Why Do We Hold Up the Lower Arms While Running?

Rolfing® and Movement, Gravity and Inertia - Toward a Theory of Rolfing Movement

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ABSTRACT

The human structure cannot be understood without taking into consideration the natural functions of walking and running. This paper attempts to extend and generalize Ida Rolf's approach to the standing body (the block model) onto the walking and running body. We will show that the role of Gravity in standing posture is equivalent to the role of Gravity and Inertia together in moving poise. While a "well-aligned" standing body resembles the block model, the "well-aligned" moving body should match the model that we will introduce here, as we discuss the old question of how Gravity can "flow through" and produce "Lift."

PREFACE: TRADITION VERSUS DEVELOPMENT

When establishing a school of thought or practice, its founder has to define boundaries against similar disciplines as one of the first actions to be done. Later on, any school has to find its way between two killing extremes: if it is too orthodox, sticking to the starting point, it will be overcome by competing disciplines that are more in tune with contemporary thought and insights. If it acts too flexibly, incorporating everything similar and losing all defining boundaries, it will not be differentiated enough from its competitors and will dissolve. Finding the path in between is a sort of art without rules to go by – an ongoing challenge.

Therefore, keeping the faith with the founder of the tradition includes two seemingly opposite tasks: on one side it means developing the method, thus integrating new knowledge and adapting according to a changing environment. On the other side it means resisting the seduction of attractive new fashions, thus maintaining its defining boundaries and holding on to the thread of tradition.

So the question for us Rolfers seems to be: how to keep faith with Ida Rolf by holding on to the tradition, as well as developing the method at the same time? Actually, both were explicitly requested by Ida Rolf herself.

We would like to present a suggestion for developing Rolfing by extending the method carefully across one, so far, more or less "sacred" boundary: the inclusion of active muscles (with their ability to exert strength) as well as active parts of the nervous system (with their ability to act with shrewd intelligence) into the Rolfing concept of "structure." This might look like abandoning the standpoint of Ida Rolf with its emphasis on The Line and the Block Model (neglecting strong muscle force and intelligent information processing). But we think it does not: restricting Rolfing for all time to immobile standing bodies or to bodies moving passively most likely belongs to the above-mentioned orthodox version. Our suggestion might also look as if we were abandoning the standpoint of Ida Rolf with its emphasis on fascia. But again we think it does not: the paradigm of a harmonious, complementary partnership of the fascial and the neuromuscular nets offers more effective ways to Structural Integration than restricting the thinking to fascia alone, satisfies Ida Rolf's need for a holistic approach to the human body, and is more in tune with modern scientific findings.[1]

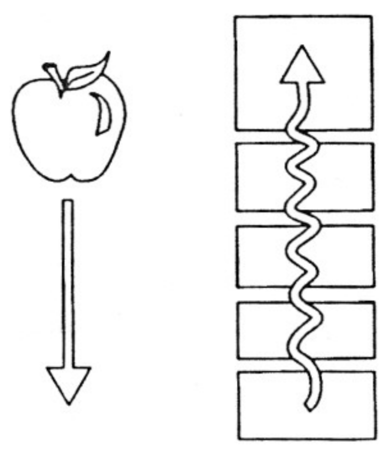
In this attempt we also would like to make convincingly clear why this approach to Rolf Movement can be really called "Rolf Movement" as something that is very clearly different and far from Feldenkrais, Alexander, Pilates, or any other method of somatic movement education. This means that we should answer the question: which sort of movement work corresponds best to Ida Rolf's theory of the standing body?

In order to answer these questions we will first examine Ida Rolf's way of looking at a standing human body in terms of physics. Second, we will use these expressions to show a way to a consequent generalization and extrapolation of her ideas onto the moving human body. Third, we will introduce a suggestion for a movement intervention sequence (a movement recipe) as a basic, backbone work toward the formulated goals.

PART 1: ABOUT GRAVITY & CO.

1.1. The Unmoving Body and the Block Model

Isaac Newton and his followers believed that Gravity is a force pulling a human body toward the center of planet Earth. Ida Rolf insisted on the alignment of body segments, thus allowing Gravity "to flow through the body." Some Rolfers even believe that this alignment makes Gravity lift the body or parts of it up. Pulling down or lifting up? Do we have a contradiction here between Ida Rolf and Isaac Newton? Was Newton



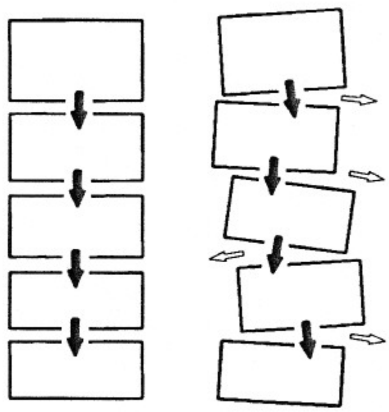
What is Gravity doing?

wrong and Rolf right - or vice versa?

Here is our answer: taking the image of "Gravity flowing through the body" as a metaphor is beautiful and can be useful. Taking it literally is nonsense in terms of physics - a force cannot flow and Gravity will lift things up only if they are lighter than air. This is the reason why we cannot sleep while standing, as well-aligned as our bodies may be.

So what could this "flowing through" mean in terms of physics?

The image of "flowing through" is the image of flow through something that is smooth and even, not containing obstacles, distraction, or edges. The difference between two columns of blocks (as in the Rolf logo) – non-ordered and ordered – is about the minimization of horizontal, rotational and shear forces through the whole ordered body.



Thus "flowing through" means the absence of horizontal, rotational and shearing forces – the direction of all forces is parallel to the gravitational one. In a well-aligned body, as long as it does not move at all - as what happens with a stack of "blocks" that are resisting compression - this can easily last indefinitely without spending any energy for preventing falling or falling apart (- a "living body" has to spend energy even then, but for other purposes). In order to make any movement possible, the body has to break the strict block order and we have to think about a new definition of what "well-aligned" means.

But what then is "Lift"? When Rolfers write "Lift" they usually put it between quotation marks – for a good reason. The sensation of "Lift" inside the body might be a true and actual reality – as a sensation. It does not necessarily mean that the body weighs less in physical reality. The sensation of "Lift" might be due to two physical facts combined: the increased order makes the body slightly taller and allows a considerable reduction of muscular effort, at the same time thus reducing active compression.

1.2. Gravity As a *Challenge*

Ida Rolf's famous quote "Gravity is the therapist" seems to us very often misunderstood. Gravity is always doing just one thing: pulling everything down. How can it be a "therapist?"

In terms of evolution, it was only recently that animals managed to leave the ocean and to move onto the land – about 80% of its whole existence on Earth, animal life was restricted to the water because it could not deal with the forces and pressures of Gravity. It was not until the insects developed chitin armor and the vertebrates developed bones that animals could survive Gravity. And even today Gravity is always alert to damage us if we don't take care. This is one of the reasons that staircases have handrails.

There is one thing about living organisms that we really have to understand: organisms have to live for the purpose they are made for or they degenerate. Putting an eagle into a cage and feeding it well might help it in its fight against Gravity (no need to lift its own weight into the sky anymore) – but probably it will not be very happy there. The same thing with human beings: everything in the body is (among other reasons) made to fight Gravity, and therefore we simply have to do it when we want to be healthy and happy. Weightlessness makes us ill because when submitted to it we don't fulfill the purpose that our design is made for: we have a structure made for fighting Gravity and are not able to use it properly. This fact might make it possible to understand that Gravity in general is a challenge, an "enemy." Each human being is an *almost* perfect and elegant fighter against Gravity, like an Aikido practitioner is with his partner. (The word "almost" shows where we as Rolfers come in.)

Let us then consider Ida Rolf's above quote from this point of view: "the better we deal with the challenge, the better we are in accordance with our natural construction and its original purpose." The challenge teaches us how to use human structure in an optimum way.

1.3. Gravity and *Energy*

Gravity generates a force that pulls material objects down. Lifting an object up to a certain height against Gravity consumes energy – climbing up a hill or a staircase makes us sweat. The heavier the object is and the higher we lift it up the more energy we spend. If the object is falling down again we usually don't gain back the energy that we spent to lift it up (we just produce heat or damage). That is: to fight Gravity means most of all two things: to save energy and to prevent damage.

But why do we have to save energy?

Primitive man developed erect posture while responding to the challenge of surviving starvation. Therefore it was very important for the human organism to develop, together with erect posture, a walking technique which kept the body's height (the height of the center of gravity of the body) at the same level as each step is taken - this saves a lot of energy and reduces the amount of food necessary for survival.

This structural condition is well known. But there is something else important for us Rolfers: running. Are we made for running as much as for walking?

It is now well accepted that primitive man had to move around a lot to keep the food flow going in an increasingly arid environment. It is also well accepted that the development from Homo Habilis to Homo Erectus brought, among other things, a change of nutritional basis toward meat eating as well as almost a doubling of body height. We can assume that the gain in height (and therefore of speed) was necessary to catch meat in a competitive environment, thus making running a daily business.[2] Several construction details, especially in the foot and the leg, seem to be optimized for the function of running as quickly and effectively as possible to survive in dangerous conditions, thus compromising, however, the functions of standing and walking, swimming and climbing (we will come to this later).

In the running movement it is not possible for the human body to maintain a constant height for the center of gravity – the body goes up and down with each step. If we assume that our structure is also made for running – how about saving energy?

We will describe in full detail later on in this paper a technique of fighting Gravity and saving energy while running: the usage of the structural features of human fascia.

1.4. Starting to Move and the *Bending Line*

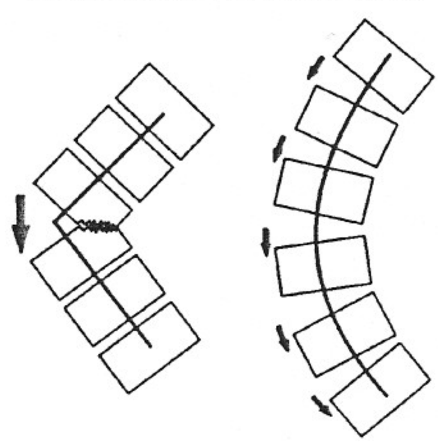
What is wrong with the above-mentioned horizontal, rotational, or shearing forces? Probably nothing, as long as they are small enough; i.e., not overwhelming local tissue capacity.

"The old idea that mechanical loading is bad for the back is slowly being replaced by an understanding, that only excessive loading is likely to cause tissue damage and back pain."[3]

"Damage occurs when the applied stress (force per unit area) exceeds some critical value, and this is most likely to happen when the force is concentrated in some small region of the tissue or structure. The distribution of compressive stress depends very much on posture. Lordotic and fully flexed postures concentrate stress on the posterior and anterior annulus [of the vertebral disc - A.Z.], respectively, and the former can lead to marked posterior bulging of the posterior annulus in cadaveric experiments. Moderate flexion, on the other hand, usually distributes the stress evenly across the entire disc."[4]

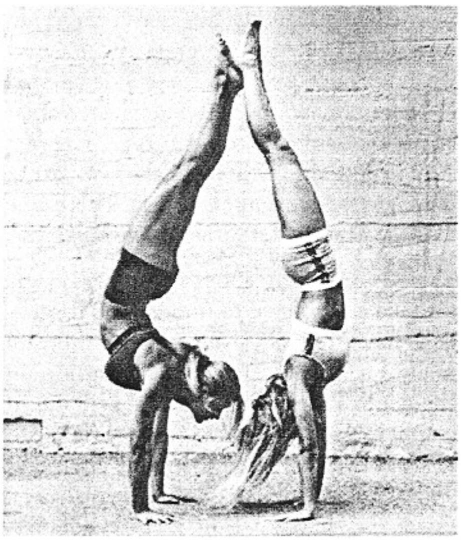
A closer look at an unordered block column shows that, due to the involved levers, even small amounts of disorder (slight angles to the vertical line) can produce considerable horizontal and rotational forces.

In order for movement to happen while avoiding local forces in damaging amounts, we can introduce the idea of "The Bending Line." In this case we transform the rule "One segment on top of the other!" into the more general rule "Even Distribution of Load!" (EDOL-Rule).[5]



The even distribution of load demands appropriate mobility everywhere along the bending line and therefore sometimes Rolfing interventions. Regions of non-sufficient mobility will produce unavoidable regions of hypermobility in which the horizontal or rotational forces can reach a damaging amount.

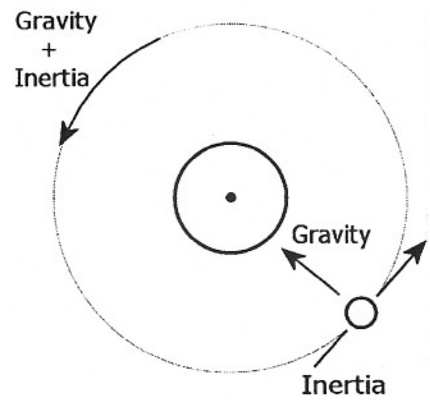
The photo of the two women performing the handstands (that for us means to deal greatly with Gravity), the more muscular of them opens the pectoralis area as well as the iliacus area much less than the other one. Therefore the vertebral line shows an edge instead of a smooth bow. At the very corner of the edge one disc is probably in the situation of a wedge. The other woman follows the EDOL-Rule much better.



1.5. Standing in Fast Motion and *Inertia*

Contrary to the common idea, Isaac Newton was thinking much less about apples than about planets. It was while doing this that he developed the concept of "force" as a cause for the creation or the changing of movement, and thus he discovered two forces at the same time: Gravity and Inertia. Therefore Gravity and Inertia were a pair of features from the very beginning for understanding the movement of massive objects.

A planet is a massive object falling directly toward the sun (Gravity). At the same time it wants to maintain its original movement direction - straight forward - as your car



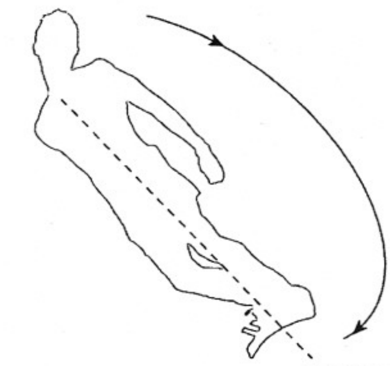
does when resisting your braking (Inertia). The superposition of both forces results in an oblique movement direction, thus creating a bend and, as it continues bending, a circle-like motion.[6] Here Gravity and Inertia are sort of equally strong forces acting together.

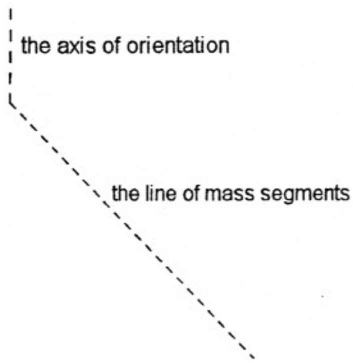
If you lift a material object up you act against Gravity. Sometime in the future Gravity will win again and the object will fall down and produce damage and/or heat. If you accelerate an object that is standing still, you act against Inertia. One day it will be stopped and will produce damage and/or heat. There is only one difference between these two forces: on the surface of the Earth, Gravity is never zero, but Inertia sometimes is – when the body does not move.

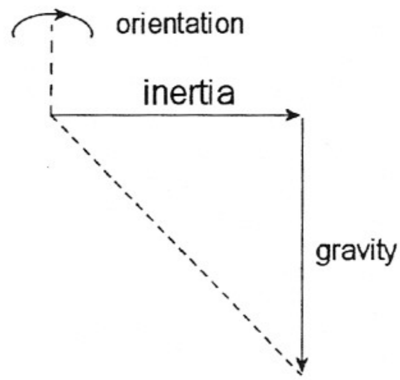
The "twin equality" of Gravity and Inertia was kind of a disturbing mystery for physicists for three hundred years.[7] The quest for resolving this riddle ended up in the General Theory of Relativity of Albert Einstein by dropping the concepts of Gravity as well as of Inertia entirely. (While dealing with the movements of human bodies we don't need to follow Einstein. Both theories differ only under very extreme conditions, such as light speed, black hole gravity, or GPS precision.)

For a human body standing still or moving slowly, the forces of Inertia are zero or too small, and thus can be neglected. When the body or parts of it are exposed to faster movements the forces can become even stronger than those due to Gravity and should be included in our theory.

The human body is not only made for standing. It is not only made for slow motions. Many structures in the body (e.g., the attachments of the hamstrings, to which we will come back later) make sense only if we







assume that they are made for fast movements. Therefore we suggest introducing Inertia into the theory of Rolfing as a force as important as Gravity.

Does this mean to "betray" Ida Rolf or does this mean to keep faith to her? We believe that the reasonable generalization and extrapolation of her theory is the best present we can give to her.

Have a look at the photo. What is this man doing?

Actually he is standing, but on a fast moving snowboard. Because the board is moving in a curve, Inertia pulls the body horizontally toward the outer side of the curve. In order to keep balance, the man has to lean toward the inner side of the curve.

His "line" and the alignment of his segmental blocks are perfect in terms of the even distribution of load as well as of the minimization of rotational forces. His line is perfectly parallel to the superposition of the force vectors of Gravity and Inertia. Only his head is almost vertically positioned – for the purpose of orientation in space. For this his line should bend smoothly in the neck area.

1.6. Walking and *String Pendulums*

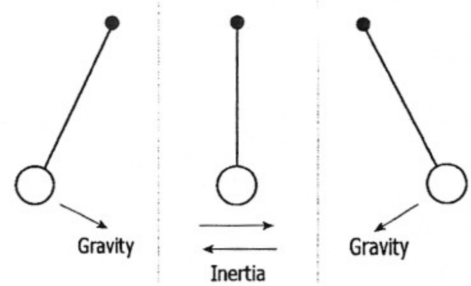
When guards stand "in the static block mode" they usually get relieved after one hour at the most. Visiting a museum can sometimes hurt much more than a long walk in the woods. Most of us can spend much more time walking or running then standing. How can this be?

While standing still, the only way to avoid holding forces is a posture in block alignment, as in the logo. Then the body can almost "rest in itself." The energy spent to maintain uprightness is minimal. This is static and therefore will hurt after a while. If we allow rhythmic movement we gain another possibility: the swinging pendulum as a dynamic way to "rest in itself."

A pendulum is an object changing fast all the time but because it moves with a certain regularity we can say that it is kind of static, too. Physicists call this quality "quasistatic." As we will see, it needs neither holding forces nor energy burning - thus corresponding to the block model.

If we pile up stones, one on top of the other, or if we stand up in the morning – in both cases fulfilling the block alignment demand – it requires work that spends energy. Once this is done we don't need to deal with Gravity anymore. Similar to this, to make a child sway on a swing or when we walk with "free swinging" arms we need to "add" energy in order to start, but once these movements are flowing we don't need to deal with Gravity and Inertia anymore.

How do pendulums work?

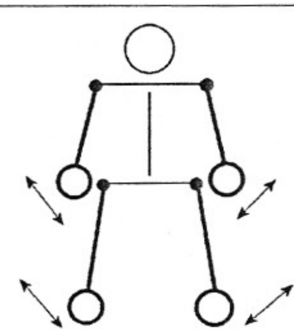


If the pendulum is at one of its turning points it is standing still for a very short moment. Therefore the Inertia is zero there. But at that moment Gravity has its greatest chance to pull the body down. The fall accelerates the pendulum and at its minimum point (where speed is maximal) Inertia is strong while Gravity cannot do anything. Therefore the pendulum just keeps moving, and even moves up – against Gravity. At the other turning point Gravity wins again and the game starts again. You see – Gravity and Inertia are equally strong partners playing with each other back and forth. This can continue forever.[8]

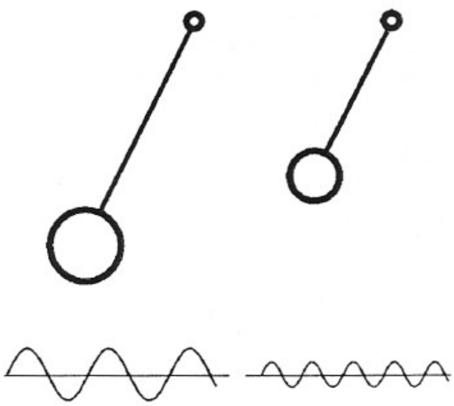
In a standing-still, well-aligned body the forces due to Gravity are constant, not changing at all. In a swinging pendulum the forces due to the superposition of Gravity and Inertia are constant, too. Thus we can see that a pendulum is for dynamics what a pile of blocks is for statics.

1.7. Pendulums Working in a *Team*

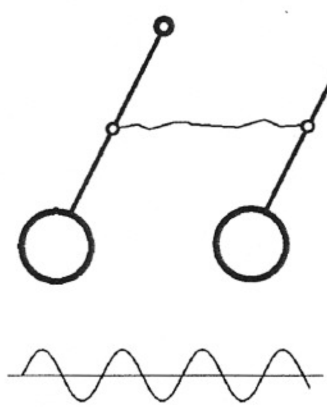
Pendulums in the human body never work in isolation. They are always connected to other pendulums, thus forming groups.



Each pendulum has its own frequency – the number of cycles per minute.

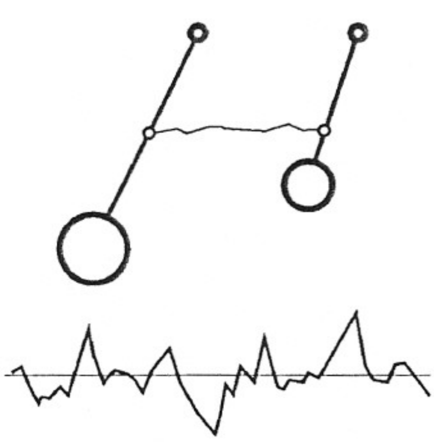


Two connected pendulums, each with the same frequency, work harmonically together – they are said to be "in resonance."

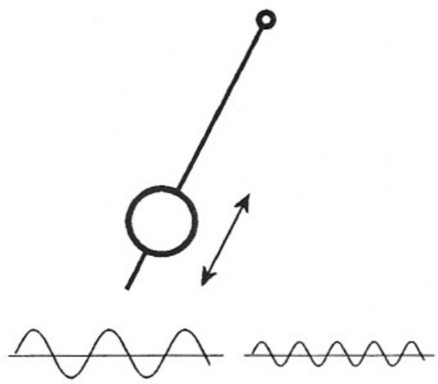


Two connected pendulums with different frequencies create problems: a painful mess can happen, the movements become irregular and chaotic, energy is wasted and damage can occur. To get the idea, you can imagine the movement of a rowing team where each member moves in its own favorite fashion.

What the sharp edge is for the block model, the unsynchronized pendulum is for the Pendulum Model!



Here is where Rolfing comes in: to improve the structure in a way that proper mechanical adjustments become possible, thus allowing variation of the resonance frequency and therefore free and synchronized swinging.



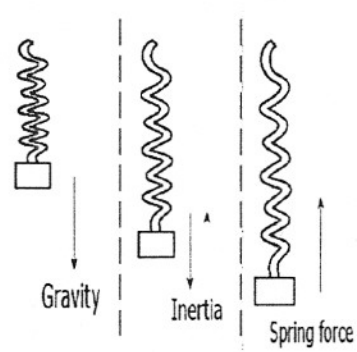
1.8. Running and *Spring Pendulums*

As long as we walk at the same height level we don't have to deal a lot with Gravity. Only if we start to walk up a hill or a staircase do we start to sweat. Walking up and down hills burns a lot of calories – we cannot gain the going-up energy back while walking down (as an electrical train or a cable car does).

Contrary to what happens when walking up and down hills, during running the body moves up and down much faster – and is able to do it without losing energy to Gravity!

How can the body do this?

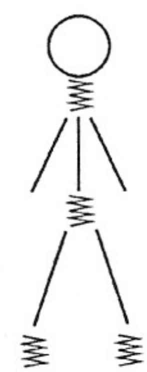
For that we have to understand spring pendulums:



When weight is falling down it compresses the spring. The spring resists progressively until it counterbalances Gravity. But meanwhile the weight has gained speed and Inertia acts together with Gravity. Therefore the weight continues falling until the spring pressure will have overcome the Inertia, too. Now the spring acts much more strongly than Gravity alone, and the weight starts to move up with accelerating speed (increasing Inertia). At a certain point the spring force is again as strong as Gravity – but this time Inertia is lifting the weight up until it is fully consumed and the cycle has completed. Once initiated, this pendulum movement can last forever without consuming energy (if it were not for friction).

Do we have springs in the human body? Surely we do: connective tissue. A long distance runner, such as a human, has much more and stronger fascia than a sprinter, such as a cat.

It is well known that some animals use the elastic properties of connective tissue in order to overcome the resistance of Gravity. Grasshoppers and fleas use catapult-like structures to reach huge heights. Less well known is another kind of elastic that structures use: swinging.



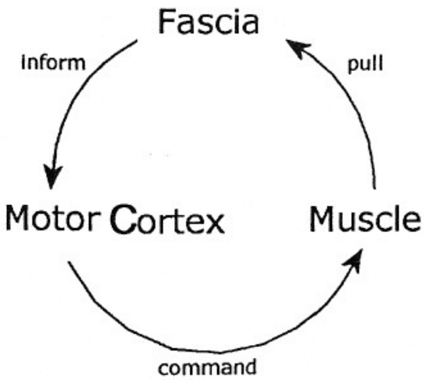
Kangaroos are among the fastest mammals on Earth. If you ever have jumped up and down on top of a trampoline you know what they do: they start with the first jump. Although using full muscle force the height is quite limited. They fall down and land onto an adjusted spring. The spring throws the body back into the air. To this throwing they add the next jump thus reaching more height. And so on. Each jump will become higher until the spring reaches the limitations of its capacity.

Human beings running act like kangaroos, their legs alternately interchanging.[9]

1.9. Pendulums and Intelligent Adjustments

While walking and running there can be many pendulums at work: the limbs as stringy pendulum, the feet as elastic hooks and the pelvis and the vertebral disks as spring pendulums. The shoulders, the ribs and the vertebrae can be rotational spring pendulums. (The rotational action of the vertebral column was called "the spinal engine" by Gracovetsky.)

Each swinging pendulum has a frequency: how many oscillations is it making per minute or hour? The shorter the lever of the string pendulum, the higher the frequency



– as you can see in any pendulum, watch, or metronome. The frequency of the extended shoulder-and-arm pendulums is too low for running, therefore we shorten the lever by lifting the lower arms up, thus adjusting the arm-pendulum frequency to the running – leg movement - frequency. This lower-arm-lifting shows that in fast motion the necessity of dealing with Inertia can overcome the necessity of dealing with Gravity.

As we will see later, during walking we have to deal as much with Inertia as we have to deal with Gravity – and using the arm pendulums is as smart as the usage of the block alignment.

Each pendulum works best within its own frequency. This frequency can be adjusted according to certain needs by changing the length and the tension of the string or the spring.

Do we have spring-adjusting devices in the human body? Surely: we have muscles.

Do we have "someone" in the body who knows everything about pendulum frequencies and fascia tonus? Surely we do: the motor cortex and its associated areas.

As we will see later, the motor cortex, the muscles, and the fascia as a "dream team" are able to work perfectly together to create and adjust the appropriate springs in running. This resembles the beautiful synchronous action of a rowing team, consisting of team members differing significantly in their mechanical properties but working together effectively and gracefully for a purpose: high speed and long endurance. We will even see that many structures, e.g., the whole structure of the foot, are more than anything else made just for this purpose. We will also see how useful Rolfing interventions can be used to improve the dynamic function of the whole structure, thus preventing the insidious damaging processes in human bodies that do more than just stand and move slowly around, as well as increasing the joy of playful use of the body by itself.

SUMMARY

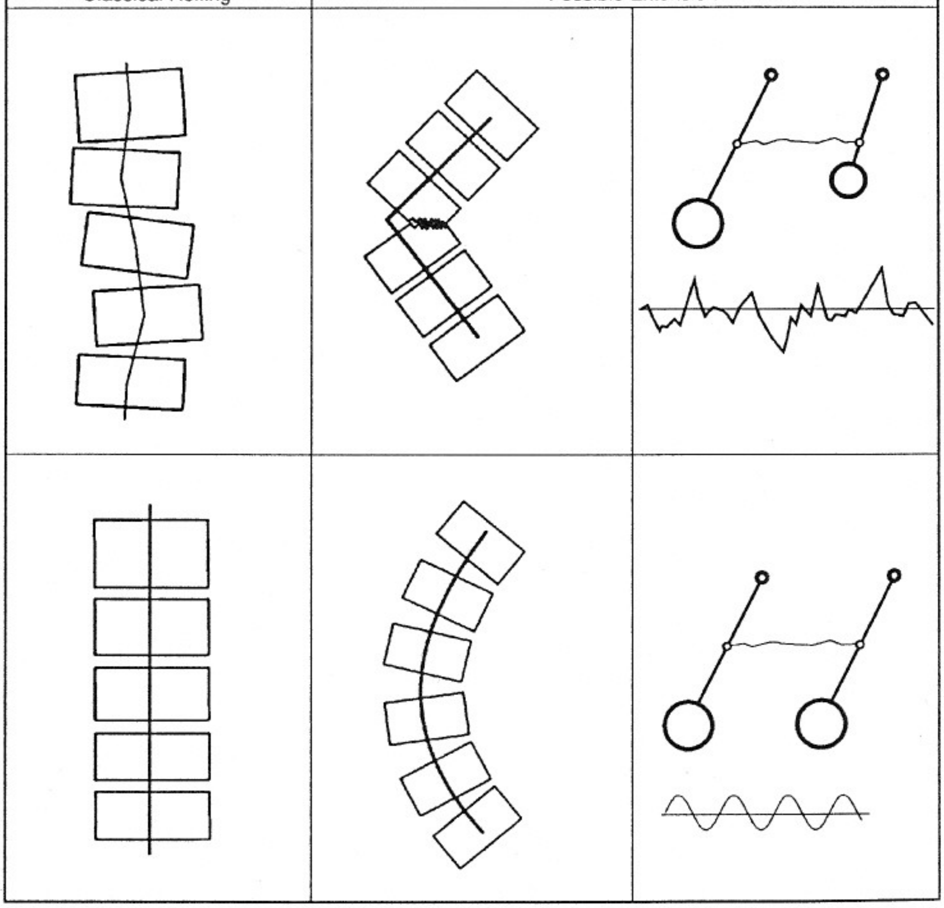
This article was about the physical basis for Rolfing and Movement. Therefore we were talking about the meaning of Gravity for the human organism and the fact that its structure has to meet the demands of Gravity. Physics tells us that Inertia becomes as important as Gravity, as soon as fast movements come in to play. It was shown that what the Block Model is for standing, the Bending Line Model is for slow movements and the Pendulum Model is for fast movements. In all these cases structural deviations can produce local overload and therefore long-term damage.

CONTINUATION

Thank you for following us on this long excursion into pure theory. Soon you will see that this worldview will have important consequences for the practical work.

In the next article we will look into some details of how all the above-described principles together shape human movements. We will see that a "good fascial structure" is one that is in tune with these principles. We will then suggest some conclusions to the practical Rolfing work and a first outline for a movement recipe integrating the above-expressed ideas. ❑

"The Line"	**"The Bending Line"**	**"Distributed Swinging"**
Block Model	Even Distribution of Load	Adjusted Pendulums
Standing	Moving	Rhythmic (Stamina) Movement
Classical Rolfing	Possible Extension	



NOTES

1. Of course we know that we are not the first undertaking this attempt. We highly appreciate the efforts of the Rolfing Movement Faculty members to develop practical techniques, as well as Robert Schleip's courageous articles about the influence of the neuromuscular net onto any body structure; Hans Flury's meticulous work about Normal Function as well as Hubert Godard's brilliant ideas about movement, perception and coordination. But all these attempts don't match very well with each other or with the present state of Rolfing theory. This is our attempt to fill a missing link, thus bringing all this work more together.

2. Humans living in the Kalahari Desert run on average about 25 km. per day. Food and water are very scarce; the climate is very hot there and resembles the conditions that stimulated the evolution of human structure.

3. Adams MA, Dolan P. "Recent advances in lumbar spinal mechanics and their clinical significance." *Clinical Biomechanics* 1995; 10: 3-19.

4. Adams MA, Dolan P. "Spinal Dysfunction and Pain: Recent Advances in Basic Science", *Fourth Interdisciplinary World Congress on Low Back and Pelvic Pain,* Montreal, Nov. 2001, p. 15.

5. At this point we still deal with the block model and therefore neglect at the moment the fact that one joint might be much stronger than its neighbor. Later on we will generalize toward the "appropriate distribution of load." Here we come to "Normal Function." For understanding the general idea, think more of the vertebral column than of the legs!

6. For reasons of no importance for us it resembles more the shape of an ellipse.

7. By the way: not so much for Newton who felt himself more like a priest than a physicist and developed all his work most of all to prove the existence of God as the ultimate explanation of all mysteries.

8. Provided there is no friction.

9. Recent research about the spring-like action of horse legs can be found at: http://www.rvc.ac.uk/Research/Structure_and_Motion/Gallery.cfm