Ease and Eccentricity
By Stacy Gehman

My title might refer to personality quirks acquired by Alexander Technique teachers and students, and I hope someone else will write that article. Instead I would like to explore with you the relationship between eccentric muscle contraction and the sense of ease that we experience when applying the principles of movement discovered by F.M. Alexander.

Let's begin by observing and thinking about a simple movement. While standing with your feet comfortably apart, allow your legs to fold, bending at the hips, knees, and ankles. There are many things to notice about this activity, but for now I would like you to observe the work that the extensors of your legs do as you bend your legs. When you are standing, with your legs more or less straight, the muscles of your legs are only slightly engaged, perhaps varying from moment to moment as small movements occur that help maintain your balance. While standing, most of the task of keeping your torso off the ground is being done by the bones of your legs; your weight is supported by the rigid structure of your bones, which are more or less aligned with each other. As you allow your legs to fold, the joints between the various bones of your legs and feet move and the muscles which extend your legs begin to support more of your weight. As you continue to allow your legs to fold, the angles become greater at the joints across which the extensor muscles work, so that the muscles have less mechanical advantage, and they need to work more the more you allow them to bend.

If you stand with your legs bent for an extended time, eventually the muscles that are working to support your weight will begin to 'burn' a bit. Where the burning sensation appears greatest depends on details of how you have allowed the bending to occur. In general it would be nice if all the muscles that work to support your weight shared the load, so that no one set had to do more than its share. Not to be too specific, these muscles are the ones that span the pelvis and upper leg (the ones down there where you sit), which control the angle between your pelvis and upper leg; the muscles in your thigh, which control the angle between your upper leg and lower leg; and the muscles of your calf, which control the angle between your lower leg and foot.

You may have noticed that in the descriptions above, I referred to "allowing" the movement to happen. For those familiar with the Alexander Technique, this construction is well known. Others might wonder, why not just say "bend your knees?" This activity in particular is pretty easy to explain why allowing the movement is important. If we think about it a bit, we can accept that gravity is actually pretty capable of bending our knees, if we only allow it. In fact we have to resist gravity's eagerness to bend our knees otherwise we would find ourselves on the ground. On the other hand, if I think 'I am bending my knees,' the tendency is to do something to help gravity, to contract the flexors of my legs to 'pull me down.' So now the extensors have to do double duty, namely to support my weight, and to resist the contraction of the flexors, which in turn puts greater pressure on the joints of my legs.

There is another reason the word 'allow' is so important in this activity, and which is related to the specific topic of this discussion. In the description above, I pointed out that as you continue to allow your legs to fold, the angles become greater at the joints across which the extensor muscles work. That means that the muscles which support us are actually getting longer as the tension in them is getting greater. We

normally think of a 'muscle contraction' as the muscle getting tighter and shorter, called a concentric contraction, i.e. the ends of the muscle are moving towards its center. Although a bit of an oxymoron, the action of a muscle which gets longer as the tension increases is called an eccentric contraction because the ends of the muscle move away from the center as the tension in it increases (i.e., it 'contracts'). Eccentric contraction of a muscle is in response to an external load being applied to it. It may be a greater load than the muscle can support, and then the muscle is forcibly extended even if we wish to support the load. For example, let's say I'm doing 'chin-ups' and I have reached my capacity, and can't complete the last one. My arms will gradually lengthen until I'm hanging from the bar, even though I may continue to make the effort to resist my arms from straightening. In this case my biceps are stretched while continuing to contract. But before I have reached my chin-up limit, each time I lower myself from the chinning bar, I gradually allow the muscle to lengthen under the load of my weight, again an eccentric contraction of my biceps, but this time more under my own control. (If you would like more information http://en.wikipedia.org/wiki/Muscle_contraction has a nice discussion of muscles and how they work.)

How we think about a movement translates very directly into how we do it. Returning to the example of bending my legs, if I am concerned about my legs continuing to hold me up as they bend (even if the concern is below my level of awareness), I might over-tighten those muscles that hold me up, namely the extensors of my legs, so that in order to continue to bend, I must do something, i.e. tighten the flexors of my legs to overcome the resistance of my extensors. A reaction like this may seem totally irrational, perhaps unlikely that anyone would do such a thing, but there is a very good physiological reason that a habit like this may develop. Muscles have a reflex, called the 'stretch reflex,' that happens at the level of the tendons and muscle cells themselves, i.e. you don't have to think to make it happen. A classic example of the stretch reflex is to hold out you hand palm up, and to ask someone to drop a heavy ball or stone into your hand while your eyes are closed. When the ball hits your hand, it extends your arm momentarily, which then reflexively reacts to return your hand to where it was. When I start to bend my legs, the muscles sense their extension, and under some circumstances may reflexively contract to stop the extension. Once this has happened it would seem necessary to contract the flexors to continue to bend my legs. This situation is very similar to the previous example of 'helping gravity,' with the result that the extensors of my legs need to work harder to support me as I bend my legs because of the opposing contraction of the flexors. When I said that you don't need to think to make the stretch reflex happen, that doesn't mean that there is no interaction between our thinking and the reflex. For example, if through childhood trauma I have a fear of falling, that fearful response might increase the sensitivity of the muscular reflex and make it difficult to overcome. However once I understand the situation, then through active, conscious direction, I can reason with my legs, and ask them to allow the extension of the muscles that are supporting me. Asking my legs to allow themselves to continue to bend can reduce the sensitivity of the stretch reflex to just the level needed to continue to support me. (Note: The underlying psychological and neurological activities are far beyond the scope of this article, and beyond my capacity to elucidate. If you are interested in more detail, the articles by Dr. David Garlick in the journal Direction, vol. 3, no. 5 would be a good starting point.)

It may be that without knowledge of the principles of movement that F.M. Alexander discovered, I could make constructive use of this information to help make bending my legs easier. However if I know that tightening the relationship of my head to my body is the first response in all of my habitual actions, then when I wish to employ the reasoning above to improve my bending of my legs, I will start by asking my

neck to be free, which interrupts my habitual responses, and which with conscious direction can include allowing the extensor muscles of my legs to lengthen, my knees to move forward, as I allow them to continue to bend. Knees forward, not down? If you think about it from a geometrical point of view, the motion of your knees will start with the horizontal part of an arc of a circle, moving much more forward than down. Another subtle point here is that forward for each knee is defined by the directions each foot is pointing. I.e. forward for each knee is such that it stays above its foot. If your feet are pointed apart, then it might help to think of your knees as moving forward and apart, but don't overdo the 'apart' since you want to respect the structure of your knee by allowing it to move over its foot. There are many more details that can be useful to think about related to anatomy, and the shapes of the various joints involved. For a beginning in understanding how to constructively use such specific anatomical information, you may find my article at http://stacyg.drizzlehosting.com/HTMLBodyMap.htm a useful starting point.

So far we have reasoned through allowing our legs to bend. We discovered that as our legs bend more and more, that the extensors of our legs work more and more to support us (although when paying the kind of attention we have above, they do much less work than when we moved habitually, and much less than we are used to feeling). Now let's consider what happens as we extend our legs to straighten them. If the muscles of my legs do more and more work in eccentric contraction as I allow them to bend, shouldn't they do less and less work as they straighten? As they straighten, more and more of my weight is being transmitted through the structure of my bones, so as I straighten my legs, the muscles need to do less and less.

When I have explained this to my students, I frequently get rather puzzled looks. What I have explained seems so reasonable, but is so counter-intuitive, that it seems nonsensical. When the thought occurred to me the first time, as a physicist I was perplexed, even though as an Alexander student, I had repeatedly experienced that impossible feeling of ease as I stood up. I know from Newton's laws (and common sense), that a body at rest (me with my legs bent) will remain at rest unless acted upon by a force. How can I extend my legs, moving my body upwards, without exerting a force, without pushing with my legs? It then occurred to me that I was leaving out something from my intuitive analysis of the situation. With my legs bent, they are already exerting a force accelerating me upwards in opposition to gravity, which wants to accelerate me downwards. In other words, my upwards force from my muscles is just balanced by the downward force of gravity, and even the slightest movement upwards increases the mechanical advantage of my leg muscles, which will move me upwards without any increased effort, in fact with continuously decreasing effort.

So, when I want to extend my bent legs, I only need think for my neck to be free, leading me delicately upwards as my legs extend, with an eagle eye out to inhibit that old habit of pushing with my legs. As my legs come close to being 'straight,' I have found almost overwhelming the tendency to want to tighten them for that last little bit. It is great fun to take my time at that point to actively inhibit that desire, and return to wishing my neck to be free, then to feel my legs gradually release and lengthen as I return to standing. If I slip-up, and I do tighten my legs to push me up, I can notice a fascinating thing. In order to do it, I need to resist the lengthening of my legs by tightening the flexors of my legs – the same thing I discussed above when bending my legs, but in the opposite direction. That is, when after tightening I come to standing, I have tightened both the extensors and flexors of my legs, leaving me feeling a bit 'pinched.' I feel it particularly around my knees, and buttocks – nice motivation to pay attention the next

time. Part of the process of inhibiting my tightening of my legs, in addition to inhibiting my tendency to tighten the extensors to push, is also to think of lengthening the flexors of my legs, which inhibits their stretch reflex, and prevents their opposing my upwards movement. I find it amazing that I don't have to 'do' anything to bend my legs, and after they are bent, I don't have to 'do' anything to lengthen them. Here 'to do' is used in Alexander's sense, being related to our habitual doing. To a large extent, when we believe we need to 'do' something, we engage in concentric contraction. As Alexander put it, "…all they need to do is to think and that wish for the neck to be free will do the trick … but none will trust to the thought. We are so brutalized by our belief in doing and muscular tension." (From Sir George Trevelyan's diary of his experiences on the first Alexander Technique teacher training course for Dec. 8, 1933.)

Now I would like you to consider walking up stairs in this same context. As I move forward toward the foot on the upper stair, if I over tighten the muscles of that leg in anticipation of their taking the load of my body, they will push me backwards (after all, the upper foot is in front of me), and I will need to push forward with the lower leg to overcome the resistance of the muscles in my upper leg. As in bending my legs discussed above, I need to inhibit the tightening of the extensors of my upper leg so that it can continue to bend, and so that I can continue to move my weight over it, as my lower leg lengthens. As in moving up from bent legs, the tension in that lower leg releases as it lengthens – no need for it to push me up the stairs. I eventually extend the foot of my lower leg as my weight moves over my upper leg, and then I move the lower foot into position on the step above. And now the former upper leg is the lower leg, and as it lengthens the tension decreases. Even in walking up stairs, there is no need for concentric contraction of my leg muscles to push me up the stairs. When from standing we bent our legs, and then straightened them, the muscles of both legs experienced eccentric contraction while bending, and then a release into lengthening while straightening. Now in moving up the stairs the upper leg experiences eccentric contraction as it accepts the weight of my body, while the lower leg experiences a release into lengthening. This thinking also applies to walking up hill, where instead of pushing my body up the hill with my legs, my legs just swing freely beneath me.

Does this way of moving mean that my legs never get tired while walking up stairs or uphill? Unfortunately, no. Eccentric contraction requires metabolic activity just as does concentric contraction – although, interestingly, not as much. About 20 years ago I read an article in a sports medicine magazine where researchers attempted to measure this relationship – unfortunately I have long since lost the reference. They organized two bicycles such that one biker pedaled in the usual way, while through a mechanical connection of the chain from one bike to the other, the other biker resisted the effort of the first. To measure metabolic activity, they also measured oxygen consumption and CO_2 produced for both bikers. With this arrangement each biker exerted the same pressure on their pedals, one through concentric contraction of their leg muscles, the other (the one resisting) through eccentric contraction. The result was that the biker working in concentric contraction did more work than the one working in eccentric contraction (sorry, I don't remember the exact ratio). Thus when we walk uphill or up stairs without pushing with our legs, we have both the advantage of not putting unnecessary resistance in our own way, but also using a mode of working of our muscles that is inherently more efficient. Hence, ease and eccentricity.

Is there ever a situation that calls for concentric contraction of my leg extensors? I think that is the case when, for example, I want to jump up into the air. I bend my legs, and in extending them I need to do something extra to build up the velocity to get me off the ground. But if I want to continue bouncing up and down after landing, the extensors of my legs have already been 'charged up' enough when decelerating my body's weight on landing, to send me back up into the air by simply releasing them into extension. I only need to add a little something if I want to go higher. If you choose to experiment with this activity, remember, "that wish for the neck to be free will do the trick." This particular activity was one of my most fun and most enlightening activities when I first experienced it with my teacher, Marj Barstow.

Is this detailed knowledge of how muscles work necessary if someone wants to apply F.M.'s discoveries? No, I don't think so. Marj never needed such long winded explanations. It is probably my own personal eccentricity as a physicist that led me to wonder why I was continually feeling more and more ease of movement as I continued my study with Marj. On one hand I like to be able to explain things to my students so that they are less likely to think that it is the 'magic in my hands' that is producing the results they feel, and are more likely to take responsibility for learning the process for themselves. On the other hand, isn't it just fun to think carefully about things? That with a little thought, knowledge of Alexander's principles, and an experimental attitude, we can make changes in habits of movement that we didn't even know we had, that get in the way of doing what we want, and have been with us almost all our lives.

I hope you have some fun with these ideas. And if you have thoughts, new ideas, or questions, please let me know at stacyg@drizzle.com – please put 'Alexander Technique' in the subject line so I won't miss it.

Biography: Stacy Gehman was educated as a physicist, has worked as a research and development engineer since 1966, and currently researches new computer techniques for analyzing the electrocardiogram. He began studying the Alexander Technique in 1977, moving to Lincoln, NE in 1980 to apprentice with Marjorie Barstow. In 1986 he moved to Seattle to help form The Performance School, a Center for the Alexander Technique where he continues to teach in the teacher education program. Stacy teaches each summer on the faculty of the Barstow Institute in Nebraska. Stacy has been a student of Tai Chi Chuan since 1973 and has taught classes and workshops integrating Tai Chi and Alexander work. He has published articles on the Alexander Technique in The Alexander Review, the Congress Papers of the 3rd International Alexander Congress, and the Journal for Anthroposophy. Some of these articles, and also several unpublished articles on the Technique are available on Stacy's website http://stacyg.drizzlehosting.com/