

Ge Meng

PhD in History of Arts, Senior Lecturer
Jiangxi University of Finance and Economics
Nanchang, China

**ARTISTIC AND CREATIVE PARAMETERS OF SAXOPHONE
EVOLUTION IN THE CONTEXT OF HISTORY OF MUSICAL ART,
ORGANOLOGY AND ACOUSTICS**

Abstract: from the first minutes of life, a person is immersed in the world of sound. We are surrounded by various sources that emit sounds that are perceived by our auditory system. Thanks to the perception of sound, we receive a very large amount of information about the surrounding objects and phenomena that make these sounds. Sound is a wave. A sound wave is a mechanical vibration that, spreading and interacting with the organ of hearing, is perceived by a person [4]. The section devoted to these waves in physics is called acoustics. The profession of people who are popularly called «hearing people» is acoustics. A sound wave is a wave propagating in an elastic medium, it is a longitudinal wave, and when it propagates in an elastic medium, compression and discharge alternate.

The purpose of the study is to identify the artistic and creative parameters of the saxophone in the context of the history of musical art, organology and acoustics.

Research objectives: to study materials on the evolution of the saxophone and determine its artistic and technical originality and advantage.

The object of the study is the artistic, expressive and acoustic features of the evolution of the saxophone.

Hypothesis of the study: the perception of the world by a person is carried out on the basis of his study of the objective laws of the universe. A person is continuously affected by a wide range of various phenomena. One of the most common phenomena that a person needs to take into account in his life, especially in the field of musical art, is such a phenomenon as resonance and musical acoustics. This will determine the

objective perception by both performers and listeners of the sound of such a musical instrument as the saxophone.

Keywords: *history of musical art, the evolution of the saxophone, artistic and creative aspects of the saxophone, musical acoustics, acoustic resonance, sound, sound features, sound wave.*

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Гэ Мэн

канд. искусствоведения, старший преподаватель

Университет финансов и экономики Цзянси

г. Наньчан, Китайская Народная Республика

ХУДОЖЕСТВЕННО-ТВОРЧЕСКИЕ ПАРАМЕТРЫ ЭВОЛЮЦИИ САКСОФОНА В КОНТЕКСТЕ ИСТОРИИ МУЗЫКАЛЬНОГО ИСКУССТВА, ОРГАНОЛОГИИ И АКУСТИКИ

Аннотация: *с первых минут жизни человек погружается в мир звуков. Нас окружают различные источники, излучающие звуки, воспринимаемые нашей слуховой системой. Благодаря восприятию звука мы получаем очень большой объем информации об окружающих предметах и явлениях, которые они издают. Звук – это волна, которая представляет собой механическую вибрацию, которая, распространяясь и взаимодействуя с органом слуха, воспринимается человеком [4]. Раздел, посвященный этим волнам в физике, называется акустикой. Профессия людей, которых в народе называют «слышащими людьми», – акустика. Звуковая волна – это волна, распространяющаяся в упругой среде, это продольная волна, и при ее распространении в упругой среде происходит чередование сжатия и разряда.*

Цель исследования – выявление художественно-творческих параметров саксофона в контексте истории музыкального искусства, органологии и акустики.

Гипотеза исследования: восприятие мира человеком осуществляется на основе изучения им объективных законов мироздания. На человека непрерывно воздействует широкий перечень всевозможных явлений. Одним из самых распространенных явлений, которые необходимо учитывать человеку в своей жизнедеятельности, особенно в сфере музыкального искусства, является такое явление, как резонанс и музыкальная акустика. Это определит объективное восприятие как исполнителями, так и слушателями, звучание такого музыкального инструмента, как саксофон.

Ключевые слова: *история музыкального искусства, эволюция саксофона, художественно-творческие аспекты саксофона, музыкальная акустика, акустический резонанс, звук, особенности звука, звуковая волна.*

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In the second half of the XX century, there was a noticeable trend in music for wind instruments to update the performing technique due to the introduction of new gaming techniques and special gaming effects. This process was connected with the search by composers for new, unusual sounds in wind music and touched, first of all, solo and ensemble literature. Since the 70s of the last century, new playing techniques have become increasingly widespread, becoming almost the main representative of «modernity» in music created for wind instruments. Musical acoustics studies the formation, distribution and perception of sounds used in music and singing. Acoustics of musical instruments, respectively, studies the processes of sound formation by musical instruments, radiation (propagation) and perception of sounds of musical instruments. Saxophone acoustics is a branch of acoustics of musical instruments that studies the processes associated with sound formation in the saxophone, radiation (propagation) and perception of the sound of instruments called the saxophone. The article discusses such a scientific concept as acoustics and acoustic resonance, which allow, based on the study of the history of evolution and the structure of the saxophone, to understand its specific sound and the technology of playing this popular musical instrument. In

one of our articles, we examined the features of the art of playing the saxophone in the context of European and American musicological studies [6, p. 171–174].

Acoustics

Acoustics is the science of sound, the name of which comes from the Greek word (akuo) – «I hear». This scientific term was first used in 1701 by the French scientist J. Soverom. Acoustics, being an interdisciplinary science, uses a wide range of disciplines to study the physical nature of sound and the problems associated with its occurrence, propagation and perception: physics, mathematics, psychology, architecture, electronics, biology, music theory, etc.

In addition, in the process of its formation and development of acoustics as a science, views and approaches to understanding the nature of sound have changed.

Acoustic resonance is the amplification of sound waves whose frequencies align with the oscillating frequencies of an acoustic system. This phenomenon occurs beyond the range of human hearing, as it is a general term related to vibrational waves in matter. Acoustically resonant objects possess multiple frequencies, particularly at harmonics, where they vibrate most easily. This isolation of a specific frequency from external excitations is crucial in instrument design, as it defines their tonal characteristics. The basilar membrane in the inner ear, for instance, resonates at different frequencies, allowing for the detection of sound. However, acoustic resonance can also lead to disastrous outcomes, such as glass shattering with a sound wave of its resonant frequency.

History of the saxophone

The saxophone, a reed-based wind instrument, was invented in 1842 by Belgian musician Adolf Sachs. Its development was driven by a desire to address the intonational issues and timbre gap within brass orchestras, particularly the replacement of bulky and imperfect bass ophicleids. Initially introduced as the «ophicleid mouthpiece» at the Brussels Industrial Exhibition in 1841, this instrument had a metal conical body, a mouthpiece borrowed from the clarinet, and ring valves based on The obaid Boehm's system. However, it also had a unique twisted shape [12].

In 1842, Adolf Sachs arrived in Paris with his new invention. On June 12, composer Hector Berlioz, an early supporter of the saxophone, published an article in the

Paris Journal des Debats introducing the instrument and naming it «saxophone». Berlioz also composed the first piece for saxophone, a Chorale for voice and six wind instruments. In 1844, the opera orchestra included the saxophone for the first time at the premiere of Georges Kastner's opera. The same year, the instrument was showcased at an industrial exhibition in Paris. Berlioz predicted the saxophone's significance in conservatory training, stating that «the moment is not far off when all composers will want to use it». Sachs received a French patent in 1846 for his saxophone system, and a year earlier, saxophones were introduced into French military orchestras to replace other instruments.

Berlioz, an expert in orchestration, wrote extensively about saxophones in «The Art of Instrumentation» and praised their capabilities. Composers often included the saxophone in operas, such as Halevi's «The Eternal Jew» (1852) and Meyerbeer's «The African Woman» (1865). The saxophone was less common in the symphony orchestra, with Georges Bizet's music for Alphonse Daudet's «The Arlesian» (1874) being a notable exception.



Fig. 1. Adolf Sachs

In the 1850s, Sachs instructed at the Paris Conservatory's military school, imparting his knowledge of the saxophone to a select group of students. Over the years, his pupils rose to become leading musicians, and he inspired numerous composers to create saxophone-specific works. Following the 1870 war, the Conservatory closed its doors, and interest in the instrument began to wane in Europe. However, American

musicians, particularly Eliza Hall, picked up the mantle, showcasing the saxophone's versatility in solo performances [7].

The early XX century marked a renaissance in classical music, with composers such as Darius Milhaud, Maurice Ravel, and Manuel Rosenthal incorporating the saxophone into their works. This collaboration between traditional and modern styles paved the way for the instrument's popularity in both classical and jazz circles.

The saxophone's journey through the 20th century was a testament to its adaptability and enduring allure.



Fig. 2. Soprano saxophone

In this time period, numerous compositions were created that feature the saxophone, showcasing its versatility. Hindemith's opera «Cardillac» (1926), Shostakovich's «The Golden Age» ballet (1930), Prokofiev's «Lieutenant Kizhe» suite (1934) and «Romeo and Juliet» ballet (1938), as well as Khachaturian's works, all include the saxophone as a significant instrument. Maurice Ravel's orchestration of Mussorgsky's «The Old Castle» play features the saxophone as the main theme, while Rachmaninoff's «Symphonic Dances» includes a lyrical solo for the instrument.

Composers such as Debussy, Glazunov, Martin, d'Andy, Schmitt, Larsson, Typher, Hovaness, Glass, Nyman, Denisov, Gubaidulina, Artemov, Peiko, Eshpai, Chudova, Kasparov, and Kapyrin have also written notable solo and ensemble works

for saxophone. These works highlight the instrument's unique sound and place it at the forefront of 20th-century music.

Since 1969, the World Congresses of Saxophonists have convened regularly, hosting competitions, festivals, and the publication of books and periodicals. In 1995, the European Saxophone Center opened in Bordeaux to preserve and promote saxophone-related materials within modern music [8].

Jazz emerged as a new musical genre in the US at the end of the 19th century, and the saxophone became its signature instrument due to its distinctive sound and expressive capabilities. The mass production of these instruments contributed to their rapid spread, and early recordings indicate the saxophone's popularity in this genre. In the swing era (1930s), the saxophone group became a standard fixture in jazz orchestras (big bands). Typically, these ensembles included at least five saxophones (two violins, two tenors, and one baritone), but the instrumentation could vary. Notably, Lester Young (1909–1954), Coleman Hawkins (1904–1969), and Charlie Parker (1920–1955) were renowned for their solo work. In modern jazz, the saxophone remains a leading instrument. Notable 20th-century performers include Julian «Cannonball» Adderley (1928–1975), John Coltrane (1926–1967), Gerry Mulligan, Bud Schenck, Phil Woods, Ornette Coleman, Stan Getz, Paul Desmond, and numerous others.

The structure of the saxophone



Fig. 3. Mouthpieces, canes, ligatures, tenor saxophone cap

The saxophone is a conical tube made from specialized alloys: tompak (copper and zinc), pakfong (same composition with added nickel), or brass. For compactness, the tube assumes a curved shape. High-pitched varieties have a short length without curvature. Modern manufacturers produce straight alto saxophones and curved

sopranos, but this remains experimental. The saxophone comprises three main components: the bell, body, and esky. The esky incorporates a mouthpiece similar to a clarinet mouthpiece. It is crafted from ebony, plastic, or metal. Variations in mouthpiece design are numerous and depend on the desired sound. Mouthpieces differ in parameters like mouth size and notch length. Classical performances use smaller mouthpieces, while others use wider ones. The sound-producing element is the reed, made from bamboo or synthetic materials. The reed's size depends on the saxophone type.

The ligature secures the reed to the mouthpiece, typically a metal device with two screws. Classical saxophones use metal ligatures, but jazz musicians may opt for leather ligatures, providing greater freedom of oscillation. To safeguard the reed, a metal or plastic cap covers the mouthpiece when not in use. The saxophone features a complex system of valves that regulate airflow through the instrument's holes, ranging from 19 to 22 valves depending on the type. The modern saxophone family comprises eight varieties.

Table 1

Varieties of saxophone [8]

A kind of saxophone	Build	Transposition
saxophone-sopranissimo	B (B flat)	small septima up
soprano saxophone	Es (E flat)	small third up
soprano saxophone	B (B flat)	big second down
saxophone-violin	Es (E flat)	big Sexta down
tenor saxophone	B (B flat)	big nona down
baritone saxophone	Es (E flat)	big third down
saxophone-bass	B (B flat)	big second in two octaves down
saxophone-double bass	EP (E flat)	big sexta two octaves down

Manufacturers produce unique saxophone models, like the piccolo and double bass, but they are rare and infrequently used. The soprano, alto, tenor, and baritone are the most common, forming a quartet. The soprano can be replaced by a second alto. These three are used in both classical and jazz, while the baritone is mainly in jazz. Saxophones are transposing instruments, with Es and B transpositions.

The saxophone was originally designed for two distinct purposes: symphony orchestras and military brass bands. The instruments intended for symphony orchestras in C and Fa-were later supplanted by those designed for military brass bands, in C and Es, due to their advantages. Over time, the «symphonic» instruments fell out of favor and were no longer mass-produced after 1930, though the soprano saxophone in C is still occasionally used by some musicians [9].

The range of the saxophone consists of three registers: low, medium and high and covers two and a half octaves. In some modern compositions, the «falsetto» register is used (higher than high), which is achieved with the help of a special fingering that allows you to achieve harmonic «flageolet» sounds.

Saxophone playing technique

The fingering of the saxophone is close to the fingering of the flute, and the principle of sound extraction is similar to the extraction of sound on the clarinet, but it is a little easier to make the ear pads. At the same time, the saxophone registers are more homogeneous than the clarinet registers.

The possibilities of the saxophone are very wide: from the point of view of technical mobility, especially in legato, it competes with the clarinet, large amplitude of sound vibration is possible, a clear accented staccato, smooth transitions from one sound to another. In addition, the saxophone has much more sound power than other woodwinds (approximately like a French horn). The ability of the saxophone (as well as the French horn) to organically merge with both a group of woodwinds and wind instruments helps him successfully combine these groups in timbre [5].

In jazz and in the performance of modern music, saxophonists use a wide variety of playing techniques – frullato (tremolo on one note with the help of language), resonant sound, performance in an ultra-high register with flageolet sounds, polyphonic sound, etc.

Conclusion

In several compositions, resonance became a central theme. Alvin Lucier utilized acoustic instruments and sine wave generators to investigate the resonance of diverse objects. James Tenney's Koan features crescendo and decrescendo on percussion instruments interacting with room resonances. Pauline Oliveros and Stuart Dempster

perform in large reflective spaces, such as a 2-million-gallon tank, with a 45-second reverberation. Terpsichord by Kent Olofsson utilizes instrument resonances to bridge acoustic and electronic sounds [10].

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