

## THE NINETEEN-TONE INSTRUMENTS OF W. A. (JIM ) PIEHL AND TILLMAN SCHAFER

Among those inspired by Joseph Yasser's seminal work, "A Theory of Evolving Tonality," to escape the confines of the traditional 12-tone scale and explore the resources of the 19-tone equal temperament were two musicians in the Bay Area, Jim Piehl and Tillman Schafer. Although each would go his own way and create his own instruments to realize Yasser's concepts, they worked and performed together in the 1930's and early 40's. Their work resulted in a joint paper which they published in the Journal of the Acoustic Society of America in 1947<sup>1</sup> on their experiments to demonstrate Yasser's ideas.

Piehl is now retired from his manufacturing business in Denver and has returned to California to reside in Mountain View with the 19-tone instruments he built and played over a period of more than 50 years. Schafer, however, now lives and teaches guitar in Connecticut after spending many years as a physicist at the Naval Electronics Laboratory in San Diego. He has apparently abandoned his experiments with the 19-tone temperament and has reverted to the conventional 12-tone tuning.

Historically, the first new instruments constructed by Piehl were still tuned to the 12-tone equal temperament. In 1932, he built a novel 10 string Hawaiian guitar out of a canvas-filled phenolic resin called "Celeron" and an electric guitar whose metal body is a Ford brake drum. He performed on these instruments from the 1930's onward and they are presently in eminently playable condition at his home in Mountain View.

Beginning in 1934, Piehl designed and built a pneumatic 19-tone pipe organ with his own version of the generalized keyboard. The keyboard consists of six rows of 30 black and white rectangular tabs and has a span of five octaves. The white digitals are arranged in lines of six to indicate Yasser's Hexads, while the black keys are placed in groups of three and four to delineate the diatonic scale. The advantage of such a keyboard is that the fingering for any scale or chordal pattern is the same in all keys. Extra digitals are provided to facilitate fingerings in distant keys without having to move the hands great distances across the keyboard. While 19-tone keyboard instruments (cembali) are known from the Renaissance <sup>2</sup> and 19-tone harmoniums from the late 19th and 20th centuries <sup>3,4</sup>, this is the first pipe organ dedicated to 19-tone equal temperament of which I am aware. The instrument was completed about 1939 and is presently in a storage crate in Piehl's home.

In 1937, Piehl refretted a National acoustic guitar to the 19-tone system. This instrument has had extensive use by both Piehl and Schafer and was later fitted with an electromagnetic pickup. As far as I can determine, this is the earliest guitar to be fretted to 19-tone equal temperament, although Ivor Darreg and others have adapted both acoustic and electric guitars to this tuning. This instrument too is housed at Piehl's home in Mountain View.

While a student at Mills College in 1941, Schafer wrote a thesis <sup>5</sup> on Yasser's evolutionary tuning theories and their embodiment on electronic instruments. He later constructed an electrically-actuated 19-tone metallophone to demonstrate these concepts. This unique instrument had three octaves of cylindrical metal bars furnished with electro-magnetic

pickups and was played from an electric typewriter keyboard. Pressing on a key caused a solenoid to propel a striker towards the proper bar. The most innovative feature of the design was the shape of the bars which was calculated to minimize the contributions of the third and sixth harmonics to the timbre because, according to Yasser's Hexad-based harmonic theories, the fifth, the minor third, and their inversions in 19-tone music must be treated as dissonances. I saw this instrument during a visit to Schafer's home in San Diego during the 1960's before he moved with his family to the East Coast. Although the electrical components had deteriorated, the array of tuned bars was still playable and is now in the possession of Ivor Darreg.

The culmination of Piehl's work is a 19-tone electric organ which was begun in 1956 and completed in 1961. The keyboard has a range of 5 octaves, comprising 91 digitals in a variation of the pattern of the earlier pipe organ. Three colors are used on the keys; white for the seven diatonic notes, black for the seven accidentals, and grey for the five extra notes, V, W, X, Y, and Z, of Yasser's nomenclature<sup>6</sup>. As with the previous organ, the keyboard is generalized, providing identical fingerings for each of the different transpositions of various harmonic and melodic figures.

The organ utilizes Conn sound-generating components and has ten timbral stops with tremolo, division and swell effects. In addition, a pedalboard provides 8 and 16 foot<sup>3</sup> bass tones. When I visited Piehl at his home in September of 1988, I had an opportunity to hear him play this organ. This instrument has a much better tone quality than the other electronic organs I have heard and the keyboard is very easy to learn and play.

Although Piehl seldom plays the 19-tone electric organ anymore due to his age, he especially enjoyed performing tonal pieces originally composed in 12-tone equal temperament in the 19-tone tuning where they acquire the particular mood of this system. Piehl feels very strongly that 19-tone temperament should be the next tuning adopted for Western music and that the transition will be made easier by first accustoming audiences to the sound of the traditional repertory in 19-tone tuning before pieces composed specifically for 19-tone performance are presented.

Unfortunately, years of use and corrosion have caused some of the contacts in the keyboard to fail, so at the moment not every note sounds in all the stops. Restoration will be comparatively easy, however, and well worth the effort to save this unique instrument. Happily, Piehl has decided to donate the electric organ and the other 19-tone instruments to the Interval Foundation/ Sonic Arts Gallery in San Diego where they will be maintained, exhibited, and played by Jonathan Glasier, Ivor Darreg, and other musicians composing and performing in 19-tone equal temperament. This action will ensure the survival and continued use of these unique and instruments.

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<sup>1</sup> Schafer, Tillman and W. A. Piehl. 1947. Musical Instruments in Nineteen-Tone Equal Temperament. *Jour. Acous. Soc. Amer.* 19 (4): 730.

<sup>2</sup> Barbour, James Murray. 1951. "Tuning and Temperament." Michigan State College Press, East Lansing, MI USA. Second edition 1953, reprinted 1961.

<sup>3</sup> Yasser, Joseph. 1932. "A Theory of Evolving Tonality." American Library of Musicology, New York, NY USA.

<sup>4</sup> Mandelbaum, M. Joel. 1961. "Multiple Division of the Octave and the Tonal Resources of 19-Tone Temperament." Unpublished dissertation, Indiana University, Bloomington, IN, USA.

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<sup>5</sup> Schafer, Tillman. 1941. "The Music of Tomorrow: The Supra-Diatonic Scale, A New Concept of Timbre, The Electronic Musical Instrument." Unpublished thesis, Mills college, Oakland, CA, USA.

<sup>6</sup> Yasser labeled the 19 tones of the octave C C<sup>\*</sup>/Y<sup>b</sup> Y D D<sup>\*</sup>/W<sup>b</sup> W E E<sup>\*</sup>/F<sup>b</sup> X G G<sup>\*</sup>/Y<sup>b</sup> A A<sup>\*</sup>/Z<sup>b</sup> Z B B<sup>\*</sup>/C<sup>b</sup> c, where <sup>\*</sup> or <sup>b</sup> indicates an inflection of 1/19 octave (Yasser's own <sup>\*</sup> and <sup>b</sup> symbols were slightly different). The standard nomenclature may also be used for 19 with the <sup>\*</sup>'s lower in pitch than the enharmonic <sup>b</sup>'s, i.e., c c<sup>\*</sup> d<sup>b</sup> d ...etc.