Arnold Jacobs Masterclass Part II

(Preamble)

I think in this second session I am going to bore you all with respiratory activity and a certain amount of anatomy and believe me it's a dreary subject, I love it but I leave most of my audience when I go into it. It's interesting when you are dealing with a human being, if you had to construct a human being, it would be quite a task. You know, if you were to construct a tuba player, that's quite a thought isn't it? You'd have to make one up, you would have to study an awful lot of physics, and you'd have to study many many things. But, Boyles Law would be involved. I don't know how many here are familiar with Boyle's Law, that has to do with gas dynamics and what happens with air under pressure. [I seem to be bending over because I like to hear myself talk, If I straighten up, I can't hear it so much. Can you? Good, its probably better that way.] What we are dealing with is the human being who is born to survive on this planet and one of the things that we must have is air. Now there is a great simplicity about this subject or we can go into great complications, lets take it from both aspects. Could I have a young man come up, a volunteer? Somebody who might be interested in making a display of himself…I might even have him strip down to the waist, ya' never know. But I promise to stop at the waist! But if I can get a volunteer up here, there we are! I met this young man outside the academy of music in Philadelphia. He's from the Curtis Institute of music right?! Larry is going to be a very good subject when I get to him. Larry make yourself comfortable, I don't know when you will be in use, but hang around. What we are dealing with of course as I say, is a person who is born into this planet without any knowledge of tubas, tuba playing, anything about it. But he has to breath, you know? What I am going to deal with on this subject, I am going to need to go to my equipment and pull out some charts and I might have to draw a little. I want to go into certain aspects of respiration and how we apply it to brass instruments and particularly to the tuba. So excuse me for a moment while I fumble around with my equipment here.

I had thought that if I had permission from the orchestra to spend the four days here with you which I had originally hoped, I would have brought my respiratory equipment here with me to analyze and each day have a period where I could have some of you come in and work with you as individuals but due to the pressure of the season, this was impossible. Maybe at some later date I could do it. The next best thing is for me to try to indicate some of the aspects of respiration.

We have what we call VITAL CAPACITY. This has to do with a quantity of air each of us has as an individual that could be used in tuba playing or anything that we want in life. This particular phenomenon, each of us is blessed by nature with a certain potential, we don't always use it, be we do have it as individuals. Now in a young man of this type, if I had the equipment here I would measure, but I can just about tell by looking at him about what he would have. We use the term liters, I am going to convert it to quarts instead. In the average individual say at about the age of 20 a young man of this type would have a lung capacity of, how tall are you? 5' 81/2'', what do you weigh? And how old are you? So you at the age of 20 would have an expected vital capacity of about 4800 cubic centimeters of air. In other words he would have approximately 5 quarts of air that he would be able to take in if he first blew all the air out of his lungs that he could blow out and then after a pause take a maximum inflation (inhales)…a non-musical breath. All the air he could take in, he would have approximately we will say, we would expect, about 4800 ml, 5 liters of air, somewhere in that range, plus or minus 20%. We can just about predict from his body size and the somatotype of the individual. Now, what I am indicating here is tuba is what we call a high flow rate instrument. I did several tests at the University of Chicago Medical School where I was hooked up to spirometric equipment and analyzing equipment and they analyzed the flow rate of air that I would use from my lungs to excite the embouchure into vibration and my vital capacity, unfortunately is quite small. Short, fat people rarely have very large lung capacities and as you get older, you get smaller and smaller. Unfortunately it is part of the aging

process and if you happen to have asthma with it, it still becomes more and more unusable. I qualify in all the negative aspects of it, but anyway, I still function so…it's a short bow and I change it often and I get by.

What I am trying to indicate to you is that at the age of twenty or so, a person will have their maximum potential in terms of quantity of air as a potential and it gradually reduces for the rest of his life. By the time that he's in his 50's, he will have considerably less, in fact most of the people that come to me with embouchure problems are people in their forties and early fifties who have qualified in this respiratory reduction and as a result are having reflex change on the upper end and it affects the embouchure. Were you going to ask a question young man? (inaudible)

Well, you can cooperate with nature to the extent that you can minimize the amount of change but you are still going to go down. But you can by using, you might say, a quantitative type of inhalation, you can ward off the undesirable effects and play until you are 100 if you want to. Its just that your bow gets shorter and shorter and as I say, if you change it often, there is no problem. If you try to make it o exactly what it did when it was a longer bow, then you are going to be in a little problem here. Now what I wanted to indicate is a variety of vital capacities that come with age and with size and with body type that come with the individual. I have a few papers here of vital capacities that I have taken from individuals. Now, I don't think this is all going to be visible when I hold it up in front of an audience. I just wonder if this line here starting at the top of the page and going all the way to the bottom is at all visible to anybody. Would that be possible to project that sort of thing? Now, let me give you a whole series of them then and we might as well put you to work. I will use one from Chester Schmitz from the Boston Symphony, that would be this vital capacity test here this line…this can be projected (?) There's one by Arnold Jacobs which I am ashamed of but you might project that and along side that is one by Roger Bobo, he likes it…I don't. Now, those are indicated. Now here we have a youngster and I want to put this on the screen also, how are we going to be able to tell

which is which? I will be able to tell I think. But you project these and let me do the guessing ok? Wait just a minute, I've got a sick person here, I've got to put him on also. This is Arnold Jacobs with a deterioration from asthma. You might take that, let me find a real bad one. I'll tell you, I have to let these people in on what the real problems are and as a result I have to find someone with pulmonary emphysema and frighten everybody out of the business…(talking)

This young man whose vital capacity I have tested, we have a piece of equipment where if a person, some of you have experienced this and know what I am talking about, but it is a breath measuring device. Spirometer. *Spiro* to do with breath, a breath meter. And when you take a huge volume of air into the lungs, as much as you can hold, (inhales) blow up like a big frog you know…and you put a tube into your mouth and you go (blows out) and empty the lungs as fully and as completely as possible this sends a little, do this into a piece of tubing and a can moves up into the air, a pen moves up on the other side, there is a revolving drum and it writes so we measure how much air you have moved out and how fast you have moved it out. Now the young man which I had on the first chart, if we were to make the chart (drawing)…This young man in taking a full breath and blowing it out as fast as he could, these charts that I am using measure seven quarts, seven liters, and overshoots we can measure much more of course. But we are measuring a specific quantity. Now this young man had huge lungs, he could fill the entire chart. He's blowing his breath as rapidly as he can into the equipment to be measured. Now in all human beings, regardless of the state of health, as you take a huge volume of air into the lungs and you move it out as fast as you can, you are going to find the velocity of the air out of the lungs is at a constant change. You move out very rapidly at the start. Now as you get to the last 20-25% of volume that are usable on a brass instrument we'll say, there is a considerable slowing up, no matter what strength you may use to try and send it out, it will not come out faster. There are physiological phenomenon involved and actually we are running into a problem where air, near the end of the breath becomes very difficult to use in a high flow instrument. It can be used in an oboe, which is a very low flow rate, but would not be practical

on a high flow instrument like the bass trombone or tuba. Now, I want to indicate, if this were seven liters that this young man had, oh…we have that now. You can see the top of the page and the curve going down and down and down. This young player was the former first trumpet player with the Minneapolis Symphony, a man who is all chest. Short legs, long torso, an enormous lung capacity. Could you put on one of the others now? Let me pick one, I want to show you a sharp contrast…This is one of my favorites. (talking) This is a twelve year old boy who is being taught by a professional trumpet teacher (talking…)This is the seven liters we'll say, and this is the 12 year old boy (drawing), or even less. In other words, the vital capacity on this youngster while it was normal for his years, his bow was extremely small. It becomes maximal at the age of 18 to 20 in the individual. His teacher was giving him length of phrase similar to what he was doing, in other words proper musical phrasing. The youngster had run into severe difficulties in playing because he is trying to take a small quantity of fuel and stretch it out in time to do what the large quantity of fuel that the teacher had to do. As a result, there was over activation of inspiratory musculature, over retention, throat reflexes coming in, severe problems developing in this young player who if he were taught quality of tone, sub-phrase within phrase so that the length of the phrase was not important because his bow is very short. At 12 years of age it's going to be short in the small individual, its going to be short unless their body type is rather unusual. But as an average, you can figure that a short person is going to have small lungs compared to the tall person. Now what we are dealing with, I want to go into this subject because it is very important. (talk)

There are two lines, one is a line of vital capacity of Arnold Jacobs, one is the line of vital capacity of Roger Bobo. The child like one is mine. And the huge quantity is Roger's. Of course it is well over 6l, mine at this time was 4 liters. Today, it is considerably less. Overweight, and too old. They both enter into it, plus pollutants and other things. But what I am trying to indicate to you is a wide variety of fuel supplies for individuals. There's another giant, of course he fills the

entire page, in other words, from the top to the bottom. These are people with enormous lung capacities, you turn right around…I always hate it when I see these big ones you know! It makes me very envious. Now I want to go into some of the ramifications of this. We have problems in respiration in individuals according to body type, according to age. We have musical requirements that we are supposed to fulfill as in my first clinic I stressed deliberately so of always keeping a perspective within your artform regardless of how much fuel you have, we have to communicate. We don't necessarily have to have the same length of phrase. There is no reason why we cannot re-breathe when we are running out of breath. So, many trombone players will be using the Rochut etudes which are simply the Bordogni vocalizes, now the Borogni vocalizes have certain phrasing indications. The tuba uses approximately twice the volume of air in a given time factor as the trombone if he is playing one octave lower. As a result, he is going to be running out of breath twice as fast. If he is trying to compete against the trombonist, he is going to be stretching and stretching his air, over activating the inspiratory muscles. He is going to be running into many problems which are very much avoidable if he would instead work for quality of tone with shorter phrases. If he is a giant, he'll compete. But if he is one of the little fellas ya know, then he can be in very serious difficulty by trying to extend the phrase equivalent to what the trombone player would do for good tasty phrases. We can have sub-phrases which are just as musical and just as valid, but we must be permitted the freedom of using our in a manner comfortable for the individual.

I want to go into this subject now. This is going to get a little complicated and I will probably loose half of you but, bear with me anyways. I want to go into, first of all, we have the vital capacity. Each individual from empty lungs, in other words, residual air is sometimes used as a statement by teachers. Residual air we can forget. This is air that cannot be taken out of the lungs by any voluntary effort that we have. In the old days, the forensic test for medicine in a sense the legal test to see if a child was born alive or dead was to take the lungs out of a youngster that was just born, if there was a doubt. They remove the lungs, they put them in water, if the lungs floated legally, that child had been born alive and

then there might be an insurance problem. If it dropped to the bottom of the water, it was heavier than water, he had not drawn his first breath. Residual air is involved in this. Once you take a first breath, some of the air remains in the lungs. Now you cannot get this air out of the lungs by anything you do on a voluntary effort and so you can forget about residual air if that subject does come up. In other words, it is not something that can be utilized in playing a wind instrument. But it will be there and it protects you always so there is a certain amount of diffusion of gasses even if you have blown all of the air out of the lungs. It is a protection to the individual.

Now I want to get into the subject of **quantity** before I get into the structures involved. The average individual at the age of twenty, you might say the average male, will be able to take 5 liters, 5 quarts of air by maximum inflation. Now half of this, less than half of this is from the diaphragm alone. If you have ever had pleurisy[1] and had this chest wrapped your physician to where the extreme pain of pleurisy is involved, they immobilize the region to allow healing and remove the pain. You cannot move the ribs. If you are left by only the diaphragmatic activity alone, the diaphragm in the average individual is capable of moving about 45% of your usable vital capacity. Now this will vary in body types according to the individual. The somatotype is very important in analyzing this. By getting the average, we'll say 45% from empty to 45% filled can be done with immobilized ribs by diaphragmatic descent. 55% of that individuals vital capacity s there utilized by the expansion in the chest due to the rib activity. Now this will vary in certain individuals from 40% diaphragm to 60%, it can go 50-50, but it will be a variable. But what I am trying to indicate is that the diaphragm in itself is only capable of moving half to a little less than half of

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[1] *Pleurisy (Pleuritis)*Inflammation of the pleura, usually producing an exudative pleural effusion and stabbing chest pain worsened by respiration and cough. Pleurisy may develop in the presence of bacterial lung infections, upper respiratory infections, tuberculosis, rheumatoid diseases, and lung neoplasms. The main symptom is pain over the chest wall at the site of the inflammation. The pain is increased by deep breathing, coughing, and chest movement. The normally smooth pleural surfaces, now roughened by inflammation, rub together with each breath and may produce a rough grating sound called a "friction rub" which can be heard with the stethoscope or an ear held against the chest.

your total usable lung volumes which we will call your vital capacity. The rest is due to the activity of the rib-cage. Now, we don't have the skeletal charts here necessary and I am a rotten artist so I won't even attempt to draw it… (talk)

In the upper right hand corner you will see a posterior or rear approach to a skeletal structure. You'll note, I can't go over there or I will loose my voice. But if I were over there, I would point to the lower ribs and you will see that they are descending. That the angle of the curve from the spine is somewhat down. Now, this is a rather important point. In the left side you will see it even more clearly that there is a curving downward of the rib cage. Now in respiration (I better do this myself, I am so fat that I think people will be able to see it on me a little more clearly than these skinny young guys ya' know?)

In taking a full breath, you will see that from a deflated position, I will never get small, there is just too much there, as I take a large breath (inhales) you will see a considerable enlargement in the chest. If you were to analyze the sternal activity, you will find that that sternum has moved downwards. You will find that it is hinged at the very top and if you liken it to a pump handle, which is so often in anatomy what we use to express the sternal activity, the bottom of the sternum, in other words the breast bone, the little bone running down here, it's complicated, it is in three sections. But we will just call it sternum. This bone, when you breathe in, to a maximal inflation (breathes) has a pumping activity like the old farm pumps. In other words, up and down. I don't know if you can see this (breathes in and out several times) I can't trust the young man to do it because he may not have it, I don't know. I might have to train him to do it. When we go to the lower rib-cage, which is no longer present, but if it were you would find that the lower ribs, I am going now down to the 10^{th} rib, if you were interested and wanted to count down we would leave the 11^{th} and 12^{th} floating ribs go, they are too low for the inspiratory activity, they fix and they have to do with the expiratory states , not inspiratory. This lower 10^{th} is one of our key ribs. You will find that these ribs are bound in front by cartilaginous attachments, its bound to the breast bone, it moves up through a cartilage, they are all attached and hooks right into the sternal region through cartilaginous attachments, they are not free

floating ribs like the 11th and 12th. Now, these ribs come down from the spine in a curve, now when you are out of breath, the lower ribs become a low inward activity, they become very short. I would love to be able to express this with pictures but, let me see if I can get it across from you in some other way. If you can just visualize my arm as one of the lower ribs. If you measure the distance from front to back, in an upward state, there is a distance between the arms in these curves that are quite large. The distance from my body forward is quite large. Now as I lower these arms, the curve comes in and the front goes down, you can see the distance between is getting smaller. The distance between my body in the front of the ribs is getting considerably smaller also. If I raise them up, they get larger. The space between increases, the distance from back to front increases. If we take the pump handle on top, if it moves down, the space becomes smaller, as it moves up and out, it becomes larger. We have a motion of this type in the rib-cage. Now, I will have to address myself to this quite a bit and somehow try to get a biological phenomenon across to where you can understand it.

In order to take maximal breaths, all parts of the respiratory system must enlarge. Most of you know about the diaphragmatic descent. I am not so sure that most of you know about the ribcage ascent, which handles the major portion of the lung volumes. There's another point that follows, that's why its important that we keep a sequence. We must recognize a follow through phenomenon that exists in nature wherever muscles are concerned anyways. We have to find what are the potentials of minimum and maximum. And in breathing, we have to very clearly, to understand respiration, we have to approach it, if you want the mechanics of it by finding maximum as well as minimum. We cannot do it for finding just enough for instrumental playing (talking).. This is the sternum (showing the skeletal model), the breast bone. These ribs are all bound by cartilaginous attachments. Under, we have two floating ribs, which I am canceling out temporarily because of their being too low for our activity. Now, when these raise up, you will find that they will have moved laterally quite a bit as well as up. In other words, the chest is in a higher position then when we are out

of breath. It's low. We have enlarge in these various planes. We have increased space in here as well as the diaphragm moving down. It is not just a diaphragmatic descent, it is a chest ascent. Now, so many people will think of it as a widening but we must recognize for the chest to widen, it must go to a higher plane. It does not widen by just pulling the ribs backwards. These are bounded. The 11th and 12th ribs can go laterally this way. They are too low to affect inspiratory activity. In the case of these, they must go up to widen. When you hear a person is taking a breath, it the back must get wider, you should also realize to get wider, you must also get higher. These ribs here, I don't have a proper illustration of the back, but when they move into the spinal column, if you trace a rib here, it moves way up into the back. As we trace that back, these ribs attach to the vertebral column and rotate on a specific axis. Depending on the position of your spine at any given time, they rotate on an axis. They are now free to do all sorts of things. When you take a large breath, they come up and enlarge the thoracic cavity. As they come up, they rotate outwards, they do not rotate outward in a low position. It is very frequently taught that way but anatomically that is not correct. They must come up to rotate and give you the increased dimension that is necessary for respiration. (talk) You can again see the curve of these ribs downwards. Now inflation, this curve would have moved up. As it moves up it would have increased the width on both sides. The same thing here. We have a tremendous enlargement potential and if you see anybody working for huge lung volumes, you will see enormous change. Now, I am not speaking in applied terms for any specific instrument, I am speaking of taking large, large breaths to capacity for measurement. Not as an application, I am going to get to that. But we have complications that come into this. (talk)

I want to indicate another step. If this line were drawn properly, it would be almost straight with a moderate curve. In other words a healthy young man blowing his breath out as fast as he can, will have a maximum speed at the start and a gradual slowing up as he begins to run out of breath and it can become quite dramatic. And in fact in this one instance, here is a gentleman in one of the major orchestras…you can see a line starting here. The (?)graph is moving at

480 ml a minute. It's specific in its time but he is blowing as fast as he can and yet you can see a line curving and curving. This young man is a woodwind player in one of the major symphonies, I won't mention the name. But he has emphysema. Now a good portion of his breath is sill usable which can keep him in his professional status but he cannot use the end of his breath. In other words, he has to be able to take a full breath and from full, he has to go down to half full and re-breathe or he would be out of his profession because the rest of the air is coming out too slow for use in his profession. Now, this is an abnormal state, it has to do with illness and we don't have to consider this too much. But I do want to explain certain factors that do occur with all of us. Now as I said, our respiratory functions are maximal between the ages of 18 and 20. There is a downwards deterioration from that time on. It seems strange when you take a man 30 years old and say well, you are not what you were ten years ago! Bit this is true in respiration, there is this very moderate reduction (talk)

We have what is called a pressure-relaxation curve which I want to explain to you that ties in and will explain certain problems that will occur in playing as we get into it. (drawing) I am drawing a curve very similar to an "S". Now, if a person has taken in as much air as he can hold…so we have Vital Capacity full lungs in this region, and we will have minimal or might say empty lungs as far as you can use it. At about this point- we have the rest position at night when you are sound asleep. The way that you all are right now, all of you could blow out your air. If you suddenly had to cough, you wouldn't have to inhale. You would have enough air that you would be able to cough right now without first inhaling. That would be from this region towards empty. Now, we can call this a plus (+) and we can call this a minus (-). We have a factor, due to the elasticity of lung tissue, and muscle fibers, many of the tissues involved in respiration; we have a work potential without muscle contraction. In other words if you take a deep yawn, and sigh and we use a water manometer or something very sensitive to pick up the movements of air, you will find that the beginning of that sigh for a man that we'll say with a 5l capacity, a young man. He will have started that sigh with about a ½ lb of expiratory pressure. And some of the bigger ones it could be

easily ¾ of a lb. This is without ever having contracted a blowing muscle, an expiratory muscle. Merely by the letting go of what was taken in. Now, it never stays still. There is a constant curve so that this ½ lb, we'll just put that down…It is in a constant varying state until he is down to zero in this region then, he has the exact opposite happening, he runs into a negative pressure. In this negative pressure, from the rest position on out, the relaxation of tissue would suck air in not move air out. Now in this region, a number of undesirable things happen. It takes much more air pressure to get it out of the lungs. In other words the inter-thoracic pressure, the pressure within the thoracic cavity has to be vastly increased to try and force air out of the lungs at that time. As you begin to increase the pressure to force it out, you begin to collapse the small tubules in the lungs. You create a condition where it is very hard to take the second breath in. As you are forcing that air out, and in the effort you will find the capillary beds begin to fill with blood. You have excessive quantities of blood in the tissues at this time; you have over-contraction of the expiratory muscles at this time. You handicap the ability to take the second breath. In other words, it becomes very difficult to really un-do some of the contraction states necessary to force this air out. Now as a person gets older, usually or, due to ill health, or certain body conditions, this line begins to move up. Instead of down here, it may be up here. We have increasing negative pressure, decreasing positive pressure which can be used very readily in playing.

What we are dealing with here is a biological condition which is not very well known amongst musicians. But it indicates very strongly that you cannot play a high flow-rate instrument with shallow breaths. I like to teach always that you play for the end of the phrase, not the beginning. You must be comfortable at the end so you can replace your breath for the next breath unless you have plenty of time and in a high flow instrument like tuba or trombone, especially bass trombone where the flow rates can be easily 60-80 liters per minute and even higher, then it is very important that you have plenty of air in the lungs or you can't get it out. Now, I am going to open this for questions right away (talk..)

Q: *When you talk about the realization that the muscles of the lungs. And in the first session you were talking about warm up, then shouldn't you also warm up your lungs? Do, specific exercises?*

A: It's very wise. That is a good question. You don't warm up in the sense of increasing the blood supply or anything like that but you do find like an arm full extension by taking several very large inhalations and exhalations, this would be very wise…And a very good thing to d in a practical sense. If I am permitted with time, I do want to get to some very practical applications, but I want you to understand that there are complications here and I wanted to get this in that, in the average individual, a young man, we expect 80% of his air to come out in one second. Blowing as fast as he can…80% of his vital capacity should be able to come out and within three seconds he should be able to take the air in the negative curve out. Now, this varies greatly in individuals and with disease states and age, that 80% can easily fall to 50% and instead of three seconds, I've had people with abnormal conditions, 19 seconds and they still haven't emptied their lungs. Obviously that slow air will have pressure, but cannot be used as flow in playing a brass instrument. In other words, if they go by pressure they think that they are still working but they have no ability to move the air as flow and as a result, it is not a practical phenomenon. They can still play but they have to get into the air that can't be moved out. I can't spend too much time on this I see because of our schedule but what I want to get into is certain practical aspects of respiration. In a warning, I would like very much to warn against the tuba player using only diaphragmatic inhalation. Its very good, in other words, the diaphragm in health is just great, the diaphragm in function is great, but diaphragm isolated from the rest of your function is a 40-50% item. And on the tuba with your high-flow, we cannot get by, in other words, flow rates of 40/50/60/80 and at times 120 liters per minute, you must always consider the end of the phrase and we cannot be having the person beginning to struggle for quantities because he is going to have all sorts of problems with his tongue and throat, and then gradually the embouchure because the air cannot come out fast enough. We have sensors in

the lungs that indicate pressure to the brain, and if you have to have pressure of air, but there is no ability to move the air, your throat will close do to the activity of a part of the brain. If your throat doesn't close, your tongue will raise up but somewhere you will take the upper end of a cylinder and choke it off. And it is done instinctively; it is not done by consciousness at all. It will free up when you have the quantities of air that you can use freely in the lungs. So, what I am trying to indicate is, I would say tuba, above any instrument above all, the average person never has to worry about over breathing. In other words, I would say the average tuba player would have approximately 5 liters lung capacity. I have only slightly in excess of three now, when I was a young man, I might have had only slightly less than 5. But nevertheless, this is not large. We have some with over seven. Now, what this means of course is that if you start out with 4 liters and you have 5, you start out with a 4.5 liter inhalation, and you end with 2, you are still in business. In other words, that next breath will be quite comfortable, you can use your bow freely,; if you start out with 2.5 liters and you are going down to empty, you are entering this region of malfunction at the bottom of the curve. Now you will see the player at that time turn Red, he will be distressed you will see the veins popping out on his neck, you'll find all sorts of contraction states coming in in the muscle, but the air is slowing up. This can be tested in a laboratory, this is not guesswork. In other words, this can be very easily corroborated. As they enter into this negative curve, they do run into problems in the upper end of the cylinder which we can like to anywhere in the larynx on up, and it will inuce this. Now, what's involved, taking the breath in (yes?)

Q: *Have you ever advised that the tuba is the wrong instrument?*

A: No no..It's a matter of finding his true, you might say comfortably large breath so the synchronization of the entire respiratory system is established in a natural way. In other words (breathes in), you can take your breath in a fraction of a second and then take it all in very easily (does breathing exercise. Blows out in

eighth notes and then inhales quickly on one eighth). I replaced my lung capacity without any problem whatsoever. If you do it by expansion of a specific part you will then take what that expansion potential calls for. But if you were to segment in any part of you, you will find that you have eliminated other parts of your vital capacity. Now, the key to it is to find the biological key to respiration and I have to explain this or it will be missed.

Nature has us protected in a way that, always in some part of us in the respiratory system, can take enough air to sustain life no matter what our posture is or what we are doing. Now, I am overweight. If I bend over to tie my shoelace and I am arched forward, the inter-abdominal pressure will increase to such a point that the diaphragmatic descent would be cancelled out. In other words I would no longer have diaphragmatic activity but I would have upper chest activity which doesn't take a great volume, but it is there. And all you need is a ½ a liter to a liter every few seconds to sustain life. So nature has it so if I am bending over and all crowded up internally, I can still expand in the upper end. I have had many many players come, I had a horn player come and study with me who's horn was in the right rib cage…as I analyzed the function, only the left lung was working. Due to the horn in the right rib cage, there was no expansion of the right rib cage. I palpated under the liver and there was no descent of the right lobes of the lung but the left side was functioning fine. But that is still only a half of a breath no matter how you slice it. It could have been a whole breath by better posture and you might say, by allowing the freedom in the right lung. A very good friend of mine, a trombone player I was working with, I happened to go behind him when he was playing and after a long concert his left elbow was digging into the left rib-cage and he is tilted like this. When I was watching his inhalations, only the right lobes were being filled. The left lobes were being inactivated, half-breaths. Now, they could have easily been larger breaths if he felt that he needed it, but he would have had posture. Now we are structured as I say that no matter what bodily position we are in, some part of us can pull air in to sustain life. If I am ding work around the house and my arms are way back like that, the chest is at right angles to the spine, only the diaphragmatic descent is

possible. They are already expanded, there is no place for them to go. So, I have diaphragmatic activity, and that's fine to sustain life. Now what brings them into unit is not the Hatha Yoga System of low breath followed by mid-range followed by upper. In other words the problem with that is that the diaphragm descends first and creates a rather great enlargement here, you will have an increase in muscle toneness…all of the muscles in this region are attached into the rib cage and they have a combined pull that is downward and inwards. That means the upward out movement of the ribs must go under a work load which normally it shouldn't have. There would already be pulled down and in. For health, its great. But for the rapid replacement of breath, it's not good. Now, what is actually involved in this is a very simple maneuver. You have to learn to suck. By that the biological of suction without friction (inhales)…you can actually hear that I am sure, (inhales). Now as soon as you do that, I use sensors at home, I use measuring devices you'll see, or if you palpate with the hand, as soon as you pull the air in here, if psychologically you pull air into the mouth, another region of the brain fires up the regions where it must go. If you go by the mechanical principals and try to enlarge them by the thinking part of the brain, you are bypassing the wonderful computer aspects of the brain and getting in your own way. But if you simply suck the air into the mouth, (inhales), it goes so fast, and in so doing you will find that the diaphragmatic descent, the rib-cage ascent…it is the simplest thing in the world to do but as I say the key is to work with the air and pull it into the mouth but avoid the apparatus aspect that pulls it in.

We all tend to go to the machine study and by-pass the regions of the brain that would be competent to give it to us. In other words we have to stop controlling the systems by the muscles involved and instead go to the signals and life which control these. If you want to take a huge volume of air into the mouth you merely draw it into the mouth (inhale)…It goes somewhere. You will find that you will have the expansion. All you have to do is suck that air into the mouth with soft muscles. It will have enlarged and you ill have it so easily that very frequently I will put a tube into a student's mouth and this upsets the old pattern of breathing habits, and with the altered stimului, I ask him to take in a

large volume of air through the tube and they take it in and they have everything I have asked for without ever knowing what they are doing. I am always against you knowing what you are doing where it comes to the interior of your body because there is no way we can know what we are doing. I examine other bodies to find it out or in dissections you get answers, observations, but you cannot get it through your own sensors. Long after it is right, you will get some awareness of what is happening based on a generalized concept. There are no details, you have no tools for analyzing. What I am trying t indicate now very strongly, is the psychology of respiration versus the mechanics of respiration. The mechanics, according to Boyle's Law, you would enlarge the various regions and in enlarging you would have lowered the pressure of the air below atmospheric, the air within the structures would be lower than the outside air, and it would rush in. Now theoretically this is great. And if you could do it this way, great. Blowing out in reduction, you would have the same thing. But (moving body), I am not moving any air. In other words, any one of these can be simulated without function. Any one can be simulated without function, with partial function, the substitution of stretch phenomenon, the valid signal needs to be sought. The valid signal, you go to air, not air apparatus. When you study a cadaver on a table you put a spirometer on the face, push on the chest and abdomen area, the air moves out of the lungs, if it is fresh. Enlarge him, air ill move in. With a live person, you never do that. You always signal the brain what you want. You want to inhale (inhales) take the air in. Its that simple, we have t find the simple answer. And you must permit the enlargement that would come with the extreme. In other words, many students come t me and say 'you must never elevate the sternum'. They don't use that word, they say 'never raise your shoulders.' Clavicular breathing would be all wrong. In other words this is clavicular breathing (inhales high)..This is of course a phenomenon which, it is not for the respiratory activity. However if you watch a person ill, with a respiratory problem, he cannot stay ill lying on his back. He has got to sit up. In severe distress he will get up and fix his hands on a table or a chair, so that the shoulder girdle will be elevated and the muscles will be in a higher position,

better position to influence the upper lobes. I am not recommending this for the brass player you understand, but I am saying that even here, there are certain elements that should be taken into consideration, this is just not a ridiculous phenomenon. But clavicular breathing in itself is something that we don't concern ourselves with. But in full capacity breathing, there is enlargement of the sternum, there is enlargement of the rib-cage and lowering of the diaphragm.

Now, we know that there is a problem nearing the end of the breath. Our vocal people have resolved much of this by taking the large volume of air, I would say not so much the large volume as the expanded position of volume, the enlarged chest. Now if I talk like this (dark bellowing voice)…going along talking with resonance and so forth, the diaphragm has already returned up, but the chest is still in the enlarged position…I have never entered the negative curve of respiration. In other words, by starting in the simulated full position of air, I am actually using quite a bit of air. There is a considerable amount of air in the lungs and due to the fact that I did not allow this deflation, I have also not entered this negative curve which would have influenced the larynx in a negative way. This is one of the techniques that many good vocal teachers use. However, that takes certain people, I worked with a young lady…a singer, who had a tiny little, 2800ml capacity and was being taught singing by a large male. And she couldn't complete her phrases. This man probably had in excess of a 6l lung capacity, and this little girl with here 2800 ml, her fraction of air that she could use would be less than half. Well, less than half even if she would have taken in a maximal breath, there would still not be much fuel. Now, if I just talk and I allow my diaphragm to raise up, in other words I am withdrawing the abdominal wall, I would be out now but I could still keep going as long as I lower the chest and gradually I hit this curve (stressing in the voice) where I am in trouble now. But, I could have gained another second or two depending on how fast I was using it permitting deflation so that all parts of you that expand in inhalation, deflate or reduce in exhalation. The muscle activity is different but what you see in enlargement actually is a return back due to muscles, but they definitely return back to their reduced state. Now any point that has enlarged should be

considered potentially a region that can reduce in exhalation. I don't favor this type of teaching, I am discussing this because of a need for understanding. I like to teach always the art-form of music and when you need air, take it. Take it in god taste, become alerted to air as a phenomenon of motion, not body. But to understand why you must d it that way, you have to realize that there are complications in the bodily activity and the ability of the body to lie is simply enormous. I can take in a huge breath (inhales), or I can simulate and you may not know the difference unless I made that sound. I could create the expansion (talk…)I would like then to ask questions. If anyone has any specific questions that I can respond to…

Q: *What I would like to know then is what would the conscious process be of taking a breath in?*

A: As I say it is a matter of suction. I have the equipment but I don't have the time to demonstrate it here. Bu if you use sensitive devices near the mouth, you can actually see the air going in as you inhale so that you work for the air as you experience it external to the body moving inward. So as I say; suction without friction. So that we don't have the sound (hissing inhalation) the sound of a fricative, but the sound of wind. If you blow out and you create a certain sound, that was too much, the sound in reverse would be very similar. It is a wind sound. When you become engrossed in the sound of the breath you will also find that you have the breath.

Q: *What about circular breathing?*

A: Circular breathing requires a big mouth. (laughing) I am not saying this in a facetious way exactly, but what is involved is putting enough air in the mouth to where through the palate activity, you can close off the pharynx, in other words breath through the nose for an instant while you are compressing the cheeks and elevating the tongue to continue the movement of air which would be momentary, while you would inhale through the nose and replace. It can be

done in pianissimo, I think Chester Schmitz does it quite a bit in Boston. I fooled around with it but I have a lot of friction in the nose. I am always having problems and I can't get much air through it. And I am not particularly enamored with it either.

Q: *Do you not go quite up to full capacity when you take a full breath?*

A: For playing, you would rarely go up to 100% but 85%,90% should be quite comfortable and you should rarely get down to within 20% of your minimum of air. In other words you stop when you are somewhat still functional so you don't confuse air pressure with air flow. There has to be a freedom of air movement with the air otherwise the wheezing phenomenon comes in.

Q: *Can you explain the relationship of pitch to pressure and how it works?*

A: Pitch and pressure are really not related in the way people tend to think. In other words if there is insufficient pressure, you will have pitch that is much softer but you can conceive that to go to a higher note will require more air pressure than a lower note. If you don't have the pressure, you will play a higher note softer. Pitch is primarily a phenomenon of embouchure and little shaping musculatures but there are requirements. In other words you could apply all sorts of pressure and never change pitch, it is not an end product. It is part of an overall system and as a result I don't quite approve of changing pitch by pressure I choose, I like to change pitch by changing pitch, just like a song. And if involves something else then fine and dandy, but don't fix on it but there..if you can find that you might do, you might say apply pressure and not change pitch, then it is really not a valid, immediate component but it is part of a system in the sense that to retain a given volume between a low C and a C two octaves above, you are going to find increased air pressure and decreased flow. But you see, you could actually have the same pressure and you would find that you are merely playing much softer up there. But pitch is an embouchure function.

Q: *Raising your shoulders, is that just because of the pressure of your lungs?*

A: It has to do with the accessory groups of muscles, it has to do with filling the lungs for your vital capacity. Now we have the ability to raise the shoulders without respiration. Every one of the respiratory muscles in life has other things to do than just respiration, there are other functions. And the shoulder girdle is free to raise and lower and it is not really necessary in any normal breathing patterns. In maximal inhalation there is a very moderate use, which should be minimized in the shoulder girdle. In other words, elevation of the sternum, even that does not require the shoulder girdle. In maximal things in terms of disease states and so forth, air hunger, there can be a certain amount of this brought in, we don't recommend it for musical purposes at all.
I think I have to stop now or Mr. Phillips will have to run me off the stage!

Thank you very much, I wish I could have proceeded further (applause)
Thank you so much, I brought all sort s of little gadgets and I can't even begin to explain them all today but a bunch of my students are in the audience, they will tell you.