SWEIGARD'S LEGACY: FURTHER EXPLORATIONS INTO BREATHING[1]

Not having had the opportunity to work with Dr. Sweigard directly has provided me with many intriguing questions and speculations about why she chose to emphasize certain functional aspects of human movement potential more than others. Sweigard's work on breathing stresses the need for flexibility of the ribcage and the hanging relationship of the ribs to their attachments at the spine and the sternum; however, her breathing imagery does not always provide the detail necessary to achieve maximum flexibility and the hanging relationship of the ribcage that she believed to be desirable. It has always interested me that while her breathing imagery is excellent as far as it goes, it does not contain the same degree of depth and detail that her work gives to other body parts. Both Dowd and Williams have told me that Sweigard believed that the most complicated (and highly individualistic) problems resided in the breathing mechanism, thus making it the most difficult area in which to provide effective imagery. Stough would certainly concur with that conclusion, although his teaching methods do not rely heavily on a formalized usage of mental imagery.[2] Since the intricacies of formulating new imagery aimed at improved breathing functions have become a subject of all-consuming interest to me, I will begin with a discussion of some of the anatomical information that has informed the imagery that I have so far developed and that I now use.[3]

Relevant Anatomical Facts

A review of Sweigard's writing about the ribcage, diaphragm and breathing (1974) reminds one that her knowledge of (and ability to describe) anatomical function was extraordinary because she wrote from the standpoint of (a) the living, moving human body and (b) a conception of ideal mechanical function. Her imagery that is meant to encourage centered breathing imparts an accurate, overall concept: an analogy is made between the action of the diaphragm moving against the inner surface of the ribcage and the image of a piston moving up and down inside a cylinder.

> Since the diaphragm is complicated in both structure and function, we shall simplify its operation here by likening it to a dome-shaped piston with centered control as it moves up and down in a cylinder. The trunk is the cylinder; the diaphragm is the piston whose <u>outer</u> circumference is attached to the <u>inner</u> circumference of the lower, very irregularly shaped opening of the rib-case (Sweigard, 1974:277-278).

This image, while concise and comprehensive, is frequently too generalized to allow for positive responses, especially in teaching situations where a student's structural and neuro-muscular breathing problems have been too complex to allow a positive response to generalized imagery of this kind. In such cases, it has been necessary to devise more detailed specific imagery relating to tension reduction and re-alignment of the ribcage first. Often, this has to be combined with initial re-alignments of the ribcage with the pelvis, spine, diaphragm and auxiliary musculature before successful re-coordination can be achieved through a generalized image.

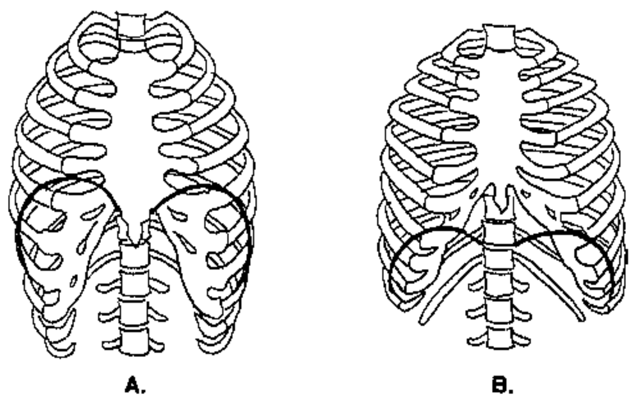
To describe the anatomical features of the ribcage and spine is somewhat easier than to describe the highly specialized structure of the diaphragm itself; however, one must bear in mind the difference between the outwardly visible shapes of the body's surface contours and the outwardly invisible shapes of the deeply internal spinal and ribcage structures.[4] Sweigard describes the overall structure of the thorax in this way:

> The thorax is sometimes called the rib-case or rib-cage, for it is, indeed, similar to a cage except in its manner of support. Of the three units of weight it has the most bones, 37 in number: 24 circular ribs, 12 vertebrae, and the breast bone or sternum, all of which articulate with each other in approximately 100 places to form a functional unit...Because of its many mobile joints, and because the ribs themselves form flexible bony arches completed at the front by pliable hyaline cartilage, the rib-case should ideally be freely movable in respiration, flexible for movement, and capable of absorbing shocks from direct blows provided the impact is not too sudden and too strong.
>
> The twelve thoracic vertebrae, forming a slight curve with their convexity to the back, are located back of the central axis of the rib-case...They support most of the weight of the circling ribs and the breast bone to which the ribs are attached at the front. The ribs extend as far as their angles. There they turn to circle to the front. Their angles are approximately in vertical alignment forming a backward curve which corresponds to that formed by the spinous processes of the thoracic vertebrae. Thus some of the structure and weight of the rib-case is back of the supporting vertebrae. The ribs and breast bone, as hanging structures, are given further support by muscles which connect them either to higher levels of the ribs or the thoracic spine, or to the cervical spine and base of the head (Sweigard, 1974:177-178 -- underline supplied).

It is the combination of bony and muscular supports that makes the functioning of the ribcage in relation to the whole body particularly difficult to comprehend. Moreover, its overall alignment to central axis alignment is crucial:

> The alignment of the rib-case relative to the head and pelvis depends on (1) the alignment of the supporting spine, and (2) the tension of attached muscles which have their origin at higher or more central skeletal parts. To conform to the principles of mechanical balance, all parts of the rib-case should be as close to the pelvic base as the structure allows (Sweigard, 1974:178 -- underline supplied).

Figure 1 gives a general front view of the ribcage and schematically represents the approximate excursion of the diaphragm in respiration.



(Illustration from Sweigard, 1974:115)

A = Front view of ribs and dome of diaphragm in ordinary expiration.
B = Front view of ribs and dome of diaphragm in ordinary inspiration.

(Fig. 1)

The significance of these facts to each individual student is, of course, impossible to describe here; however, it cannot be overstressed that, contrary to nearly all commonly accepted notions of expansion of the ribs away from the central axis of the spine, "broader" chests, and such,[5] it is always necessary to re-evaluate and re-think the relationship between the facts of the structure and the student's (sometimes very fanciful) pictures of the structure. For example, it often seems 'natural' to students that on expiration, their diaphragms are 'down' or 'away from' their heads; on inspiration their diaphragms are 'up', drawn there by the in-flowing breath. Such 'picture-notions' are hard to shake, yet it is clear from Figure 1 that the structure of the diaphragm simply does not function in this way.

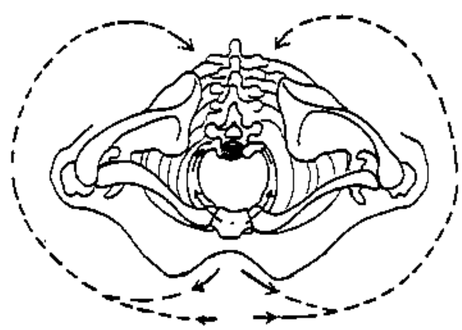
Mabel Todd adds these comments to the total developing picture:

> The ribs hang from the spine, being articulated with the vertebrae by two series of joints, the heads in each case joining with the bodies and inter-vertebral discs, and the necks with the transverse processes of the vertebrae. These double contacts make for strength and flexibility.
>
> The gutter of the spine has a considerable depth and in it lie the great longitudinal muscles of the back. These extend from head to pelvis and make a flat contour for the middle region of the back (Todd, 1937:108-109 -- underline supplied).

The degree of movement allowed by each articulation may be small, but in total, the existence of approximately 100 movable joints in the ribcage indicates an enormous amount of movement potential among the bony structures of spine, sternum and intervening rib circles.

Because the thoracic vertebral bodies of the spine thrust almost halfway into the body's thoracic cavity from front to back (See Figure 5), and because the slender rib circles are more deeply curved at the back in order that they may nestle into demi-facets between those vertebral bodies, actions between spine and ribs are more difficult to perceive than actions that may occur between sternum and ribs.

Viewed from above,[6] the construction of sternum, ribs and spine is heart-shaped, with rounded wells of the heart-shape at the back (See Figures 2 and 5). In Figure 2, it is also clear just how narrow the top rib circle is: about one-third of the width of the shoulder girdle, and a bit smaller around than is the base of the neck. The appropriate 'broadness' at this level of the body belongs to the shoulder girdle, not to the ribcage.



(Illustration courtesy of I. Dowd)

(Fig. 2)

Tension in the long, thick muscles of the back wall of the trunk often (if not always) limits the mobility of the deeply internal spine-to-rib connections. The front wall of the thorax is less heavily muscled than the back and is not limited by inter-connecting spinal curves, as is the back wall. Also, there is no comparable bony connection between the bottom of the sternum and the front of the pelvis such as that supplied by the lumbar vertebrae at the back. These two factors make the front wall of the trunk more malleable and more easily expandable with regard to the act of breathing, tending to create an imbalance in smooth, cylindrical muscle coordination throughout the whole trunk.

Except for the top rib circle, which is almost horizontal, the rib circles might be visualized as a series of bucket handles hanging suspended between the spine and sternum, with the back attachments of the bucket handles being higher than the front attachments. When the diaphragm performs its upwards excursion inside the ribcage (producing an exhalation), the bucket handles fall downwards and inwards against the sides of the irregularly shaped bucket. When the diaphragm makes its downwards excursion (producing an inhalation), the bucket handles swing slightly outwards from their attachments. If each handle has truly been hanging down against the bucket-shape at the end of the exhalation, the two handle attachments will be higher than the side of the handle. The handles are meant to swing out gently and just a little bit for the inhalation. They drop down for the exhalation, but they always maintain an easy hanging relationship to their attachments. They do not lift up for the inhalation. They always remain lower than their attachments and ready to continue swinging in either direction.

Relevant Ideokinetic Properties of the Ribcage and Spine

The ribcage is an open, lightweight structure. It has more 'air-spaces' on the whole than it has bone. The ribs are quite thin and delicate, compared, say, to the thickness and sturdiness of a femur. The ribs should be able to float on the air, so to speak, which is inside of the lungs which they protect. The ribs must be totally prepared to respond to the movement requirements of the diaphragm, whatever these may be at any given time.

It is unusual, given an ideokinetic notion of bodily hierarchies, to ask that bone be subservient to muscle, but in the case of breathing, that situation must obtain if the ribs are to give; that is, to yield and to get out of the way -- to let the diaphragm move as it wants to move, and as it was designed to move. Stough's cinefluorography and roentgenography films show that a well-developed diaphragm swings all twenty-four half-rib-circles upwards and outwards, expanding the base of the thorax from the twelfth rib consecutively upwards on the inhale; with the opposite motion occurring on the exhale. If one half-rib-circle is out of synchronized action with its neighbors, the resistance that is thereby created is enough to prevent the diaphragm from completing its appointed rounds in a fully coordinated manner. In other words, when the ribs really operate from a hanging position, the lowest ribs are much closer to the top of the pelvis than is generally supposed -- or than is generally depicted in anatomical illustrations in books. It would not be unusual for the hanging ribs to fall within an inch of the pelvic crests, almost resting on top of or within them, if good alignment and relations have been achieved.[7] One might imagine the lowest pair of floating ribs (which are attached to the spine but not to the sternum) as fingers reaching around from back to front and down inside the crests of the pelvis. It is also useful to think of wearing a cummerbund backwards so that the wider part is at the back, the narrower part at the front, thereby uniting the front lower ribs to the pelvic crests and expanding the back lower ribs both lengthwise and widthwise in relation to the pelvis.

It is also important to remember that while the diaphragm is similar to other muscles in the body in some respects, its unique function has endowed it with certain differences from other muscle structures. Its action is not wholly under conscious control. The diaphragm's function demands that the serious student remain open-minded about the nature of this most important structure.

It seems to be commonly agreed that the diaphragm is the prime mover of breathing. Yet, setting up the bodily circumstances within which the diaphragm can actually function as the principal agent in the act of breathing can be complicated, representing, in my view, the centerpiece of all alignment concerns, whatever the individual's unique patterns of muscular coordination and postural alignment may be. The many muscles that might interfere with or compete with the diaphragm's chief function -- which should be to 'head' the coordinative musculo-skeletal 'team' of muscle groups -- are far too numerous to mention, but they require the same reduction of tension and unnecessary activity in the subsidiary musculature that is required for any other group of muscles before a new, more efficient neuro-muscular pattern of coordination can be achieved.

(Fig. 3)

(From the Anatomy Coloring Book, plate 13)

The opposing curves of the spine -- an outward curve in the thoracic spine, an inward curve in the lumbar spine -- play an important role in breathing function. If kyphosis is present in the thoracic spine, making the curve too deep and too short, the ribs will tend to be compressed, with a variety of possible distortions in the shape of the ribcage. If the thoracic spine is in a straight line or an inward curve (the opposite direction from its normal shape), the necessary rounded surface of the inner rear thoracic wall is destroyed. In either instance, free movement of the ribs and diaphragm is restricted. Sweigard talks about the detrimental effects of lordosis (too much inward curve) in the lumbar spine:

> The person with a hollow low back (lordosis) and an increased antero-posterior tilt of the pelvis uses the front half of the diaphragm more than the back half, and the movement of breathing occurs disproportionately more in lifting the chest and in forward movement of the abdomen. Such abdominal movement is sometimes wrongly attributed to strong use of the diaphragm; in fact, it reflects poor trunk alignment and corresponding inefficient coordination of all the muscles engaged in breathing (Sweigard, 1974:277).

If the converse situation obtains, in which the lumbar spine is in a straight line or an outward curve, which often combines with the pelvis being tucked under, the crura (tendinous attachments of the diaphragmatic dome to the lumbar spine) would tend to be too far behind the central axis of the body and cannot participate in the piston-in-a-cylinder action of the diaphragm.

Relevant Facts About the Diaphragm Itself

Capturing the precise shape, location and action of the diaphragm in words is difficult, to say the least, but the main features of it are these: first, the diaphragm is shaped like a double dome, and it separates the thoracic from the abdominal areas of the trunk. Dowd describes the diaphragm as the 'floor' of the thorax and the 'roof' of the abdominal cavity.

> Its muscular fibers arise either directly or by tendinous attachment from the complete internal circumference of the lower opening of the thorax; they insert in the central tendinous portion of the diaphragm.
>
> The right side of the diaphragm is higher than the left because it arches over the liver, a much larger organ than the stomach on the left. The right side also contains stronger muscle fibers and a longer tendon attachment on the lumbar vertebrae to cope with the resistance of the liver to its movement (Sweigard, 1974:110).

All of the muscle fibers of the diaphragm converge towards the center of the structure to attach to a central tendon, and there are two more tendinous attachments (the crura) that attach it to the lumbar vertebrae. "The whole structure of the diaphragm is in the shape of a lop-sided mushroom with its stem nearer to the back margin than the front" (Todd, 1937:221). Stough likens the diaphragm to a half-ball in a socket in the following way: the heart-shaped 'ball' of the diaphragmatic dome fits into the partially corresponding heart-shaped 'socket' formed by the flexible inner wall of the ribcage. The overall 'socket' is shaped like an egg -- narrower at the top, broader at the bottom. The 'ball' fits neatly into the 'socket' and is a close fit. Both accommodate each other to achieve a smooth movement coordination.

All of this should convince even profound skeptics that the old, familiar image of the diaphragm as a kind of muscular structure shaped like a dinner plate is completely wrong. As an image, it is so unlike the realities of the structure that many defective tensions can be produced by thinking of it in this way, or in any other way that does not correspond with the facts of the matter. There is a tendency, too, for beginning students to believe that the mental pictures they have of structures internal to their bodies do not matter, yet those who know and understand Sweigard's principles know that wrong pictures produce wrong (or distorted and/or misaligned) movements. Because the diaphragm is centrally placed in the trunk of the body and because it attaches all the way around, its movements tend to affect everything else in profound ways.

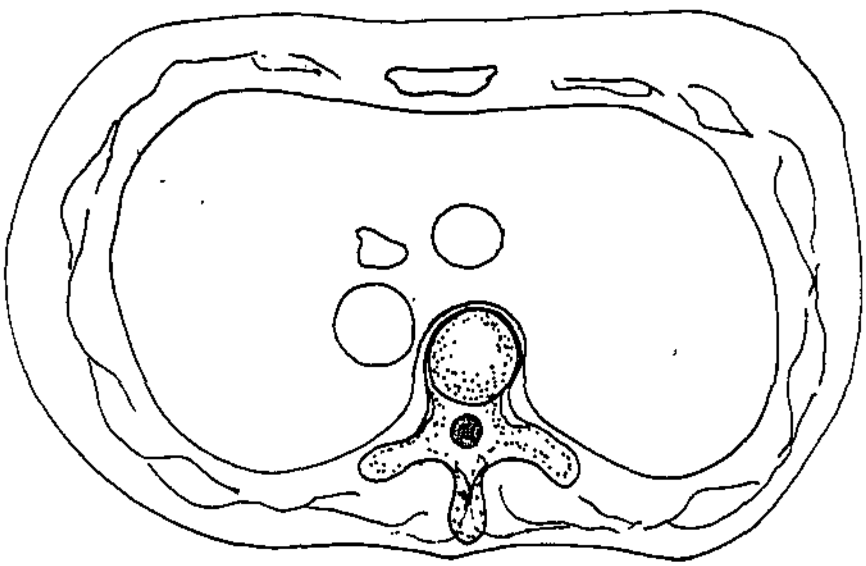
However, the outer circumference of the diaphragmatic dome is not attached to the inner circumference of the ribcage in the same way that nearly all other muscles are attached to bone, i.e. by tendons that form a firm binding between muscle and bone. The sides of the dome of the diaphragm join fibers with those of the transversalis muscle which is located all the way around the circumference of the trunk (between the inner ribcage and inner pelvic crests) like a cinch-belt. The two muscles, diaphragm and transversalis, are woven together and act as one because of their inter-digitation of fibers (See Figure 4).

(Fig. 4)

(Illustration from Sweigard, 1974:112)

The elasticity of this unique kind of joining between the diaphragm and the transversalis muscle provides the mushroom-shaped dome with a great range of potential movement against the inner surface of the ribcage. The crura are likewise elastic enough to accommodate the fullest possible excursion of the dome. The best way to think of the relation between ribs and diaphragm is this: the diaphragm conforms to the rounded shapes of the lower ribs, but it is not, as it were, sewn down to them.

By now, the reader who is interested in some form of movement or another should be prepared for something of a surprise -- at least many students have told me that they find it surprising to know that the vertebrae project so deeply into the body. And this fact also influences the improved functioning of the diaphragm. The remarkable thing about the next drawing (See Figure 5) which was taken from a photograph of a dissection,[8] is that one can see that the front of the vertebral body (either the fifth or sixth thoracic vertebra) projects fully half-way into the cavity of the ribcage from front to back, justifying the 'heart-shaped' image given earlier.



(Illustration courtesy of I. Dowd)

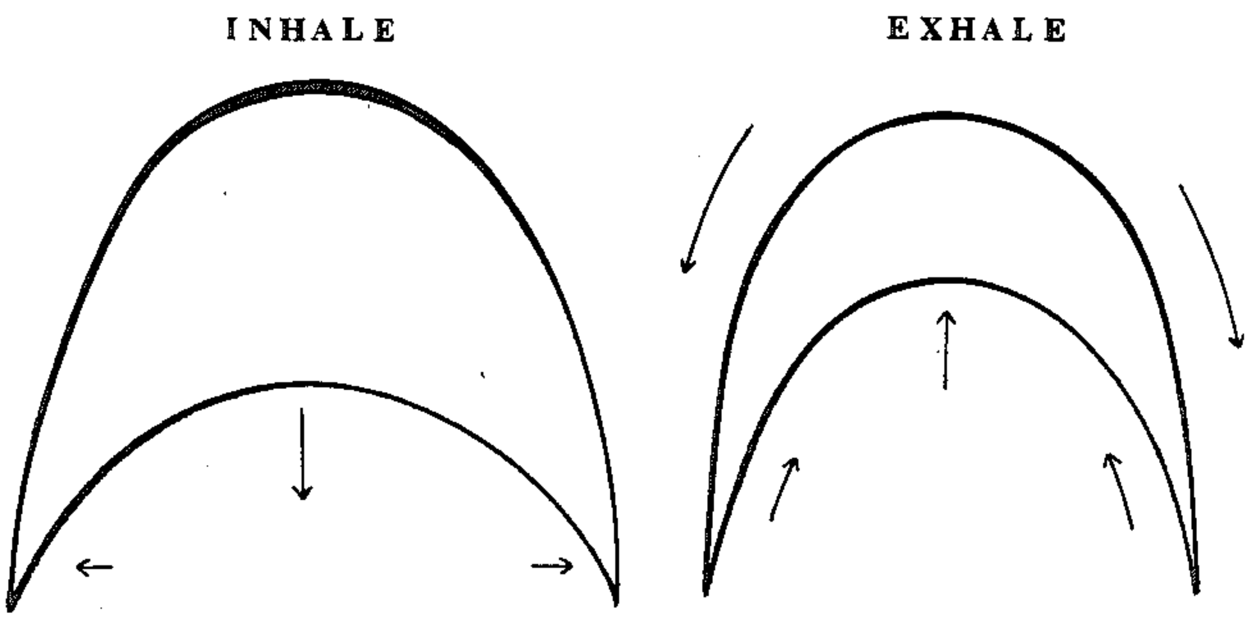
(Fig. 5)

Some Points About the Action of the Diaphragm

The action of the diaphragm is that of rolling (or crawling) up and down against what should be a responsive, tension-free, inner thoracic wall. Because the dome of the diaphragm also adheres to the base of the lungs, it slides downwards to allow the lungs to be filled and billows upwards, like a mini-double-domed parachute, to empty the lungs, moving closely against the inner thorax.

Many writers[9] have declared that the dome-shape of the diaphragm flattens (or is 'depressed') on its downward excursion. Stough's findings, based on years of clinical experience, tend to disagree with that notion, and in my own work, I have adopted his ideas because I find them far more effective, not only for general postural alignment work, but for dancers and singers as well. Stough is convinced that the diaphragm should maintain its dome-like shape on both inhalation and exhalation phases of the breathing process.

While it is true that a forceful inhalation might flatten the dome on its downward excursion, this simply means that the structure must re-form or re-shape itself into a dome again on the upward excursion, thus creating extra work and energy expenditure, and limiting its capability of making a complete exhalation. Because of this, a light, unforced inhalation encourages the diaphragm to retain its shape throughout the breathing cycle and allows it to perform more efficiently. A well-developed, unimpeded diaphragm will rise to the level of the fourth or fifth rib circle on a maximal exhalation. The depth of its descent will vary according to the size of the breath, but it might go as low as the eighth rib circle. Determining the exact position of the diaphragm at any given moment is virtually impossible, as it is always in motion, hence the importance of understanding its range of possible operation, bearing in mind that its movement varies according to the size and duration of both the inhalation and exhalation. While the diaphragm is rolling in an upward direction, the entire ribcage folds down around it, gently enveloping and caressing the diaphragm. When it is 'peeling' itself downwards against the inner thorax, the entire ribcage is delicately swinging outwards in an arc (not upwards) to accommodate the in-rushing air. A simultaneous upward/downward opposition is created. (See Figure 6.)



(Fig. 6) (Illustration courtesy of I. Dowd)

The scope of this article does not allow space to discuss the anatomically pertinent aspects of the lungs or of the larynx and pharynx, which structures are also intrinsic elements of the breathing mechanism. The interdependence between the efficiently functioning larynx during phonation and all other aspects of the respiratory function is too large a subject for inclusion here.

Breathing-related imagery is complex and can be handled only on an individual basis, not because the images themselves are entirely different for each person, but because individual patterns of imbalance and tensions intrude themselves in such a way that even though two or three students might be given the same imagery, they are not given it in the same order, nor at the same times during their re-training. It is possible, however, to recapitulate the images that I have given of the structures themselves, for that is the first step towards better function.

The first two images relate to the ribcage.

1. Bucket handles. The bucket handles represent the twenty-four half-rib-circles that hang suspended between the spine and the sternum, twelve on each side. The rear attachment of each handle is higher than the front attachment. The bucket handles are always hanging and always (however slightly) in motion. Upon inhalation, they swing out from both attachments in a lateral direction; upon expiration, they drop gradually downwards and inwards to rest against the imaginary bucket.

2. Floating ribs as fingers. Because the two pairs of floaters are the lowest of the ribs and articulate with the spine only, they often become compressed and do not join readily with the other ribs as they drop into hanging position. Seeing the 'fingers' as separate from each other and actively extending downwards into the bowl of the pelvis provides the floating ribs (and all of the other ribs as well) with more 'hang space'.

Images three through six locate and describe the diaphragm itself.

3. One-half ball in socket. This image, suggested by Stough, represents the dome-shape of the diaphragm as a half ball and implies its snug fit into the socket, which represents the inside wall of the lower and middle ribcage. The possibility of a smooth inter-action between the sides of the dome and the inner thorax is thus set up.

4. Mushroom cap and stem. Mabel Todd likens the diaphragm to a mushroom cap, again emphasizing the dome-like aspect of the diaphragm. The addition of the 'stem' encompasses the concept of the crura providing strong yet resilient anchorage to the lumbar spine. As an imaginary central vertical axis would probably graze the front vertebral bodies of the lumbar spine -- near where the crura tie down -- this image also supports Sweigard's concept of 'centered breathing'. Inter-action among the lumbar spine, the crura, and the diaphragmatic dome would tend to follow the route of the central axis.

5. Parachute. The parachute incorporates all of the characteristics of the mushroom cap and stem, but adds several qualitative details. The silky fabric of a parachute might be seen as more subtly responsive in movement than either a half-ball or a mushroom cap. One might easily visualize a parachute as floating on imaginary air, which is a good textural concept for the movement of actual air in and out of the lungs.

6. Heart-shape. When viewed from above or below, in trans-section, the heart-shape represents the circumference of both the diaphragmatic dome and the bony structure formed by the spine, ribcage and sternum. The two deep curves of the heart indicate the back halves of the rib circles as they sweep around from front to back and turn inward to meet the vertebral bodies of the thoracic spine. This heart is not pointed at the front, but is almost straight across where the hyaline cartilage melds the front rib circles to the sternum. The important pictures delivered by the heart-shape are (1) the back half of each rib circle as fuller and more deeply curved than the front half; and (2) the internal depth at which the rib circles join with and move in relationship to the spine -- almost half-way into the thoracic cavity from back to front.

The last two images relate to the abdominal muscles.

7. The cummerbund. Worn backwards around the waist, the cummerbund is quite narrow at the front and much wider at the back. The front half of the cummerbund is meant to establish a close muscular relationship between the lowest ribs and the tops of the pelvic crests; it is placed between the ribs and pelvis. The back half of the cummerbund is too wide to sit between the ribs and the pelvis (the ribs are intended to hang almost as much in the back as they do in the front); it wraps around the back of the lower ribs and the pelvic crests. The wide back part of the cummerbund both supports the middle back and lengthens the lumbar curve of the spine. The breadth of the back half of the cummerbund assists in balancing the thorax more directly over the pelvis.

8. The cinch-belt. The transversalis muscle is visualized as a broad belt with crosswise elastic fibers. This cinch-belt is worn inside the lower ribcage and pelvis and circumferentially connects the outsides of the diaphragmatic dome to the inner pelvis. Because of its elastic properties, the cinch-belt moves with and responds to action of the diaphragm in any direction. The cinch-belt also promotes a smooth coordination among the muscles of the inner thoracic wall and abdomen, from the top rib circle to the base of the pelvis.

Two important points facilitate success in using the above imagery. First, the trunk (indeed, the entire body) must be thought of as being three-dimensional.

> First of all, the body has to come off the flattened textbook pages and be thought of as a kind of cylinder which, in breathing, functions all the way around, not just in front, as it would often seem to (Stough, 1970:205).

The ideal coordination would consist of an equal degree of movement all the way around the torso cylinder. The student must monitor his responses to the imagery to insure smooth action throughout the relevant muscle groups. Some muscles, or segments of muscles, are often found to be over-active, some under-active. It is well to remember that a large number of the muscles engaged in breathing are situated so deeply inside of the body they cannot be seen or palpated at the level of surface musculature. The positive function of 'invisible and untouchable' muscles is often reflected in the action of surface muscles. If the outer muscles are working less, but never holding still or preventing movement, the chances are good that deeper muscles will be participating more fully in the coordination.

Second, the bony entities and their attendant muscle engines are inter-related and inter-dependent. As is true in all other areas of neuromuscular recoordination, with reference to the breathing mechanism, the relative alignment of the ribcage, spine and pelvis determines the ability of attached muscles to act freely. Conversely, the capability of the musculature to function fully influences the relationship of bony parts to each other and to the whole structure.

General Concepts About Breathing

There is only one breathing process that has to carry each individual through many activities, not separate breathing methods for singing, dancing or meditation, just as there is only one body per person that dances, sings, meditates, swims, plays tennis or whatever. References are often made to alleged 'different types' of breathing, i.e. 'clavicular', 'costal', 'diaphragmatic', 'abdominal', 'back breathing', and such. Dividing breathing into separate components (some of which are more, some less, accurate references to the actual event) leads to deleterious attempts to improve disparate sections of what is meant to be a cohesive, inter-dependent system. As we have seen, breathing involves the whole trunk of the body, and to emphasize one <u>part</u> over the whole is to disturb the overall synergy of function. It is true that sometimes a student may leave out an aspect of the overall function, and therefore the teacher may give imagery to bring that part into better coordination with the whole. Such emphasis does not mean that one phase is more important than any other, but it may be important at one particular time. Indeed, this is one of the ways in which the timing of imagery choices made by the teacher may be significant.

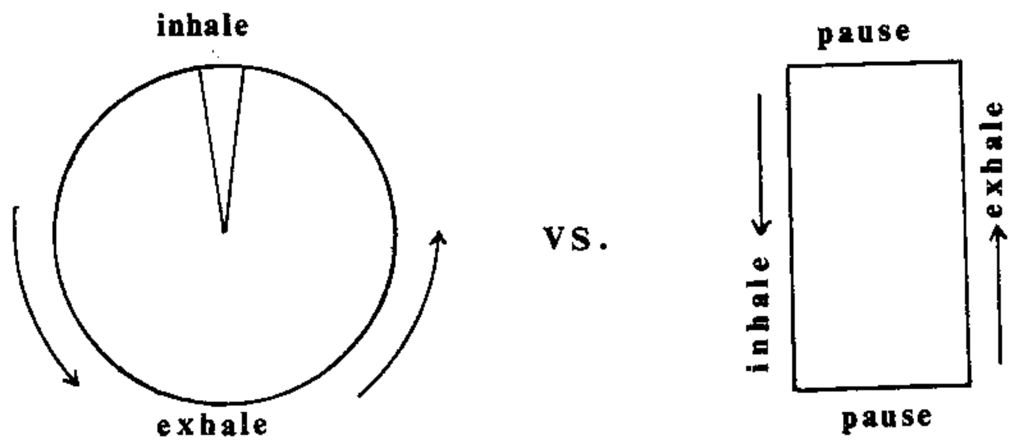
Breathing is often called the 'bridge' between the voluntary and involuntary functions of the body. Basically, it is more under the direction of the involuntary nervous system and therefore requires a specific attitude towards it. Because the breathing mechanism <u>can</u> be voluntarily controlled does not mean that its optimal function may be achieved through such control. Breathing is primarily a life-sustaining function. Special demands may be placed on the breathing mechanism in order to sing successfully, say, a Schubert song. Such demands do not totally change the nature of the breathing cycle; they merely ask the exhalation phase to extend or otherwise accommodate itself to the needs of musical phrasing.

Students should try to create the conditions, through accurate and factually correct imagery, to allow the diaphragm to function at maximum capacity and range of movement. This usually requires intense study of the structures, their shapes and workings, because all too often, the student arrives with completely wrong pictures, not only of the diaphragm itself, but of the bony structures involved and the actions that take place.

The diaphragm is the prime mover. That is to say that all other muscles and bones (the ribcage, the spine and the sternum) are (or should be) subservient to the movements of the diaphragm, and they should be conceived of as if they respond to the needs of the diaphragm.

> Contrary to general belief, the more important phase of breathing is the exhale, the movement of air from the lungs. If a container is to be refilled, it must first be emptied of its contents (Stough, 1970:206).

Prolonged exhalation is advocated by Stough to bring the emptying of the lungs to a logical conclusion, creating space in the lungs for oxygen-laden air to enter. (According to Dowd, this concept was frequently emphasized by Sweigard in her laboratory classes.) Too much emphasis on inhalation, i.e. 'hauling too much air into the tank', is not good because it (1) creates tension throughout the musculature which must manage an unwieldy volume of air in the lungs, and (2) diminishes the chances of fully exhaling the 'used' air to the level of minimal residual volume in the lungs. When the exhalation is allowed to complete its cycle, the reflexive trigger of the next inhalation is prompted by the increased carbon dioxide level in the bloodstream, thereby letting the body's reflex system time the inhalation to the exact moment it is needed, and not sooner, i.e. before the exhalation is really finished. When these factors are in correct balance, the exhalation is many times longer than the inhalation. The inhalation is short, fast, and occurs with the least amount of effort by the diaphragm. The cycle becomes a continuous, uninterrupted, smooth circle instead of a rectangle (See Figure 7).



(Fig. 7)

Because there is an inequality in the duration of the two phases of breathing and because the inhale should occur in response to the body's need for oxygen, the overall cycle always varies in length. It should never be forced into a particular rhythm or count. The cycle has its own intrinsic rhythm which differs for each and every breath.

Finally, breathing, as an act, should be more passive than active. It should be watched, not controlled, then allowed to strengthen and function according to its design.

Conclusion

In the day-to-day teaching of Ideokinesis, the teacher is constantly called upon to make decisions that affect both the immediate and long-range success of the ideokinetic process. Confronted with a particular student -- with his or her unique structure and neuromuscular patterns, history, personality, and predilections for comprehending information -- the teacher chooses imagery to fulfill the needs and goals of the student in that session and in addition chooses imagery which the student may practice over a period of time. These choices often represent a combination of carefully planned imagery and spontaneous applications of imagery made on the spot. When creating new imagery, as opposed to merely modifying or tailoring pre-existing imagery to fit a student's needs, the teacher is aware of the responsibility for making a possibly permanent contribution to his or her imagery repertoire and therefore tries to adhere to the stringent standards set by Dr. Sweigard. The choice to present new imagery is always informed by the basic principles that Sweigard established regarding sound anatomical fact, plus accurate location, direction, and lines of action in the body. These firm yet flexible criteria apply to all attempted additions to the knowledge we have received from Sweigard. Her teaching provided counsel and suggestions about how to proceed. Sweigard's guidelines act as a trigger to inspire further thinking, and her example can compel us to preserve and extend this rich inheritance.

Lynn Martin

NOTES

1. As a second-generation Sweigard student, I received my training in the practice and teaching of Ideokinesis from Dr. Drid Williams and Irene Dowd, with whom I have studied since 1976 and 1977 respectively. Such training places me in the fortunate position, I believe, of receiving the best elements of all three methods and applications. After years of close association with Dowd and Williams, it is easy to perceive the features of discipline, the meticulous attention to detail, the clarity of thought and the comprehensive understanding of anatomical function, plus the principles of Ideokinesis that Sweigard instilled in the minds of the people she trained to teach.

Possessed of diverse personality traits and ever-inquiring minds, both Williams and Dowd have developed different aspects of Sweigard's original work in unique ways (characteristics that seem to have been encouraged by Sweigard). Dowd has continued to study and stays current with new developments in the neuro-sciences and motor-learning -- both fields having changed enormously since Sweigard's death. Williams's work with the light beam imagery for dance classes and her insistence upon the differentiation between aesthetic imagery and ideokinetic imagery represent outstanding applications of Ideokinesis to the dance. The beauty of the knowledges that were transmitted from Sweigard to these two students is that the principles Sweigard taught were apparently so valid, so specific and so fundamentally correct that they may be logically applied to other areas of human actions that Sweigard herself did not explore.

At the suggestion of Mary Bakalian (who introduced me to Sweigard's work and subsequently to her teacher, Williams), I started Breathing Coordination instruction with Carl Stough in 1976. Breathing Coordination is the major physiological discovery made by Stough in the early 1960's. Before Stough isolated and identified the physiological principles governing the mechanical function of the respiratory system, no absolute standard for the mechanics of respiration had been described in the history of medicine. The concept totally altered conventional thought on respiration and led to the establishment of the field of Respiratory Science. In 1970 William Morrow & Co., Inc., published Stough's book, Dr. Breath (the name the 1968 Olympic athletes gave Stough while he was working with them for the high altitude of the Mexico City games). The book gives the account of the discovery of Breathing Coordination.

Two years later, I began voice study with Conrad L. Osborne, whose teaching method is ideokinetically based and concerned with the relationship between vocal production and neuromuscular efficiency in the rest of the body. These studies have been coincident with and complementary to my work in Ideokinesis. Stough's and Osborne's work, combined with the special concerns of singers related to bodily alignment and breathing, have encouraged me to apply Sweigardian principles to the development of imagery specifically aimed towards the improved function of the breathing mechanisms of the human body. I have accomplished this following Sweigard's principles for creating imagery described by Dowd and Williams.

2. Stough's work involves observation, examination, palpation and vocal sound to diagnose faults in the breathing pattern and to guide the recoordination and development process. A natural voice with fundamental pitch and maximum overtones is the result of perfect breathing coordination and is essential to redeveloping the diaphragm. This work, however, is not tied directly to the presentation of a particular visual mental image, such as would be used in Ideokinesis. Stough does provide imagery to give the student a concept of breathing-related function but does not ask the student to concentrate on a specific image while awaiting a subtle neuromuscular response to that image (which may or may not occur), as is done in Ideokinesis.

3. This article is meant to assist those already familiar with Sweigard's work towards an understanding of the new applications I have made.

4. The smoothly contoured, multi-layered musculature that superficially forms the back of the trunk masks the deep inwardly curved shape of the posterior ribcage and the depth of the inter-actions between ribs and vertebral bodies. (See Figure 5.)

5. Images of the 'high' chest have been espoused by both men (to show 'manly pride' or well-developed pectoral muscles) and women (perhaps to enhance feminine endowments of bosom, real or illusory). The maintenance of such imagery limits the flexibility of all of the ribs, not just the upper ribs which comprise the chest. Such lifting of the ribs away from the central axis of the spine also interferes with the smooth action of the abdominal muscles that link the ribcage, spine and pelvis.

6. Few people ever imagine their ribcages from this viewpoint and thereby miss some important features of proportions and relations to the whole. For example, the circumference of the top rib circle is approximately equal to the circumference of the funnel-like base of the pelvis (the 'true' pelvis). One might imagine the vertical central axis connecting and passing through the center of these two bony rings.

7. This ideal position of the ribs in relationship to the spine is achieved by the elimination of muscular tensions and diaphragmatic weakness that would tend to hold the ribs upwards; it does not include any sacrifice of the elongated curve of the thoracic spine. The compressed downward position of the ribs that often accompanies kyphosis (an exaggerated curve of the thoracic spine) is not in any way the same thing as the desirable 'hanging' ribcage.

8. Irene Dowd drew this figure to scale from McMinn and Hutchings, A Colour Atlas of Human Anatomy. In the original photograph the diaphragm is lit from below, so one may see clearly the dome shape and the relationship between its periphery and the inner wall of the thorax. Unfortunately, this photograph could not be reproduced easily.

9. Such writers include Sweigard and Todd in the field of Ideokinesis and Vennard and Reid in the field of vocal technique.

REFERENCES CITED

Dowd, I. 1981. Taking Root to Fly: Seven Articles on Functional Anatomy. Contact Collaborations, Inc., New York, New York.

Kapit, W. and L.M. Elson. 1977. The Anatomy Coloring Book. Canfield Press, New York, New York.

McMinn, R.M.H. and R.T. Hutchings. 1977. A Colour Atlas of Human Anatomy. Wolfe Medical Publications, Ltd., London.

Reid, C.L. 1983. A Dictionary of Vocal Terminology. Joseph Patelson Music House, Ltd., New York, New York.

Stough, C. 1970. Dr. Breath. William Morrow & Company, Inc., New York, New York.

Sweigard, L. 1974. Human Movement Potential: Its Ideokinetic Facilitation. Harper & Row, New York, New York.

Todd, M. 1937. The Thinking Body. Dance Horizons, Inc., Brooklyn, New York.

Vennard, W. 1967. Singing - The Mechanism and the Technic. Carl Fisher, Inc., Boston, Massachusetts.