Chapter Five: The relationship between stiff pole, and flexible pole vaulting

Great journeys often begin with an epiphany. Anon

As we suggested in the previous chapter, coaches must to do everything in their power to develop a safe environment for pole vaulting. However the most important thing they can do is to teach their athletes how to jump properly, for there is little doubt that poor technique is a major cause of injury and even death in this event. This raises the obvious question, how do we teach young athletes to jump high in safety?

The aim of this book is to provide a detailed answer to that question. It is only possible for us to attempt this because in 1986 we were fortunate enough to have an epiphany – an experience which completely changed our perception of effective technique in the pole vault and set us on the path to writing the original "Beginner to Bubka". This epiphany occurred when Alan met Vitali Petrov and Sergei Bubka at the World Cup in Canberra, Australia in 1986.

As an unknown nineteen year old athlete from the Ukraine, Sergei had won the men's pole vault at the first ever World Championships in Track and Field, held in Helsinki, Finland in 1983. What few observers at the time realised was that Bubka was employing a completely new technical model of pole vaulting.

A technical model in track and field is simply a specific method of solving the biomechanical problems posed by the event. The best example of the introduction of a new technical model is the flop technique of high jumping, which was developed by Dick Fosbury in the late 1960s and which he used to win the Olympic Title in 1972. Now used by every high jumper in the world, the flop technique was completely revolutionary when it was first introduced. However it quickly became clear that it was bio mechanically superior to the straddle technique it replaced. Figures 5.1 and 5.2 illustrate these two technical models. **However while the differences between them are blindingly obvious, the differences between Bubka's technical model and that used by the majority of pole vaulters in recent times are much more subtle.**

Bubka's technical model had been developed by the coaches of the former Soviet Union as they set out to challenge the long standing dominance of the United States in the pole vault. To achieve their goal, the Soviets brought together their leading coaches, along with bio mechanists and gymnastics coaches to examine the event afresh, unhampered by the shackles of tradition. As a result, for the first

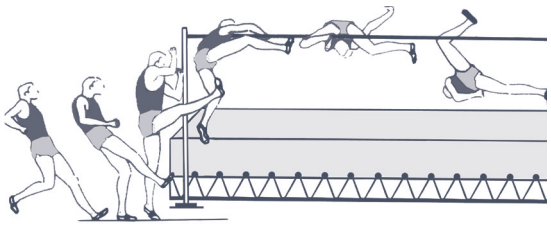

Figure 5.1 The Straddle

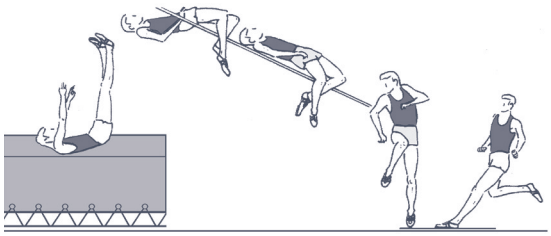

Figure 5.2 The Flop

time in the history of the event, technique was to be based on a critical analytical methodology and not on a grab bag of myths and misunderstandings or the slavish copying of the technique employed by latest Olympic champion.

We believe that readers should be prepared to go through a similar critical, analytical process, one which may challenge their fundamental beliefs, if they are to understand the implications of the ideas we are presenting here. An epiphany is a potentially positive life changing experience, but it usually requires a paradigm shift in thinking, never easy for any of us.

When we first met Petrov, the revolutionary ideas he put forward certainly challenged almost everything we believed about effective pole vaulting. Indeed it is possible that it was only the impact of his personality which encouraged us to consider what he was saying more carefully and which stimulated us to re read the paper he had presented at the European Coaches Congress in Birmingham, England in 1985.

Without that experience we might have joined the legions of coaches who appear unable to bridge the gap between the technical model he presented there and traditional thinking about pole vault technique. A gap so great it must be said, that in retrospect it is perhaps understandable that the ideas in Petrov's paper were not immediately taken up and widely applied.

So why a chapter on vaulting with stiff poles?

It is now clear that in the evolution of their ideas

and methods, one of the most significant influences on the Soviet coaches was a detailed study of the techniques of the great vaulters of the past, including the Americans, Cornelius 'Dutch' Warmerdam and 'The Reverend' Bob Richards, as well as a Russian vaulter of the pre war era, Nicholai Ozolin.

So the journey towards enlightenment must begin with an examination of the principles of vaulting on stiff poles. This process will help readers understand,

1. The negative effects of the myths and misunderstandings outlined in Chapter Six.
2. The advantages of the Petrov/Bubka technical model.
3. Why the development of pole vaulters should be based on the principles of vaulting on stiff poles.
4. Why stiff pole vaulting should be an integral part of a vaulter's training throughout their career.

Stiff pole vaulting

While stiff poles did in fact flex up to three feet, it was not possible to store energy in them. As a result the athlete had to continue to put energy into the vaulter/pole system for as long as possible after they left the ground!

They did this by:

- Ensuring a fast, accurate and balanced run up.
- Taking off 'out', or at least beneath the top hand - never 'under'!
- Driving the pole up and forward at take off.
- Springing up at take off
- Applying the principle of pendular oscillation or swing.
- Swinging into inversion with a long body.

Figure 5.3, a sequence drawing from Ozolin* on the facing page, illustrates all of these elements.

Taking off out

The first important message is that stiff pole vaulters never wanted to take off under. This was because they knew that taking off under would kill the all important swing after take off. Figure 5.4 which shows Dutch Warmerdam, perfectly illustrates the comments of Father Coulthard, who writing on the technique of stiff pole vaulting in 1960 states,

The take off point should be immediately below the top hand or at a point up to 6" or so behind that spot, but never in front of it.

He goes on to say,

Taking off too close, ……., will whip the vaulter off his feet and force his legs up too early into the swing which in turn takes him past the pole on the way up and destroys its momentum.

Figure 5.4

Driving the pole up and forwards at take off

Figures 5.5, another image of Warmerdam, reproduced from G. Pearson's 1963 text, "Athletics", shows that not only is he taking off out, but that he is driving up and forwards with his whole body. The comments that describe this aspect of his technique

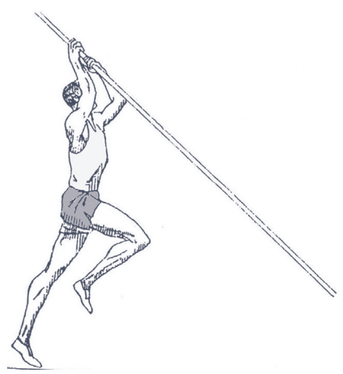

Figure 5.5

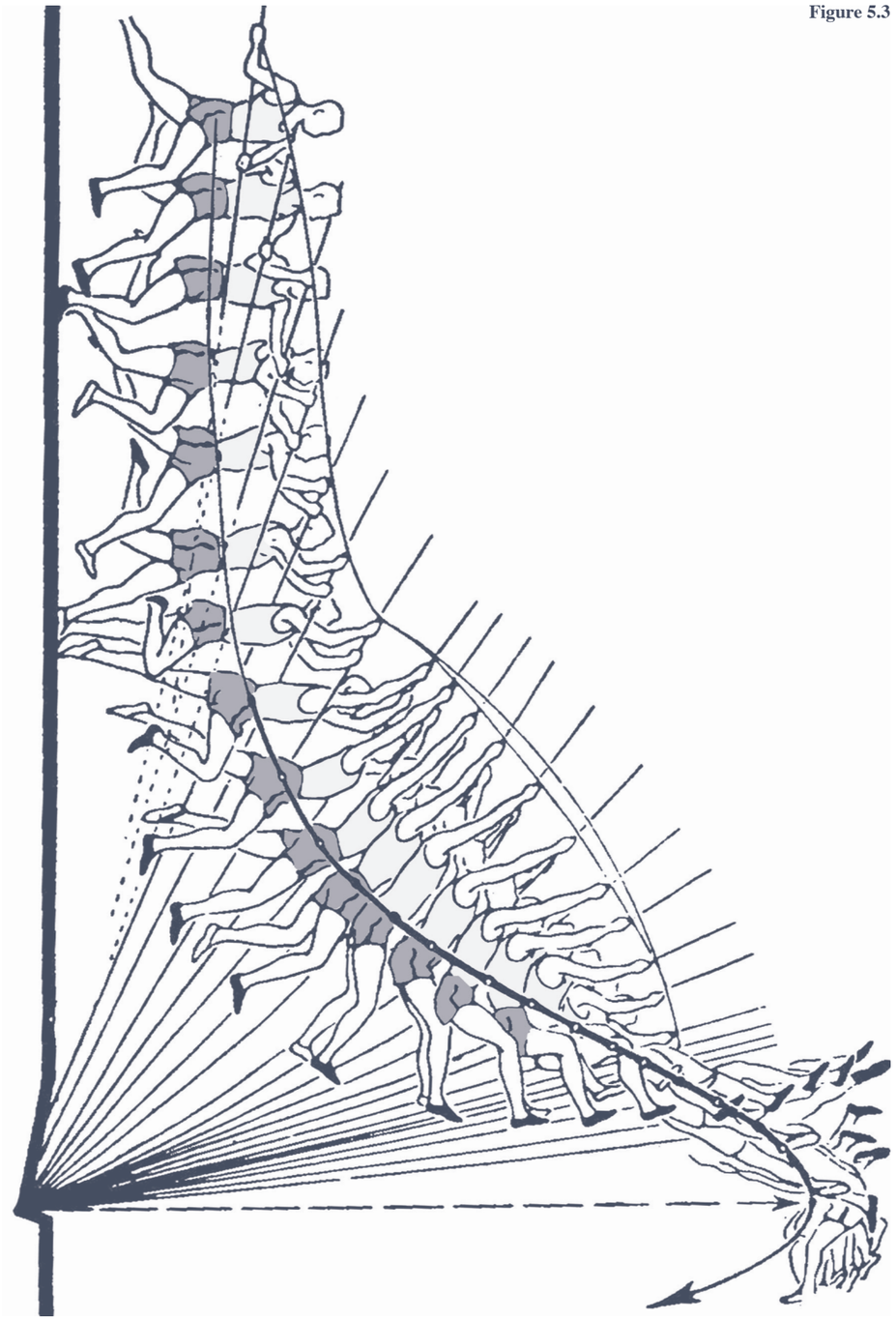

Figure 5.3

Take off foot a little behind the hands, shoulders shrugged well up to pole, vigorous knee lift – the bold upward forward movement is in every line of the body.

are also significant. Apart from the comment about the 'shoulders shrugged well up to the pole' this could describe the take off of a Petrov vaulter.

Springing at take off

The second point is that stiff pole vaulters tried to jump up at take off, They had to drive their resisting pole up and forwards at take off - they certainly could not afford to be ripped off the ground. 'The Reverend' Bob Richards, a dual Olympic Champion from the stiff pole era, said that his ability to hold a high grip was because of his spring at take off and that he sedulously practiced the high jump because of this.

Another athlete from that period, subsequently recognised as an authority on this event, Richard Ganslen, said,

The springing take off deserves serious consideration and all vaulters should experiment with it. Specifically the springing take off helps the take off velocity and swing and aids the vaulter in changing his pure linear velocity to angular velocity.

He also noted, *While Dutch Warmerdam initially claimed that he simply ran off the ground, it subsequently became clear that he actually jumped at take off.*

Applying the principle of pendular oscillation – or the Swing

Because they could not store energy in a 'stiff' pole, athletes had to continue to put energy into the vaulter/pole system after take off so as to keep it moving forward rapidly. They did this by employing a long pendulum swing of the entire body around their hands. Figure 5.6 shows dual Olympic champion Bob Richards executing this long swing to perfection. In his excellent book, "Modern Track And Field", first published in 1953, J. Kenneth Docerty wrote,

The all important function of the swing is to maintain the body momentum that has been attained during the run and take off. To delay all action deliberately and to permit the momentum already attained to run its full course are essential.

He goes on to quote Richards,

.....the swing is the most important part of the

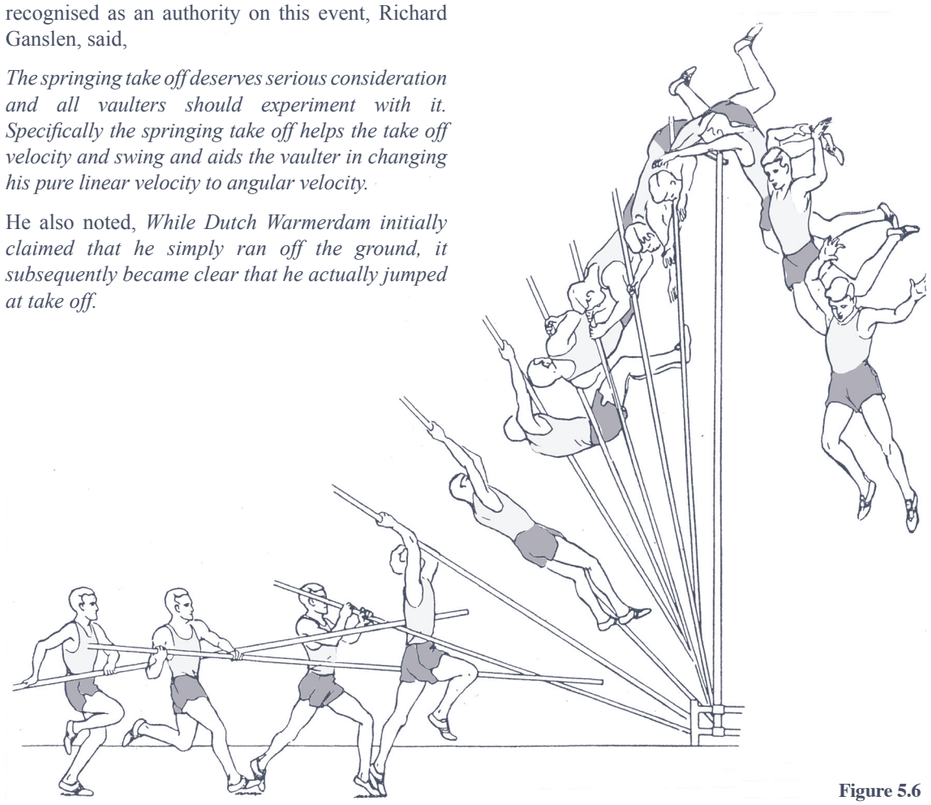

Figure 5.6

vault and the difference between a good and a poor vaulter is the ability to swing correctly. The secret lies in holding your pull up until the legs have gone by the pole.

On the same topic Warmerdam stated,

"There is a definite delay - in the swing - to take advantage of the velocity which has been developed during the run up. If the vaulter delays momentarily, the body moves forward, the arms extend, the legs swing up automatically as the grip of the hands on the pole stops forward progress."

He went on to say – and this one of the most important statements ever made about pole technique,

So the vault becomes a giant swing carried on and on .

And,

Novice and expert alike will profit in coordinating their efforts into one action of a giant swing.

Swinging into inversion with a long body

There are no specific references to this element of technique in the literature of the period, probably because it was simply accepted that the vault was indeed - *a GIANT swing carried on and on!* This appears to be confirmed by Figure 5.7, which shows Warmerdam in this phase of the vault and by Figure 5.8, (taken from Nicolai Ozolin's, "The pole vault"). Both mini sequences confirm that while the stiff pole vaulter did break at the hips to speed up the rotation of the body about the hands, they did not flex markedly at the knees or go into a tight tuck. Clearly the emphasis was on continuing the swing of the body with no hesitation as occurs with the large number of modern vaulters who move into a tight tuck and wait for the pole to recoil.

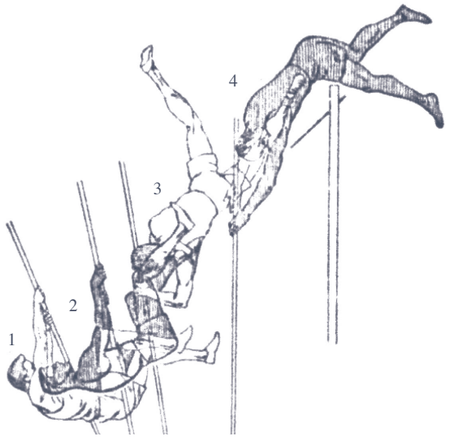

Figure 5.7

Figure 5.8

This notion of the vault as a giant swing clearly had a major impact on Petrov's thinking. He saw that as the legs swung upwards in a continuous movement, they took the hips up with them so that the athlete inverted naturally. There were no passive phases and therefore no place for the 'tuck and shoot' method discussed in the next chapter.

In summary, the best vaulters of the stiff pole era tried to:

- Take off out NOT under!
- Spring up and forward to DRIVE the pole up and around the tip at take off.
- Execute a long, but fractionally delayed, swing of the whole body with extended arms.
- While they shortened the body by breaking at the hips once it had passed the pole, in order to speed up the swing into inversion, they did not 'tuck and shoot'.

An important factor in the effectiveness of this swing was that the best stiff pole vaulters tried extend the take off and to fractionally delay the commencement of the swing. Anyone who has watched gymnasts on the high bar or trapeze artists in a circus will appreciate the timing of this

movement and the energy it can generate.

These elements were stressed by all good coaches at the time. This becomes clear when one studies the ideas of Nikolai Ozolin, a Soviet vaulter during the 1930's, who became a very perceptive and influential coach at the Moscow Institute of Physical Culture. Father Coultard illustrated some of the drills Ozolin employed which were "designed to acquire a hang and to keep the take off well out". He went on to describe how Ian Ward, a British record holder of this period, used the same drill "to increase his hang and delay his swing".

The theses of this chapter are that the factors which were important to vaulting on a stiff pole are still important in vaulting with a flexible pole and that many of the faults detailed in Chapter Six are the same faults that coaches and athletes tried to eradicate in the stiff pole era. Fittingly it was Bubka himself who tied everything together for us when, at the clinic held in conjunction with the 2003 World Junior Championships in Jamaica, he said,

Before the fibre glass pole, pole vaulters put their focus on moving the pole, then when the flexible pole appeared many people put their focus on bending the pole. The pole (should) bend as a result of the speed and mass of the jumper, therefore, it is more important to concentrate more on moving the pole towards the plane of the bar, rather than being aware of bending it.

The matter of fact way in which he spoke indicated how basic and deeply embedded these ideas were for him. However his views should come as no surprise to those who have heard Petrov's catchphrase "Move the pole always".

To help readers fully appreciate the implications of Bubka's words and to help them better understand the relationship between stiff pole and flexible pole vaulting, we have broken this statement into three elements and intend to deal with each in turn. Note that we have made minor changes in order to ensure that Bubka's ideas are presented as clearly as possible.

1. *Before the fibre glass pole, pole vaulters put their focus on moving the pole ……. (Now with the fibreglass pole) it is (also) more important to concentrate -- on moving (it) towards the plane of the bar, rather (than trying to bend it).*

In this sentence he is emphasising a critical element of technique common to vaulting with both stiff poles and flexible poles, namely driving the pole forwards/upwards at take off without making any overt attempt to bend it before the vaulter leaves the ground.

The dramatic photograph of Bubka, Figure 5.9 immediately after take off in his World Record jump of 6.00 metres (19'7") in 1985, clearly shows this. The pole is still essentially straight, even though Bubka has already left the ground. It is also clear that he has taken off 'out' with a powerful upspringing action.

Figure 5.9

2. *The pole (should) bend as a result of the speed and mass of the jumper.*

This simply re emphasises the importance of the free take off in modern vaulting.

3. *When the flexible pole appeared many people put their focus on bending the pole.*

There can be little doubt about Bubka's antipathy towards this misguided emphasis.

What is so fascinating about all of the above is that it becomes obvious that the coaches and athletes of the stiff pole era had a clear and accurate understanding of the technical requirements of vaulting. It is therefore ironic that if the coaches at the beginning of the fiberglass era had continued to apply the principles of stiff pole vaulting to the newly arrived flexible poles, many of the problems detailed in the next chapter might have been avoided!

Unfortunately the evolution of the technique of vaulting on flexible poles was driven by the athletes, not by the coaches! The latter had never vaulted on

flexible poles, did not appear to understand the fundamental biomechanics of the vault and so were forced to defer to their athletes – who - although they themselves were searching for solutions to the problems they faced, became the 'experts'. If we accept the validity of Bubka's comments above, it is clear that they got it wrong!

This claim can be supported by the comments of leading coaches and athletes at that time. For example Aubrey Dooley, whom Kenneth Docerty believed *might very properly be called the pioneer of fibreglass vaulting,* certainly concentrated on bending the pole, not on moving it. Richard Ganslen, who had watched him in person and on film for four years, stated,

The first observation the spectator makes of Aubrey is the fierce manner in which he bends the pole. This bending of the pole is not a natural consequence of a normal swinging take off, but a deliberate effort on the part of the vaulter.

And

At take off he pushes the pole toward the pit with his lower hand, which actually prematurely bends the pole. (Ordinarily a pole does not begin to bend until the vaulter swings past it). This push stores some of the energy of the run and Dooley then drives straight ahead.

Father Coultard, also writing about Dooley's technique, says,

It is possible, as Dooley does, to take a wide grip, push with the lower hand and pull with the upper and hold the bend longer until you require it - storing the whip.

Finally on this topic, when Docherty summed up what he saw to be the advantages of the flexible pole he wrote,

The driving action forward at the take off must be accentuated in order to get an optimum bend and therefore propulsive force out of the pole.

Unfortunately the limitations of sports science may be one reason why these erroneous ideas still impact on the technique of pole vaulting. For example in the fourth edition of his popular text, "The biomechanics of sports techniques", the late Dr. James Hay wrote,

If the athlete drives upward and forward across the line of the pole, the magnitudes of the parallel forces are relatively small and their tendency to bend the pole is minimal. On the other hand, if the vaulter drives forward into the pole, the magnitudes of the parallel forces and the resulting bending of the pole are correspondingly greater.

The first sentence clearly suggests that the vaulter *should* actively try to bend the pole at take off while the second reflects the erroneous ideas and methods of the very early pioneers of fibreglass vaulting. Note that Dr. Hay's book was reprinted in 1993, ten years after Bubka clearly demonstrated that the athlete should not attempt to bend the pole before they leave the ground and eight years after Bubka's coach, Vitali Petrov, publicly advocated a free take off where the pole is not loaded, and therefore not flexed, until after the athlete has left the ground.However the key to understanding the real limitations of the methods of the original fibre glass vaulters is captured in a seemingly innocent paragraph from Docerty where he stated, after take off, *He (Dooley) now deliberately HOLDS HIMSELF BACK behind the pole .*

He then goes on to quote Dooley who says,

By keeping my body in an L shape with both legs straight or on the same level I can hang or ride the pole long enough TO WAIT FOR the bend of the pole to come back to the vertical.

Both statements are important because they confirm that the vaulter was prepared to accept what we now term passive phases, that is periods in which they were not applying any forces to the pole, as a normal part of their technique. This is of course completely the opposite of the methods of stiff pole vaulters who had to keep the vaulter/pole system moving forward from the instant they left the ground if they wanted to reach the safety of the sawdust landing area!

Petrov and Warmerdam

Petrov was especially influenced by the technique of the great Cornelius 'Dutch' Warmerdam of Fresno State University, the Bubka of his time! Figure 5.10 (next page).

The biomechanics of Warmerdam's technique were relatively straightforward as he fully exploited what the coaches at the time called *the double pendulum*. As the pole – the first pendulum - rotates towards the vertical, the vaulter – the second pendulum -

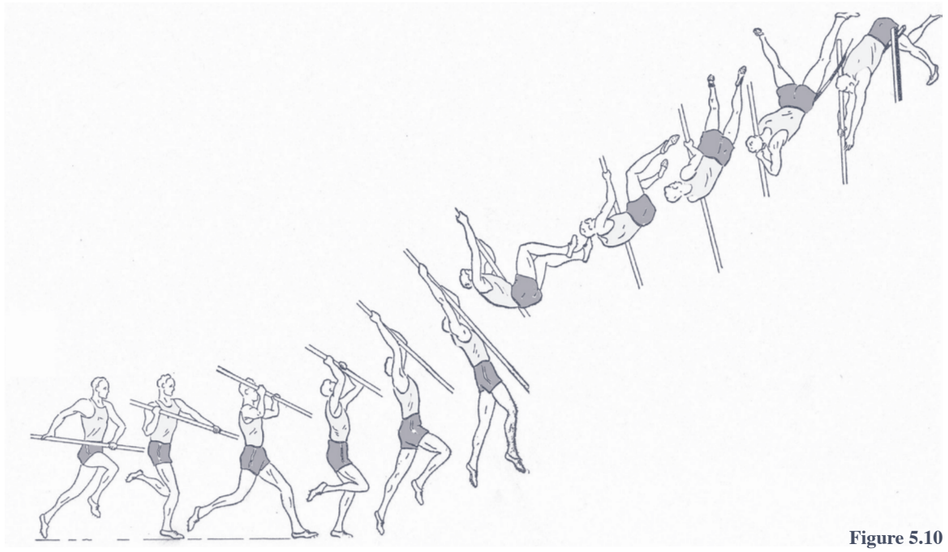

Figure 5.10

swings their body on the pole, Figure 5.11.

The run up and take off put the first burst of energy into the system to make the pole move forward after take off – the first pendulum. Then, the long swing of the whole body around the hands – the second pendulum - puts more energy into the system. This long extended swing also served to keep the centre of mass low – so that it would continue to move forward quickly.

Warmerdam's technique met the biomechanical requirements of vaulting on a stiff pole at least as well as that of any other athlete of the period. It was relatively straightforward, and because no energy could be stored in the pole the keys to success were a strong take off and the long swing into inversion. The simple phrase 'spring and swing', summarises the essence of his method.

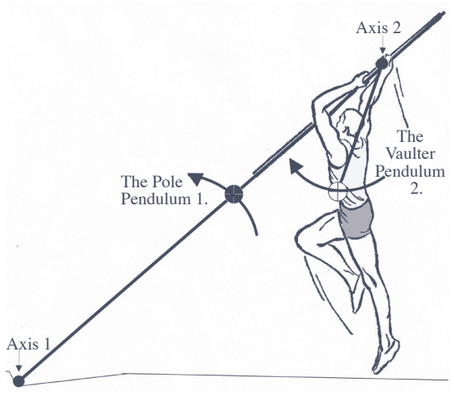

Figure 5.11

In studying Petrov's ideas it becomes clear that he believed that most of the key elements of Warmerdam's method could, and should be, transferred into vaulting with a flexible pole. Roman Botcharnikov, a life long Petrov disciple, who trained under the great man, captured the essence of the his ideas in the seminal article, "The continuous chain model", when he wrote:

- *An athlete using a flexible pole should copy the stiff pole vaulter and spring up at take off – to drive the pole upwards and forwards.*
- *The left arm should perform as a with a rigid pole because lower arm resistance breaks the continuous chain of energy flow in the event. And ---------- this action should be minimised or eliminated.*
- *The vaulter should keep his body as straight (long?) as possible during the inversion (rock back) phase. This will keep the centre of mass lower for a longer time, which will contribute to the penetration.*
- *The push pull phase in the event is almost identical to the similar phase with a rigid pole.*

In vaulting with a rigid pole the vaulter will not wait for the pole to recoil, but they will continue their actions on the pole without delay from the beginning of the inversion until they are off the pole. There is no reason why the vaulter cannot perform in the same way on the fibreglass pole. Delay with the pull-push action and waiting for the pole to recoil breaks the energy flow input into the system: so, according to the continuous chain model, the waiting phase should be eliminated.

It is clear that both Petrov and Botcharnikov see a direct transfer of technical elements from the stiff pole to the flexible pole. However it would seem that **THE critical concept that Petrov took away from his analysis of stiff pole vaulting, was that the athlete must continually interact with the pole** – there could be no passive phases if vaulters of that era wished to clear a high bar and land safely in the sawdust! This was perhaps his epiphany! Because this concept inevitably lead him towards the continuous chain model of pole vaulting. However it is also important because it also exposes the limitations of methods based on the myths and misunderstandings that are discussed in Chapter Six.

We believe that this insight may help coaches to bridge the conceptual gap between stiff pole vaulting and flexible pole vaulting if they stop thinking of the flexible pole – as a single flexible pole! They should instead think of an infinite series of straight poles, each decreasing infinitely in length until maximum pole bend and then infinitely increasing in length until the pole is again straight, as shown in Figure 5.12.

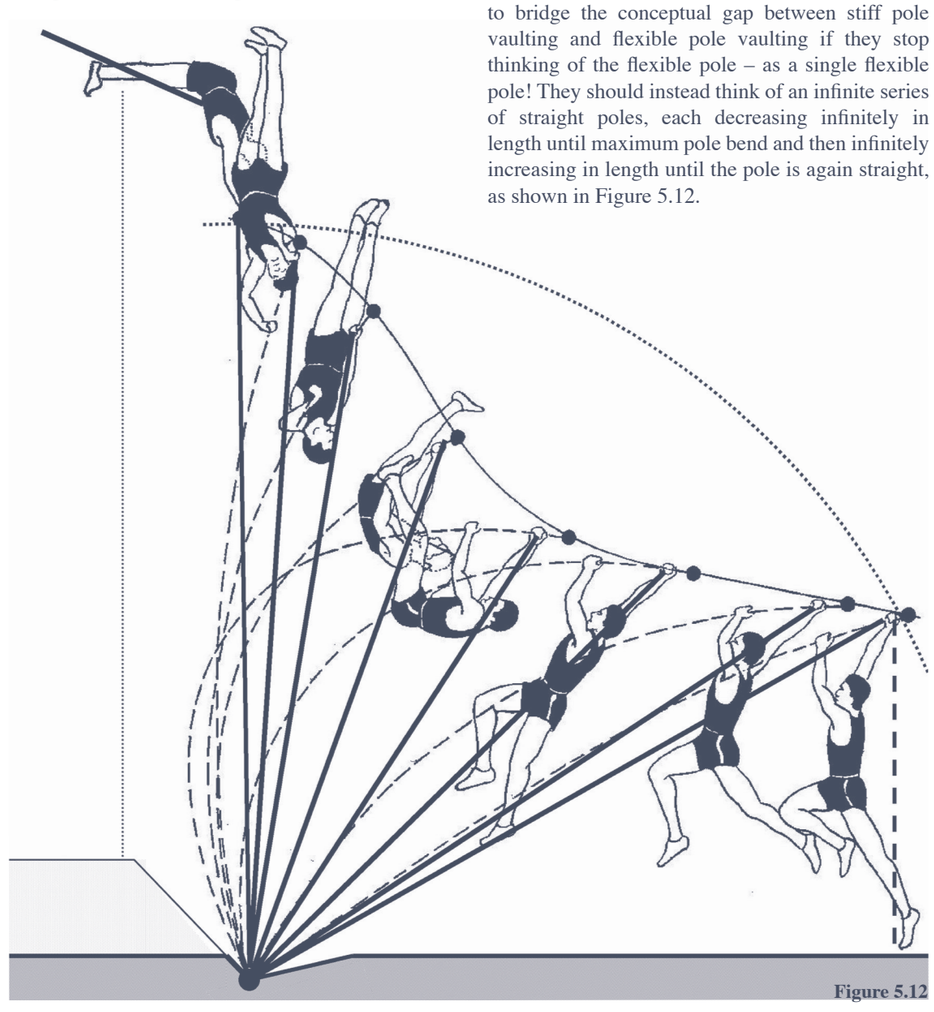

Figure 5.12

This variable length straight pole is of course the chord of the actual pole. **From a biomechanical perspective this infinitely varying invisible chord, (the Cpole) is the pole.**

So as the actual pole flexes, the chord of the pole (The Cpole) shortens; this means that it will rotate towards the pad more quickly. It is almost as if the vaulter can lower their grip through the early phases of the vault. and can then raise it again as they approach the bar.

Once this notion of an infinite series of straight poles is accepted. it is possible to apply the principles of effective pole vaulting on a stiff pole directly to vaulting with a flexible pole. So the modern vaulter should try to drive the pole upwards and forwards as powerfully as possible at take off and continue to do so throughout the vault. They can do this by employing the methods of the stiff pole era and:

- Generate great controlled velocity in the run up.
- Take off beneath or outside the top hand, never under.
- Make an upspringing take off.
- Ensure that their body is solid from take off toe to the top hand.
- Make no attempt to bend the pole at take off.
- Execute a long whipping swing of the body around the top hand until they are inverted – this helps to keep the vaulter/pole system moving forward.

Footnote: In his famous work "Gymnastics for youth", published in 1792, Guts Muths included a section on pole vaulting. In it he stressed the importance of the swing and the take off – where he warned against taking off too close!