# Acoustics Class, September 22, 2009

## Presentation by Bertrand Cattiaux (Liourdres, France-- www.orguescattiaux.org) and George Baker (Dallas, Texas)

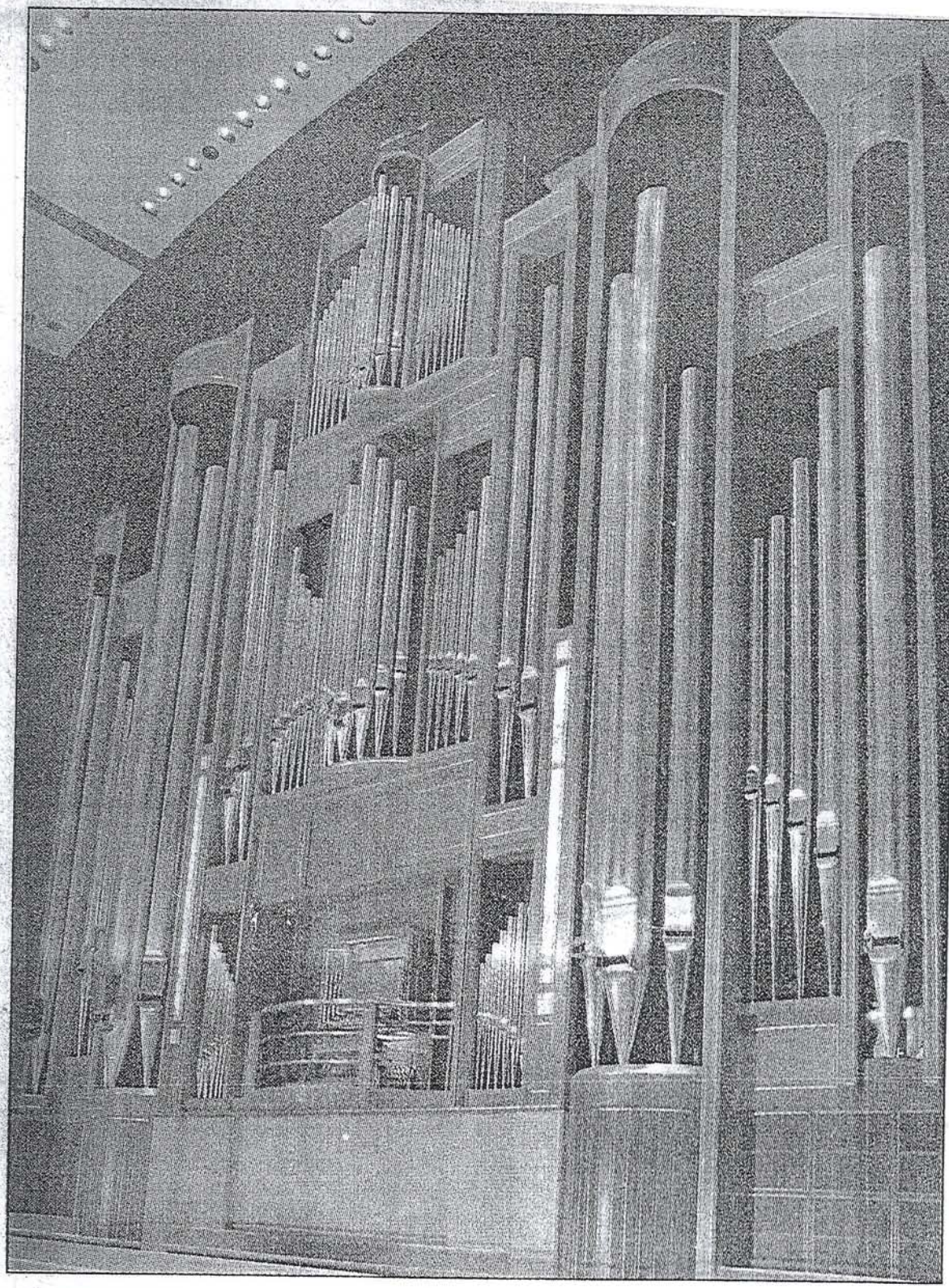
**Demo CD:**

1. Etampes (16th c.): Fantasie (Charles Racquet)
2. Bolbec (1630): Conditor al siderum (Jean Titelouze)
3. Houdan (1732): Plein Jeu (Clérambault)
4. Versailles (new organ in 18th c. style): Te Deum (Louis Marchand)
5. Poitiers (1790): Noël Etranger (D'Aquin)
6. Lunéville (1750, 1850): Basse de Trompette (DuMage)
7. Toulouse St-Sernin (1888): Carillon de Westminster (Vierne)
8. Notre-Dame de Paris (1763, 1863, 1963, 1975, 1992): Free improvisation part 1 (Philippe LEFEBVRE)
9. Free improvisation part 2
10. Chartres (1969): Cortège (Milhaud)
11. George Baker Orgue de Salon (2009) Fugue in D Minor, BWV 565 (Bach)
12. George Baker Orgue de Salon in Chartres Cathedral Acoustics (Altiverb)

**Temperaments of the organs:**

Etampes: meantone 1/4 comma
Bolbec: meantone 1/5 comma
Houdan: meantone 1/4 comma
Versailles: Corette 1/5 comma
Poitiers: Corette 1/4 comma
Lunéville: equal
Toulouse St-Sernin: equal
Notre-Dame de Paris: equal
Chartres: equal
Baker Orgue de Salon: equal

C.B. Fisk Organ, Gloucester, MA opus 100 p. 1
www.cbfisk.com



**The Lay Family Concert Organ** at the Morton H. Meyerson Symphony Center is an achievement of architectural beauty, craftsmanship and superb tonal quality.

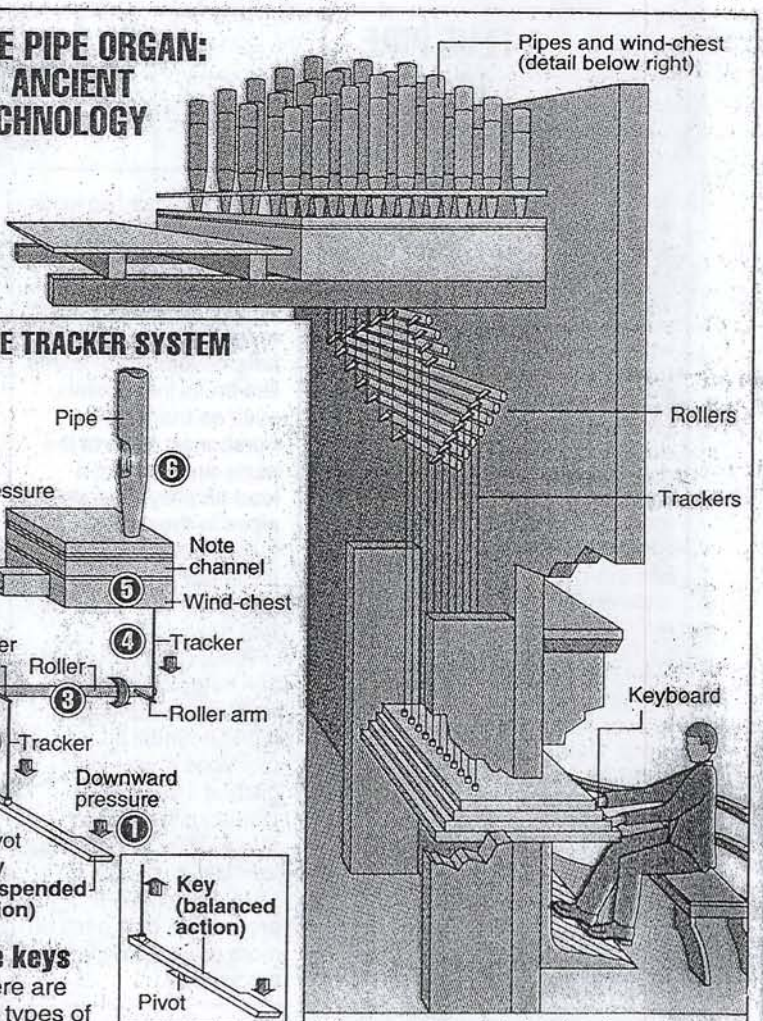
4535 pipes Dimensions: 44½' wide x 50' high x 6½' deep
4 manual keyboards (61 notes) + pedalboard (32 notes)

From: Dallas Morning News Sunday Aug 30, 1992

# THE SYSTEM BEHIND THE SOUNDS

The Lay Family Concert Organ is one of the largest mechanical-action organs built for a symphonic hall. Mechanical action means there is a direct connection between the keys and pipes. When the organist presses a key, that action is carried to the pipes through an elaborate series of rods, levers and rollers.
For example:
① The organist presses the F1 key.
② It pulls down on an aluminum rod known as a tracker.
③ The tracker rotates a roller, which transfers the motion to another tracker.
④ That tracker is routed to a wind-chest. The wind-chest has air pressure in it supplied by an air blower system.
⑤ The downward pull of the tracker opens a valve in the wind-chest. That allows air to fill a chamber above it called a note channel — in this case the F1 note channel. On top of the note channel is an arrangement of pipes. Nothing happens, however, unless the organist has pulled one of the stop knobs on the left or right side of the keyboard. A stop knob aligns an opening between the note channel and the pipe, allowing air to flow into the pipe.
⑥ Therefore, pressing the F1 key with the stop knob pulled out enables the proper F1 pipe to "speak."

## THE PIPE ORGAN: AN ANCIENT TECHNOLOGY




### THE TRACKER SYSTEM




**The keys**
There are two types of keys: suspended action (left) and balanced action (right). The difference is the location of the pivot. With a balanced action key, an extra lever is needed in the system to achieve a downward pull.

*"The organ may date back as far as fourth-century Greece. By 1300 in Europe, the system of stops to control the number of pipes that speak per key was in place. By the 18th century, the organ had evolved to its modern state for which J.S. Bach and his contemporaries composed."*
**— Greg Bover of C.B. Fisk Inc., project manager**

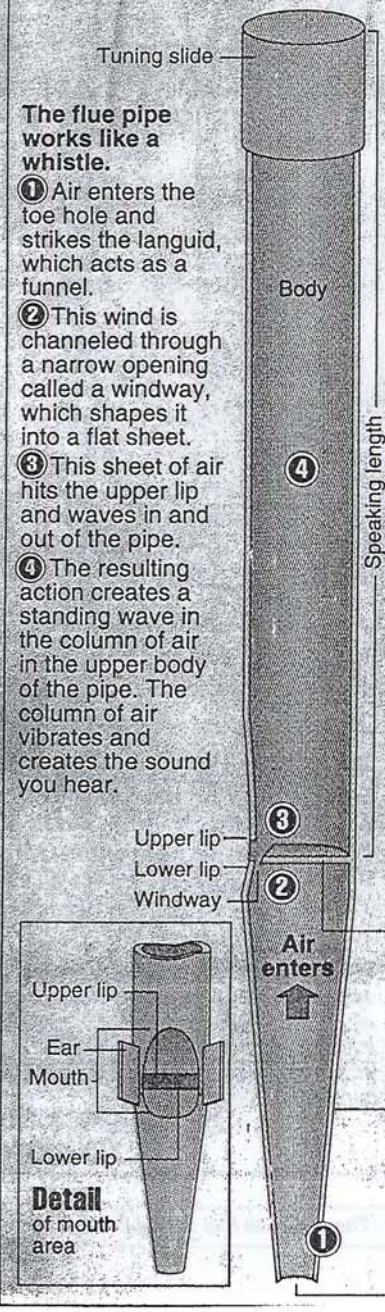
SOURCES: Greg Bover of C.B. Fisk Inc., Morton H. Meyerson Symphony Center, *The Facts on File Visual Dictionary*

# THE PIPES

## FLUE PIPE

**The flue pipe works like a whistle.**

1. Air enters the toe hole and strikes the languid, which acts as a funnel.
2. This wind is channeled through a narrow opening called a windway, which shapes it into a flat sheet.
3. This sheet of air hits the upper lip and waves in and out of the pipe.
4. The resulting action creates a standing wave in the column of air in the upper body of the pipe. The column of air vibrates and creates the sound you hear.



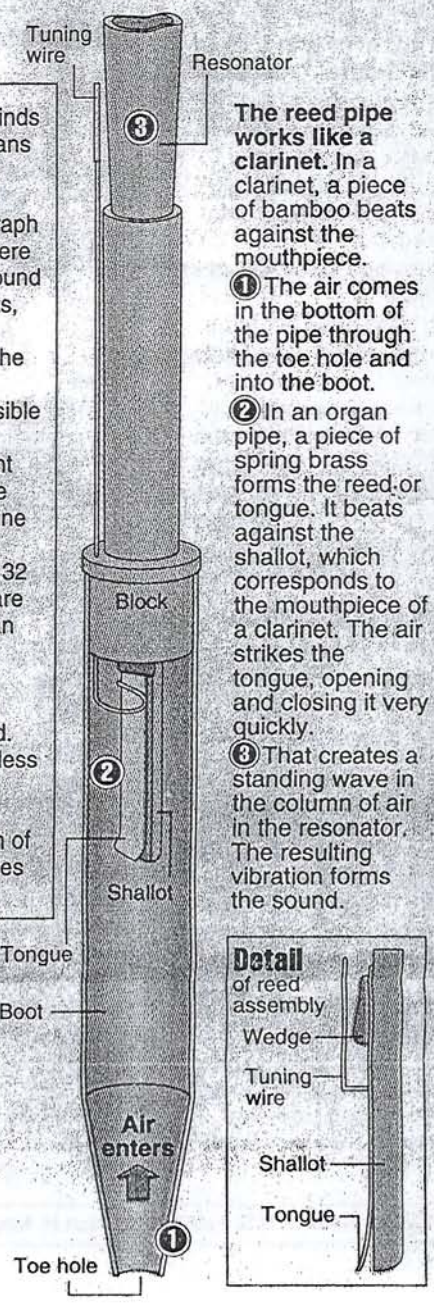

The organ has two kinds of pipes. At first, organs used only flue pipes. These are the pipes visible in the photograph at left. Reed pipes were later developed to sound like brass instruments, such as trumpets or trombones. Most of the pipes are made of a lead-tin alloy. The visible pipes in the organ's facade are 75 percent tin. Other pipes in the organ are made of pine and poplar wood.

The largest pipe is 32 feet long, 2 feet square and weighs more than 3,000 pounds. It produces a very low pitch at a cycle of 16 vibrations per second. The smallest pipe is less than 3/4 of an inch in speaking length. It produces a high pitch of more than 8,000 cycles per second.

## REED PIPE

**The reed pipe works like a clarinet.** In a clarinet, a piece of bamboo beats against the mouthpiece.

1. The air comes in the bottom of the pipe through the toe hole and into the boot.
2. In an organ pipe, a piece of spring brass forms the reed or tongue. It beats against the shallot, which corresponds to the mouthpiece of a clarinet. The air strikes the tongue, opening and closing it very quickly.
3. That creates a standing wave in the column of air in the resonator. The resulting vibration forms the sound.



# TUNING THE PIPES

The musical qualities of this organ were achieved by carefully voicing and tuning each of the 4,535 pipes. Voicing is the process of giving the pipe a particular speech quality, such as making it sound brighter or more mellow. Tuning is achieving the proper pitch. It took 10 months to voice all the pipes and three weeks to tune them.

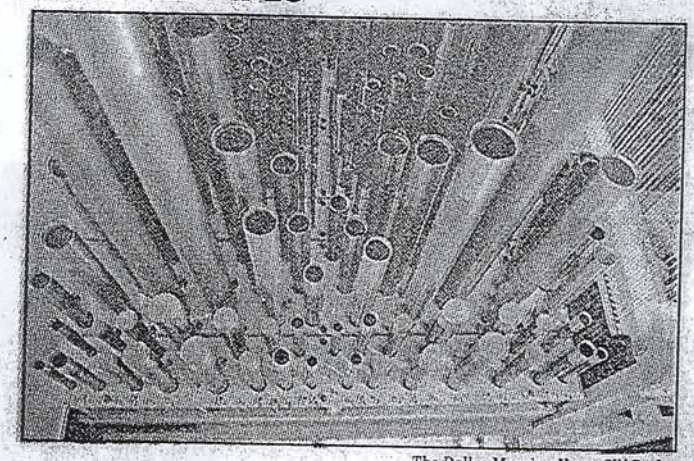
Voicing takes place only once. It is accomplished by manipulating the relationship of the parts of the mouth and the toe of the pipe and setting the distance from the upper lip to the lower lip. Almost microscopic changes are made at this point. The voicer can make the pipe louder by increasing the size of the toe hole.

Tuning is done more frequently. The pitch is determined by the length of the pipe. A flue pipe has a tuning slide or sleeve on top. Tuners tap the sleeve up or down to get the proper pitch. A reed pipe is tuned by adjusting the tuning wire. Tapping up or down on this wire increases or decreases the length of reed available to vibrate, changing the pitch. To mellow or intensify the sound, the resonator is sized to match the wavelength of the vibration that has been set up by the tongue.

Reed pipes might be tuned or touched up before a concert. The flues are checked about every 10 years.

The diameter of the pipe also affects the characteristics of the pipe's sound. For example, an 8-foot pipe might have a large, medium or small diameter. All three would have the same pitch, but sound different. On one end of the scale are the large-diameter pipes, which are the flutes. On the other end are the small-diameter pipes, which are the strings. In the middle is the principal scale, which is the standard relationship of the pipe's length to diameter.

Each of the organ's 65 stops controls pipes of a particular sound characteristic. The sound characteristics are determined by the size and shape of the pipes.

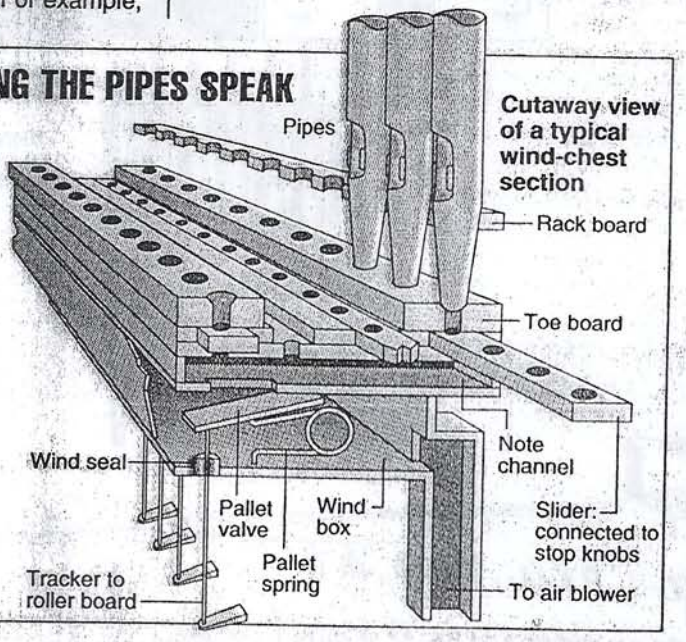


The Dallas Morning News: Clif Bosler

**A wind-chest and pipes** are located behind the facade of the organ on one of five levels.

## A WIND-CHEST: MAKING THE PIPES SPEAK

The wind-chest is a box with air pressure that controls the flow of air to the pipes. There are 14 major wind-chests, plus individual wind-chests for larger pipes. They are supplied by a blower system located far below the organist. The stop knobs next to the organist control sliders, which have holes in them. Located inside the chest is a pallet spring that holds up the pallet valve. As a key is pressed the pallet valve opens, allowing air to flow into the note channel. The pipes that have their stops pulled will then speak.




The Dallas Morning News

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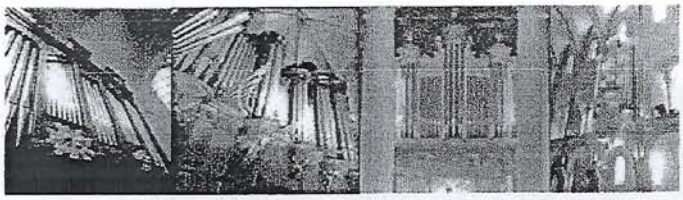

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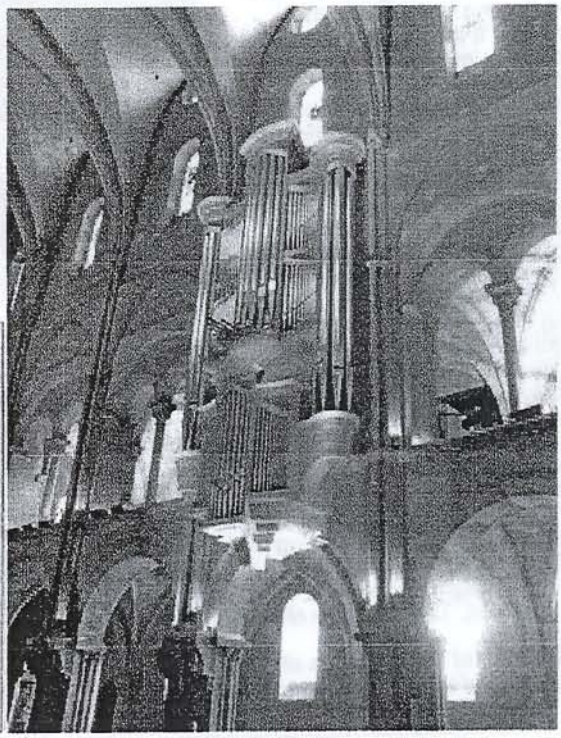

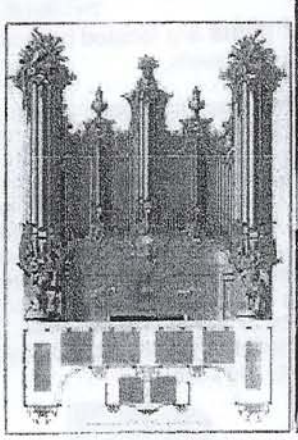

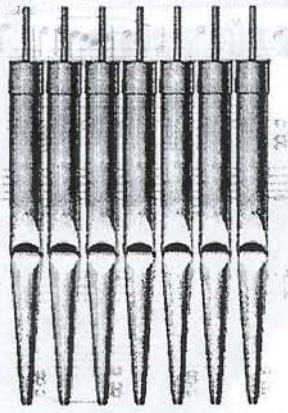

EURL au capital social de € 12.000
Locataire gérant du fonds

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