SERGEI BUBKA ABOVE THE BAR

By V. Jagodin

Sergei Bubka finished 1991 with the world title and set eight new global records during that year. The following technical analysis is based on the film analysis of his 6.08m vault at the Moscow Grand Prix on June 9, 1991. The photo sequence is by V. Pavlov and the article is a slightly abbreviated translation from Legkaya Atletika, Moscow, No. 4, April 1992. It should be noted that the author makes comparisons to Bubka's 1983 (5.65m) and 1986 (6.01m) vault sequences which are unfortunately not available to us. Re-printed with permission from Modern Athlete and Coach.

A comparison of Bubka's 1983, 1986 and 1991 vaults shows relatively small differences in the major performance parameters (table 1). This leads to the question of what has been responsible for the improvement of his performances?

PARAMETERS OF THE VAULT	RESULTS (CM)		
	5.65	6.01	6.08
Run-up velocity (m/sec)	9.5	9.7	9.7
Velocity after the takeoff (m/sec)	8.0	8.55	8.54
Maximal rising velocity of the body (m/sec)	5.6	5.7	6.7
Rebound velocity of the pole (m/sec)	—	4.5	5.6
Velocity of the body at the release of pole (m/sec)	2.3	1.8	3.2
Angle of the body at the release of the pole (degrees)	47	56	53
Angle height from ground level (cm)	4.79	4.95	4.95
Height of the bar above the grip (cm)	1.40	1.50	1.59
Hardness of the pole (pounds)	205	210	215

TABLE 1: Major performance parameters of Bubka's vaults in 19893, 1986 and 1991.

As can be seen in Table 1, the run-up velocity and the velocity after the takeoff have remained virtually unchanged. Consequently there is only a minimal increase in Bubka's grip height. However, noticeable changes have taken place in the velocity of the vaulter's rotations during the support phase (Table 2). This is responsible for faster rotational forces that allow to bend a harder pole for a better catapulting effect as the pole straightens and consequently makes it possible to clear the bar higher above the grip height. It is also confirmed by the more dynamical temporal and rhythmical characteristics of the support phase (Table 3).

PARAMETERS OF THE SUPPORT PHASES (SEC/%)	RESULTS (CM)		
	5.65	6.01	6.08
Hang — swing	0.10/8.3	0.114/8.3	0.105/8.6
Rock — back	0.56/43.8	0.551/40.0	0.48/39.62
Extension of the body	0.38/29.7	0.374/27.3	0.33/27.58
Support turn and push-off	0.23/18.2	0.332/24.4	0.29/24.2
Total time	2.27	1.37	1.205

TABLE 3: Temporal and rhythmical characteristics of Bubka's vaults in 1983, 1986 and 1991 in the support phases.

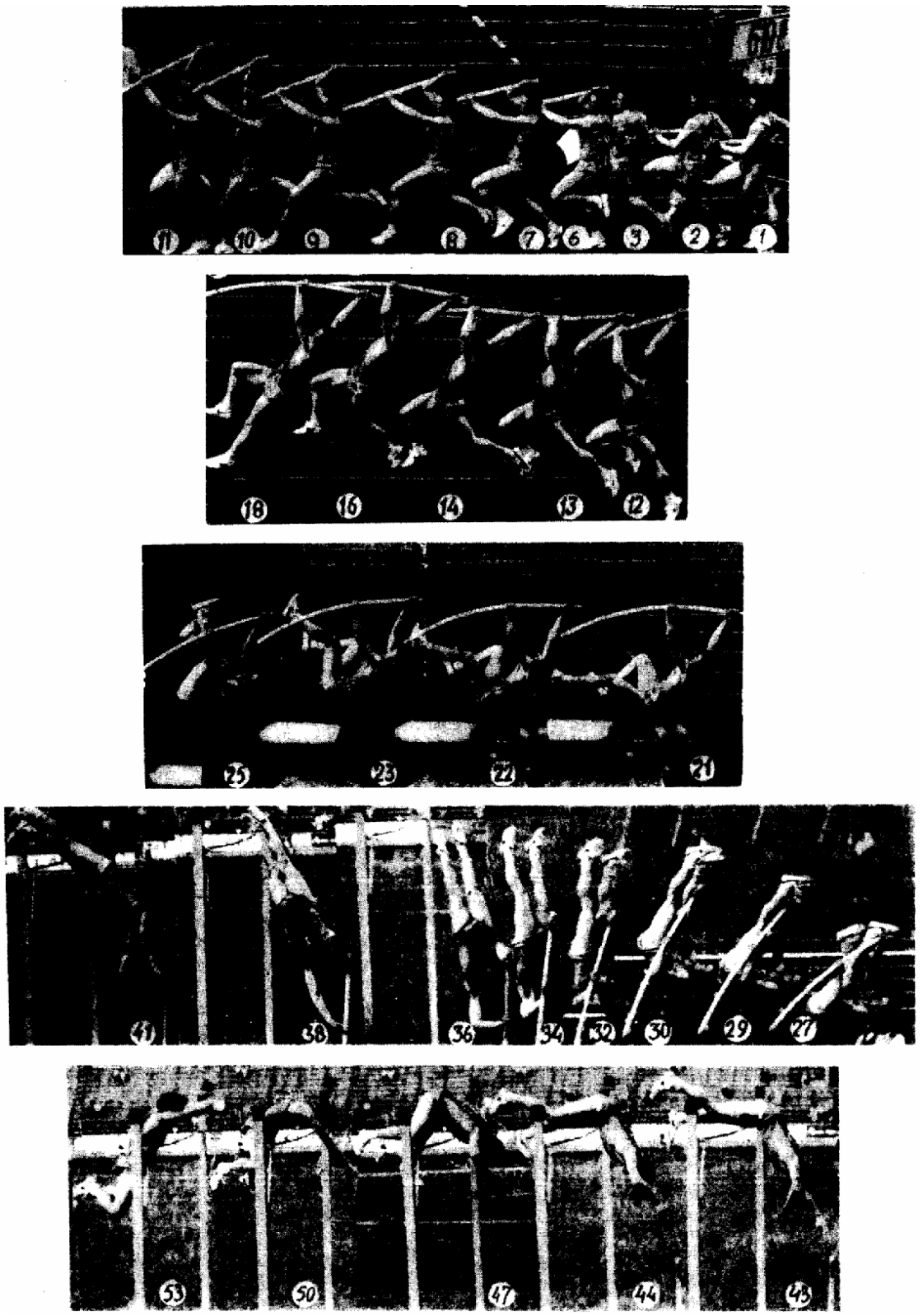
PARAMETERS	RESULTS (CM)	
	6.01	6.08
Rotational angular velocity of the body from the shoulders (rad/sec)	5.5	6.0
Rotational angular velocity from the pelvis (rad/sec)	12.3	14.5
Linear horizontal velocity of the takeoff leg (m/sec)	15.6	17.0
Maximal vertical velocity of the takeoff leg (m/sec)	12.5	13.6

TABLE 2: A comparison of Bubka's rotational velocities during the support phase between the 1986 and 1991 world records.

OBSERVATIONS OF THE 6.08 VAULT

The 20-stride run-up is characterized by a smooth acceleration with a particularly energetic second half. The end on the pole is carried high to be gradually dropped as the athlete approaches the takeoff. The planting of the pole begins on the left foot two strides before the takeoff (frames 1, 2). The pole is moved upward close to the body with some of the not recommended rotation of the right shoulder (frames 2, 3). Attention is drawn here on the left hand that moves together with the pole forward-upward (frames 2-6). The last two strides are performed with an attempt to keep the hips as high as possible.

The last stride is executed with an emphasized right leg drive (frames 6,7) and a simultaneous upward forward lift of the pole. The takeoff foot is placed flat on the outside edge (frame 9). The actual takeoff itself is executed fast with a minimal bending of the support leg (frames 11 ,12) and a short swing of a well bent lead leg. The pole end is placed into the box during the takeoff as the athlete continues with a very active lift of the upper part of the pole. The takeoff point is exactly below the projected line from the top hand of the grip (frame 12). The velocity of the athlete at the end of the takeoff is 8.54m/sec and the takeoff angle 20°.



The swing that follows the takeoff is performed in a deep hang in order to exploit the available velocity. The left arm is relaxed and placed slightly on the left side

with the chest moving forward but kept behind the left arm in order to avoid an early forward swing (frames 13, 14). A deep and prolonged hang is necessary and important because it allows to use a higher grip and a harder pole. In the shown vault the duration of the hang is 0.105 sec. and makes up 8.6% of the total support phase. This is longer than in the previously analyzed sequences.

The prolonged swing is performed by using the strength of the arms to keep the shoulders back and is followed by an accelerated lead leg upward swing (frame 16) that initiates the rotation around the shoulder axis. Bubka has made noticeable changes to the performance of this phase of the vault. In his 1986 vault over 6.01 m the rotation was executed with a relatively small bend in *he hip joint that shifted the centre of gravity somewhat outside the axis from the upper hand straight down to the pole end in the box. The vault was “saved” only by the athlete’s shoulder strength.

In this action Bubka performs after the hang a powerful leg swing, keeping the centre of gravity close to the above described axis (frames 18-21). The long swing creates inertial forces around the shortened radius (frames 22-27) and therefore is responsible for an increased angular velocity of the body (see Table 2). This type of a rock-back also assists the bending of the pole that reaches its maximum in frame 23.

The following arrangements of the body segments occur after the pole has began to rebound (frames 25-27). As the pole straightens the athlete exploits the accelerating rebound with an active extension of the body (frames 29-34). The extension occurs first forward-backward (frames 29,30) and after that the virtually vertical (frames 32-34). The well bent and extremely hard pole catapults the athlete in the analysed vault much faster than in the previously analyzed performance sequences. It reaches top speed in frames 32-34.

Bubka executes his vertical turn in this particular vault a little late and consequently has “lost” some of the pole support for the pushoff (frames 36-38). However, he succeeds to move closer to the pole support in the final stages of the action due to his extremely fast catapulting speed and executes a very active push-off (frames 39-41) without dropping his legs prematurely.

The high vertical velocity makes it possible for the vaulter to lift his centre of gravity a further 35 to 40cm after the pole has been released. The actual folding of the hip joint takes place only after the hips are well above the bar (frames 43-47). It is followed by a slightly delayed and smoothly executed lift of the shoulder, head and arms when the hips and the pelvis have dropped behind the bar.

The sequence presented here shows how Bubka maintains his movement potential and, due to rational changes of his technique, is capable of improving his record performances.