The Science of Reps: The Strength Training Contributions of Dr. Richard A. Berger

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One set of ten or ten sets of one? Five sets of four or four sets of five? One hundred percent of 1RM or ninety percent? Or fifty percent? Dynamic or isometric? Slow or fast? Free weights or machines? One day per week or five times per day? Before practice or after practice? Out of season only or out of season and in season, too? Full moon or quarter? Boxers or briefs? These and related questions have been asked for as long as we have had written records, and they will no doubt persist as long as there are human beings to debate them. Training theories are a bit like certain body parts—everybody seems to have one. Some theories are preposterous, of course, some are commercially driven, and some are accepted simply—and simplistically—because the person recommending them is: 1) heavily muscled, 2) a good athlete, or 3) speaking with an Eastern European accent.

What we need in order to find our way through this briar-patch of conflicting information is research—fact-based, carefully designed research. Even though resistance training is hardly new (We have evidence from as far back as forty-five hundred years ago of men lifting heavy objects over their heads), systematic research into how best to train to build strength and athletic power only began within the last fifty years. One of the first men to apply modern testing procedures and statistical analysis to some of the above questions was Richard A. Berger, now Professor Emeritus at Temple University. Beginning in the late 1950s Berger turned his agile mind to several of these questions, but he is remembered most for his probing analysis of the effect of varying sets, loads, and repetitions on the development of strength.

Berger grew up in Chicago, and as a boy he loved sports, particularly football. He played throughout high school and started at running back. Following high school Berger served a hitch in the Marines, and then returned home where he got together with John Hagen, a high school pal who had just finished his own tour of Marine Corps duty. Both young men had done a lot of exercise during their time in uniform, of course, but only Hagen had been introduced to something revolutionary—weight training. Hagen, in turn, made a revolutionary of Berger. Together, they built a place to train on the Hagen family farm, in an abandoned 6’6” x 6’6” chicken coop just barely large enough to accommodate their six-foot exercise bar. The coop was unheated, and that winter the two young men began every session dressed in many layers of clothing. “We took off more and more clothes as the training progressed and we gradually got warmer,” Berger recalled with a laugh. “We trained hard, too—five days a week—because we were getting ready to try to make the Michigan State football team. We trained for about a year, and we actually over-trained because we just didn’t know what we were doing.”

Over-trained or not, once at Michigan State, Berger made the team and, as he had done in high school, played as a running back. He continued to lift on his own in the off-season during his playing days at Michigan State, and even a bit during the season itself. He had to do it on the sly, however, in much the same way most other weight-trained athletes did back in the day when the myth of muscle binding held sway throughout the land. In fact, he recounted an incident in which Biggie Munn, the legendary Michigan State coach, having heard that Berger was seen lifting weights, told him, “Berger, I don’t want to hear about you doing any of that lifting. It’s bad for you. I want you to get a summer job doing heavy construction work. That’s what you need, not those weights.”

In any event, Berger left the team after two years as he had gotten married; he was working full-time, too. But he stayed in school and took a BA in Social Work in 1951. He remained at Michigan State through his Mas-
ter’s degree, awarded in 1956, but he switched to the department of Physical Education. During most of those years he worked forty hours a week on a night shift job and also had a graduate assistantship in his department. Even with his job, his academic work, his assistantship, and a growing family that eventually totaled eight children, Berger somehow managed to get to the gym fairly regularly and lift weights. By that time he had been introduced to the strength sport that helped to shape his life—competitive weightlifting. As he said, “Olympic weightlifting added greatly to my interest in strength research.”

When asked who might have influenced him as a researcher in this “new” field, Berger hesitated, then said that several of his professors at Michigan State and at the University of Illinois, where in 1960 he took his Ph.D., had influenced him through their work ethic, knowledge, and professional dedication. “They didn’t share my enthusiasm for research into progressive resistance, however,” he added. Then, almost as an afterthought, he said, “you know, the man who had by far the biggest influence on me in the field of strength research wasn’t an academic. That person was Bob Hoffman, who owned the York Barbell Company, published Strength & Health magazine, and sponsored the York Barbell Club, the top weightlifting team in the U.S. I read every article Bob wrote in S&H, because he usually wrote either about competitive lifting or about how weight training would make you better at your chosen sport—my two main interests. Bob wasn’t a scientist, but he had a remarkable memory and knew thousands of anecdotes about athletes who lifted weights, and I was a great admirer of his. There weren’t many academics working in my field of study, and so I think I appreciated Bob even more, although with his non-stop talking and with those lifting medals all over his coat he was quite a character. I’d lifted weights myself to improve athletically, so I knew that what he was saying was correct, but it was always a big help to get new ammunition every month from his articles or from listening to him tell his stories at the lifting meets.”

By the time Berger was well into his doctoral work at the University of Illinois, he was a nationally ranked weightlifter, and he continued this pursuit after he graduated, did some post-doctoral work there, and took an Assistant Professorship at Texas Technological Institute in Lubbock, Texas, in 1962. At 5’8” and weighing in the 175 to 185 pound range, Berger’s best lifts in competition were 300 pounds in the press, 275 pounds in the snatch, and 360 pounds in the clean and jerk. In practice, he managed a 375-pound clean and jerk and a 325-pound press off the rack. In the late 1950s and early 1960s, Berger was often a competitor in the National Weightlifting Championships. He tied for third place on two occasions in the 181-pound class to such elite lifters as Tommy Kono, nine-time world champion and Louis Riecke, one of the last American lifters to hold a world record in the sport. Riecke, in fact, is connected to Berger in another way, as the Louisiana lifter was one of the first U.S. athletes to use anabolic steroids to enhance his performance. Under the tutelage of Dr. John Ziegler, Riecke began doing isometric contraction and taking methandrostenolone (Dianabol) in 1960 and made astonishing progress in the following months. Competitive by nature, Berger was curious about this new wonder drug and hungry for the gains it promised. Thus it was that after much deliberation, he began taking Dianabol. But he only took it for a week. He says now that the more he thought about it the more it bothered him to be taking
The 177 subjects were freshmen and sophomores in nine groups. The subjects were divided into nine groups and were designated both by Roman numerals (signifying sets) and Arabic numerals (signifying repetitions), so that the nine groups were: I-2, I-6, I-10, II-2, II-6, II-10, III-2, III-6, and III-10. Whenever a subject was able to perform one more rep than the number designated for his group, the training load was increased accordingly. Conversely, if a subject could not perform the required number of reps he would be assisted just enough by a spotter so that the appropriate number of reps could be done. Also, as Berger says in the article, “The loads were always intended to elicit maximum effort for a given number of repetitions.”

The subjects worked up to a 1RM effort once every three weeks.12

All nine of the groups made statistically significant gains in the 1RM bench press, and all nine made significant gains in all four testing phases. However, by using analysis of covariance to test for significant interaction between sets and repetitions, Berger was able to demonstrate that the III-6 group, using three sets of six reps, “was more effective in improving strength than any other combination of sets and repetitions per set.”13

Berger continued to mine this particular field for several more years, and to publish his results in Research Quarterly.14 His efforts increased our understanding of this increasingly important methodology in ways that were, we might be forgiven for saying, statistically significant.

Berger also made important and early contributions to the battle against the myth of the “musclebound lifter.” His studies provided insight into the effects of strength training on performance, or showed the importance of strength as a component of physical prowess. In one study, college students in a beginning basketball course resistance-trained the muscles used to extend the arms in shooting baskets. After ten weeks, shooting accuracy at fifteen feet was significantly improved compared to a control group of students.15 In another study of sixty-six college males, both static and dynamic tests of leg strength were significantly related to leg power with correlation coefficients, respectively, of R=.61 and R=.71.16 In yet another study, when forty-nine college males did barbell squats three times weekly for seven weeks, significant improvements occurred in vertical jumping.17 Other studies by Berger have reported significant relationships between general body strength and the AAHPER youth fitness test, and Barrow’s test of motor ability, which contains events such as sprinting, softball throw or medicine ball put, and agility run.18 The logical implication provided by these studies is that an increase in strength should improve athletic performance.

Berger left Texas Tech in 1968 and assumed...
similar duties at Temple University, where he taught for twenty-five years, retiring in 1993. During his teaching career at these two institutions, he was the main advisor for more than a hundred master’s theses and doctoral dissertations. When Berger left Lubbock, where he could drive to the university weight room in less than ten minutes, and moved to Philadelphia, where it took him at least forty-five minutes to make the drive, he retired as a competitive weightlifter. This decision was also influenced by his growing responsibilities as a father of eight young, active children. He still trained with weights, lifting three times each week on seven exercises chosen from a group of fifteen that make up his basic program. Number of sets? Three, of course. His reps? Five or, usually, six, and occasionally as many as ten. For many years Dick also played a lot of handball and he won the intramural championship at both Texas Tech and Temple. He also went through a period when he ran ten miles twice per week, but then moved to fast walking in his neighborhood in order to stay fit for hiking trips.19

All in all, Dick Berger has had an enviable career. President of the Physical Fitness Council of the American Alliance for Health Physical Education and Recreation from 1973 to 1974 and an associate editor of the Research Quarterly from 1965 through 1968, he has published more than one hundred articles in strength research and its application to sports training, testing and measurement of physical performance, statistics, physical rehabilitation, personality, and work physiology. He also published three books—Conditioning for Men (Allyn & Bacon, 1970), Applied Exercise Physiology (Lea & Feibiger, 1982), and Introduction to Weight Training (Prentice-Hall, 1984). Berger is one of those lucky men who found a thing he loved to do and then found a way to make a living doing it. He loved strength training and he loved to think about it, and this combination forged his life’s work. As he put it, “What I really like to have the data in front of me and then to analyze them. I get a little high that way—to see what the data tell me. I have in my mind a hypothesis, and the data tell me if my hypothesis is correct, or incorrect, or if it needs to be modified. The answers are all in these numbers. That process has always been fun for me; the fun was part of the job I had.”20

NOTES:
Portions of this article appeared previously in the Journal of Strength and Conditioning Research, 15, no. 3 (2001): 275–278.

4. Berger interview.
5. Ibid.
6. Ibid.
13. Ibid.
20. Ibid.