EXPERIMENTS WITH STRENGTH DEVELOPMENT METHODS

By Anatoli Bondarchuk

Prominent sports scientist and former world hammer throw record holder, Dr. Bondarchuk, presents summaries of experiments with different combined intensities and dynamic-isometric sets in strength development, as well as different modes of microcycles and long-term preparation principles. The article is based on translated from Legkaya Atletika, Russia, No. 4, April, 1993. Re-printed with permission from Modern Athlete and Coach.

The information that has so far been available suggests developing strength capacities by using three methods: repetition, moderate intensity and close to maximal resistances. The first method employs loads around 50 to 75% of the maximum with repetitions ranging from 8 to over 25. The second method is based on resistances of 80 to 90%, performed in 4 to 8 repetitions, while resistances in the third method reach 95 to 100% in 1 to 4 repetitions.

VARIATION	LOAD INTENSITY ZONE (%)	NUMBER OF REPETITIONS	LOAD INTENSITY ZONE (%)	NUMBER OF REPETITIONS
1	50-60	10-12	90-95	4-6
2	60-70	8-10	90-95	4-6
3	50-60	10-12	95-100	1-4
4	60-70	8-10	95-100	1-4
5	90-95	4-6	50-60	10-12
6	90-95	4-6	60-70	8-10
7	95-100	1-4	50-60	10-12
8	95-100	1-4	60-70	8-10
9	80-90	6-8	95-100	1-4
10	95-100	1-4	80-90	6-8
11	50-60	10-12	80-90	6-8
12	60-70	8-10	80-90	6-8
13	80-90	6-8	50-60	10-12
14	80-90	6-8	60-70	8-10

TABLE 1: The sequences in the use of different intensity zones combinations in one set of lifts.

Although these methods have justified their use and have been responsible for high level performances over several generations, it has nevertheless been noticeable lately that the rate of improvement in using these methods begins to slow down as the athlete's performance level improves. It appears that this can be explained by the fact that an extended use of the above described methods creates an anti-reaction in the organism and the adaptation of the neuro-muscular system to training loads diminishes gradually.

We planned in our search for new methods to develop strength capacities a combination of several intensity zones, as well as dynamic and isometric

contractions, in the performance of a single set of lifts. The plan included the establishment of 14 variations of training loads in different intensity zones (see table 1) and 10 variations of combined dynamic and isometric work (see tables 2 and 3). The subjects for the experiment, that lasted several years, were athletes in the high performance category.

VARIATION	ISOMETRIC		DYNAMIC	
	INTENSITY ZONE (%)	DURATION (SEC)	INTENSITY ZONE (%)	NUMBER OF REPETITIONS
1	Maximal	6	50-60	10-12
2	Maximal	6	60-70	8-10
3	Maximal	6	80-90	6-8
4	Maximal	6	90-95	4-6
5	Maximal	6	95-100	1-4

TABLE 2: The sequences in the use of the isometric and dynamic work combination in one set of lifts.

Subjects in our first experiment performed three exercises (half squat, snatch and clean) in different variations of intensity zones in a single set of repetitions. Participants in the second experiment performed six exercises, made up from three dynamic (half-squat, snatch, clean) and three isometric exercises (holding a barbell on the shoulders in a half-squat position, starting the pull of a snatch with a barbell the athlete is unable to lift, pressing a barbell the athlete is unable to press.

VARIATION	DYNAMIC		ISOMETRIC	
	INTENSITY ZONE (%)	NUMBER OF REPETITIONS	INTENSITY ZONE (%)	DURATION (SEC)
1	50-60	10-12	Maximal	6
2	60-70	8-10	Maximal	6
3	80-90	6-8	Maximal	6
4	90-95	4-6	Maximal	6
5	95-100	1-4	Maximal	6

TABLE 3: The sequences in the use of the idynamic and isometric work combination in one set of lifts.

The procedures to perform one set of multi-intensity exercises was organized as follows:

- Barbells with individually adjusted loads were placed on the platform close to each other
- The athlete executed the exercise first with one load, followed immediately (1 to 2 other sec.) with the other load.

This procedure also allowed an athlete to perform combined dynamic and isometric contractions in one single set. For example, the athlete performed the

starting phase of the snatch by pulling on a barbell he was unable to move (isometric) and without delay executed the same exercise by performing a normal snatch (dynamic). The same applied to the half-squat in which the isometric contraction was executed with a load that made the straightening from the knee bend impossible.

The described experiment lasted 10 years during which all subjects improved their exercise results, although the improvements in the competition exercise varied. The average improvements achieved in the combined exercises are presented in tables 4 and 5. It should be noted here that the improvement rates varied considerably between individual athletes. For example, some athletes increased their half-squat result by 50kg, while others had to be satisfied with an improvement of only 10 to 15kg. The results in the snatch and the clean showed less variation, ranging between 5 to 15kg and 10 to 20kg respectively (see tables 4 and 5).

It should also be noted that the improvements in the results of the exercises did not necessarily transfer to the competition exercise. There were cases where improvements helped to develop only performances with heavier throwing implements.

DETERMINATION OF WEEKLY TRAINING CYCLES

Sports scientists compared two modes of the realization of the weekly training cycles during the development and maintenance periods of form. The first mode was based on changes in the training means after every three or four weeks, also employing different volumes and intensities of the training loads. The second mode foresees standard, predetermined parameters, in the use of weekly training cycles that are based on the following:

- A predetermined exercise complex is used in each weekly cycle.
- Each cycle is used until the athlete has reached the desired form.
- The inclusion of new exercises is not allowed during the form development period.
- The execution sequence of the exercises remains unchanged in all training units.
- The desired sequence of training and recovery days is maintained in the weekly cycles.
- The determined volume and intensity of the training load is closely observed, although some slight changes from one weekly cycle to another might take place.

- The desired ratios of intensity zones are adjusted according to the developmental progress. Intensity is increased as the training and competition results improve.

EXERCISE	RESULT (KG)	
	BEFORE STUDY	AFTER STUDY
Half-squat	205	235
Snatch	97.5	107.5

TABLE 4: Average improvements in using several intensity zones in one set of lifts.

Our experimental studies revealed that athletes who used the first mode of the weekly cycles in the form development period reached top form only once a year. Athletes who used the second mode, based on standardized parameters, reached top form twice in the yearly cycle. Further, the improvements in average competition distances were considerably better in the second group.

EXERCISE	RESULT (KG)	
	BEFORE STUDY	AFTER STUDY
Half-squat	200	240
Snatch	102.5	110

TABLE 5: Average improvements in using the dynamic-isometric method in one set of lifts.

The second stage of our experimental study attempted to find standardized weekly cycles that have the most positive transfer of the increased strength to the implement in the actual throw. We tested a total of 250 differently structured cycles over five years and discovered only 12 that were responsible for a favorable strength transfer to the competition exercise. All these 12 weekly training cycles were not only responsible for a positive transfer of strength, but also helped to improve competition performances independent of the individual characteristics of an athlete.

The use of standardized predetermined weekly cycles revealed further that each cycle had a specific reaction. This was reflected in the way the athlete feels, as well as in the performance dynamics that changed from one training day to the other. For example, in the use of a variation made up from two training days followed by a recovery day, 95% of the athletes felt average on the first and extremely good on the second training day. The level of their performances varied accordingly, as the results on the second day turned out to be considerably better. In a combination of six training days and one recovery day some athletes performed better on the first, other on the sixth day.

Knowing the athlete's reaction to certain combinations of training cycles is helpful in planning the pre-competition weekly cycle. It also makes it possible to prognosticate roughly expected performances.

In the choice of weekly training cycles with predetermined parameters it is extremely important that all cycles include the competition exercise. Other exercises can be completely or partly changed. We changed the exercises at the start of each mesocycle (4 weeks). This procedure assisted in the maintenance of the achieved performance level during the competition period.

In summary, it can be stated that the fluctuation in competition results during the season was 2.6% in the use of standardized weekly cycles. The fluctuation was 6.3% in the use of training cycles based on changes in training means, volumes and intensities in every microcycle. Also, athletes who used the standardized cycles produced five performances in the 99 to 100% range from personal best during the season, while the variation method was responsible for only two such performances.

LONG-TERM PREPARATION METHODS

Finally our experimental study looked at long-term preparation methods in which the use of general and specific exercises was evaluated. According to the previously accepted training theory athletes involved in power events made use of five developmental stages, beginning with basic general preparation exercises, followed stage by stage with an increased volume of specific preparation exercises, while the volume of general exercises was gradually reduced.

Our experiment with two groups of throwers attempted to follow their development of performances over a considerable time period. During this period the first group employed 80 to 90% general preparation exercises. The second group was already in the first years introduced to a volume of 80 to 90% of specific preparation exercises. The evaluation of the results took into consideration:

- The volume and intensity of the exercises used in this period.
- The performance dynamics during the period.
- The rate of improvement from one training year to the next.
- The drop out rate.

The results allow us to confirm that the preparation system that begins with emphasis on general preparation exercises is less effective in the long-term development of throwers than the system where specific preparation exercises dominate right from the start. Observations over 10 to 15 years indicated that the first group required four years to reach the former Soviet II level standards, while

the specific preparation exercise group needed only two years and six months. The required time to reach the international master of sport standards were 11.4 and 8.5 years respectively.

It appears from the above that the principles of long-term development in the training theory should be based on the following fundamental rules:

1. The long-term performance development (from novice to champion) should basically employ specific preparation exercises.

2. General developmental exercises are mainly used only in the warm-up and recovery phases.

3. Complex training loads (exercises, volumes and intensities) must be periodically adjusted to correspond with the expected performance. The complex of training loads must therefore be increased by using new specific exercises, volumes and intensities at the start of each new cycle for improved performance.