matter. To the Wesleys, English organists owe the introduction of classical organ music from Germany ; to Dr. Gauntlett, instruments

* *In aede sancti Raphaelis Venetiis instrumentum musici cujusdam forma extat ei nomen "Rigabello."* Sansovinus lib. VI (apud Rimbault and Hopkins's "The Organ.")

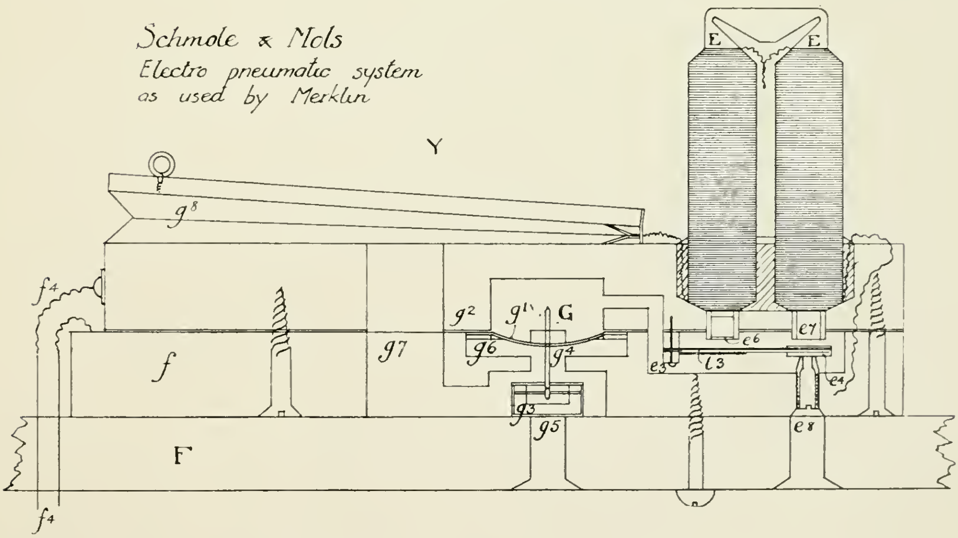
† Hopkins (op. cit.)

Plate X.

Systeme Conti (of Genoa)



Schmole & Mols
Electro pneumatic system
as used by Merklin



so constructed as to be available for the performance of such music. These two men were the pioneers who opened the way for George Cooper, E. J. Hopkins, W. T. Best, and others, who virtually created the English school of organ playing.

Electric Action.

The first application of electricity as an agent to effect communication between the keys and windchests in organs, was undoubtedly effected by the late Dr. Gauntlett, being only one of a great many remarkable experiments and inventions due to this gifted pioneer in musical art.

Dr. Gauntlett's patent is dated 1852, and described as a system enabling organs—both finger and barrel—pianos, and seraphines to be played from a distance by electrical agency.

The method by which this was effected appears to have been exceedingly crude, viz. : the fixing of an armature on the pallet itself, with a strong magnet immediately beneath to pull it down. Dr. Gauntlett neglected to follow up the really practical part of his idea, which he had formulated in the following terms :

"The apparatus known as the pneumatic lever can also be worked by electro-magnets." (Spec. of patent, 1852).

In 1863, Mr. Goundry patented an electric system by which the drawstops could be worked. This appears to have been the first attempt to effect something which has not even yet been quite satisfactorily accomplished.

The next departure was made by Mr. Barker, and gave effect to Gauntlett's idea that "the Apparatus known as the pneumatic lever" could be worked by the agency of electricity. This combination of electricity with pneumatics was first successfully applied by Mr. Barker to the large organ at St. Augustin, Boulevard Haussmann, Paris, and it was the writer's privilege, as a youth at the time, to witness the construction of this instrument, as well as to help the venerable inventor in many of his experiments.

The practicability of the electric system having been thus demonstrated, organ builders, who hitherto had fought shy of what seemed a mere costly and unreliable fancy, soon approached Mr. Barker. Early in 1868, Messrs. Bryceson purchased the patent. In April, 1868, a further improvement was patented by Mr. Bryceson, and from that time electricity, as a motive power in organs, came to stay.

On Plate XI, fig. 3, will be found a diagram of Barker's action slightly modified from that used in the organ at St. Augustin, 1867, and at fig. 4, Mr. Bryceson's improvement, patented April 6, 1868.

The following were the first electric organs built in England: they were by Messrs. Bryceson.

Her Majesty's Opera, Drury Lane.

Christ Church, Camberwell; this instrument having previously been used at the Gloucester Musical Festival, September, 1868.

St. George's, Tufnell Park.

Reviewing the condition of electric action during most of the period embraced between 1868 and 1890, it will be noted that very powerful magnets, with costly batteries, were used *directly*, to do comparatively severe and heavy work in opening the valves, admitting air to the pneumatic bellows or motors, which acted on the soundboard pallets. These large magnets involved strong electric currents, costly to produce, and, as will be seen, difficult to control.

The main drawback and danger resulting from these strong currents was the possibility of *permanently* magnetising the electro-magnet, thus causing a cipher; or, if the magnetising were but transient, at least a failure of "repetition."

During the last decade very great improvements have been effected in pneumatics, which have revolutionised electric action, and rendered the forms now in use as much superior to the Barker system as the latter was to Dr. Gauntlett's. This is principally due to the introduction of what may be called secondary pneumatics.

Secondary pneumatics can be defined as tiny motors, just powerful enough to open the valves which supply larger motors ; these *latter* doing the work of traction or propulsion. An example of secondary pneumatics is clearly depicted in the Système Conti shewn on Plate X. The *secondary* pneumatic is there marked S.

Mechanical resistance being reduced to that of the almost microscopic valve of a secondary motor, small electro-magnets and comparatively few batteries have proved most successful, as introduced by Conti of Genoa, Merklin of Paris (Schmoele and Mols system), Hope-Jones, Gern, Rev. J. B. Crofts at St. Matthew's, Westminster, and others, both in England and abroad.

I now refer the reader to Plates X, XI, XII, where he will find some typical systems intended to illustrate the progress made in the art of electric organ building.

These have not been selected as being better than many others, but every system closely approximates to one or other of the types given ; and in the choice made, it has been my endeavour to present the simplest and clearest as specimens. I should, with great pleasure, have added diagrams of many others, but in answer to my applications very many builders have courteously replied—in terms almost identical—that they are still making experiments and improvements ; thus intimating that they do not wish systems to be published which they may themselves condemn in a few months. (See also page 124.)

Chapter vii.

Explanation of Plates.

In the folding diagram, and in some of the other illustrations, details and accessories are purposely enlarged, in order that their nature and uses should be more clearly apparent.*

Folding Diagram.

Sectional view of a typical tracker organ, at the same time shewing the general appearance and location of the pipes belonging to the different stops.

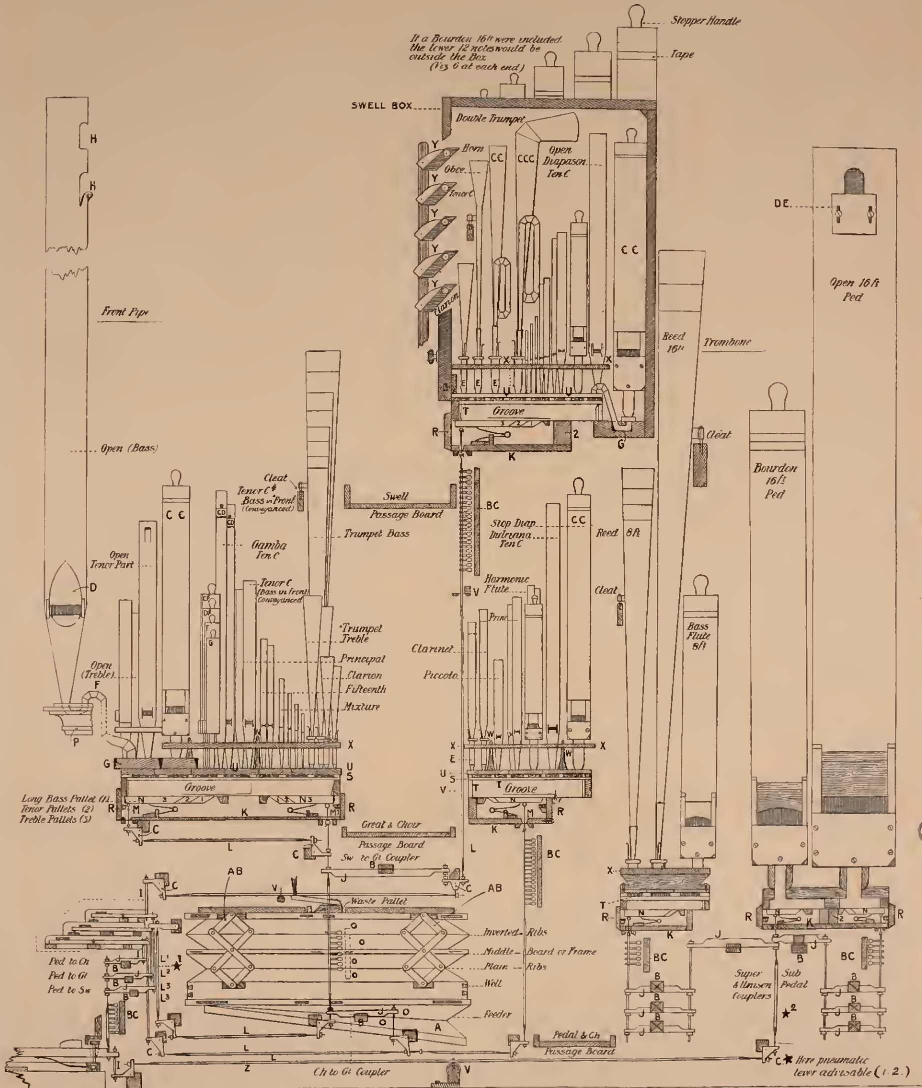
This organ is supposed to be provided with two pairs of bellows—or one pair of bellows and a reservoir—situated, respectively, left and right of the key-action, which passes straight through the centre of the instrument.

It will be noticed that the manual action connecting each set of keys with its pallets is by square and tracker, levers, or backfalls, being only used for coupling purposes.

To ensure a satisfactory touch, especially if the number of stops shewn were slightly exceeded, it would be advisable to have pneumatic levers at the points indicated by the asterisks—viz., one set to lighten the great organ touch and relieve it of the extra strain of the couplers, and an independent set to relieve the pedal touch in like manner. These it was not easy to shew on the diagram without confusing other essential parts ; and it is for the same reason that the trunks and drawstop actions are omitted.

* The illustrations in the text are drawn by the author.

Front Pipe


Stopper Handle
Tape
If a Bourdon 16ft were included the lower 12 notes would be outside the Box (Viz 6 at each end)
SWELL BOX
Double Trumpet
Horn
Oboe
Tenor C
Clarion
CC
CCC
Open Diapason Ten C
Groove
Swell Passage Board
Trumpet Bass
Stop Diap.
Dulciana Ten C
Harmonic Flute
Clarinet
Piccolo
Reed 8ft
Reed 16ft
Trombone
Cleat
Bass Flute 8ft
Bourdon 16ft Ped
Open 16ft Ped
DE.
Front Pipe
Open (Bass)
Open Tenor Part
Open (Treble)
Gamba Ten C
Tenor C♯ Bass in Front (Conveyanced)
Tenor C (Bass in front) Conveyanced
Trumpet Treble
Principal
Clarion
Fifteenth
Mixture
Long Bass Pallet (1)
Tenor Pallets (2)
Treble Pallets (3)
Great & Choir Passage Board
Sw to Gt Coupler
Waste Pallet
Inverted Ribs
Middle Board or Frame
Plain Ribs
Well
Feeder
Ped to Ch
Ped to Gt
Ped to Sw
Pedal & Ch Passage Board
Ch to Gt Coupler
Super & Unison Couplers
Sub Pedal
Here pneumatic lever advisable (1.2.)

The various parts are thus denoted :

A Feeder.
B Backfall beam, or stock.
C Square.
D Bayleaf.
E Boot.
F Conveyance.
G Groove board.
H Slots.
I Stickers.
J Backfalls.
K Purse board.
L Tracker.
M Pull down.
N Pallet.
O Bellows ribs.
P Impost.
Q Wind bar.
R Face board.
S Table.
T Slide.
U Upper, or cover board.
V Register.
W Rack pillar.
X Rack board.
Y Swell louvres.
Z Pedal tracker.
A B Bellows-regulator, or counterpoise.
B C Roller board.
C D Tuning clips.
D E Tuning slide.

All the couplers are "lever" couplers, and are brought into play by *depressing* their respective "stocks" (which are everywhere lettered B)—except the three pedal couplers—Choir to Pedal, Great to Pedal, and Swell to Pedal. These are brought on by *raising* their stocks.

Plate I.

Sections of wood pipes, of a metal flue pipe, a Bell Gamba, and enlarged section of a reed pipe. Figure of a Wind-Gauge.

Plate II.

Metal pipes. Bär-Pyp, Chalumeau, Clarinet, Cor Anglais, Dolcan, Flute a Cheminée, Gamba, Harmonic Flute, Keraulophon, Open Diapason, Regal (apfel), Stopped Diapason, Trumpet, Vox Humana, etc. French-mouthed front pipe. Section of the Euphone.

Plate III.

The Organ at Dulwich College Chapel. This instrument was originally built by George England the elder, in 1760—See Hopkins and Rimbault on *The Organ*, page 154—costing the sum of £260, together with the old instrument by "Father" Smith, which England took in part settlement. In 1887, the organ was inspected by Dr. E. J. Hopkins, at the suggestion of Mr. W. H. Stocks, the then newly-appointed organist to the College, and Dr. Hopkins pronounced the

instrument to be a magnificent specimen of England's work, one well worthy of reverent and thorough restoration.

Effect was given to Dr. Hopkins's suggestion, and this noble old organ was saved from being destroyed, or ruthlessly mutilated and "improved," a fate which during the last half century has befallen so many equally fine or even finer instruments. Extra bellows were provided; a Venetian Swell was substituted for the old "nag's head" or Jordan Swell; pedals of modern compass were added; and other important additions were made, the old pipe work being jealously guarded and preserved.

Specification.

GREAT ORGAN CC–G.
56 notes.

1. Open Diapason.
2. Stopped Diapason.
3. Principal.
4. Twelfth.
5. Fifteenth.
6. Mixture II Ranks.
7. Mounted Cornet IV Ranks.
8. Trumpet.

SWELL ORGAN CC–G.

9. Open Diapason.
10. Stopped Diapason.
11. Principal.
12. Mixture.
13. Trumpet.

CHOIR ORGAN CC–G.

14. Dulciana.
15. Stopped Diapason.
16. Flute.
17. Fifteenth.
18. Vox Humana.

PEDAL CCC TO F.
30 notes.

19. Open Diapason 16ft.
20. Bourdon 16ft. tone

Couplers, 21 to 26 (6); 5 composition movements, etc.

The restoration was effected by Messrs. Lewis and Co., Brixton.

The illustration is reproduced from a photograph taken by W. H. Stocks, Esq., L.R.A.M., the organist.

PLATE IV.

Various kinds of key action. Backfalls (how to "set out"), Lever Pallets, Roller Boards and attachments, Trackers (how to make), Trunnels, etc., etc.

PLATE V.

Coupling, and drawstop action. Concussion Bellows.

Couplers—Tumbler, Ram (Robson's), Kirtland and Jardine's.

Various Drawstop Actions—Groove Block, Trace Rods, Trunks, etc.

Plate VI.

Organ with separate Console. See *Console*, p. 64.

Plate VII.

Pneumatic Action, Tremulant, Pallets, Cleats, and Arms.

A system for intensifying the wind by obtaining a supply of air of greater pressure, as well as one of less pressure, from the same feeder. Patent 2408. Gern.

A is a box containing a reservoir bellows B which at the bottom communicates with the trunk C provided with a valve *c* opening towards B and also with a trunk D provided with a valve *d* opening away from B. The trunk C is supplied with air from the main bellows, and the trunk D is for conducting air at a higher pressure to some part of the organ where such high pressure is required.

The box A has two openings, one to the outer air, governed by the valve E, and one to the trunk C, governed by the valve F.

The valves E and F are fixed to the lever G so that when one is open the other is closed. On the fulcrum of the lever is pivotted a heavy plate H, which acts as a "tumbling weight" and by means of the studs K^1 K^2 is thrown right and left, thus alternately closing E and F. When E is closed—as shown in the diagram—it is evident that the wind enclosed in the box A exerts pressure on the top and ribs of the reservoir B, consequently the greater density of the wind then supplied from B will equal the pressure to which B was loaded in the first instance, plus the external pressure of air in the box. When E is open, this external pressure being removed, wind is supplied from B at the lower pressure. Patent No. 2408.

Kegellade Sound Board. A B C D are longitudinal divisions of the sound board over each of which are planted a set of 56 pipes forming a complete "stop," which becomes available when wind is admitted at *a* by a valve actuated by the manual drawstop. When wind is admitted to groove N (by means of a pallet opened by the

key) M—which is the thin leather covering of the groove N—bellies out, raising all the buttons I. J. K. L. thus opening all the valves E. F. G. H. If the division A is full of wind (admitted at "a") the valve E being raised will admit wind to the speaking pipe O. On the contrary, if no wind is admitted to A the pipe O will not speak, although the valve E be lifted. The small diagram represents the leather covering of the transverse key-grooves M M. At M^2 they are at rest, at M^1 they are inflated.

Split Pallet. On depressing the pull-down D the small pallet A will open until it catches the button B. This latter in turn will act upon the large pallet C, but meanwhile air will have passed through the mortice E (uncovered by the small pallet A) and pallet C, thus being relieved of much suction, will open easily.

This and similar contrivances have never been wholly satisfactory. Since the general introduction of pneumatics, split pallets are more seldom used.

Simple form of Tremulant. By opening the pallet A the bellows C is inflated. When it is full the pallet D (which is provided with a weight of lever E, after the manner of a steam safety-valve) begins to flutter, exactly as the safety-valves of locomotives and steamboats do sometimes. This tremor is communicated to the main bellows, and consequently to all the pipes supplied therefrom.

Plate VIII.

Pneumatics and Tubular Pneumatics.

Figs. I, II, illustrate the sliding valves of a steam engine. In each case A is a chamber filled with steam and *c* and *d* are the "ports" (or orifices) by which the steam travels into the cylinder *f*, and B the exhaust pipe. In Fig. I the slide valve G is so placed that steam enters the cylinder by the port *d*, thus impelling the piston *e* in the direction shewn by the arrow ; at the same time the port *c* is placed in communication with the exhaust pipe B, and as the piston travels

from right to left it drives out the steam through the port *c*. Fig. II shews how the piston is driven from left to right when the slide valve is shifted to open the port *c*, and to unite *d* with the exhaust B.

If motion is needed only in one direction, *i.e.* to pull, *or* push—not to pull *and* push—it becomes a question of " one way in and one way out "—these being alterately closed and opened.

Actions which work by Exhaust differ in nothing from the "three-way" and "two-way" systems given above, except that suction being applied to the *exhaust* orifice, it is *the ordinary atmospheric pressure* on the opposite side of the piston which supplies the motive power. *e.g.* whether we blow at A (in Fig. IV) or suck at B it is evident that the piston C will travel in the direction of the arrow.*

Fig. III shews how the same system of slide valves and ports can work a fixed board E joined to two accordion bellows, one on each side.

Richter Pneumatic Stop Valve, patented by A. Richter (of Rudolstadt, Germany). The valve box has openings (e, e,) which are closed by a band (b) of leather. The band is secured to a metal plate (C) which can be depressed by a rod to clear the openings e, e. The valve is equally applicable to pressure or exhaust apparatus.

No. 19,048, Nov. 4, 1891. Musical Instruments.

Soundboard with two wind pressures, patented by Walther Albert Henri Drechsler, 1886. Explanation of the diagram. The wind in chamber B is of at least 1½in. heavier pressure than that admitted severally to the stop chambers A A. On the manual key being depressed, a small pallet similar to a harmonium pallet (not shewn in the diagram) is opened, and high pressure wind is sent through the tube I, eventually filling the chamber K, and inflating the leather which forms the top of the chamber. This raises the large button M, which in turn raises the double-seated pallet L. In so doing, the

* N.B.—Slide valves of the kind shewn are not usual in organs, though the *principle* of the valves used is the same ; but a pneumatic drawstop action, almost identical with that shewn at Fig. III, was added to the organ in St. George's Chapel, Windsor, during a restoration effected about forty years since.

communication between the high pressure chamber B and the channel D is closed, and at the same time—the hole under the pallet L being opened—the air in the channel D escapes. The leather purse F relieved of the pressure of air, which caused it to assume the position shown, yields to the impact of the low-pressure wind in A, and falling against O leaves the way clear for the wind to pass out at H and sound the speaking pipe placed above. This system is useful for uniting the pneumatics of several manuals for Coupling purposes, rather than merely to sound single speaking pipes as here shown.

The Principle of Pneumatic Actions Generally.

By pneumatic action is meant mechanism used to overcome the resistance of pallets, stops, or any other "moving part" in organs, the motive power being compressed air, or atmospheric pressure rushing in to fill a *vacuum.*

The motor in every case is a bellows, *i.e.*, something extensible or collapsible. It is not necessary that the bellows have ribs; it may be a mere bag of leather, or a groove or hole covered with leather, which is capable of being bellied out, or sucked in. So long as any surface is made to rise or fall, and thus to move any adjacent part, it is termed a motor or bellows.

Motors may be (*a*) near the keyboard, and transmitting power to the required quarter by a means of a long tracker (Pneumatic Lever); or (*b*) they may be placed immediately adjacent to the part which has to be moved, in which case these main, or principal, motors are governed by other tiny motors, placed near the keys, and connected with the large ones by small tubes of indefinite length. In this case the transmission of power is by a *tube*, and not by a *tracker* as in the first instance, and the action is termed "Tubular Pneumatic."

It would be very helpful to students to refer to the diagrams of cylinders and valves of simple steam engines (Plate VIII). Once they have well mastered these, pneumatic action will have no mysteries

for them, and they will be able to trace out the actions of the most complicated systems with the greatest ease.

"Two ways in and one out" may be taken as describing the valves of all motors which exert power backward and forward, be the motor the piston of a steam-engine or the board of a bellows.

Details of Moitessier's "Abregé Pneumatique."

Exposition de Toulouse.

(Juillet, 1850).

MOITESSIER, de Montpellier, Facteur D'Orgues, Brévetè.

Exposant : Sous le No. 343, un Orgue de Choeur à deux claviers et 14 jeux avec pédale de 16 pieds.

Report of the Committee named to examine the large organ at La Dalbade by Moitessier.

RAPPORT.

Fait á MM. le curé et fabriciens de la Dalbade à Toulouse, sur l'orgue construit par M. Moitessier, facteur a Montpellier par la Commission nomée pour la vérification et la réception de l'orgue.

MM.

Lefébure-Wely, Organiste de la Madeleine, à Paris.
Barrére, Professeur de Musique.
Bécqure, Organiste de St. Jerôme.
De Brucq, Directeur de l'Ecole de Musique.
L'Abbé Chabrol, Chanoine de la Métropole.
Delord, Architecte de l'Hospice.
Estenave.
Gurçeau, Organiste au Taur.
Leroy.
Leybach, Organiste de la Cathédrale.
Mas, Professeur d'Harmonie.
Megniel, Professeur d'Harmonie.
(And others, 22 in number).

MESSIEURS,

Pour justifier la confiance dont vous avez bien voulu l'honorer . . . . . . la commission s'est reunie le 7 Fev., 1850. . . . . . Hâtons nous de dire que cet habile facteur (M. Moitessier) a rempli consciencieusement et au de la de ses engagements toutes les conditions qui lui étaient imposées.

La construction de cet Orgue repose sur un plan entièrement *neuf* . . . . il a doté votre instrument du precieux appareil qu'il nommé "Abregé pneumatique. . . . . ."

Fait a Toulouse 18 Fêvrier, 1850.

Orgue de la Dalbade (Specification of the Great Organ). Compass CC to F, 54 notes.

				English equivalent.	
1.	Flûte en montre	tin	16ft.	Open diapason	16ft.
2.	Flûte	tin	8ft.	Open diapason	8ft.
3.	Flûte	wood	8ft.	Clarabella	8ft.
4.	Sallicional		8ft.	Salicional	8ft.
5.	Bourdon	tin, wood basses	16ft.	Bourdon	16ft.
6.	Bourdon	tin, wood basses	8ft.	Stop diapason	8ft.
7.	Flûte		4ft.	Flute	4ft.
8.	Prestant		4ft.	Principal	4ft.
9.	Quinte-au-prestant		3ft.	Twelfth	3ft.
10.	Doublette		2ft.	Fifteenth	2ft.
11.	Grand Cornet		(V rangs)	Cornet	V ranks
12.	Plein jeu		12 rangs	Mixture	12 ranks
13.	1re Trompette		8ft.	Trumpet	
14.	2de Trompette		8ft.	2nd Trumpet	
15.	Bombarde		16ft.	Double Trumpet	16ft.
I6.	Clairon (sans reprise)		4ft.	Clarion (through)	4ft.
17.	Euphone		16ft.	(See page 13).	

Choir of 11 stops. Swell of 8 stops—including one of 16ft, which is most unusual in France, even now (1899). Pedal organ of 6 stops.

These particulars are given to show that Moitessier's system was

successfully applied to a very large organ, and was not merely judged from a model, or from the small instrument at the Exhibition of 1850.

Further details from the original French specification.

"All backfalls and rollers are replaced by tubes—each key has its own tube—and no matter how great the distance to be covered between key and pallet, the mechanism cannot become more heavy or complicated: it is only necessary to provide a longer tube."

When the key M is depressed, the sticker *c* raises the square K and shifts the pallet C D, opening the orifice E and closing F. By E the groove B is placed in communication with the exhaust chamber A. The pallet H will feel the suction *before* the pallet C D will have traversed its whole distance. It (H) will therefore close before the key is right down and by that means the effect will be instantaneous.

A and B now being united, suction will extend down the tube to the movable piston N. The latter will instantly yield to the atmospheric pressure on its under side, and, in rising, drag up everything connected with the tracker O.

Thus it appears that a complete system of tubular pneumatic transmission *was patented in 1835*, and successfully applied to the large organ at la Dalbade in 1850, shortly after the first application of Barker's pneumatic lever to the organ at the Abbey of St. Denis, near Paris.

1. Tubular pneumatics (simple form of). The box W is filled with wind, also the pipe soundboard E.

(*a*) When the key is depressed—as shown—the pallet B is opened, and the wind from W passes along the channels, inflating the motor bellows C, which pulls down the pallet D, allowing wind from E to sound the pipe.

(*b*) When the key is released, the pallet B is closed by its spring, and the pallet A is opened. B cuts off the wind from W, and A being open permits the spring of the pallet D to close the pallet and collapse the motor C. It is evident that by increasing the dimensions of C it could be made to draw stops, or to work the swell shutters.

The name of Mr. Henry Willis will, in England, always be associated with tubular pneumatics. It is said that Mr. Willis was much struck by a system of tubular pneumatics which was introduced in an organ shewn at the Paris exhibition of 1867, and that thus stimulated he turned his energies to developing an improved form of tubular work. Improvement followed upon improvement, until in his organ at St. Paul's—which was built in 1874—the various experiments and improvements he had previously made became crystallized into a new and definite school of organ building.

Plate IX.

Fig. I. *Gern's Tubular Pneumatic Action.* A is a tube (length immaterial) conducting air into the chamber Æ, which is covered by a thin skin B. When the chamber is filled with air the skin is bellied out and thus raises the large button C, which in turn lifts the double pallet D, thus closing the passage M (by which the motor F is kept inflated) and opening the exhaust N. When this is done the pressure of the wind upon the *external* surfaces of F causes the latter to collapse, pulling down the pallet H by means of the wire G^2.

On the supply of wind being stopped at A, the skin B sinks down (as shewn), and the double valve D following it, wind is again admitted at M, filling the interior of the motor, thus counter-balancing the pressure of air upon its external surfaces. The motor then rises, from the effect of the light spring under the pallet.

The separation I divides the well of the sound board into two parts, the upper containing the pallets, and the lower the motors. This was introduced by Mr. Gern to ensure steadiness of wind to the pipes. The two divisions of the well are supplied with wind from separate trunks, taken from opposite ends of the bellows, in order to avoid any tremor from the motors affecting the upper division.

When a separation is not provided, the larger motors are apt to act as so many tremulants, seriously disturbing the speech of the pipes.

Fig. II, III. *Barker's Pneumatic Lever.* B is a chamber always supplied with wind from the bellows. When the sticker H is raised (by the key) it acts on the lever G, which simultaneously opens the pallet E, and closes the pallet F, thus wind being admitted by E, and its exit at F being closed, the motor bellows A is inflated (Fig. II). When H is released, the pallet E closes by means of its spring and the pallet F opens. The supply of wind is cut off by E, and F being open lets out the wind contained in A, which latter collapses immediately (Fig. III).

The valve I is so adjusted as to shut off the supply of wind from the motor A and thus prevent the motor from opening beyond a certain limit, being well clothed with felt, and *inside* the wind-box its action is noiseless.

N.B.—Barker's original drawing is elaborately coloured in black, yellow, pink, and green, but it is only possible here to produce the outlines.

Kegellade (M. M. Claude, 1845) "Cam" for Drawstop Action.

Plate X.

Systeme "Conti" (of Genoa). Schmoele and Mols's Electric Action. The following is a description of the System of Electric Action, patented A.D. 1881 (No. 3386), by William Ford Schmoele and Alexis Mols, of Antwerp, Belgium. The interior electro-pneumatic mechanism consists of a tubular electro-magnet combined with pneumatic levers, situated in the part marked Y on the drawing. The levers have valves in their air channels. The electro-magnet is formed by deeply notching an iron tube in two places, so as to allow of its being bent into a U shape.

The ends of the magnet are fixed in holes bored in the board f (Figure 6), which forms a part of the air passage in which the pallet of the magnet is placed. The pallet (e^4, Figure 6) is covered with thin leather, only slightly roughened (velouté). It is supported by one pole of the magnet or from an adjacent part of the wood, and

this pole is altogether sealed by a plug of metal, e^6. The pallet is free to vibrate at its other end between its seat e^8 and the other pole e^7 of the magnet, which end is not plugged but remains open in order to admit the wind pressure to the channel e^3 in which the pallet is situate. The weight of this pallet is nearly counterbalanced by a tail, l^3 (of non-magnetic metal), which extends on the other side of the point of support. The electro-magnet in attracting its pallet from its seat e^8 has only to overcome the difference in weight between the pallet and its tail piece, plus the wind pressure on the small vent hole in the seating e^8, which seating may be adjusted to suit the range of the electro-magnet.

When the pallet is attracted and in contact with the magnet, the hollow e^7 thereof is closed, and the wind pressure from Y is prevented from entering the channel e^3, while the opening in the seating e^8 empties that channel, and gives a back pressure on the pallet in contact with the hollow end at e^7 of the magnet.

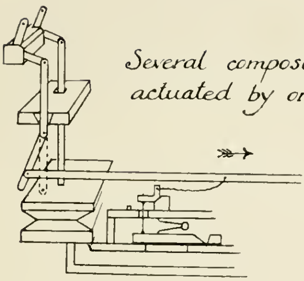
The wind pressure on the hollow arm of the magnet is not strong enough to force off the pallet when the current is passing, but is strong enough to overcome the residual magnetism, and forcibly reseat the pallet when the current has ceased.

The first air chamber or bellows is fitted with a flexible pneumatic diaphragm composed of a disc g^1 covered with a fine envelope of sheepskin which is held securely in place by a ring of card or metal nailed to the framework. To this diaphragm is attached a double-seated valve by means of a tapped wire.

G is the first pneumatic lever ; g^3 is the secondary valve consisting of a bobbin or disc of wood presenting two surfaces covered with soft leather, one of which closes the entrance g^4, and the other the exit g^5.

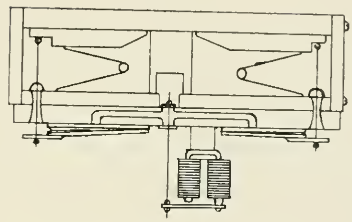
The space g^6 is in permanent connection with the wind pressure from Y in the interior of the wind chest, allowing it to enter freely the second puematic lever g^8 when the secondary valve g^3 is lowered ; but when this valve rises it closes the opening g^4, and the air in the

Plate XI.



Several composition movements actuated by one motor only

Electro-pneumatic lever Barkers' Patent 1868 (January)



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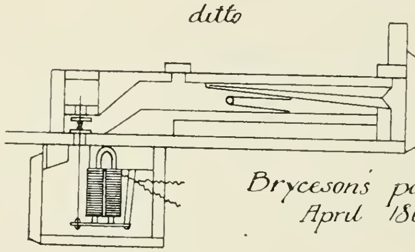
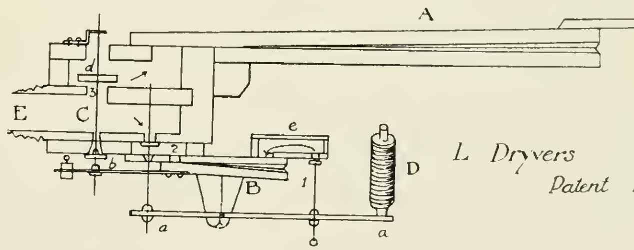
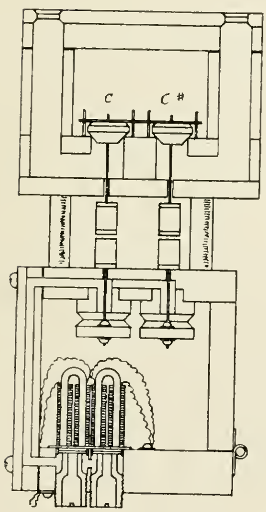


Brycesons patent April 1868

ditto



L. Dryvers Patent 1885



M August Gern's System Electro-pneumatic action

lever g^8 rushes out by the exit g^5, the wind pressure on its outside causing the lever to collapse, and actuating the final valve which admits wind to the pipes.

Plate XI.

Several forms of Electro-Pneumatic Action—Barker, 1868, Bryceson, 1868; Dryvers, 1885; Gern, 1898.

Several composition movements actuated by one motor.

Plate XII.

Hope-Jones Electro-Pneumatic Action. Upon the key marked A being depressed the tail of the key rises, thereby lifting end of Contact Lever marked B.

Through the Contact Tray B2 (which is constructed of a highly insulating substance) fine platinum Wires C2 and D are passed.

Lying upon the upper surface of the Contact Tray B2, and held in position by suitable bearings, are two metallic Rollers Y and Y2. These Rollers are also provided with fine platinum Springs C and X.

The Lever B is made of a thin insulating substance, and through this substance are passed at intervals small gold Pins Z and E.

When the Coupler Rollers Y and Y2 are turned the fine platinum Springs which are attached to them are brought into contact with the gold Pins passing through the Lever B; therefore when the Lever B is raised as before mentioned by reason of the depression of the Key A the gold Pin is brought into such a position that it establishes an electrical contact between the Coupler Rollers and the fine platinum Wires passing through the tray. It may here be mentioned that the Coupler Roller Y2, which controls the Unison Action, always remains in the position shown.

The Electric Current is now at liberty to flow from the Dry Leclanché Cell through Contacts C and D, by means of the gold Contact Pin E, to a terminal G attached to a Test Board, from which it flows through the Electro-Magnet H in the Electro-Pneumatic

Action Box (containing wind under pressure) and back to the cell through the return Wire I.

Upon the Electro Magnet H being energised the small Disc J is drawn down on to the poles of the Magnet, thus cutting off the supply of wind to the small Motor K, and at the same time allowing the wind already in the Motor K to exhaust to the atmosphere through the Channel L and Ports M in Valve Seat N. The wind pressure in Action Box now collapses Motor K, owing to its area being greater than that of Valve O, to which it is connected by means of Wire P. The Valve O now being lifted off its seat, wind under pressure is admitted to the external Motor Q and thereby inflates it owing to its exhaust Valve R (wrongly called B in the diagram) being closed as supply Valve O opens, the two Valves being connected by means of Wire S which passes through the Hinge T of Motor Q. Motor Q now being inflated draws down the pallet in the soundboard by means of the Pulldown U.

To reverse the Action—Pressure being removed from the outer extremity of Key A, it immediately rises owing to its tail being depressed by means of the Contact Lever B, which in turn is depressed by the Spring V, thus breaking the electrical contact between platinum Wire D and gold Pin E. The Magnet H having now lost its power the wind in the Action Box is able to blow up the Disc J and thus close the Ports M in Valve Seat N. The wind now enters Motor K and thereby equalises the pressure on both sides and thus enables the wind to close the Valve O and at the same time open the Valve R. The Motor Q now having its supply valve closed and its exhaust open, is closed by means of the spring on the soundboard pallet.

The Coupling is arranged as follows :

Upon the Coupler being drawn the connecting Wire W draws Roller Y until the Contact X rests on gold Pin Z.

Upon the Key A being depressed, contact is made between Contacts C2 and X by means of the gold Pin Z. The current is now at liberty to flow from the cell along the main (which is common to all

Plate XII.

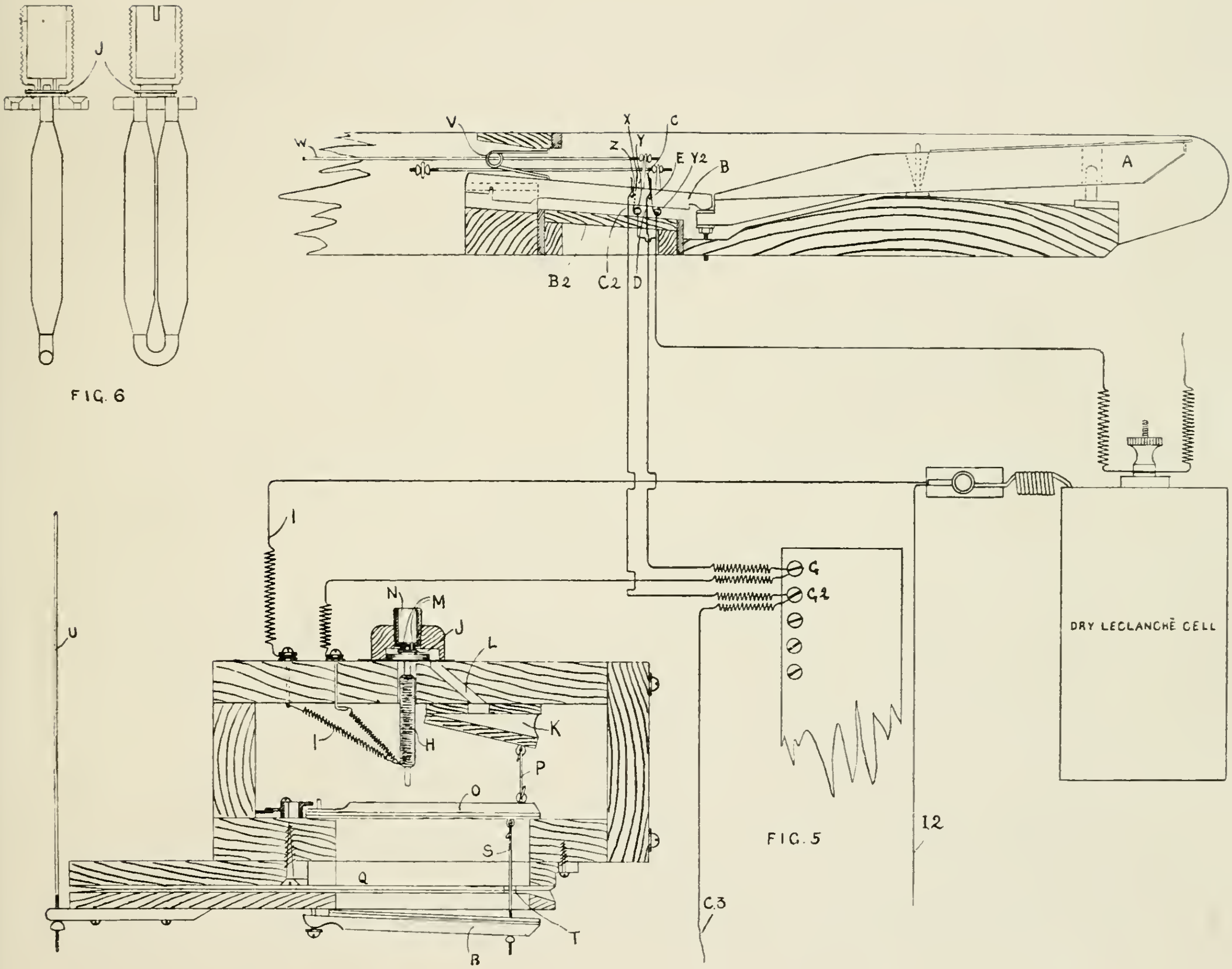


FIG. 6

FIG. 5

the rollers contained by one tray) through the contacts and on to the Terminal G2 on the Test-board, from which it goes on through main C3 to the Magnet in connection with the note required to be coupled, and back to Cell through return Wire I2.

An enlarged view of the Magnet and one of the styles of Valve Seat employed is given in Fig. 6. The small circular armature Disc J is also shown in the position of rest.

This apparatus is so arranged as to be exceedingly sensitive to the action of an electric current, and the Magnets are designed in such a manner that no sparking whatever shall take place at the breaking of the contacts at the keys.

Mr. Hope-Jones informs me that Armature Disc J moves less than a hundredth part of an inch, and yet, through the peculiar construction of the Valve Seat, it effects a very large area of opening. The action will "repeat" upwards of sixty times per second.

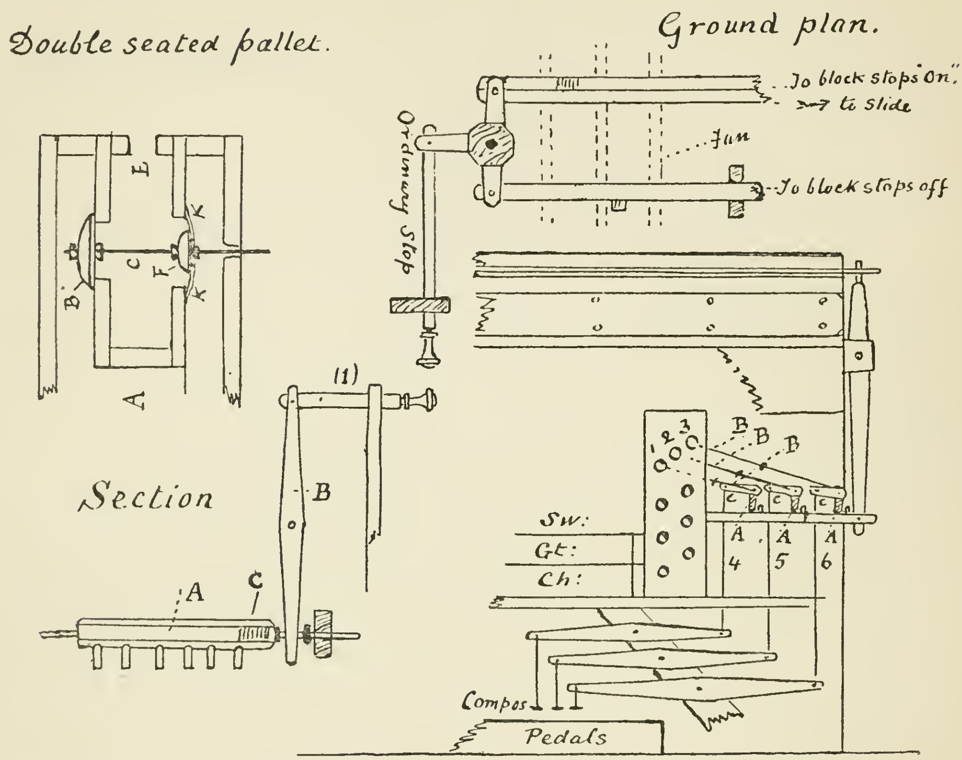
A very ingenious method of obtaining several different combinations from one composition pedal—and one which would be a great boon in the case of organs not provided with pneumatics—was introduced by Mr. H. Wedlake so far back as 1859, in his organ at St. Nicholas, Strood, Kent. By referring to the diagram, it will be seen that each drawstop trunnel has two arms, thus admitting of the use of one fan only to do the work usually done by two. The fan A is made to shift sideways, like the barrel of a mechanical organ, or musical box, by means of the splayed lever B.

When the combination stops 1, 2, or 3 are in, the corresponding composition pedal will produce a certain selection of stops. When either stop is drawn out it will shift the fan to which it is attached by the lever B, thus causing the composition pedal to produce a different selection of stops.

The trace rods 4, 5, 6 work through a register. They are broad at their upper ends, to allow the trunnel or "fan" arm C to slide the required distance for the change.

The draw-stop traces are also broad (see ground plan), to allow of

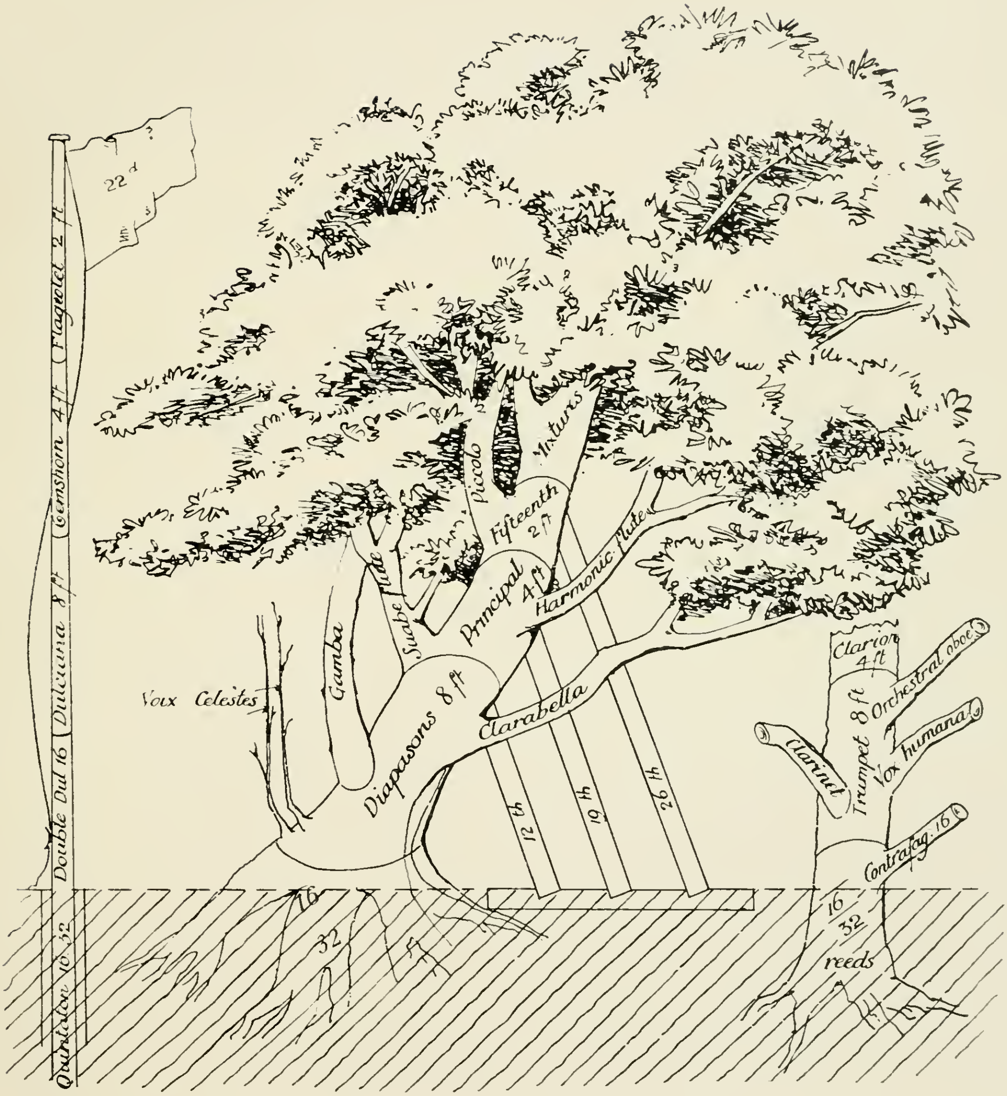
the composition blocks—which, of course, cannot be in the same line. By making the trace rods still wider, even more changes can be obtained.



WEDLAKE'S COMPOSITION PEDAL AND DOUBLE-SEATED VALVE.

Wedlake's Double-seated Self-adjusting Valve. This double-seated valve is provided with a flexible seat (K K). When the wire C is raised, the valves B and F rise simultaneously. B leaving its rigid seat, at once admits wind, but the flexible leather seat KK *follows the valve F* a little way, thus forming a pneumatic motor which helps the valve B to rise. When the seat can follow F no farther, the opening in its centre is uncovered, and both valves (B and F) admit wind. When the two valves are being closed, the elastic seat K K is driven by the wind pressure against the lower sur-

Plate XIII.


22d
Flageolet 2 ft
Gemshorn 4 ft
Dulciana 8 ft
Double Dul 16
Quintaton 16 32
Vox Celestes
Gamba
Suabe flute
Piccolo
Mixtures
Fifteenth 2 ft
Principal 4 ft
Harmonic flute
Diapasons 8 ft
Clarabella
12 th
19 th
26 th
16
32
Clarion 4 ft
Orchestral oboe
Vox humana
Trumpet 8 ft
Clarinet
Contrafag. 16
16
32
reeds

face of the valve F directly this latter approaches it—and it (K K) again becomes a motor which counteracts the shock resulting from the valve B coming down on its hard seat. This system has been used with great advantage for winding large pedal pipes, and was a feature in Mr. Wedlake's organ at the Inventions Exhibition, 1885. (See report by Dr. C. W. Pearce).

Plate XIII.

Balance of tone pictorially illustrated.

Plate XIV.

Modern *Manual and Cylinder Organ (1896).* The "Combination Organ" in the Music Studio of the late J. H. Van Ryn, Esq.

Appendix.

Short Extracts from Works on the Organ.

"The noise from mechanical actions (in sticker or tracker actions) results *when the key rises*, and not so much when it falls. The greater part of this noise *can be eliminated by careful playing*."

"The best of all (actions) is a bushed square and tracker, which . . . . . . gives a pleasant touch, and a prompt response."

"Builders sometimes rely too much on their ability to produce tone from a pipe of small scale."

The organ in the chapel at King's College, Cambridge—upon the screen dividing the nave from the choir—*is in the best possible position*, from a musical point of view. An organ *may* of course be divided, but it undoubtedly *suffers in consequence*.

"As a rule it is better to have a large pipe softly voiced than a small pipe loudly voiced."

"Dissonance is virtually power, and an organ out of tune appears to be much more powerful than when in tune."

Elliston's *Organs and Tuning*, pages 15, 18, 56. Weekes, 1898.

"Electric action is never necessary, except to enable one to play an organ from a distance, which is sometimes a very questionable advantage."

"Pneumatic action—applied to large organs—is a *necessity*, unpleasant in some degree, as the pneumatic lever *is noisy*, independently of the player—and tubular pneumatic tends to destroy the *sense of*

attack, and diminish the individuality of touch. Still, if the organ be very large, there is no alternative but to use pneumatics in some form."

"All kinds of pneumatic and electric systems are contrivances to overcome mechanical resistance where such *legitimately and unavoidably* compels their assistance.

Electric or pneumatic work in *small* organs—"Steam cranes to lift flies."

Some organist wrote (in the *Musical News*, if my memory serve me): "Playing on tubular or electric action is like 'kissing by deputy'"—a very happy illustration.

Several different pressures of wind needed to produce the proper effects of different stops. "That one pressure of wind will not do equal justice to pipes whose scale is materially different can be easily proved by experiment.

"If we take two pipes of equal length, one scaled to one-eighth (which is about the scale of the six-inch C on a large open Diapason), and another scaled to one-sixteenth (as the CCC on the pedal open), and place them on the same wind, we shall have either to lower the mouth of the large scale unduly, or to 'cut up'—and thus totally spoil—the small scale. If we do the former, the large pipe will be weak, and the small one good; if we do the latter, we sacrifice the small one altogether. Wind instrument players know well that the pressure used in blowing a high B♭ bugle would not suit an E♭ bombardon or even a euphonium. Here, again, the fact they so well know experimentally can be adduced to the difference in the scale of the tubes, which is obviously larger in the treble instrument.

If these results, proved by theory and experience alike, are to go for anything, it follows that reeds cannot fairly be placed on the same wind as foundation stops, as if they are to have suitable wind it will be too intense for the flue-pipes. The old builders solved the problem in a way: they kept their foundation stops sweet and mellow, at the price of having merely "bee in a bottle" reeds, thus sacrificing

the interest of the few to that of the many. We—perhaps less logically—sacrifice the many to the few, by using pressures suited only for the few (the reeds); or we make compromises, spoiling *all*, less or more."

"As the temperature of the air in buildings appears to vary in *horizontal strata*, it is much to be desired that all sound-boards should be on one level.

"If the Choir organ is situated in a frigid zone, the Great in a temperate, and the Swell in a torrid one, distinct differences of pitch must ensue."

The power of an organ not proportionate to its size. "That power is not proportionate to the size or number of pipes in an organ is obvious. Many organs of eight or ten stops exist which are more powerful than others of twenty or twenty-five stops. What, then, is power proportionate to? Power is directly proportionate to the *pressure of wind* used, as we can prove for ourselves with any wind instrument, even a tin whistle. From this proposition grow two obvious corollaries: (1) The heavier the wind, the fewer stops are needed to produce a given degree of power, but the more coarse and unmusical will be the result. There will also be the less variety of tone-colour, as the stops are reduced in number. (2) The lighter the wind, the greater number of stops will be needed to make up the same given degree of power; but the *more singing, round, and melodious* will be the tone, and, the stops being proportionately numerous, there will be abundance of varied tone colour.

Caution needed in accepting the statements of inventors. "The present period, being essentially one of transition and one of experiments in the art of building organs, would seem to point to the need of especial caution in forming opinions as to the claims of any one system to supersede either its predecessors or its contemporaries. Nearly every system introduced has added to the sum total of re-

sources, upon which the competent organ-builder can draw, just as newly-discovered drugs, while, perhaps, not always the panaceas their inventors claim them to be, yet add to the resources of the physician."

Organ Construction not sufficiently studied. It would seem that some organists write the specification of an organ and "superintend its erection," without possessing any really intimate knowledge of organ construction.

Musical professors, and more especially voice specialists, are keenly alive to the fact that there does exist a large class of teachers who give lessons in voice production, though in no way qualified in that subject, and it cannot be denied that there is a great analogy between the two cases.

Mr. J. W. Warman in his book, *The Organ: writings and other utterances on its structure* (1898), speaks very strongly upon the lack of intimate knowledge of organ construction possessed by organists.

There is much truth in his remarks,* which would be still more impressive were they not expressed with oracular severity. Among many, and still stronger statements, we read on page 5 of the above work, "The general ignorance of English professional organists and other musicians as to organ structure, is equalled only by the impertinence of their claims to be regarded as the chief critics and adjudicators on the instrument.

English Organs short-lived. Mr. Arthur G. Hill in his excellent work on the organs of the Renaissance period, after describing the great organ at Haarlem, adds remarks to the following effect:—"Had this organ been in England, nothing would now remain of the original structure. Each successive organist would have left his mark on the instrument. One would have had reed stops removed and flue ones put in their places. Another would have had the mixtures removed, and so on, until, after four or five organists (together with the builders they employed) had aired their likes and dislikes, the

* See page 141.

instrument would have become a mere collection of rickety incongruities, and one in no sense representing the original conception of the builder. Worse than this, in due time even the noble case itself would have ceased to command respect, and sacrilegious hands would have been laid upon it. Wings of unsightly pipes would have been thrown out on either side, and strange excrescences elsewhere. In a word, a noble masterpiece would have been totally spoiled and lost to the world. * * * While the foreign system has doubtless tended to preserve intact masterpieces precious historically and artistically, our easy-going system has had great advantages, too, in facilitating the introduction of improvements.

The advocates of CC compass were not careful to preserve or imitate the mellow singing and essentially English tone of the older builders. Again, in material and workmanship, the first generation of CC organs stood in sad contrast to those which their constructors broke up "with axes and hammers."

These CC organs have mostly been worn out, or rather have *fallen to pieces*, being replaced by instruments, which again do not, in some cases, appear destined to have a long lease of life.

(From *Capabilities and Construction of Organs* [1891], by J. W. Hinton M.A., Mus. D., unless otherwise stated).

Inaccuracy of the usual Tablature of Stops: A Suggestion.

It may strike some readers as peculiar that I have not described the Twelfth and the Quint as $2\frac{2}{3}$ and $5\frac{1}{2}$ft. respectively.

I do not see why there is need of such accuracy—or rather, of such *seeming* accuracy. To be perfectly accurate, 8ft. should be (according to scale) 7ft. 10in., 7ft. 11in., etc., and—in the case of reeds—Horn, 7ft. 10in., Clarion, 3ft. 2in., etc., etc.

The term 8ft., applied to a stop, means that its pitch is as that of

the piano, violin, or any non-transposing instrument. The absolute length of pipes can be of no interest to the player, except as expressing the harmonic interval (octave or fifth) and the pitch at which this occurs.

It is suggested that the indication 8ft. should be abolished, and some term implying "Standard" or "Unity" substituted. Other stops of 16ft., 4ft., or 2ft. pitch could be expressed in terms defining their relation to this standard, without introducing the question of the absolute length of the pipes.

Pedal Pipes.

Pedal open pipes are treated variously. Some builders favour the immediate production of the fundamental tone, others admit of the fifth or twelfth being heard first in the speech of the pipe. In Cavaillé's organs the Pedal Opens 16ft., usually sound the 8ft. tone, dropping down to the 16ft. afterwards. This system gives a *semblance* of promptness in speech, as the ear does not realise the substitution of 16 for 8ft. so perceptibly as it does that of 16 for 6ft. Probably the best system is that which gives the 16ft. tone quickest without having resort to either expedient. It is, however, impossible to get a mellow, soft, *pervading tone* out of prompt-speaking pipes of small scale* (such as are, of necessity, all pedal pipes). It would therefore seem wise, in the case of large organs, to include one Open, slightly slow of speech, in order to possess a *really pure* 16ft. quality available with the softer stops upon the manuals.

Of Blowing Apparatus.

The principal methods of blowing now used are: Hydraulic (or water) engines, Gas engines, and Electric motors. Manual power is but rarely employed, except for very small instruments; or in localities where there are no water, gas, or electric mains, whence motive

* See page 95.

power can be derived. Oil engines, from the odour of the oil, require to be placed at some distance from the organ—if possible *outside* the main wall of the edifice—and as yet they do not appear to have become popular.

Where there is a good supply of water from a high-pressure main, hydraulic engines of any approved pattern undoubtedly furnish the best means of blowing an organ. All modern specimens are furnished with automatic appliances which admit more water as the bellows falls, and cut the water off altogether when the bellows rises to a certain point. Moreover these two effects are produced gradually, so that there can be no jerking of the bellows, and the amount of water used is thus exactly proportionate to the amount of wind required.

Many Gas and Electric motors, on the contrary, do not run fast or slow in proportion to the quantity of wind used. Their superfluous power has to be removed—wasted—being got rid of by fast and loose pulleys, breaks, and other wasteful appliances.

It is surprising that the time-honoured bellows handle, which came into use during the time when light wind pressure was universal, should still exist now that pressures are increased.

Human power, applied to the old-fashioned handle, is certainly most unsatisfactory, except in the case of very small organs. It has been proved over and over again that the treadmill action—by which the blower's weight is utilised in place of the muscular action of his arms—is the form of labour which enables a man to exert the *greatest amount of power for the longest period of time.*

Again, it is almost impossible to jerk the wind when blowing with a treadmill—any jerk resulting in far greater discomfort to the blower than to the player—consequently the blower will be the person most interested in avoiding them. Cavaillé-Coll, and nearly all other Continental builders, employ the treadmill exclusively. Mr. August Gern has used this system in some of his organs in England, but there appears to be much prejudice against its general introduction.

Of the Position of the Organ in Churches.

It is impossible to lay down any definite rule in this matter, considering that the circumstances vary in almost every case.

Generally speaking, however, the organ must stand high, and it should not be enclosed in any way. If its office is primarily that of accompanying the choir, it must be placed near the choir—or the choir must be brought near to it.

All these statements are obvious truisms, which no amount of talking or writing can alter. An organ will sound well, or be unsatisfactory, in the proportion in which these rules are complied with or disregarded.

Unfortunately most of our churches erected during the last century are ill-suited for organs, since (for ecclesiastical reasons) the choir is removed to the chancel. In these buildings the west-end is (musically) the only possible place for an organ—*and there it must not be.*

In cathedrals, collegiate churches, and other ancient edifices which were built for Catholic worship, it has long been found possible to reconcile the claims of the organ with its utility as an instrument for accompaniment by placing it on a screen dividing the nave from the choir (as is still the case at Norwich and Exeter Cathedrals).

While this position for the organ may be taken as being the result of the experience of our forefathers, and, although it perfectly complies with modern acoustic discoveries, yet it is now a forbidden one, as the architects—worthy descendants of Sir Christopher Wren, who declared that "Father Smith's —— box of whistles spoilt the proportions of St. Paul's Cathedral"*—have vetoed it. When both West Gallery and Central Screen are tabooed, there practically remain but the North† or South Transept available. In most cases these situations

* *Musical Gazette*, edited by Dr. Busby, January, 1819 (Hopkins and Rimbault, *The Organ*).

† The North Transept is (musically) the only position possible for an organ in the cathedral church of St. Saviour, Southwark, where a truly lamentable instance of organ location utterly mars a magnificent specimen of organ-building.

are not entertained, as the organ would be considered a decided eyesore, and would occupy much seating room. One by one, all the eligible positions being forbidden, organs go—and apparently will continue to go—into ignoble nooks, arches, and recesses.

There are many parallels to the present unceremonious treatment organs receive. While nowadays money is lavished on instruments which are stowed away as something to be ashamed of, or are placed —by means of electrical, or other far-fetched devices—in places where they can be but of little use, we are nevertheless inconsistent enough to recognise the organ as an indispensable adjunct to church worship!

"The most usual position for the organ . . . . for at least the last three hundred years, has been the West end, as for example at Amiens Cathedral (1429); Chartres Cathedral (1513); Freiburg Cathedral (1520); and St. Peter's Church,* Hamburg.

"Next to the West end, the best place for the organ, as indicated by the laws regarding the propagation of sound, will be some elevated position, having space above and both sides free.

"A most unfavourable plan, for the tone of the organ, is that of putting the instrument in a recess (organ chamber).

"The worst possible arrangement is that of putting the *organist*, as well as the organ, into a chamber." Dr. E. J. Hopkins's *The Organ*, chap. xxxii and passim.

"The organ has suffered sadly by being brought down from the gallery at the West End, where it was a great architectural feature of the church until the Puritans smashed the noble old organ-cases of carven woodwork. Our modern architects, with perverse disregard of acoustics, almost always place the organ on one side of the chancel, in a sort of box or cupboard, which they term an 'organ chamber.' They might almost as well put it on the steeple. It is stifled as a

* The date of the erection of this organ is not known, but Burney informs us that a Mister Pfiffer, the Organist of St. Peter's, told him that it was upon record that a Mister Margenhof made two of the key-boards in 1548—when the organ was (presumably) enlarged from a two to a four manual instrument.

solo instrument and rendered almost useless as an accompaniment to congregational singing. Something may be done (if there must be a chamber for the organ) by insisting on a concave wooden roof, plenty of space between the topmost pipes and the ceiling, and plenty of free room for the sound to spread. But the west gallery is the proper place for the organ, and to the west gallery let it be restored, even if the choir must be left at the east end. The evils of distance from the choir are great; but they are less than those of imprisoning the organ in a stone cell and separating it from the congregation." The Rev. Professor Shuttleworth.—*The Place of Music in Public Worship*, p. 56.

In an article on "Famous Organs and Organists," a writer in the Church Family Newspaper, Feb. 1899, thus succinctly recalls some hard times through which the organ has passed:

"It is curious to find that in the thirteenth century, when organs would seem to have become quite common, they were condemned as adjuncts to Divine service. Five centuries before, Pope Vitalian had not only sanctioned, but strongly recommended them for use in churches and chapels; but many of the Greek and Latin clergy alike then denounced them as abominations. The organ survived this attack, as it did the far more serious attacks made on it by the Puritans of the seventeenth century. During the period of Puritan predominance, many a fine instrument was destroyed. In August 1643, an ordinance was passed by "The Lords and Commons assembled in Parliament" for abolishing superstitious monuments. On May 9th, 1644, a second ordinance was passed for further demolishing monuments of idolatry and superstition, in which the destruction of organs was enjoined.

"The ordinance ran: 'The Lords and Commons in Parliament assembled, the better to accomplish the blessed reformation so happily begun, and to remove all offences and things illegal in the worship of God, do ordain that all representations of the Trinity, of any angel, etc., in and about any cathedral, collegiate, or parish church or chapel,

shall be taken away, defaced, and utterly demolished, and that all organs, and the frames and cases wherein they stand, in all churches and chapels aforesaid, shall be taken away and utterly defaced, and none other hereafter shall be set up in their places.

"So thoroughly did the Puritan iconoclasts do their work, that it would be much easier to give a list of the organs that escaped their destructive fury than those that were destroyed. Among the latter was the organ at Westminster Abbey. In 1646, the soldiers of Westbourn's and Caedwood's companies were quartered in the Abbey, where 'they brake down the rayl about the altar and burnt it in the place where it stood. They also brake down the organs, and pawned the pipes at the several alehouses in the neighbourhood for pots of ale.'"

Situation of the Keys and Pedal-Board.

During the year 1891, various musical papers stated that the late Mr. Best had expressed his unwillingness to perform in future upon organs built so as to have "C-under-C pedal-boards." This most practical method of protest, from an artist of the absolutely unique attainments and unparalleled experience of Mr. Best, certainly commends itself to the serious consideration of all concerned in the building of organs. Nevertheless, it would be ungracious to speak of any changes of measurement without first recalling the invaluable service rendered by the College of Organists when, by the happy thought of calling together a thoroughly representative conference—Mr. Best, of course, having been invited to grace that assembly by his presence—they established a code governing the relative positions and dimensions of keys and pedals. From a veritable chaos was evolved *one* standard, returning (very nearly) to the plain, straight form of pedals which have ever been used, discarding the extravagantly radiated and concave forms which, while supposed to be scientifically adapted to the human body and its motions, certainly never in reality accomplished the ends proposed.

Now that a moderately successful standard has been thus secured by the graceful compromises and concessions of the members of the conference—uniformity of scale, *be it what it might*, being the first and great desideratum—one may be permitted to suggest that the time seems to have come to slightly extend and further perfect one or two of the clauses contained in the accepted arrangements.

It is perhaps rather late to discuss whether C-under-C be the best standard. It was the wisdom of the conference assembled by the College of Organists so to decide ; but facts are stubborn things, and the following statements can perhaps hardly be controverted.

1. The notes from low F to highest A or B are most used in service music, and in music generally. Witness the silent testimony of wear on the pedals, even where used only by artists of the most undisputed competence.

2. The notes below the F are used at least twice as often as those above B.

3. Top F is simply an addendum, added because, in the case of a couple of pieces, Bach has written it—doubtless from mere *contrapuntal* necessity—in these particular cases.

These facts would seem to corroborate Mr. Best's contention that the pedal board should be moved upwards. Personally I should advocate C-under-D, and that top F be abolished, on the following grounds :—(1) The presence of the top F, together with the unavoidable gap between E and F, tend to bring the pedal-board too much to the left (otherwise the precious note could not be reached at all). (2) It (F) mars the symmetry of the 29 notes. (3) It gives no adequate compensation for the above-named defects. (4) Because the distance between CC and F is too great : CC and top F cannot easily be played from the same position, unless by organists possessing very long legs. (5) and as a corollary to 1—Because this inaccessibility is not confined to the fancy top notes but is shared by the useful notes CC and DD, which are thrown too far to the left.

It may be remarked that the College of Organists' conference has

laid down no distinct rule for the treatment of two-manual organs. Measures calculated for three-manual instruments only, cannot be applied to two-manual ones—where the player of necessity sits nearer—unless a set of keys representing the choir be introduced. Here is a case, not of abrogating well-considered rules, but of adding the clause "*mutatis mutandis.*"

In many good two-manual organs, by Lewis and other builders, the distance from the Great ivories to the pedal surface is 29½in., as against 32in. College measure.

Couplers.

Like everything else, couplers are a good thing when they do something unattainable by other means and useful in itself. When such is not the case, and when they introduce unnecessary complication, they cannot be hailed as an improvement.

Let us first approach the subject from the point of view of the tone, considering especially the aggregation of stops in *mf* and *ff* combinations.

We know* (1) that the fewer stops needed to produce a given amount of power, the more coarse and unmusical will be the result ; there will also be less variety of tone colour as the stops are reduced in number. (2) That the lighter the wind, the greater number of stops will be needed to make up any given degree of power ; but the more singing, round, and melodious will be the tone, and—the stops being proportionately numerous—there will be a greater abundance of *varied* tone colour.

Again, the organ is obviously only a collection of voices—a kind of mechanical chorus. (As we have already remarked, the Germans very appropriately use the term *Stimme*, or voice to express a "stop." See page 6). Now this chorus of mechanical voices bears a close analogy to a choir or chorus. If its *pianissimo* is to be restful and dignified, it must be the self-controlled, suppressed power of *a number*

* See page 124.

of soft stops ; not a solitary Dulciana, painfully struggling against the disadvantage of heavy wind, like a horn player fearful that his note may "break off" in a *pp* passage. Nothing but mere vulgar blatancy can be got out of the *fortissimo* of a very small organ, when voiced to fill a church obviously too large for it, were its pipes speaking within their legitimate power.

These considerations should suffice to demonstrate that *richness and mellowness* of tone are results which are directly proportionate to the *number of subdued tones* which are combined.

So much for the *aggregate* effects.

Again, if solo stops are to have a distinct character, they will generally be found useless or harmful *in combination* ;* and the extent to which they are either useless or harmful may be taken as the *measure of their excellence* as imitative stops.

Here again we have another argument against restricting the number of stops in an organ.

But what about Couplers ? No one will assume that I am deprecating Unison Couplers, the soft "Choir sub" or the Swell "sub" and "super"—either for solo effects, or even for an occasional *sforzando* crash. What I do deprecate is the planning of an organ so that its legitimate effects are dependent upon these (or more far-fetched) contrivances. In a large organ every effect, other than occasional solo combinations, should be obtained, either from the manuals separately, or with unison couplers only. *Couplers introduce no new tone colour.*

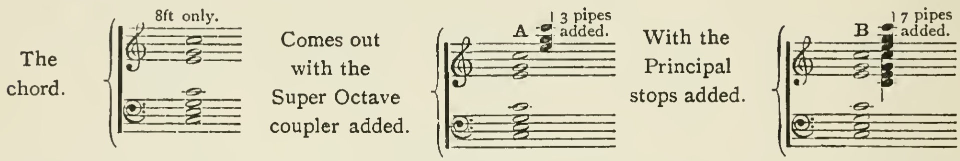
I was lately invited to inspect a very elaborate and up-to-date electric chamber organ. This in the first instance I preferred to listen to without seeing the stops, hoping thus to better appreciate the results of the scientific combinations.

"Why, you have only about eight stops," was my spontaneous remark—and, truly, there were but ten.

* *e.g.* The flute. If a flute stop is to be imitative it must have a lisping, sibilant tone. Now as pipes are nicked to get rid of this sibilant quality, which would prevent their blending with others, it follows that if a flute is imitative it will not blend with other stops, and that if it will blend, it is not really imitative.

I grew weary of the poverty of the instrument, and I could not accept octave duplications as new tone colours, still less as new effects.

Couplers are sometimes a fraud. When we add a Principal stop we strengthen the middle of the instrument—similarly with a Double 16ft. or any other stop of pipes—and we get an *extra* pipe for *every* note we play.* Not so with octave Couplers.†



Lastly I will propound a little paradox. Why is it that we have the other catch-word of the day "*All* stops of CC compass," and why is a tenor C stop looked upon as a kind of fraud, or as an anachronism?

Surely there are many solo stops which *are not wanted* below tenor C, *e.g.*, the flute—if as a *Solo*—and therefore a *non-blending* stop. To carry the *Voix Célèstes below tenor C is perhaps the height of absurdity in this direction.*

I do not advocate tenor C work—except in the case of some Solo stops, and, exceptionally, for reasons of economy—*far from it*; but a tenor C stop does not rob the organ of tone as a coupler does, and does something to strengthen the *really useful part* of its compass. It is curious that the parrot cry "full compass" in stops should be made an unthinking article of faith when poverty of tone is growing every day by the use of couplers.

As regards the *pedal* organ, all kinds of couplers are admissible, *because we do not usually employ more than one note at a time.* I should advise that each pedal stop either of 16ft. or 32ft. pitch should always be continued up, so that a 16ft. would give 16ft. and 8ft.

* In the case of Octaves, note that Couplers add only one note (either above or below as the case may be). In case A, there are originally three C's.—Tenor C, Mid. C, and 1ft. C—but only 6in. C is added by the Coupler. These three pipes (A), moreover, only give shrillness—there is nothing added to *the middle* of the chords.

† "A Double diapason is better than a Sub Octave Coupler"—Elliston. *Organs and Tuning*, p. 81.

stops, a 32ft., 32ft., 16ft. and 8ft. stops (three stops from 54 pipes). The enormous saving amply justifies this, especially as there is no perceptible drawback.

From two 32ft. and one 16ft. we get the following large pedal organ of eight stops, sufficient to balance 60 manual stops, viz.:

Stopped	32ft.	54	gives	(1) Sub Bass 32; (2) Bourdon 16; (3) Bass flute 8
Open	16ft.	42	,,	(4) Open wood 16; (5) Unison 8
Reed	32ft.	54	,,	(6) Contra-Trombone 32; (7) Trombone 16; (8) Trumpet 8
		150		

Thus 150 pipes give the same effect as 240—at *less than half* the cost.

My readers will perhaps forgive me if I do not figure out the enormous amount of combinations to be obtained from the above scheme, but if any reader of mathematical attainments will favour me with the solution, I shall have much pleasure in retaining this information for use in a subsequent edition. Supposing however that *only two* stops each of 16ft. compass were used, the number of *combinations* possible amounts to sixty-three as shown below.

Table of Combinations

Which can be produced from two stops of pipes and three couplers acting on each stop, *viz.:* (1) Reed stop, 16ft., 54 notes with sub-octave, unison, and super-octave couplers; (2) Open diapason, 16ft., 54 notes with sub-octave, unison, and super-octave couplers. (Total number of pipes 108).

From Reed only, 54 *notes.*

1. Trombone 16ft.
2. Trumpet 8ft.
3. Clarion 4ft.
4. Trombone 16ft., and Trumpet 8ft.
5. Trombone 16ft., and Clarion 4ft.
6. Trumpet 8ft., and Clarion 4ft.

Every combination or single stop is of 30 notes compass, being that of the pedal-board (CCC to F).

7. Trombone 16ft., Trumpet 8ft, and Clarion 4ft.

T

From Flue stop only, 54 *notes.*

8. 16ft. Open.
9. Unison 8ft.
10. Principal 4ft.
11. Open 16ft., and Unison 8ft.
12. Open 16ft., and Principal 4ft.
13. Unison 8ft., and Principal 4ft.
14. Open 16ft., Unison 8ft., Principal 4ft.

From both stops.

15. Trombone 16ft., and Open 16ft.
16. Trombone 16ft., and Unison 8ft.
17. Trombone 16ft., and Principal 4ft.
18. Trombone 16ft., Open 16ft., and Unison 8ft.
19. Trombone 16ft., Open 16ft., and Principal 4ft.
20. Trombone 16ft., Unison 8ft., and Principal 4ft.
21. Trombone 16ft., Open 16ft., Unison 8ft., and Principal 4ft.
22. Trumpet 8ft., and Open 16ft.
23. Trumpet 8ft., and Unison 8ft.
24. Trumpet 8ft., and Principal 4ft.
25. Trumpet 8ft., Open 16ft., and Unison 8ft.
26. Trumpet 8ft., Open 16ft., and Principal 4ft.
27. Trumpet 8ft., Unison 8ft., and Principal 4ft.
28. Trumpet 8ft., Open 16ft., Unison 8ft., and Principal 4ft.
29. Clarion 4ft., and Open 16t.
30. Clarion 4ft., and Unison 8ft.
31. Clarion 4ft., and Principal 4ft.
32. Clarion 4ft., Open 16ft., and Unison 8ft.
33. Clarion 4ft., Open 16ft., and Principal 4ft.
34. Clarion 4ft., Unison 8ft., and Principal 4ft.
35. Clarion 4ft., Open 16ft., Unison 8ft., and Principal 4ft.
36. Trombone 16ft., Trumpet 8ft., and Open 16ft.
37. Trombone 16ft., Trumpet 8ft., and Unison 8ft.
38. Trombone 16ft., Trumpet 8ft., and Principal 4ft.

39. Trombone 16ft., Trumpet 8ft., Open 16ft., and Unison 8ft.
40. Trombone 16ft., Trumpet 8ft., Open 16ft., and Principal 4ft.
41. Trombone 16ft., Trumpet 8ft., Unison 8ft., and Principal 4ft.
42. Trombone 16ft., Trumpet 8ft., Open 16ft., Unison 8ft., and Principal 4ft.
43. Trombone 16ft., Clarion 4ft., and Open 16ft.
44. Trombone 16ft., Clarion 4ft., and Unison 8ft.
45. Trombone 16ft., Clarion 4ft., and Principal 4ft.
46. Trombone 16ft., Clarion 4ft., Open 16ft., and Unison 8ft.
47. Trombone 16ft., Clarion 4ft., Open 16ft., and Principal 4ft.
48. Trombone 16ft., Clarion 4ft., Unison 8ft., and Principal 4ft.
49. Trombone 16ft., Clarion 4ft., Open 16ft., Unison 8ft., and Principal 4ft.
50. Trumpet 8ft., Clarion 4ft., and Open 16ft.
51. Trumpet 8ft., Clarion 4ft., and Unison 8ft.
52. Trumpet 8ft., Clarion 4ft., and Principal 4ft.
53. Trumpet 8ft., Clarion 4ft., Open 16ft., and Unison 8ft.
54. Trumpet 8ft., Clarion 4ft., Open 16ft., and Principal 4ft.
55. Trumpet 8ft., Clarion 4ft., Unison 8ft., and Principal 4ft.
56. Trumpet 8ft., Clarion 4ft., Open 16ft., Unison 8ft., and Principal 4ft.
57. Trombone 16ft., Trumpet 8ft., Clarion 4ft., and Open 16ft.
58. Trombone 16ft., Trumpet 8ft., Clarion 4ft., and Unison 8ft.
59. Trombone 16ft., Trumpet 8ft., Clarion 4ft., and Principal 4ft.
60. Trombone 16ft., Trumpet 8ft., Clarion 4ft., Open 16ft., and Unison 8ft.
61. Trombone 16ft., Trumpet 8ft., Clarion 4ft., Open 16ft., and Principal 4ft.
62. Trombone 16ft., Trumpet 8ft., Clarion 4ft., Unison 8ft., and Principal 4ft.
63. Trombone 16ft., Trumpet 8ft., Clarion 4ft., Open 16ft., Unison 8ft., and Principal 4ft.

The *Sforzando Pedal* is a coupler brought on by means of a

pedal, its object being to bring about an instantaneous increase of power.

Generally speaking Sforzando pedals couple the Great to the Swell, so that while the pedal is held down the two manuals are played from the Swell keys. Sometimes the Sforzando pedal is so arranged as only to bring on (temporarily) the "sub" and "super" octaves of the Swell organ itself.

The Sforzando pedal was introduced by Lincoln in his organ at St. Olave's, Southwark, built in 1844.

Crescendo Pedals have been introduced by various builders, effecting a gradual crescendo and decrescendo upon one or all the manuals.

Drum Pedal. This term was applied to a contrivance by which the two largest pipes in the organ were sounded simultaneously, thus producing a "beat" somewhat similar to the slow roll of a kettle drum. Drum pedals existed in many English organs during the eighteenth century. Instance—St. Botolph's Aldgate.

Closely akin to this obsolete and unworthy arrangement are the "Tonnerre"* and "Effets d'orage" pedals in French and Belgian organs.

This kind of realism was carried, I think, to its utmost extent, by the French organ-builder who introduced a small drum of parchment strained over a wire cage or frame, filled with peas and beans. M. Hamel† alluding to this arrangement thinks it kind not to hand the inventor's name down to posterity.

I have seen one of these machines in an otherwise most excellent three-manual chamber organ by Callinet. The noise of the peas rattling, together with the blast of wind rushing out of the motor which made the drum containing them revolve, was not unlike that of a hailstorm.

* I am informed that there is still a "pédale de Tonnerre" in Cavaillé-Coll's organ at the Carmelite Church, Kensington.

† Preface to Dom Bedos' *Art du Facteur d'Orgues*, Paris, 1849.

On Designing Organs—Balance of Tone.

Anticipating a possible feeling of surprise on the part of some readers, that I have failed to cater for them the customary "Menu" of Organ Specifications, usual in most works upon the organ, I wish to point out the fact that Specifications mean but very little, except so far as they describe the material contents of an organ. Of the result —*i.e.*, of the tone of an organ—they can present no definite picture.

If the best possible specification were given to a score builders, the result would be a like number of organs, dissimilar in tone, and ranging in quality from excellent to quite the reverse.

Exactly the same would ensue, if a score artists were set to reproduce in colours some given photograph, or line engraving.

To design an organ is not merely a matter of writing a list of stops, or specification. The most perfect specification is only like a medical prescription giving the names of certain drugs, without stating the exact *quantities* of each. It is as meaningless for any person who has not *practical* knowledge of Organ Construction to sit down and write a list of stops, or specification, as it would be for him to write out a list of drugs known as suitable for the treatment of any given malady, and to call it a prescription.

In the first case, the various details would have to be settled by the man who fully understands the subject, *i.e.*, by the organ builder.

In the second, they would have to be determined by the chemist. Of course these practical men would laugh in their sleeves at the directions, but if able to command their own price, they would, as a matter of policy, receive them deferentially.

To conceive in one's mind a finished instrument, to prepare clear notes of this conception for the guidance of the organ-builder, and above all to be able conscientiously to assume the responsibility of seeing this original conception thoroughly carried out, many qualifications are necessary. (1) To have had *many* years of varied experience

derived from hearing and playing upon organs. (2) To have analysed the causes of the various effects noted. (3) To have carefully sought out the reasons for which things, identical in themselves, have given different results in different surroundings. (4) To have cultivated a habit of generalising, and of referring particular instances to principles. (5) Last and not least—to have practical and experimental knowledge of organ construction.

If I have been able to give some definite information on the structure of organs, and especially if it has been my good fortune to have inspired any student with the desire to pursue this interesting subject farther, and to gain experience by patient investigation, I shall I think have done something towards enabling him to conceive or design an organ.

Such being the case, no direct rules can be given "how to design an organ."

The following are however some conditions upon which a satisfactory balance of tone depends.

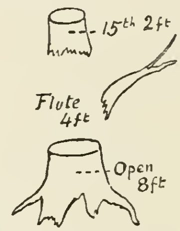
First of all it is essential that at least the *Great* Organ *shall be an Organ*, viz., that its Diapasons, Principals, Twelfths, Fifteenths, and Mixtures, be homogeneous, *i.e.*, practically all of one tone-quality—and produced by pipes of the same shape and style of voicing, differing but little in scale, and, if possible, made by the same pipe maker and voiced by the same voicer. The Combinations—Open and Stopped Diapasons; Diapasons and Principal; Diapasons Principal and Fifteenth (with or without Twelfth)—must each be *perfect blends*, in which it must not be possible to identify or separate the component parts. In other words—adding the Principal, Twelfth, Fifteenth, and Mixtures, must not *alter* the tone of the organ but only *extend* it so to speak—just as the tone of a bell *extends*, but does not radically *change*, by being struck harder. This result, which the best builders of the last century knew so well how to attain, has almost become a lost art, principally because it has become usual to endeavour to make certain stops serve in a dual capacity, *i.e.*, both as foundation stops and as solo stops;

also perhaps in some degree from the insensate antipathy to Mixtures which so largely prevails among organists, some of whom have positively never heard a good Mixture—and others who have not heard one for so long that they forget that such a thing is possible. To render what assistance I can to the reader I have treated organ stops pictorially (Plate XIII) so that the eye may aid in making my theory plain.

The trunk of the tree (Plate XIII) represents the Foundation work, the branches the Solo Stops. If we apply the analogy afforded by the tree to the construction of our specification we shall find that we must have the trunk complete before we can get the branches.

To write a specification of the following kind would be as absurd as is the diagram representing it

Fifteenth 2ft.
Flute 4ft.
Open Diapason 8ft.



The bough representing the Flute springs from nothing, and the top section of the trunk representing the Fifteenth rests on nothing—both evident physical impossibilities. (It will be noted that the flute is in a dual capacity—as Flute and Principal.)

It is important to observe that if any of the foundation stops be voiced "flutey," even though their *names* may remain orthodox the same *lapsus* will occur. Flutiness in foundation work *is the worst of defects*, as it destroys the bell-like cohesion of the various foundation tones. Flutes, or Clarabellas—if powerful enough to assert themselves when drawn with the foundation work—are either like drops of oil floating on water, but not mixing with it, or else they simply render the whole tone muddy—as if oil and water had been shaken up until an impure compound of froth and bubbles had resulted.*

* Messrs. A. Hunter and Sons, of Clapham, imitate the tones of open wood pipes very successfully in their large scale Stopped Diapasons—which they designate as "Clarabellas" upon the Stop Knob. Their object in so doing is to obviate the drawbacks above mentioned which attend the use of small open wood pipes generally.

What I have said applies primarily and principally to the Great Organ, which indeed is *the* organ proper.*

The Swell organ is always more or less muddy for the following reasons : (1) from being confined in a box, (2) from the fact that the advantage of *cres.* and *dim.* are required for many stops of *different* character and construction, thus necessitating the association of disparate tones whenever many of these stops are used together.

The Choir organ is virtually a Solo organ ; so, provided that the stops are individually good, and that some can be combined in groups, balance of tone is not necessary.

I shall now give three specifications, in order to further illustrate the theories I have laid down ; further supplementing them by remarks where necessary.

Specification of Two-Manual Organ, 20 Stops.†

Great Organ.		Swell Organ.	
1. Open Diapason	8ft.	1. Double Diapason	16ft.
2. Stopped Diapason	8ft.	2. Open Diapason	8ft.
3. Gamba (powerful)	8ft.	3. Gamba	8ft.
4. Dulciana	8ft.	4. Voix Célèstes (44)	8ft.
5. Principal	4ft.	5. Principal	4ft.
6. Harmonic Flute	4ft.	6. Fifteenth	2ft.
7. Twelfth	3ft.	7. Mixture (12, 22)	
8. Fifteenth	2ft.	8. Oboe	8ft.
9. Trumpet	8ft.	9. Horn	8ft.
10. Clarinet	8ft.		

* Before quitting this part of my subject, it is needful to point out that unduly large-scale stops are of necessity " muddy " in tone. It is, alas, only too common to find one huge Open Diapason in the Great Organ taking the place of at least two 8ft. stops, which appear to be necessary.

Dr. Hopkins (*The Organ*, chap. xxxvii, p. 283) explains this very clearly in the following words : " The fact is, when the scale is increased, the pipes no longer remain members of the " Principal Work " (Foundation Work), but, *from that enlargement*, merge into the " Flute Work."

Again (page 136), Dr. Hopkins remarks, " Each Foundation Stop, commencing from the Open Diapason upwards, is voiced brighter." Example—Sound successively Middle C Open Diapason, Tenor C Principal, Double C Fifteenth : each of the last two reiterate the pitch of the first, but their sound will be successively brighter, and there will be less of it.

† Usual Couplers are assumed in the case of each of these Specifications.

Pedal Organ (1) Bourdon, 42 pipes, with octave couplers, giving

Bourdon	16ft.
Flute Bass	8ft.

Open wood bass, 16ft., prepared.

Remarks. The Stopped Diapason in Great is preferable to a Clarabella, as when used with the Dulciana it gives a "choir organ" on which to accompany the Swell. It also strengthens the Gamba when used with it. A Clarabella would be too "woody" and "hooting" in tone for these purposes. It might be a boon to those who have to put up with two-manual organs, if the builders would arrange some mechanism by which, on drawing out, say the Clarinet or the Harmonic Flute, the obviously unusable stops such as the Open, Principal, Fifteenth, etc., should be cut off or pushed in; and that, when *any one* of these were again drawn the Clarinet should *ipso facto* be silenced. Such an arrangement could be easily effected and would be most helpful, as the difficulty of changing the stops is very great in two-manual organs. The same principle might also be applied to the Voix célèstes and Vox humana in the Swell.

Specification of a Three-Manual Organ, 30 Stops.

Great Organ.		Swell Organ.	
1. Double Open Diapason	16ft.	1. Double Diapason	16ft.
2. Open Diapason	8ft.	2. Open Diapason	8ft.
3. Open Diapason (Small)	8ft.	3. Stopped Diapason	8ft.
4. Clarabella	8ft.	4. Gamba	8ft.
5. Gamba	8ft.	5. Voix Célèstes (44)	8ft.
6. Principal	4ft.	6. Principal	4ft.
7. Harmonic Flute	4ft.	7. Gemshorn	4ft.
8. Twelfth	3ft.	8. Fifteenth	2ft.
9. Fifteenth	2ft.	9. Mixture IV, with 12th	
10. Mixture, IV ranks		10. Oboe	8ft.
11. Trumpet	8ft.	11. Horn	8ft.

Choir Organ.		Pedal Organ.	
1. Dulciana	8ft.	1. Open Diap., 16ft., 42 pipes	
2. Lieblich Gedact	8ft.	2. Bourdon, 16ft., 42 pipes	
3. Viol di Gamba	8ft.	Open wood	16ft.
4. Wald Flute	4ft.	(By octave coupler),	
5. Flautina	2ft.	Unison	8ft.
6. Clarinet	8ft.	Bourdon	16ft.
		(By octave coupler),	
		Bass Flute	8ft.

Remarks. In the Great organ a Clarabella is introduced and the Dulciana and Clarinet are removed, as the Great organ has no longer to do double duty as both Great organ and Choir.

The Stopped Diapason is transferred to the Swell, and the Gemshorn is added, enriching that organ by the group, Stopped Diapason, Gamba and Gemshorn, which form a useful and pleasing *mp* combination. The Stopped Diapason, too, is invaluable for assisting the Oboe in soft combinations.

It would greatly enhance the richness of tone in the Great organ if stops 1, 3, 6, 7, 8, and especially 10, were on, say $2\frac{3}{4}$ inch wind—2, 4, 5, 7 and 11 being on $3\frac{1}{2}$ inch, or even heavier, wind. The advantage would become more apparent by adding a Stopped Diapason to the first group, and a large Principal to the second one, together with large scaled Full Mixture of V ranks, and a Trombone, 16ft. of 42 pipes on the Pedal Organ.

Specification of a Four-Manual. Forty-one Stops.

Great organ as in previous (three-Manual) specification with the addition of a *Clarion*—twelve stops in all.

Swell as before with Contra-fagotto 16ft. and Vox Humana 8ft. added—thirteen stops.

Choir.			Solo.		
1.	Small Open Diapason	8ft.	1.	Tuba	8ft.
2.	Lieblich Gedact	8ft.	2.	Cor Anglais	16ft.
3.	Dulciana	8ft.	3.	Orchestral Oboe	8ft.
4.	Principal	4ft.	4.	Harmonic Flute	8ft.
5.	Wald Flute	4ft.	5.	Viole-d'amour	8ft.
6.	Piccolo	2ft.	6.	Stopped Flute	4ft.
7.	Clarinet	8ft.			

Pedal.			
1.	Open Wood 16ft.,	42	as before.
2.	Bourdon 16ft.	42	,,
3.	Trombone 16ft.	42	,,

Effect.		By Octave Couplers.		
Open Wood	16ft.		Unison	8ft.
Bourdon	16ft.		Bass Flute	8ft.
Trombone	16ft.		Trumpet	8ft.

Pressure of wind recommended : Great and Pedal flue work, 3½in. ; Swell, 3in. ; Choir, 2½in. ; Reed work generally, 4in. to 6in. ; Tuba, 10in. ; but these must be calculated to suit the particular building in which the organ is to be placed.

The remarks upon varied pressure of wind in the Great organ, in No. 2, are equally applicable to the present case.

Of course no *balance of tone* is attempted in the case of the Solo organ ; it is merely a collection of disparate elements intended to be used singly.

Illustration of a Defective Specification Corrected.*

Two-Manual Organ.

Great.		Swell.	
1. Open Diapason	8ft.	1. Open Diapason	8ft.
2. Clarabella	8ft.	2. Gamba.	8ft.
3. Harmonic flute	4ft.	3. Principal	4ft.
		4. Cornopean	8ft.

Pedal Bourdon, etc. etc.

* This example is taken from a published specification.

Remarks.—Great Organ. (1.) No cohesion of tone—three disparate, incongruous stops.

The combination of the Clarabella and the Harmonic flute would generate much *sympathy*. The aggregate windiness and looseness of tone of these stops would not only be distressing, but would successfully defy any attempt at accuracy in tuning. (2.) There is no suitable accompanying stop. (See page 145).

Swell Organ. No provision for combinations. Open and Principal combine, but lack the rounding and mollifying influence of a Stopped Diapason. Open and Cornopean is a raw combination : each stop *takes something from* the other.

Open and Gamba — bad, because the Gamba is overmatched. Gamba and Principal—worse, for the same reason.

Suggested rearrangement.

Great.		Swell.	
1. Open Diapason	8ft.	1. Gamba	8ft.
2. Stopt Diapason	8ft.	2. Clarabella	8ft.
3. Principal	4ft.	3. Gemshorn	4ft.
		4. Cornopean	8ft.

Advantages.

(1). Great organ is now " crisp " and firm, and can be tuned accurately.

(2.) The Stopt Diapason is available to accompany the Swell with. (See page 145).

The following combinations are possible on the Swell.

(1.) Gamba and Gemshorn *(p)*

(2.) Clarabella and Cornopean *(solo)*.

(3.) Clarabella and Gamba *(mp)*.

(4.) Clarabella Gamba and Gemshorn *(mf)* All stops except (3) are available for Solo purposes. And the Full Organ effect is excellent.

Finally, the student is advised to read the report of the Committee for investigating the Architectual Arrangements affecting the Musical requirements of churches.—*Journal of the Royal Institute of British*

Architects, Vol. VII., page 325. Much valuable information can be gathered from it.

Some Particulars concerning French Organ Builders.

Period previous to the Great Revolution. Cliquot — Francois Henri (born 1728, died 1791), may be considered to have been the most talented French builder of the eighteenth century. Not only were his instruments more perfect in mechanical arrangement than those of his compeers, but, as a reed voicer, he brought that art to extreme perfection.

Stops of his construction now remaining in France are venerated and preserved, as stops by "Father" Smith or Renatus Harris are in this country. The organ at St. Gervais, Paris, is doubly interesting from the facts that Cliquot's work has been preserved almost in its entirety, and that the Couperins—one of them the celebrated composer—presided over it as organists for several generations.

In 1760 Cliquot took Pierre Dallery into partnership.

The following are a few principal Parisian organs built by Cliquot and Dallery : St. Nicolas-des-Champs, La Sainte-Chapelle, St. Méry, and the organ in the Chapel of the Chateau de Versailles—besides many in the provinces. Eventually Dallery set up on his own account.

Cliquot was engaged upon the enormous organ at St. Sulpice when the Revolution interrupted his labours, and he died shortly afterwards. This organ, which would probably have been the largest in the world, met with no serious injury at the hands of the revolutionists, but had a tragic end—being wantonly destroyed by Louis Callinet in 1843, as is related elsewhere.

Period following the Revolution. After the times of sacrilege and vandalism, which disgraced the great popular upheaval, had passed, and the churches commenced timidly to take down their shutters, it was found that in most cases the organs had been damaged or destroyed. Religious life in France having almost ceased to exist, it was hard for

the priests to get funds sufficient to effect even the most rudimentary repairs. Organ builders had therefore little else to do but patch up old organs in the cheapest way possible. Moreover, their trade having practically ceased to be exercised in France for a quarter of a century, there were but very few competent builders left. The following appear to have been the principal ones: Pierre François Dallery (son of Pierre Dallery), F. Somer, and Louis Callinet.

Dallery was a pupil of Cliquot. Of Somer's training I have on particulars whatever. Louis Callinet, an Alsatian, was the youngest of several brothers—all organ builders—one of whom (Ignace) built many large organs in the North of France, Belgium, and Switzerland, and enjoyed a merited and extensive celebrity. The Callinets had been organ builders for many generations, the earlier members of the line having plied their trade in Germany.

Dallery worthily upheld the fame of his master Cliquot as a voicer, and his musical taste led him to suppress Mixtures with which the old organs were so lavishly supplied, and to substitute foundation stops. This—good in itself—was not always wise, as he crowded up the instruments with pipes for which no room could legitimately be found, and in many cases thus accelerated their destruction; the wind supply consequently proving inadequate, these organs used to "rob," and "full organ" playing was impossible on them.

Moreover, and partly from the wretched scale of remuneration he had to take, Dallery was always in financial straits. It is also averred that he was not over scrupulous. His new pipes were of the basest material, and he would often remove good stops under pretext of repairing them, afterwards substituting inferior ones.*

Louis Paul Dallery, his son, succeeded him, and between 1830 and 1845 did much really excellent work. He was fortunate enough to obtain orders to build a few entirely new organs.

Louis Callinet was a thoroughly competent and resourceful builder,

* M. Hamel's *Biographie des facteurs d'orgues*—op. cit.

who successfully followed his calling for many years. Some small organs of his remain, but his largest organ, that at the Oratoire du Louvre, has been entirely renovated. In 1839, Callinet went into partnership with M. Daublaine. M. Daublaine was a man of means, but of his training in organ building I find no record.

The firm of Daublaine and Callinet was entrusted with the completion of the monumental organ at St. Sulpice which had been left unfinished by Cliquot. This instrument was nearly completed when Callinet—after an altercation with his partner Daublaine, who refused to advance him a certain sum of money which he urgently needed—utterly and completely wrecked the organ (1843).

As he was practically penniless, no proceedings were taken against him. He ended his days as a workman in Cavaillé-Coll's employ.

Up to about 1840, organ building in France remained as it was in the time of Cliquot. Indeed it may be said to have retrograded.

Period of Renaissance in French Organ Building.

Such was the condition of things when Sebastian Erard, the inventor of the modern harp and of the improved pianoforte action which is still so largely used, turned his attention to the building of pipe-organs. His ideas were far from practical, and he originated nothing which has remained, but in his searches for ingenious and clever artificers to work out his inventions, he happened to engage an Englishman named John Abbey, who had worked as an organ-builder with Davis and also with Russell.

While in the employ of Erard, Abbey built the organ at the chapel of the palace of the Tuileries, and a chamber organ for the pianist Kalkbrenner, besides one at the Acadèmie de Musique.

Later, Abbey set up in business for himself, and the list of his organs in France embraces many "Grandes Orgues," besides about sixty small chancel organs, which latter he originated.

Abbey introduced into France the Venetian Swell, composition pedals, bellows with inverted ribs, and many other things which, while

commonly used in England half-a-century earlier, were a revelation to the French.

The late J. B. Stoltz was Abbey's chief pupil in France. He gained the reputation of being a very excellent workman, and for some years was "chef d'atelier" (foreman), with Daublaine and Callinet. After the reconstruction of that firm—under the style of Ducroquet et Cie—Stoltz established himself in 1845. His sons, MM. Edouard and Eugéne Stoltz, still continue the business.

Among the larger organs* built by J. B. Stoltz are those at the cathedrals of Cahors, and St. Jean-de-Maurienne, St. Germain des Prés, Paris, and several instruments in Spain, where the firm still have a large connection.

The history of French organ building during the reign of Napoleon III is practically all contained in the ledgers of the firm of Cavaillé-Coll. And, moreover, is such an oft-told tale, and one to be read in so many works on the organ, that I shall confine myself to giving a few less known facts concerning the Cavaillé family.

Gabriel Cavaillé, a musical amateur of Gaillac (Tarn), the first member of the family of which we hear, does not appear to have built organs, but his two sons, Pierre and Joseph, were strongly imbued with his musical tastes. Pierre eventually became a chemist, and Joseph an organ builder. Later both took orders. As a monk, and in conjunction with another monk named Isnard, Joseph Cavaillé built several organs in monastic establishments.

Jean Pierre Cavaillé, a younger son of Gabriel Cavaillé, joined his brother Joseph, who taught him his trade.

About 1750 Jean Pierre Cavaillé removed to Spain, where he built several large organs, and during his sojourn in Barcelona, married a lady of good family, whose maiden name was Coll. Hence the composite name Cavaillé-Coll by which his descendants were named. His

* Also the "Grand" organ at the church of St. Joseph, Paris, which suffered severely during the late Dreyfus riots. (This instrument was ordered by the Commission des Beaux-Arts in 1874).

son, Dominique Cavaillé-Coll, built many organs, which are highly commended by Dom Bedos. (Facteur d'orgues, op. cit.)

Aristide Cavaillé-Coll, the son of Dominique, and one of the most celebrated builders of any century, was born at Montpelier, Feb., 1811 (died Paris, Oct., 1899).

Great excellence, durability, and above all thorough conscientiousness, stamp every instrument he produced.

From 1845 to 1870 Cavaillé-Coll's career was a triumphant one. Success was succeeded by success, and victory by victory, until he practically enjoyed a monopoly of organ building, not only in France, but, to a great extent, all through the Latin countries. Very magnificent were the terms Cavaillé was able to secure—and later to enforce. For the Madeleine organ (one of his earliest efforts) an instrument of 48 complete stops, and pedal organ of incomplete compass, his remuneration works out at about £53 for each stop.* Even these terms were often considerably exceeded when he reached the zenith of his popularity.

Cavaillé should have died a very rich man, but his ideas were large in every sense, and his expenditure lavish. The whole of the compensation he received from the city of Paris on the demolition of his works in the Rue Vaugirard, when the Rue de Rennes was made in 1866-67, did not suffice to cover the cost of the enormous factory and palatial residence he built in the Avenue du Maine. It is sad to learn that when the old man became physically unable to attend to business, the goodwill of the concern which had once produced a princely revenue, only brought him £4,000 cash and a small annuity.

Cavaillé's success appears to have been largely due to his perspicacity in adopting Barker's pneumatic lever, at a time when every other builder refused to entertain it, and still more to the fact that he was

* The brothers Callinets' organ at St. François, Lyons, built a few years previously, also contained 48 stops, four manuals and pedals: its price was 20,000 francs, or about £17 per stop, which, considering the prices of material and the cheapness of labour, and the quantity of mixtures and small stops usual at that time, must have been fairly remunerative.

not only a very able man, but that his *opportunities were unparalleled* in the whole history of organ building.

All that Abbey had done was but a drop in the ocean, considering that scarcely any new organs had been built in France for sixty years, and that the old instruments were in the last stage of decay—from age, and from incompetent repairs by unskilled mechanics.

Above and beyond this, during the Empire great sums were spent upon the churches by the State ; and the introduction of railways suddenly raised the material prosperity of the land.

Unfortunately Cavaillé did not evince the same foresight in latter years with regard to tubular and electric work, which had served him so well when in presence of the pneumatic lever.

He continued, up to the time of his retirement, to build organs provided with a primitive and comparatively crude type of pneumatic lever, ventils, and pursed soundboards, containing much of the paraphernalia of old times, as used by Cliquot and Dom Bedos, which—having disappeared in England since a period past any living organ builder's recollection—were actually thought by many to have been systems invented by Cavaillé. His solitary important invention—a practical and reliable way of obtaining harmonics in pipes (*e.g.*, Harmonic flutes, Harmonic reeds)—will probably be remembered as the most lasting benefit he conferred upon organ building.

Under the Republic the church again fell on evil days. Deprived of the extraneous support and official patronage enjoyed during the Empire, it soon became evident that the number of loyal followers she could count upon was very small—Materialism and Atheism having by this time leavened the whole nation.

As a natural consequence very few organs have been built in France since 1870.

During this period of complete stagnation Cavaillé's magnificent establishment in the Avenue du Maine lay practically idle. M. Stoltz fils had to supplement pipe-organ building by pianoforte and harmonium making, and Merklin withdrew his chief factory to Brussels. The

Republic may therefore be said to have coincided with a period of decadence in organ building.

Latterly, there are signs of renewed activity in the organ-building trade in France, and foremost in the ranks of contemporary builders may be mentioned the firm of Merklin, who are the pioneers of electric and tubular work in France. Among their recent instruments, those at St. Clotilde, St. Jacques du-Haut-Pas in Paris, and, especially, their remarkable triply-divided organ at St. Nizier, Lyons, are to be noted.

Barrel, or Cylinder, Organs.

These instruments range from the, now practically obsolete, street organ, first introduced by a builder named Hicks, *circa* 1805, to the elaborate mechanical orchestras provided in the "Orchestrions" of Imhof and Mukle, and of some Swiss and German makers.

The late C. S. Robson once told the author that his great grandfather (who was named Wright) made a barrel organ for Fulham church about 1730, and this fact is also recorded, with some reserve, in Dr. E. J. Hopkins's article on Barrel Organs in Grove's Dictionary of Music.

The Robsons and Flights, were, during several generations, the principal makers of these instruments, which continued, for fully a century, to be in great demand for different places of worship.

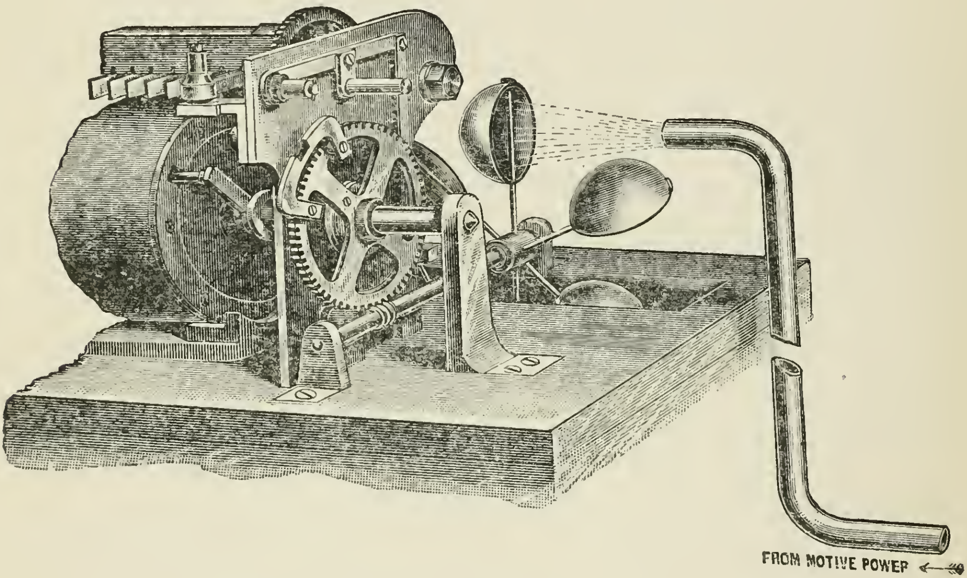
After the death of John Robson, this branch of industry passed to Messrs. Imhof and Mukle, of Oxford Street, and the making of mechanical instruments has almost become a lost art in England.

The celebrated Apollonicon, built by Flight and Robson, cost about £10,000, and was completed in 1818. This instrument was provided with five manuals available for separate players, and was also actuated by mechanical agency which further governed sundry instruments of percussion, thus completing the orchestral effects.

Fuller descriptions of this great masterpiece of human ingenuity may be found in many encyclopædias and works upon the organ.

At the present day the use of barrel organs in churches is extinct, but excellent "Orchestrions" are made, reproducing the orchestra in a way which not even five players on separate manuals could effect. In this case mechanical agency does something which cannot be done by one pair, or even by many pairs of hands; and therefore the barrel organ survives in this particular form.

A very successful miniature Apollonicon, or combination manual and cylinder organ, in which are several novel features never before introduced, was built by Mr. Wedlake for the late J. H. Van Ryn,



Atmospheric Propeller for Barrel Organs, invented by Leopold Mukle (Imhof and Mukle, Oxford Street), as used in Mr. Van Ryn's organ above described.

of Pembroke Square, in 1896 (see Plate XIV), of which the following is the synopsis.

Synopsis of the Organ: Two manuals, CC, 56 notes. Pedals 30 notes. *Great Organ*, 10 stops. *Swell Organ*, 10 stops. Pedals 2 stops. Total 1,114 pipes, 7 couplers, 4 combination knobs to Great, 4 ditto to Swell.

"COMBINATION" ORGAN.

(Modern Manual and Cylinder, 1896)

IN THE STUDIO OF THE LATE J. H. VAN RYN, ESQ.

Self-acting Mechanism Department. No. 1 Cylinder (Swell Organ) contains 74 keys, 18 being used for shifting the stops of both Great and Swell Organs.

No. 2 Cylinder (Great Organ) contains 74 keys. The 18 in addition to the note keys are used for Bass notes (12), and the following instruments of percussion : Large Drum, Tympani and Cymbals, Side Drum, Triangle. The Swell Louvres are worked automatically from the Cylinders.

There are no slides used in this organ, the action being tubular pneumatic throughout.

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Burton, W. J., Org. Builder, Winchester.
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Charlton, J., m.a., Leigh.
Clare, A. J., London.
Clarke, G., Peterborough.
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Collyer, A. H., mus. bac., f.r.c.o., Dollar, N.B.
Compton, H., Leicester.
Conacher & Sons, Org. Builders, Huddersfield.
Conrath, E. H., Frithwood.
Cook, E., Bristol.
Cooke, C. E., Kirkstall.
Cosway, M. W. G., Wandsworth.
Cox & Co., Cork.
Cox, T., f.r.c.o., Org. & Chm., St. Paul's, Wolverhampton.
Crackel, H., a.r.c.o., Masborough.
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Custard, R. Goss, a.r.c.o., St. Leonard's.
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Davis, J. A., West Bromwich.
Davies, Miss M., London.
Deavin, C. H., a.r.c.o., a.t.c.l., Gloucester.
Domaille, C. H., Guernsey.
Doubleday, W. W., Sheffield.
Drew, R. W., a.gld.o., Bath.
Drinkwater, J. E., London.
Dunn, L. P., Worcester.
Dunnill, J., Wakefield.
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Eardley, E. Stanbury, m.a., Birmingham.
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Elliott, H., Pinxton.
Ellis, C. J., Walsall
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Foster & Andrews, Org. Builders, Hull.
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Fuller, C. J. P., Horwich.
Gabriel, W. H., a.r.c.o., Tredegar.
Gaffe, G., f.r.c.o., Org., The Cathedral, St. Alban's.
Garrard, Lindsay, Lechlade.
Gardner, Rev. G., mus. bac., Cheltenham.
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Gilbert, H., a.r.c.o., Stoke-on-Trent.
Gott, C. H., Bradford.
Gray, M.A., Lieut-Col. I.S.C., Bedford.
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Griffen & Stroud, Org. Builders, Bath.
Grindrod, B. R., Org. Builder, Rochdale.
Groom, R. F., Stamford.
Guille-allés Library, Guernsey.
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Hamilton, C. & F., Org. Builders, Edinburgh.
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Hammond, Wm. G. C., London.
Hampson, H. P., Manchester.
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Hanson, J., London.
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Harker, H. F., Coventry.
Harling, Edwy, f.r.c.o., Org., St. George's, Dunster.
Harris, F., Org., Parish Ch., Paignton.
Harris, J., c.e., Hemel Hempstead.
Harrison, T., Bishop Stortford.
Hartridge, W. R., Guernsey.
Haselden, W. H., London.
Haskins, A. E. B., Maldon.
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Herbert, G., London.
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Heywood, J., Birmingham.
Hicks, E. J., Organ Builder, Guernsey.
Higgins, R. W., Exeter.
Hindell, J. F., a.r.c.o., Newmarket.
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Holgate, J., Oldham.
Holland, F., Leyton.
Holland, J. H., Birmingham.
Holloway, H., mus. bac., Bournemouth.
Holt, E., Walsall.
Howkins, T. Maudsley, l.d.s., Grimsby.
Hudson, J. W., mus. bac., Hull.
Humphries, H. C., London.
Hunt, N. A. Bonavia, Kilburn, London, N.W.
Hunt, F. J., London.
Hunt, T. F., f.gld.o., London.
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Jones, W. S., Bristol.
Jonson, F. Ashton, London.
Johnson, Basil, b.a., Org., Rugby School.
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Jowett, A., mus. bac., Leeds.
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Keates, A., Org. Builder, Sheffield.
Keighley, T., Stalybridge.
Kempster, W., Watford.
Kendrick, T. H., Hon. Org., St. Michael's Smethwick.
Kirkland, A., Organ Builder, London.

Knox, J., Newark.
Kruse, C. W. E., Org. & Chm., St. James', Gravesend.
Lancashire, A. J., F.R.C.O., Grimsby.
Lane, E. Burritt, MUS. BAC., F.T.C.L., London.
Lasle, A. T., London.
Law, J. W. J., A.R.C.O., Ilford.
Lawson, Percy, Org. & Chm., St. George the Martyr, Southwark.
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Lee, J. C., Organ Builder, Coventry.
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Litt, —, Ballaghaderin, Ireland.
Lloyd, C. & Co., Nottingham.
Loam, G. Langford, Org. & Chm., St. Edmund's, Crickhowell.
Lord, Miss M., A.R.C.M., Liverpool.
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Luscombe, G., Org. & Chm., St. David's, Exeter.
Lyon, W. H., West Kirby.
Lyttel, E. S., Glenalmond, N.B.
Mackenzie, D., Newquay.
Maggs, F. W., Org., Christ Church, Blacklands, Hastings.
Manders, F., London.
Maskell, J., Lewisham, S.E.
Mason, W. J., Hull.
Matimer, Malcolm, Org. & Chm., Christ Church, Shooter's Hill.
Mathews, J., Org., St. Stephen's, Guernsey
Mathews, J. A., F.GLD.O., Cheltenham.
Mayne, W. H., London.
Melling, W. E., Radcliffe.
Miles, Alderman J., J.P., Org. & Chm., St. Mary's Parish Church, Deane.
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Miller, C. J., London.
Miller, Frank, New York.
Miller, J. R., Organ Builder, Dundee.
Millington, R. A., Bradford.
Minns, J. E., St. James', Taunton.
Mirrlees, Alexr., Org. Builder, Glasgow.
Mitchell, F. W., Macclesfield.
Mitchell, J. W., Sunderland.
Moore, H. T., Redruth, Cornwall.
Moore, H. E., Halifax.
Moore, Reg. B., MUS. BAC., F.R.C.O., Exeter.
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Morgan & Smith, Org. Builders, Brighton.
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Noble & Co., A., Org. Builders, Derby.
Noble, W., London.
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Parker, W. H., Org., Par. Ch., Oswestry.
Palmer, E., London.
Parker, F. J., E. Grinstead.
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Pitman, G., London.
Pitts, Reginald, Guildford.
Pointer, E., Org. & Chm., St. Michael s, Betchworth.
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Ponton, W. A. J., Londonderry.
Pool, Reginald, London.
Porritt, J., Organ Builder, Leicester.

Powell, A. Seymour, Org. & Chm., St. Catherine's Par. Ch., Ventnor, Isle of Wight.
Preston, J. W., Gateshead-on-Tyne.
Pullein, F., a.r.c.o., Org. & Chm., Par. Church, Wrexham.
Ramsey, A. K., Devizes.
Read, H. Vincent, Wanstead.
Reeve, A. A., London.
Rendle, W. H., a.t.c.l., Org., Par. Ch., Bushey.
Richards, C. E., London.
Ridgway, Cecil, Hampton.
Rigby, W., mus. bac., a.mus.t.c.l., Org. and Dep. Chm., Congregational Ch., Bury.
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Rodger, D., Port Glasgow.
Rook, E. Franklin, London.
Rousseau, Samuel, Paris.
Ruggles, T., London.
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Sadler, E. R., Org. & Chm., Church of the Resurrection, Brighton.
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Sharpe, R., Southampton.
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Shaw, J., London.
Sheppard, Dr. W. J., London.
Shergold, C., Org. & Chm., Parish Ch., Cookham.
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Shore, S. R., Birmingham.
Sinclair, D., London.
Smith, F., Wiveliscombe.
Smith, G. H., mus. doc., Hull.
Smith, H. F., a.r.c.o., Org. & Chm., St. Saviour's, Nottingham.
Smith, J. Turner, Skipton.
Spencer, A., Sleaford.
Stedman, Eustace, Wallington.
Steel, J. G., London.
Stenson, H. F., a.r.c.o., Spondon.
Stephenson, E., a.r.c.o., Sunningdale.
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Stevens, F., Old Hill, Staffs.
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Stocks, G. Gilbert, Huddersfield.
Stocks, H. W., Org., Essendon Church.
Stokes, F. H., London.
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Taylor, Stephen, Leicester.
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Thornber, W., Manchester.
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Whitley, Winifred A., Weybridge.
Whitehead, H., Godstone, S.O.
Whittaker, J. J., Carlton, Nr. Barnsley.
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Williams, J. H., F.R.C.O., L.R.A.M., Nottingham.
Wilson, E., Org. & Chm., St. Paul's, Wednesbury.
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Wright, C. F. J., Org., St. Philip's Clerkenwell.
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