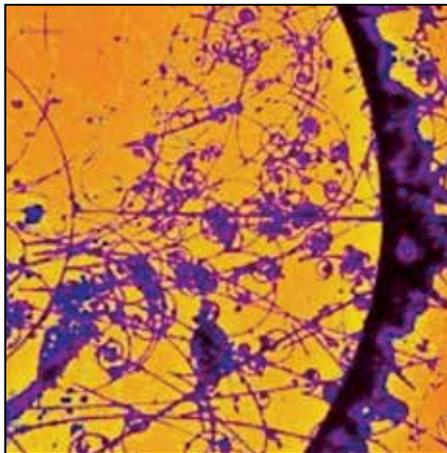


It is important to understand that plants and animals do not follow the Phi spiral because it is beautiful or interesting, but because it is the most economical and energy efficient way. There has been a lot of published research in this area, but it would be too much for this article. The important thing is that Phi is a *blueprint* that Nature uses again and again - simply because it works.

The quantum leap in the understanding of Phi comes, when you see that this principle works on all levels, both in *microcosmos* and in *macrocosmos*. Phi spirals are so evidently "right" that they have to be found also in macrocosmos, here pictured as our own spiral galaxy:



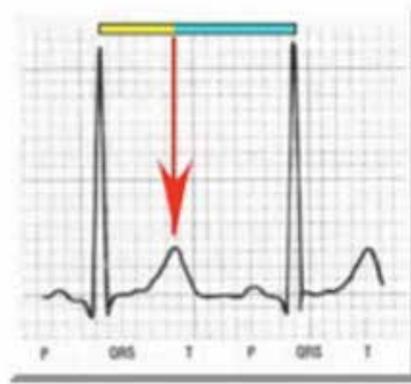
Even if we take a dive into something of the smallest that we can imagine - the decay of subatomic particles - we will see visible Phi spirals.



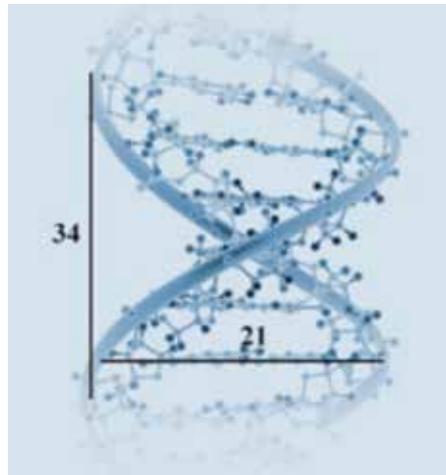
The next logical step is to look for Phi in Man. Naturally Phi doesn't exist solely "out there" but also in our human body. The Phi spiral is found in our ears and in the dimensions of our bones and in the proportions of our body.



Deeper inside our body we find the pulse of our heart. The relation between the systole and diastole gives Phi 1.618. Amazingly, our heart beats to the rhythm of Phi.



If we venture further into our body we find Phi spirals even in our DNA profile.



With some liberty we could claim that we have a body that is proportioned according to Phi, with a Phi hearing and with a heartbeat in Phi rhythm. No wonder that a body in movement will display Phi characteristics. So how can an art form devoted to energy and Qi not have Phi spirals as an essential part? So if Tai Chi is a journey towards a more natural, relaxed and energy filled Qi body, it is logical that Phi must be an essential part of Tai Chi.

When we look at all these examples of Phi in the body, we can now see how Phi operates on these levels:

- Macrocosmos (galaxies)
- Man (DNA, bones, fingerprints, ears, heart etc)
- Microcosmos (subatomic particles)

Solid and fluid states

Before we can explore Phi in Tai Chi we first have to study how Phi works in fluid states, because this is relevant for Tai Chi. A solid form is Phi in a nautilus shell, but it is important to realize that Phi is primar-

ily a fluid state - in other words *movement*. It is only when you see the movement, that you understand the fundamentally brilliant thing about the Phi spiral. This example is a tornado spiral.



Wind moves according to Phi. Water in a whirlpool also moves according to Phi. This shows Phi spirals as *movement*. The important thing about fluid states (and Tai Chi) is that every energy movement is best expressed in a curve that follows the Phi spiral. Wind and water follows the Phi spiral not because of beauty, but because of certain advantages, and it is precisely these advantages we need to know in Tai Chi. When science studies movements like these, they call it *fluid dynamics*. Our aim here is to study fluid dynamics within Tai Chi.

Instead of just making claim, is it at all possible to *prove* these advantages? Well, we can demonstrate the whole thing in a very concrete way. Instead of a large and complicated experiment you can do a simple test in your own kitchen. Take a large flask and fill it with water. Turn the flask upside down and count how long it takes for the water to drain. Now do this again, but this time you should *swivel* the flask in an ongoing spiral movement. You should recreate the whirlpool or the tornado. This experiment will show you quite specifically one of the advantages. In one of our own experiments the "straight" way took 13 seconds. The "spiral way" took 8 seconds. Try it for yourself. This shows that the spiral way is faster than the straight way. Yes, the straight way is the shortest

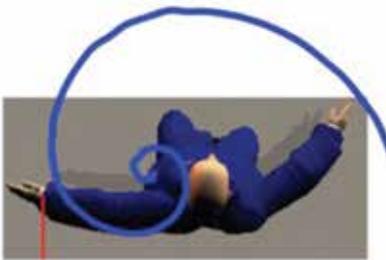
distance, but it takes more time and energy. The funny thing about our own experiment is that if you divide 13 seconds with 8 seconds, you get close to 1.618!

Why do we get this advantage? The “straight” way is, after all, the shortest distance between A and B, so why do tornadoes and whirlpools not choose that? When you pull the plug in a bath tub and watch the water drain, the water “chooses” the spiral way for the same reason that the galaxy chooses a spiral path, and for the same reason a tornado chooses a spiral path. Not because it is a beautiful movement, but because it is the most time and energy efficient way to move. The straight path is the shortest way in distance, but not in time and energy. “Nature abhors moving in a straight line”. That is an important lesson in understanding why Phi makes Tai Chi so effective. And *now* we can finally move on to the Tai Chi part of things.

Phi in Tai Chi

We will now study where the spirals turn up in Tai Chi. This is not intended to be a complete list of spirals in Tai Chi, because that will require much more space than a short article like this. Just be aware that there are many more spirals than we show here, and that they are also present in Tai Chi weapon choreography etc. Here we focus on the Yang style slow set, but naturally the other styles have plenty of spirals also, because in essence the energy movement is the same.

We don't have to go far to find the first Phi spiral. It is already present after the first movement, in “beginning”.



We will describe this first spiral a bit deeper (but due to the length of the article we cannot do this for all the tai chi spirals). This first spiral is drawn by the persons right hand movement. This person starts with his arms pointing down, and bends his knees, turns his body 90 degrees to the right while the right arms follows the turn of the body. The *arc* of the arm will then follow the blue curve in the above picture. This is a near perfect Phi spiral. It is important to note the start of the movement. Even though the body starts by turning to the right, the arm actually moves to the *left*

(only in the beginning). This special twist gives the small spiral that you can see in front of the man on the drawing. This makes it a complete Phi spiral that starts with a small circular movement, and arcs out to follow the path perfectly. We have now done our first Phi spiral movement with our own body!

Just for a sense of completeness we can show the beginning and the end together. This is the final movement of the slow set, *cross hands close*.

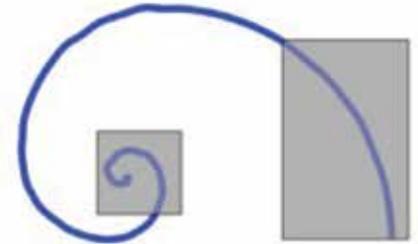


Here we have not one, but two spirals. The center of the spirals is where the hands meet. Already now we see that spirals are drawn both in a horizontal plane (first movement) and in a vertical plane (last movement). This alternates throughout the slow set.

Spirals in Tai Chi are primarily found in the movements of the arms. Practically speaking a spiral can be done with the whole arm (originating in the shoulder) or just with the forearm (originating in the elbow) or, less frequent, only in the hand (originating in the wrist). Phi spirals in Tai Chi is, as a consequence of this, both large and small depending on whether the pivot point is located in the shoulder, elbow or wrist. But the central part is that a spiral must originate from the rotation of the torso - the center - and not from muscles. Every time you try to move your arm “externally” with muscles you won't get any energy advantage. It is only when the spiral is drawn softly, without use of inner tension - and with torso rotation - that the true effect of the spiral emerges. It takes quite some time for a new student to experience this for himself, and it is our hope that a proper understanding of Phi spirals and fluid dynamics can bring him or her sooner to this experience.

The next spiral drawing shows that it is not necessary to make a complete spiral from start to end. There are some movements in Tai Chi that performs the com-

plete spiral (the whole blue line in the drawing below), but most movements are only performing central parts of the spiral (the blue line minus the grey areas). The grey areas marks the area of the Phi spiral that is most often left out in Tai Chi movements.



It is not a problem that a movement is “missing something” (the grey areas). An analogy could be a runner who sets a goal to run 10 km, but only completes 8 km. This runner doesn't say that the exercise was “wasted” (because he didn't complete all the 10 km). On the contrary, the runner has achieved 8 km of good exercise that gives him benefit. In the same way it is not necessary to perform the complete spiral in order to benefit from it. Just a part of the spiral is enough, and in each case it is the Tai Chi choreography (of every style) that decides how much of the spiral to perform. The rule must be that *any movement that follows the Phi spiral creates energy - regardless of how much of the spiral that is performed, and regardless whether the movement is small or large*. The main benefit doesn't come from performing one spiral curve completely, but by doing spiral curve after spiral curve after spiral curve throughout the whole slow set. It is the constant repetition of spirals that creates energy.

In the Tai Chi literature there are numerous references to *circles*. It is important to acknowledge that there are circles in the choreography also, even though some of these circles are actually Phi spirals. We just need to realize that the choreography contains both circles and Phi spirals. Each has its place and function.

Now we will look for more spirals in the choreography. We find them everywhere, from small to large movements. It will be too much to show them all here as this would require a separate manual, but a few examples would be fine to point out:



Snake creeps down - the left arm perform a spiral, from center and out



Brush Knee and Push - The "brush knee" hand perform a spiral, from center and out.

Roll back and press - both left and right arm perform a spiral, from outside into center.

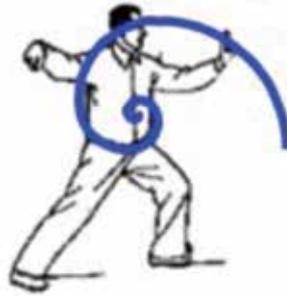


You only have to do a few slow sets before you start discovering spirals in all sorts of places. The last picture *Roll back and press* shows a blue spiral line and a straight orange line. That is an indication of a composite movement, and we find this in many of the movements. The blue spiral shows where the arms are pulled back in a spiral arc and lowered. The last part of the movement (orange line) is a *push*. This push is not a part of the Phi spiral, and that is why we have drawn it with an orange line. This is a straight line, and is used for self defense. So we have two movements: First a Phi spiral that *accumulates the energy* and then a push (the orange line) that *distributes energy* - in this example to the opponent so that he falls. The transition between these two movements (the blue and the orange line) is gradual.

Principally there are two directions the spiral movements can follow. Either from the center and outward, or from outside into the center. It is difficult to verify, but our feeling is that spiral movements towards the center could be an accumulation of energy, whereas an outward spiral movement could be a distribution of energy. What many describe as a *pulse* in the Tai Chi movements could possibly be caused by this accumulation/distribution

of spiral energy. Try to sense the difference yourself.

We could describe every spiral movement in the Tai Chi slow set here in a much more detailed way, but these few examples should be enough to inspire you. We hope this knowledge about Phi spirals is able to help Tai Chi students grasp and understand the movements. The movements are no longer "separately different", but are made up of a recognizable principle - Phi spirals - like here in *Single Whip*:



There is also a spiral in *White Crane*, and a very beautiful, complete spiral in the left arm of *Diagonal Flying* etc. etc. We encourage you to explore and discover them in the slow set, because they are everywhere. Some of them are hidden and will only reveal themselves after some time.

This article is only a quite short extract of a longer study. A short article like this is more straight to the point without the explanations, finer points, exceptions etc. Do make allowance for the omitted explanations that could have made the discussion more clear. Also make an allowance for the fact that the author is by no means a master of either physics, Phi or Tai Chi.

The previously mentioned longer study is covering much more ground than this article. We can briefly mention some of the topics as an inspiration to show that there is much more to the Phi theme:

From 2D to 3D

- the simple concept of 2D Phi movements is expanded into 3D Phi spiral, which is the real way that we move.

Phi angles - Phi is not only movement, but also *natural angles*. These Phi angles are directly influencing the Tai Chi postures (the progression of feet placement, and of feet position relative to arms).

Outro

The sheer number of Phi spirals that we have discovered in Tai Chi means that we could almost use the wording *Tai Phi*. It is our view that artificial, unnatural movements display an *absence* of Phi spirals. So the many spirals we find in Tai Chi is actually an expression of the deep wisdom that makes this art form beautiful, energy efficient and *natural*. Phi spirals may possibly have been mentioned before in connection with Tai Chi, but to our knowledge it hasn't been recognized fully as a universal principle that connects so many parts of the movements. We hope this can be an inspiration, and possibly the start of further study. There is still much to learn.

Tom Bundgaard