Chapelle Notre-Dame de l’Hôpital du Val-de-Grâce
Evolution of Cavaillé-Coll’s symphonic organ

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Prologue
In the history of musical culture, romantic organs created in France in the 19th century are commonly called symphonic instruments. For French Baroque organs, called Classical organs – which to this day occupy a significant card in the history of organ building – symphonic instruments constituted an opposition pattern of construction, educated in the spirit of the aesthetics of the Romantic era. These instruments, being predominantly the works of one artist, Aristide Cavaillé-Coll (1811-1899), combine a repetitive structure of elements whose mutual relations influenced their individual tone. This structure of elements paved the way for many 19th-century organ composers and improvisers, and then created perspectives on 20th-century music. The legacy of French composers-improvisers associated with this particular type of organbuilding is a direct reflection of the features of these instruments.1

The literature on Aristide Cavaillé-Coll’s organist and organist is very rich. France has well-preserved archives, and the 19th century has already been a time of comprehensive use of permanent methods of recording both text and image (initially figures and then photographs). In addition, Cavaillé-Coll left many written materials – notes, scientific articles and other publications including illustrations; many non-existent instruments were sketched or photographed. First of all, many instruments have survived to this day, which are tangible proof of the features and skills of their author. The uniqueness of Aristide Cavaillé-Coll’s instruments and their influence on many phenomena of organ art caused and cause the development of many scientific studies.

In this article I would like to show the evolution process of Cavaillé-Coll’s symphonic organ throughout the whole life of this visionary organbuilder.

Periodisation of Cavaillé-Coll’s works
In the literature on the subject, Kurt Leuders divides Cavaillé-Coll’s organ works into three periods: 1. post-classical period, 2. operatic period, and 3. symphonic period.

The first post-classical period includes eight early instruments made up to 1850; the larger works of this period include the organs of Saint-Denis (1841) and Congrégation du Bon Secours de Paris (1850).

The middle operatic period includes fourteen works made from 1851 to 1871 (during the Second Empire); the most important of which are organs in Chapelle Notre-Dame de l’Hôpital du Val-de-Grâce (1853), Chapelle de la Fondation Eugène-Napoléon (1857), Saint-Louis-d’Antin (1858), Saint-Bernard-de-la-Chapelle (1862), Saint-Sulpice (1862), Congrégation des Lazaristes (Chapelle Saint-Vincent-de-Paul) (1864), Saint-Jean-Baptiste de Neuilly (1865), l’Église Évangélique Luthérienne de la Résurrection (1866) and Charenton-le-Pont and Chapelle de Conflans (1866).

The late symphonic period includes sixteen works made from 1872 to death; the most important of which are organs in Notre-Dame-de-la-Croix (1874), l’Opéra de Paris-Garnier (1875), Saint-Clodoald/Cloud (1877), Chapelle Notre-Dame-de-la-Médaille-Miraculeuse (1880), Maison de la Congrégation des Sacrés-Coeurs et de l’Adoration Perpétuelle (1880), Notre-Dame-du-Rosaire (1880-1890), Notre-Dame-d’Auteuil (1885, later electrified and expanded), Sainte-Geneviève-des-Grandes-Carrières (1890), Charenton-le-Pont, Saint-Pierre (1891), Saint-Martin-des-Champs (1893), Saint-Antoine-des-Quinze-Vingts (1894), l’Église de la Mission Espagnole (1897), Basílie du Sacré-Cœur (1898) and Saint-Augustin (1899, later rebuild). According to this classification, the Cavaillé-Coll organs are not in themselves synonymous with the “symphonic” instrument, and the above approach to the division of Cavaillé-Coll’s work is also confirmed to a certain extent by Daniel Roth and Pierre-François Dub-Attenti2 or Mariusz Wrona3. Despite the awareness of this fact, the term “symphonic organ” will be used in this article for all Cavaillé-Coll instruments, as an emphasis on the phenomenon of the evolution of the symphonic element in all instruments of this organbuilder.

Characteristics of Cavaillé-Coll’s symphonic organs
Depending on the size of the room and the musical function of the instrument, Cavaillé-Coll built various organs. From 4 to 7 stops he placed in one-manual instruments. Two-manual projects with 8 to 26 stops distributed on Grand-Orgue and Récit expressif sections, between which he then placed the Positif section (from 1865 often also in a separate expressive box). When the number of stops exceeded 50, he introduced the fourth manual, Bambarde, and basically put it in mixtures and reeds from Grand-Orgue section. Usually the Pédale section was populated modestly, but quite extensively (16’, 8’ and 4’ labial stops and reeds, widened in larger instruments with 32’ stops and overtone stops ie fifths, tirds,
seventh). During the re-use of classic organcases, Cavaillé-Coll kept the balustrare positive for the Positif section, but in the new organs he always placed all the sections in one cabinet. Cavaillé-Coll expressive boxes have relatively thick walls, and initially placed only stops from 8’ up, while lower stops were outside the box; only later, all the stops of the Récit section were placed inside the expressive box. In the first instruments he also used the classical scale of the pedalboard, from F to f’. From the 1840s to around 1862, the scales of all manuals had 54 notes (C to f”), while the pedal had 27 notes (C to d’); then extended the scale to 56 notes (C-g”) for manuals and 30 notes (C-f) for pedalboard. 61-note manual (C-c”) appeared only in a few late instruments exported to England and the Netherlands. All keyboard couplers, swell shutters controllers and switches to Jeux d’Anches were controlled by foot pedals to allow the organist to use them without taking their hands off the keyboards. From around 1872, a spoon-shaped pedal to operate the foot of a rather uncomfortable three-stage opening of the swell shutters located on the right-hand side of the pedalboard was replaced with a modern, weighted pedal placed in the central section above the pedalboard.

Cavaillé-Coll and his clients preferred free-standing and inverted consoles; built-in consoles (console en fenêtre) were not uncommon, especially in reconstructions and small instruments; in two-manual organs they were often mounted on the side, which was a mechanically and liturgically beneficial solution. He remained faithful to the mechanical action, although many of the larger instruments fitted Barker’s lever. Particular attention was paid to the supply and distribution of wind; he used large collective storage bellows, which collected the necessary amount of air and smaller compensation tanks for each wind changes necessary for frequent sonic changes to stabilize his pressure. In addition to extreme cases,
the wind pressure was between 90 and 110 mm. Most often, the wind pressure for reeds and the upper range of labial stops the higher range of windchests is higher than for Jeux de Fonds and the lower range of windchests.

Each section of the medium and large Cavaillé-Coll’s instrument contains tonal elements of Grand-Chœur, with Trumpets complemented by 4-foot Clairons (most often harmonics) and 16-foot Bassons or Bombardes (sometimes both). One or more reeds had its upper part of the scale of the harmonic type (double length resonators) for increasing the richness and balance of tone, and several large organs have sets of horizontal resonators topping the sound of a given section. Cavaillé-Coll introduced and perfected overtoned flutes; he called them Flûte harmonique 8’ (Flûte traversière 8’ in Récit sections), Flûte octavante 4’, Octavin 2’ and Piccolo 1’, which form the characteristic sound unit of the Récit section. The main Jeux de Fonds (basic voices) are: Montre (Principal in the Grand-Orgue section or Diapason in secondary sections), Prestant (and softer, conical Octave 4’ placed in the Jeux d’Anches group), Bourdon 16’ and 8’ (stopped 4’ Flûte douce) and narrow-voiced stops, ie Quintaton, Viole de gambe, Salicional and Violoncelle. Other reeds used by Cavaillé-Coll were Basson and Cor Anglais 16’, Cromorne, Voix humaine and Clarinette 8’; the upper part of the Hautbois 8’ scale was often combined on one register with the bottom part of the Basson 8’ scale, and the free-voicing Voix céleste (in Récit combined with Gambas) and Unda maris (in Positif combined with Principals or Salicionals) were permanent components of the section. The Récit section in the first instruments represented the post-classical solo function of the Echo section, and only gradually became symphonic for decades. From the beginning of 1860s, the pitch in France was a=435 Hz.

Making contacts with several leading French scientists, Cavaillé-Coll constantly carried out experiments in the
design of pipes, eventually creating a concept of geometric scaling. His passion for the adjective “harmonique” can be attributed to his quest for the famous “ascension”, thanks to which usually weaker higher tones gained strength in his organs. The Mixtures and Cornets composition differed significantly: in general, classical compositions dominated – except from around 1857 to around 1875, when he favored “progressive” Plein Jeu (imitating German standards), deprived of higher choirs in the lower ranges of scales.

One of the greatest achievements that Cavaillé-Coll brought to the organ building was the flexibility and expression of the gradation of the tonal volume of the instrument: from delicate to full sound. The great crescendo and diminuendo became more and more characteristic of the music of the era. In Central Europe crescendo was carried out on the basic stops by adding in turn the aliquotes, reeds and mixtures, thus leading to significant changes in the color of the sound. The Cavaillé-Coll’s solution takes better account of the nature of the instrument: by decomposing the important Grand-Chœur elements in each organ section, it suggests to put into use the first closed in Récit section the Trompette and Clairon, making it possible to increase and decrease the volume while maintaining the same basic color on each dynamic level. Because the section couplers, expressive box and Jeux d’Anches were controlled with foot-switches, the player could get a full crescendo with a uniform sonic tone despite going through the whole dynamic range of the instrument without removing the hands from the keyboard.

Cavaillé-Coll was the true creator of French romantic organs, and his influence on English and German organ building was significant. He added the flutes and reeds to the classical French organ, the expressive box and horizontal trumpets used in Spain, as well as the string-shaped stops inspired by the German style. The workmanship and materials of the Cavaillé-Coll’s organs are excellent, and his stops are excellent sounding. Important classical elements, such as the choirs of Mixtures and Mixtures with broad scales, were a bit neglected, which made his organs not suitable for performing the early French repertoire. However, the greatest French composers of organ music, from César Franck to Olivier Messiaen, were inspired by the instruments he created. In addition to the legacy of world-famous organs, Aristide Cavaillé-Coll has left a reputation for a dedicated ally of valuable musicians and their affairs, which is the embodiment of the integrity of the idea of humanism and artistry.

Aristide Cavaillé-Coll, realising and developing the vision of symphonic organs, also had to consider the issue of appropriate performers who made music on his instruments on a daily basis. Even the most wonderful instrument without proper musician remains silent. His friends were: Louis-James-Alfred Lefébure-Wély, César-Auguste Franck, Nicolas-Jacques Lemmens, Félix-Alexandre-Amédée Guilmant, Charles-Marie Widor, Charles-René Collin, Henri-Victor Tournaiillon and Henri Messerer. Each of these characters played a significant role in the history of the evolution of the vision of the Aristide Cavaillé-Coll’s symphonic organ, while most also in the history of organ-development of symphonic music entering permanently into the canon of immortal its creators.

**Stages of Cavaillé-Coll organ building development**

The essential stages in the development of the idea of symphonic organs in the work of Aristide Cavaillé-Coll were:

1. Invention of the poikelorgue (Toulouse, 1832);
2. Windchests with two or three sections of different wind pressure (Billetes, 1839);
3. Swell box (Récit-expressif) with three-stages level of opening (Saint-Denis, 1841);
4. New organ stops: flûte harmonique (Saint-Denis, 1841), reeds possibly faithfully imitating the same orchestral instruments, strings stops, free-heating stops (Voix celeste, La Madeleine, 1846; Unda maris Notre-Dame, 1868);
5. Barker’s lever (Saint-Denis, 1841);
6. first organ with 4 manual console (Saint-Roch, 1842);
7. Swell box for two sections (Exposition Universalle, 1855);
8. Widening the keyboard scale: manual up to 56 tones, C-g”, pedalboard up to 27 tones, C-d’, Exposition Universalle, 1855);
9. Widening the keyboard scale up to 61 tones, C-c”’ (The Albert Hall, Sheffield, England, 1873); 61-tone scale was used in few others organs only: two times for baron de L’Espe (Paris, 1894 and Ilbaritz, 1898) and for The Manchester Town Hall;
10. An expression box operated with a pedal with a smooth range of movement (The Albert Hall, Sheffield, England, 1873);
11. An expression box for three of four manual sections (The Albert Hall, Sheffield, England, 1873);
12. Advanced pneumatic system for switching the stops (Saint-Sulpice, 1862);
13. Amplification of additional harmonic tones by new stops eg sevenths (Notre-Dame, 1867);
14. Octaves graves and Octaves aigus.

The sound spine of symphonic organs
Considering the optimal statistical instrument coming out of the Cavaillé-Coll’s workshop, which had three manual sections (Grand-Orgue, Positif, Récit) and the Pédale section, the spine of the set of stops that occurred in almost every instrument in the individual sections, are:

<table>
<thead>
<tr>
<th>Stops</th>
<th>Description</th>
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Cavaillé-Coll, realising and developing the vision of symphonic organs, also had to consider the issue of appropriate performers who made music on his instruments on a daily basis.

Features of Aristide Cavaillé-Coll’s symphonic organs
When analyzing Cavaillé-Coll’s instruments, one can distinguish several features that constitute symphonic organs.

Orchestral organ stops: Invention of new organ stops – i.e. Flûte harmonique 8’ (and its variations Flûte octaviante 4’, Octavin 2’), reeds possibly faithfully imitating the same orchestral instruments (Hautbois, Basson, Clarinette), reeds harmonique (Trompette harmonique, Clairon harmonique), strings stops, free-heating stops (Voix celeste and Unda maris) – was like a window for introducing fresh air into organ music. Cavaillé-Coll used orchestral quartet of organ stops, which was: 1) choir of principals, 2) choir of flutes, 3) choir of strings and 4) choir of reeds.

Sections layout: The optimal instrument of the Cavaillé-Coll had three manual sections (Grand-Orgue on the lowest keyboard, Positif above G.O., Récit above two previous) and the Pédale section. In larger instruments there were extra manuals with special features: Grand Chœur (containing reeds and mixtures from G.O., Bombarde (reeds), Solo (with mainly solo stops).

Swell box (Récit-expressif): The express-box box with a movable shutter originates from the Echowerk section in the German pre-romantic organ building, although similar solutions were also used simultaneously in Spain and Portugal. Pipes of such a section were placed in a lockable box (usually above the head of the player, which made it easy to open it). Next, a spoon-shaped foot lever, which enabled three-step adjustment of the door and later the shutters (closed, semi-open and open). As the prototype of an expressive box in the shape we know of today (i.e a box equipped with movable shutters), the solution developed by English organ master Abraham Jordan and used in England from the early 18th century is considered, it was supposed to help “emit a sound expressing the passion of growing and lowering every note on the pattern of human breathing”7. The first application of the expression cabinet (with a three-stage pedal paddle) in...
France belongs to Aristide Cavaillé-Coll in the Récit section of Saint-Denis organ and since then the expression box has become an integral part of all French romantic instruments. A great advocate of this solution was Abbé Georg Joseph Vogler (1749-1814), who propagated it in German organ-building, although at first without much interest. Another was the use of an expressive cabinet: in French music it was mainly used to shape the melodic line, while in German music – to express emotions.

**Steps’ combinations:** The distribution of stops within each section into Jeux de Fonds and Jeux d’Anches enabled the following solution: thanks to the pneumatic mechanisms for the turning on and off of stops, the Anches section could be fully integrated and detached (via foot levers: appel d’Anches G.O., appel d’Anches Pos., Appel d’Anches Rec., Appel d’Anches Ped., etc.). In the case of disconnecting the Anches section, the manubriated stops became, to some extent, “memorised” stops, and their launch took place when the lever of the appel d’Anches was pressed. In comparison with the manual registration of each of several dozens of stops separately in the case of a mechanical register action, this invention has improved the registration process in a unique way.

**Quality:** No less important feature of Aristide Cavaillé-Coll’s symphonic organ was their very high quality. The use of the best possible raw materials and precise execution made the sound of instruments the its main determinant. Cavaillé-Coll took care of the appropriate metal composition for the production of pipes and the thickness of the pipes’ walls, which are key elements for sound quality. In addition, convenient access to all the mechanisms that require regular look-up, tuning or adjusting was a model for other organ-makers.

**Interiors of large cathedrals:** Undoubtedly, an important factor for the organ’s sound is the interior in which they are placed; it sounds different in the sacral space with a frequent reverb, and in a dampened concert hall. The Cavaillé-Coll’s symphonic organs gained a lot from locating them in large French cathedrals, where high walls, stone floors and vast space constituted unusual resonant boxes for the sound source. If we add to the purely physical features of the interior the weight and nature of the celebrations held in them (sublime religious worships, resting places of kings and purples), then we will get a full picture of the importance of this factor in shaping the sound of French symphonic organs.

**Evolution of the idea of Cavaillé-Coll’s symphonic organs**

The evolution of organ building in the nineteenth century was forced by a change in musical aesthetics of the society of that time. The definitive departure from polyphony in favor of a homogeneous sound was evident throughout all areas of music, both vocal and instrumental. The development of orchestras and choirs gave to listeners and composers new possibilities of using musical material. Directing the attention of the nineteenth-century listeners to the color, dynamic diversity, changing nature of the sound forced the organ-makers to review their actions and pay attention to the search for such organ-master solutions, so that the prevailing expectations can be realised. This is where you can see the genius of Aristide Cavaillé-Coll; as the first in the French cultural circle he began the path towards orchestration and symphonisation of organ building; he did so earlier than required by society (turned away from the Church on the wave of the Revolution) and composers of organ music (they did not write for this instrument because it was for them a synonym of old music art). The vision of Aristide Cavaillé-Coll consisted in the fact that despite loneliness in this way, he walked without braking and without deviation from his chosen course. Thanks to his persistent attitude, during his life he was able to transfer organ...
music from the past of history to the heights of artistic art, where he is still today.

Description of the comparative methodology
Due to the very extensive time (66 years between 1833 and 1899), range (organs from 4 to 100 stops) and geographically (France, England, the Netherlands, Belgium, South America, etc.), the area of Aristide Cavaillé-Coll’s organ works, there are large discrepancies in the determination of their actual quantity. Sources speak of numbers from over 400 to over 600 organs made. In any case, the highest opus number used by the company is 678 for the instrument at the Paris church Saint-Ferdinand-du-Ternes put into use in December 1898 (ten months before Aristide Cavaillé-Coll’s death), which suggests that this is the total number of organ works (but not separate instruments) carried out by the company. There are many indications that every work done by the company was opussed: building new instruments from the beginning, rebuilding and expanding existing organs, further extensions of own instruments, and translocations.

Due to the fact that Aristide Cavaillé-Coll constructed from the beginning to the end, or significantly rebuilt, giving them a symphonic character, probably about 450 differentiated in many respects organs, I took additional criteria into the selection of the research material. The comparative methodology was built as follows:
1. I rejected unrealised projects;
2. I reviewed censuses (Cavaillé-Colls, Huybens, Eschbach, Galtier, Shuster-Fournier) of organ-master works (instruments built from the beginning, extended instruments) by Aristide Cavaillé-Coll according to the following features: built and located in Europe (I rejected the instruments that were exported outside of Europe, because the company most often did not assemble them on their own, but only entrusted these works to local organbuilders that had a large impact on the final shape of the work, and we do not know the state of potential damage that could have occurred during transport for several weeks such long distances and possible repairs); the number of stops at the time of commissioning by Aristide Cavaillé-Coll; the date of putting into service; the place where they were located when they were put into service (and they are often still found there);
3. from this set I chose organs with a total number of stops 45 and more; there are 31 of them representing the entire creative period - from the first years after the arrival of the 22-year-old organ master in 1833 from Toulouse to Paris (the first instrument Op. 4 in L’Eglise de Lorette in Paris was placed in this collection in 1838) until the last years before the death of the organmaster in 1899 (the last placed in this collection was the instrument Op. 678 built in the residence of baron De L’Espee in Biarritz-Bidart in France); all of these instruments had (have) from 3 to 5 keyboards and a pedalboard;
4. each of these instruments was then described in more detail according to the following characteristics: the building in which they were located at the time of putting into use (most are still there), the type of instrument (church instrument, home instrument), country of destination, total number of real stops, number of keyboards, opus according to catalogues and plates of the organ master, date of putting into use, total price in French francs (if it was possible to determine it), number of stops in the Grand-Orgue section, number of stops in the Positif section, number of stops in the Récit-expressif section, number of stops in the Pédale section, number of stops in other sections (Bombarde, Grand-Chœur, Solo), this concerned large instruments with the number of manuals 4 and 5); 5. the above set of 31 instruments I ranked according to the official date of inauguration of each instrument; 6. this way I received a set of 31 instruments for quantitative and qualitative analysis.

Analysis of selected great instruments of Aristide Cavaillé-Coll
According to the methodology described above, from the analysis of all 678 works carried out by Aristide Cavaillé-Coll, I selected instruments with 45 or more stops. The list 31 of these organs is presented in Table 1.

Conclusions
By mapping the calculations made in accordance with the research methodology described above, the graph shows clear trends in the distribution of stops in particular sections of the instruments (see: Picture 1).

During the second and third thirds of the 19th century, we observe changes in the meaning of individual (basic) sections of organs. The importance of the Récit section increases from 16% to 37% [(37-16)/16*100%] by 131% compared to the starting point. The increase in the importance of the Récit section is twofold: first, this section has been extended to the entire manual section scale (C-F” in relation to the limited scale of classical instruments (eg c’-f”); secondly, the section – equipped with an expressive box and new orchestral and harmonic stops – it became a kind of a romantic heart of the whole symphonic instrument, which, through links with the other sections, gave each of them a new dynamic dimension.

The significance of the Pédale section is growing from 15% to 21% [(21-15)/15*100%] by 40% compared to the starting point. The growing importance of the Pédale section is also twofold: firstly, the section scale has been extended to the manual section scale sounds (from C as opposed to the Pédale section limited scale in classical instruments (eg F-F’); secondly, the section – provided with low-sounding stops (16’ and often 32’), stops amplifying harm-
onic tones (fifths, thirds, later also sevenths) and new orchestral stops – it became the bass foundation of the whole symphonic instrument, which was created to perform homophonic music, in which the most important is, except the soprano line, the bass line also.

The Positif section decreases from 26% to 21% [(21-26)/26*100%] by -19% in relation to the starting point. This situation results from the departure in Romantic music from Baroque dialogues between the main section of the Grand-Orgue and, placed on the balustrade of the music empor, the Positif section (a mirror, though more modest reflection of the Grand-Orgue section). Some stops completely lose their raison d’être (usually single- or multi-row principal choirs above 2’ and Cornetts), others change their role through modifications in construction (traditional flutes 8’, 4’ and 2’ for harmonic flutes - Flûte harmonique 8’, Flûte octavante 4’, Octavin 2’), others they appear (orchestral reeds - eg Clarinette, Fagott, or strings – eg Gambe, or characteristic stops - eg Unda maris). Despite the significant depletion of their own stops, the connection of Positif with the Récit-expressif section makes it an important field of playing more distinct – in relation to the Récit-expressif section – music runs.

The Grand-Orgue section is maintained (or decreased very gently) from 31% to 29% [(29-31)/31*100%] by -6% compared to the starting point. The Grand-Orgue section throughout the nineteenth century maintained its primacy in terms of the volume of stops cast and is still the basic sound section. Only the issue of qualitative sound has changed: some stops change their role through modifications in construction (traditional flutes for harmonic flutes), and others appear (orchestral reeds or strings). Thanks to the combination with the dynamic section of Récit-expressif, it has become possible to create new sound surfaces, e.g. semi-Grand-Chœur, which is characterised by a full section of the Récit-expressif (included all Jeux de Fonds and all Jeux d’Anches) connected to the Grand-Orgue section with only Jeux de Fonds group (16’, 8’ labial stops, and some 4’); in this way, the dynamic space of the richly sound Récit-expressif section takes place on a very powerful base of Grand-Orgue Jeux de Fonds. The same effect can be obtained on the pedalboard, when the Pédale section with only the stops of the Jeux de Fonds group is joined by the full Récit-expressif section (including Jeux de Fonds and Jeux d’Anches).

At the beginning of the work of Aristide Cavaillé-Coll (3rd and 4th decade of the nineteenth century) the...
stops of his average instrument were distributed more or less in the following proportions: Grand-Orgue 35%, Positif 29%, Récit 17% and Pédale 15% (in the remaining 100% statistical stops quantity is filled with auxiliary and low sound and scale sections Bombarde, Solo, or Echo). This corresponds to the initial situation when Cavaillé-Coll rebuilt the classical French organs of the Golden Age with well-mannered Grand-Orgue and Positif sections and the “nascent” section of the Récit-expressif and the emerging in a new way Pédale section.

One of the examples of the very beginning of the evolution of symphonic organs can be here the instrument for Saint-Denis, France (see: Table 2) and for the medium stage – the instrument for Albert Hall in Sheffield, England (see: Table 3). The instruments from the final stage of Aristide Cavaillé-Coll’s work (the last decades of the 19th century) are a completely different sound reality. The Grand-Orgue section still dominates (28%, or the total cast of the Grand-Orgue and Grand-Chœur sections), but only slightly ahead of the main determinant of organ symphonism in the Récit-expressif section (27%). The importance losing Positif section (20%) is equated with the growing Pédale section (20%). In the remaining up to 100% statistical number of stops, additional sections extending the sound of the instrument (Bombarde, Solo) are planted.

An example of the last instruments of Cavaillé-Coll where the symphonic idea shows its culmination can be the organ of Saint-Ouen in Rouen, France (see: Table 4).

Table 1. Organs over 45 stops built by Aristide Cavaillé-Coll.
Source: Own elaboration.

<table>
<thead>
<tr>
<th>Place</th>
<th>Number of stops</th>
<th>Number of manuals</th>
<th>Opus</th>
<th>Day of inauguration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eglise de Lorette (Paris, France)</td>
<td>48</td>
<td>3</td>
<td>4</td>
<td>1838/10/22</td>
</tr>
<tr>
<td>Basilica (Saint-Denis, France)</td>
<td>70</td>
<td>3</td>
<td>10</td>
<td>1841/09/21</td>
</tr>
<tr>
<td>Eglise Saint-Roch (Paris, France)</td>
<td>49</td>
<td>4</td>
<td>14</td>
<td>1842/06/02</td>
</tr>
<tr>
<td>Eglise la Madeleine (Paris, France)</td>
<td>48</td>
<td>4</td>
<td>26</td>
<td>1846/10/29</td>
</tr>
<tr>
<td>Cathedral (Beziers, France)</td>
<td>46</td>
<td>4</td>
<td>43</td>
<td>1850/10/29</td>
</tr>
<tr>
<td>Eglise Saint-Vincent-de-Paul (Paris, France)</td>
<td>47</td>
<td>3</td>
<td>52</td>
<td>1852/01/26</td>
</tr>
<tr>
<td>Cathedral (Saint-Omer, France)</td>
<td>50</td>
<td>3</td>
<td></td>
<td>1855/06/26</td>
</tr>
<tr>
<td>Cathedral [Saint-Jean] (Perpignan, France)</td>
<td>58</td>
<td>4</td>
<td>112/5</td>
<td>1857/12/24</td>
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<td>Cathedral [Saint-Louis] (Versailles, France)</td>
<td>46</td>
<td>3</td>
<td>184/153</td>
<td>1863/10/22</td>
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<tr>
<td>Cathedral Notre-Dame (Paris, France)</td>
<td>86</td>
<td>5</td>
<td>230/204</td>
<td>1868/03/06</td>
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<tr>
<td>Eglise la Trinite (Paris, France)</td>
<td>46</td>
<td>3</td>
<td>271/254</td>
<td>1868/07/04</td>
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<tr>
<td>The Albert Hall (Sheffield, England)</td>
<td>64</td>
<td>4</td>
<td>374/363</td>
<td>1873/05/05</td>
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<tr>
<td>Cathedral (Rennes, France)</td>
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<td>3</td>
<td>366/355</td>
<td>1874/08/08</td>
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<tr>
<td>Cathedral (Angers, France)</td>
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<td>367/356</td>
<td>1874/08/27</td>
</tr>
<tr>
<td>Cathedral (Lisieux, France)</td>
<td>46</td>
<td>3</td>
<td>389/384</td>
<td>1874/11/23</td>
</tr>
<tr>
<td>Mr. Hopwood’s residence (Ketton-Hall, England)</td>
<td>45</td>
<td>3</td>
<td>330/317</td>
<td>1875/05/10</td>
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<tr>
<td>Palais de l’Industrie (Amsterdam, The Netherlands)</td>
<td>46</td>
<td>3</td>
<td>447</td>
<td>1875/10/26</td>
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<tr>
<td>Palais du Trocadero (Paris, France)</td>
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<td>1878/08/06</td>
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<tr>
<td>Cathedral (Orleans, France)</td>
<td>54</td>
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<td>507</td>
<td>1880/02/04</td>
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<tr>
<td>Eglise Saint-Francois-de-Sales (Lyon, France)</td>
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<td>521</td>
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<tr>
<td>Eglise Sainte-Etienne (Caen, France)</td>
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<td>3</td>
<td>569</td>
<td>1885/03/03</td>
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<tr>
<td>Eglise Saint-Waast (Armentieres, France)</td>
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<td>1888/09/27</td>
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<td>Eglise Saint-Sernin (Toulouse, France)</td>
<td>54</td>
<td>3</td>
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<tr>
<td>Cathedral (Amiens, France)</td>
<td>51</td>
<td>3</td>
<td>620</td>
<td>1889/12/20</td>
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<tr>
<td>Basilica Saint-Ouen (Rouen, France)</td>
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<td>630</td>
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<tr>
<td>Eglise (Pithiviers, France)</td>
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<td>3</td>
<td>638</td>
<td>1890/06/23</td>
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<tr>
<td>Eglise Saint-Francois-Xavier (Paris, France)</td>
<td>58</td>
<td>3</td>
<td>633</td>
<td>1890/12/14</td>
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<tr>
<td>baron de l’Espee’s residence (Biarritz-Bidart, France)</td>
<td>70</td>
<td>4</td>
<td>678</td>
<td>1898</td>
</tr>
</tbody>
</table>
Specification

I. Positif
1. Bourdon 16' 
2. Bourdon 8' 
3. Flûte [harm.] 8' 
4. Prestant 4' 
5. Flûte [harm.] 4' 
6. Nasard 2 2/3' 
7. Doublette 2' 
8. Tercer 1 1/3' 
9. Cymbale IV 2' 
10. Fourniture IV 1 1/3' 
11. Flûte octaviante 4' 
12. Flageolet 2' 
13. Trompette [harm.] 8' 
14. Hautbois 8' 
15. Cor d’harmonie 8' 
16. Cromorne 8' 
17. Clairon [harm.] 4'

II. Grand Orgue
1. Montre 32' (from F, 24 notes) 
2. Montre 16' 
3. Bourdon 16' 
4. Montre 8' 
5. Bourdon 8' 
6. Viole 8' 
7. Flûte [harm.] 8' 
8. Prestant 4' 
9. Flûte 4' 
10. Nasard 2 2/3' 
11. Grande Fourniture III 2 2/3' 
12. Petite Fourniture III 1' 
13. Grande Cymbale III 1 1/3' 
14. Petite Cymbale III 1/2' 
15. Cornet à pavillons V 8' 
16. 1e Trompette [harm.] 8' 
17. 2e Trompette [harm.] 8' 
18. Basson-Cor anglais 8' 
19. Clairon [harm.] 4'

III. Récit-expressif
1. Bourdon 8' 
2. Flûte [harm.] 8' 
3. Flûte [harm.] 4' 
4. Nasard 2 2/3' 
5. Octavin [harm.] 2' 
6. Trompette [harm.] 8' 
7. Voix humaine 8' 
8. Clairon [harm.] 4'

Pédale
1. Flûte 32' (from F) 
2. Flûte 16' (from c) 
3. Flûte 8' 
4. Quinte 5 1/3' 
5. Flûte 4' 
6. Basse-contre 16' 
7. Bombarde 16' 
8. Basson 8' 
9. Trompette 8' 
10. 2e Trompette 8' 
11. Clairon 4' 
12. 2e Clairon 4'


Table 2. Specification of the organ finished in 1841 in Saint-Denis, France.
### Specification

I. **Grande-Orgue**
1. Montre 16’
2. Bourdon 16’
3. Gambe 16’
4. Montre 8’
5. Diapason 8’
6. Flûte harmonique 8’
7. Viole de gambe 8’
8. Bourdon 8’
9. Prestant 4’
10. Octave flûte 4’
11. Quinte 2 2/3’
12. Fourniture V
13. Cymbale I/IV
14. Bombarde 16’
15. Trompette 8’
16. Clairon 4’

### III. **Récit-expressif**
1. Bourdon 16’
2. Diapason 8’
3. Flûte traversière 8’
4. Viole de gambe 8’
5. Voix céleste 8’
6. Flûte octavante 4’
7. Viole d’amour 4’
8. Doublé 2’
9. Cornet II-IV
10. Cor anglais 16’
11. Trompette 8’
12. Clairon harmonique 4’

### III. **Récit-expressif**

### IV. **Solo-expressif**
1. Bourdon 16’
2. Diapason 8’
3. Flûte harmonique 8’
4. Flûte octavante 4’
5. Quinte 2 2/3’
6. Doublétte 2’
7. Terce 1 3/5’
8. Tuba magna en chamade 16’
9. Trompette en chamade 8’
10. Clarinette 8’
11. Musette 8’
12. Clairon en chamade 4’

### Pédale
1. Principal basse 32’
2. Contrebasse 16’
3. Soubasse 16’
4. Quinte 10 2/3’
5. Basse 8’
6. Violoncelle 8’
7. Corno dolce 4’
8. Contre-bombarde 32’
9. Bombarde 16’
10. Trompette 8’
11. Clairon 4’

### Keyboards:
- C-c’’, pedalboard: C-g’
- Pedale d’Orage, Tirasse Grand-Orgue,
- Tirasse Positif, Tirasse Récit, Tirasse Solo,
- Anches Pedale, Anches Grand-Orgue,
- Anches Positif, Anches Récit,
- Anches Solo, Octave grave Positif au
- G.O., Octave grave Récit au G.O., Octave
- grave Solo au G.O., Récit au Positif

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**Table 3. Specification of the organ finished 1873 for The Albert Hall in Sheffield, England.**

Table 4. Specification of the organ build in 1890 for Saint-Ouen Basilica in Rouen, France.
Aristide Cavaillé-Coll’s contribution to the field of organ building is extensive; it concerns the sonic sphere (organ stops) and technical solutions (improvements in mechanisms, air system), which were aimed at making the organs as expressive and versatile as the symphonic orchestra. He standardised the layout of keyboards (sections) and register switches, and obtained perfect balance and uniformity of sound in every stop thanks to the careful process of intonation, retaining the ability for strong contrasts of colors characteristic of romantic symphony orchestras. It is worth adding here also the loyalty of the mechanical action (with Barker’s lever) as the most precise and permanent one.

A long period of life and professional activity combined with a visionary approach to organ sounds has resulted in a beautiful process of evolution of the idea of symphonic organs, culminating in great instruments built mainly in France, but also in many other countries around the world, which was and still are great inspirations to many generations of organists.

Footnotes

8. In 1712, as the first in history, this solution was used in the organ of the church of St. Magnus-the Martyr in London-Bridge. In 1712, Harris proposed this solution to six-manual organ at London’s St. Paul’s (however, it is not certain if this project has been implemented). See: Sumner William Leslie, “The Organ, Its Evolution, Principles of Construction and Use”, MacDonald & Co. Ltd., London 1958, pp. 183-186.