Smith, André M. , RESPIRATION FOR WIND MUSICIANS: FROM THE BRONZE AGE
TO THE END OF THE 20th CENTURY A Synoptic Review,
T.U.B.A. JOURNAL, Summer, 1993

The Mirror

That something so simple and commonplace as a mirror could be classed as a teaching device for wind students is a reminder that we are surrounded by simplicities that could be put to good educational use if we would but contrive ways to use them. When Arnold Jacobs was assembling the various diagnostic and analytical devices for use in his teaching in Chicago he had recently come from his studies in the laboratories of scientists whose research units were well-equipped to study the most complex problems of pulmonary function. The cost of their equipment was beyond the means and needs of Jacobs. So, for about $5000 he gathered together some used medical equipment, heating & air conditioning machines, miscellaneous hardware, etc. that, he was told by the scientists, ultimately yielded the same results as their more costly apparatus. In this class of humble, but valuable, devices is the mirror.

Dancers and actors may have been using mirrors with their studies so long as mirrors have existed. Musicians can use mirrors for similar reasons. Full length mirrors to check body alignment have proven worth. Small mirrors to view the external refinements of embouchure placement can have their value enhanced by their use with an embouchure visualizer.

The Work of Arnold Jacobs

W.H. Smith wrote that "It was always on the borderground between two great subjects of study that new phenomena were often to be looked for." And it was in that spirit of enquiry that a few inquisitive wind musicians in the last half of the nineteenth century began independent readings -- not independent investigations -- in the advancing respiratory physiology. They drew conclusions about respiratory function they believed were well-founded but were, more often than not, merely informed guesses. Much of the new knowledge was therefore hardwon by musicians through trial and error, as it had been for centuries. This remained the practice until the end of World War II, with the first attempts by Arnold Jacobs in Chicago to place the teaching of wind instruments on a rational basis founded on the most recent advances of physiologists and physicians.

The interest Jacobs had in this subject -- specifically, the elucidation of the relationship between respiratory function and its efficient use for the performance of all of the wind instruments -- grew out of his general interest in human biology shortly after he joined the Chicago Symphony in 1944. He determined to transform a set of nagging questions into a rigorous quest (something he has later referred to modestly as his "hobby"). In the late 1950s, the research that clearly determined the course that Jacobs' work in this subject would take for the rest of his life began with his collaboration with Benjamin Burrows57 (b. 1927), a physician at the University of Chicago. Another doctor with interests similar to Jacobs' was his tuba student, Bruce Douglass58 of the Mayo Clinic in Rochester, Minnesota. It was Douglass who gave Jacobs his first spirometer, a McKesson Vitalator, that the Mayo Clinic no longer had use for. Paul Walton, former tubist of the Minneapolis Symphony, and a young neighbor of Jacobs at the time, recalls that "I remember when the Mayo spirometer arrived. Arnold called me over to help assemble it. We finally got the thing going, only to discover that the machine was missing one small part. After we managed to make the part, Arnold was on his way."59

It was from his association with Burrows and Douglass that form was given to Jacobs' understanding of the true functions, and limitations, of the principles of respiration as applied to wind instruments.

Musicianship: The Point of Departure & The Goal

The primary concern of Jacobs the teacher is with the cultivation of a student's musicianship. This in itself may seem to be the concern of all music teachers; not therefore an emphasis that could be thought to be a major advance in the history of pedagogy of the teaching of wind instruments. But, aside from his innovative gifts as a music teacher, Jacobs' understanding has an elusive dimension that may best be called "revelatory." Anyone who has seen him work with a student whose problems with the fundamentals of blowing into a wind instrument have seemed intractable, or otherwise attributed to the physiological limitations of the student, has seen this gift for understanding manifest. [Fig. 17] Attempting to define satisfactorily ones particular gift for teaching -- to another who has never experienced it -- may be as successful as attempting to define an overpowering emotion to one who has never loved. But, as poets wax on in the hope that their writings about love may lead to some of it, writers about the bond between respiration and music continue to write about it in the hope that what is known by too few will continue to find a wider field of adherents and practitioners.

The Foundation of Jacobs' Work

In music, all of the psychological and physical elements of mind and body functions are brought into a continual complementary interplay to facilitate the pursuit and fulfillment of a preconceived ideal. Conscious emotion, i.e., controlled emotion aware of itself, may be said to be the point from which the teaching of Jacobs departs. As words convey ideas in the language of speech, so the sounds of music can convey them in ways peculiar to the art form. The transporting medium of music is sound. For wind instruments, this sound is provided by a wind source that must remain uninhibited in its course, from its conception in the mind to its realization in tone. For purposes of initial understanding, the significant word in this context is "uninhibited." Inhibition need not result only from reticence; it may be a consequence of either distraction or misplaced emphasis, both of which are very common in the performance of a music instrument. Jacobs has said that "We have to recognize what we're trying to accomplish; the orders that come from the various parts of the brain must be based on the sound of the instrument. We have to make sure that we don't take the level of the brain at which we have volitional thought and try to take charge of the human machine through its individual components."60 And more, "But wind is finally only a minor part. Tone production is the major. You use the wind as fuel. With a wind instrument, the horn resonates sound waves; it's reacting to sound and amplifying it according to acoustical properties. Our air isn't used to fill an instrument. It's used by the embouchure as energy so the lips vibrate."60 Studies in respiration always have been, and remain, founded on a good working knowledge of the fundamental sciences. It is all the more surprising then that the ideas of one who has studied these as they relate to the performance of wind instruments continues to draw conclusions about physiology that have their origins, not in physiology, but in music.

For a musician, largely self-taught in the biological sciences,61 Jacobs is uncommonly versed in the rational principles of the scientific method and its application to the specific problems arising from the performance of wind instruments. He is not in the least reluctant to offer an explanation to a music student that may be spontaneously drafted in a form that could be included in a medical textbook on the subject. From a wide range of problems that may have a direct solution with recourse to physics as applied in medicine, and of which Jacobs makes use when need arises, Boyle's law will serve as one example.

"The volume of a gas varies inversely as the pressure[,] provided the temperature remains constant."62

[Figs. 18a & 18b] Boyle's law has had wide application in any physical context dealing with the pressure of gases in confinement, including those in the human lungs. It is for this reason therefore that Jacobs may invoke the law in his explanation to a student whose expiratory function may be inhibited by the simultaneous engagement of the thoracic muscles of expiration obstructed in their function by a closed glottis, resulting in the pelvic pressure syndrome of parturition or defecation. An apt elucidation of this law is that "When a certain number of molecules of a gas which are occupying a unit volume, say for example one liter, are forced into an enclosure one-half this unit volume without changing the average velocity, that is, without changing the temperature, twice as many molecules strike the walls of the confining space as originally. Since pressure is due to the bombardment of the walls of an enclosure by the molecules of a gas, the pressure, therefore, is doubled. Simultaneously the volume is halved. Forcing these same molecules into one-fourth the space causes four times as many bombardments upon the walls of the space. The pressure, therefore, is increased four times while the volume is reduced to one-fourth the original. On the other hand, if the volume is increased from one liter to two liters, half as many molecules occupy a unit space and the bombardments of the walls of the space are half as frequent. The pressure, therefore, is one-half the original when the volume is doubled."63 For the wind music student, the single most important physical point to be observed here is that the function of exertion by thoracic compression of the muscles of expiration may be overridden by a closed glottis, thereby yielding nothing more than increased intrathoracic pressure that is useless for the sounding of a tone because the wind remains confined within the thorax by that closed glottis. Just how that problem in a student is addressed will depend upon psychological and physical factors that define the context in which the problem developed. There is not, and cannot be, a "Jacobs Method." From just this one example, it can be seen how fruitless any attempt to codify the work of Jacobs into a "method" has been.

"Jake, When Are You Going To Write Your Book?"

To address the question about his book (which he must have been asked thousands of times over the decades), it must be said that Jacobs' overriding concern in teaching is with the needs of the student sitting beside him. Because there are as many variant, challenging problems as there are students, Jacobs until recently has not seen fit to give hard-cast form to enlightened principles that remain successful so long as they retain their fluid adaptability.

In an era of publish-or-perish paper-glut, such as our own, the reluctance of Jacobs to publish may seem a subtle way to avoid his obligation to those who may not have the opportunity to study personally with him or of shirking a presumed responsibility to his pedagogical descendants. But we must remember that any act of creativity in teaching that depends for its successful realization on the active interplay between two personalities can be seriously compromised, or distorted beyond recognition, in the absence of the master of the two. This has happened often enough with the principles that Jacobs elucidates to his students to cause him to realize that wholesale distortion and petrifaction by others may very well result from any attempt by him to cast his ideas into a permanent form that, predictably, the uninitiated may seek to apply universally. It is for these reasons that a book by and about Jacobs has not yet been written. Until that time, his enduring legacy will live, as with all remarkable teachers, in his students.64

Motivated by the work of Jacobs with Burrows and Douglass in Chicago, many researchers around the world were led to develop and apply the new ideas in pulmonary function to extracorporeal respiratory purposes, including rehabilitation medicine and sports medicine. Perhaps independently, but certainly in

the spirit of the two decades following the initial studies in respiration coming out of Chicago, Martha Graham wrote that in dance "The first principle taught is body center. The first movement is based upon the body in two acts of breathing -- inhaling and exhaling... These two acts when performed muscularly only, are called 'release,' which corresponds to the body in inhalation, and 'contraction,' which corresponds to the exhalation."65

One of the more influential researchers in respiratory physiology in the United States was the Dutchman, Arend Bouhuys (1929-79), working at Yale University. [Fig. 19] With some exceptions,2a&b most of the work of Bouhuys was in a variety of subspecialties within respiratory physiology not dealing directly with music instruments but which have direct application to studies of the relationship between respiration and music.66

Research in pulmonary physiology continues its hold on the imagination of scientists and musicians alike. Even a casual perusal of Science Citation Index, Biological Abstracts, and Index Medicus will show that interest in this subject remains as firm as it has been at any time in the last 200 years. To what use, if any, performers and teachers of wind instruments will put this continuing accumulation of information will be determined, as always, by the strength of their conviction that the fruits of these studies can contribute substantially to the advancement of our collective knowledge of the physiology of respiration during the performance of a wind instrument. ENDNOTES

57. Benjamin Burrows received his MD in 1949 from The Johns Hopkins University School of Medicine in Baltimore. He concentrated on the hepatic portal vein and its tributaries in his early work; current research is in pulmonary disease, pulmonary physiology, pulmonary diffusion & epidemiology. He was a teacher of medicine in the University of Chicago Medical School, 1955-68; professor and director of the division of respiratory science at the University of Arizona Health Sciences Center in Tucson since 1968. (a) Directory of Medical Specialists 1:870. 25th ed., 1991-2; (b) American Men & Women of Science 1:887. 18th ed., 1992.

58. Bruce Douglass was for many years a specialist in internal medicine and preventive medicine. He now lives in retirement in Interlochen, Michigan.

59. M. Dee Stewart, ed., Arnold Jacobs. The Legacy of a Master, pp. 92-3. The Instrumentalist Company. Northfield, 1987.

60. Kevin Kelly, "The dynamics of breathing with Arnold Jacobs and David Cugell, M.D." The Instrumentalist, pp. 6-12, Dec. 1983.

61. Until the appearance of the modern vogue that required a college degree as the imprimatur of education ordinary citizens made their achievements known merely by the qualities of their daily lives. One example, from many, of a younger contemporary of Jacobs may confirm this point. "Though he must have seemed quite a young man to Max, who was approaching forty, Mencken was cocky, brilliant, talkative, blunt, self-taught, extraordinarily learned (as the self-taught often are), extraverted, and fearless -- in a word, formidable." Ranice W. Crosby & John Cody, Max Brödel. The Man Who Put Art Into Medicine, p. 165. Springer-Verlag. New York, 1991. N.B. Henry Louis Mencken (1880-1956).

62. Robert Boyle (1627-91). A Defence of the Doctrine Touching the Spring and Weight of the Air. J.G. for Thomas Robinson. London, 1662. See also his New Experiments Physico-mechanical Touching the Spring of the Air. H. Hall for T. Robinson, 1660. N.B. "Boyle showed the effects of the elasticity, compressibility, and weight of air. He investigated its function in respiration, combustion, and conveyance of sound. The importance of this work in the history of respiration is Boyle's demonstration that air is essential for

life." Jeremy M. Norman, ed., Morton's Medical Bibliography. An Annotated Check-list of Texts Illustrating the History of Medicine (Garrison and Morton), p. 154. Scolar Press. Aldershot, 1991.
63. John Adriani, The Chemistry and Physics of Anesthesia, p. 13. 2nd ed. Charles C. Thomas. Springfield, 1962.
64. This has not impeded many persons sympathetic to the work of Jacobs from attempting to describe and codify it in some ways. See Brian Frederiksen, "Arnold Jacobs -- A Bibliography." International Trumpet Guild Journal 17(4):25-27, 1993.
65. Selma Jeanne Cohen, Dance as a Theatre Art: Source Readings in Dance History from 1581 to Present, p. 142. Dodd, Mead. New York, 1974.
66. Arend Bouhuys, (a) "Physiology and Musical Instruments." Nature 221:1200, 1969; (b) Airway Dynamics. Physiology and Pharmacology, ed. Bouhuys. Charles C. Thomas. Springfield, 1970; (c) Breathing. Physiology, Environment and Lung Disease. Grune & Stratton. New York, 1974. See also "Arend Bouhuys." Who Was Who in America 7:63, 1977-1981.