# Pioneers of Strength Research: The Legacy of Dr. Richard A. Berger

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ne set of 10 or 10 sets of 1? Five sets of 4 or 4 sets of 5? One hundred percent of 1 repetition maximum (1RM) or 90%? Or 50%? Dynamic or isometric? Slow or fast? Free weights or machines? One day per week or 5 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 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 partseverybody 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 (a) heavily muscled, (b) a good athlete, or (c) 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. Although resistance training is hardly new (we have evidence from as far back as 4,500 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 50 years (15). One of the first men to apply modern testing procedures and statistical analysis to some of the above questions was Dr. 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 known 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 as a 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 last 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-ft, 6-in by 6-ft, 6-in chicken coop (just barely large enough to accommodate their 6-ft exercise bar). The coop was unheated, and that winter the 2 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—5 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 overtrained because we just didn't know what we were doing" (12).

Overtrained or not, once he and Hagen got to Michigan State University, Berger made the football 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 musclebinding held sway throughout the land (16, 17). 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" (12).

In any event, Berger left the team after 2 years: he had married and was working full-time. He stayed in school, however, and earned a Bachelor's degree in social work in 1951. He remained at Michigan State through his Master's degree, awarded in 1956, but he had switched to the physical education department. During most of those years he worked 40 hours a week on a nightshift 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 8 children, Berger somehow managed to get to the gym fairly regularly to lift weights. By that time he had been introduced to the strength sport that helped shape his life—competitive weightlifting. As he said, "Olympic weightlifting added greatly to my interest in strength research" (12).

When asked who might have influenced him as a researcher in this new field, Berger hesitated, then said



**Figure 1.** Richard Berger attempting a squat clean with 350 lb in the 1962 Senior Nationals. Although he missed this attempt, he totaled 840 lb and placed 4th overall in this event. (Photo courtesy of the Todd/McLean Collection at the University of Texas at Austin.)

that several of his professors at Michigan State and at the University of Illinois (where he earned his PhD in 1960) 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 United States. I read every article Bob wrote in Strength & Health because he usually wrote either about competitive lifting or about how weight training would make you better at your chosen sport-my 2 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 nonstop 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" (12).

By the time Berger was well into his doctoral work at the University of Illinois, he was a nationally ranked weightlifter (Figure 1), and he continued this pursuit after he graduated, did some postdoctoral work, and took an assistant professorship at Texas Technological Institute in Lubbock, TX, in 1962. At 5-ft, 8-in. and weighing in the 175–185 lb range, Berger's best lifts in competition were 300 lb in the press, 275 lb in the snatch, and 360 lb in the clean and jerk. In practice, he managed a 375-lb clean and jerk and a 325-lb 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 on 2 occasions in the 82.5 kg (181 lb) class against such elite lifters as Tommy Kono, 9-time world champion, and Louis Riecke, one of the last American lifters to hold a world record in the sport (10, 11, 13).

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 John Ziegler, Riecke began doing isometric contractions and taking methandrostenolone (Dianabol) in 1960 and made astonishing progress in the following months (14). 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 it, and so he just stopped. "I'm glad I stopped, because I don't think I took enough to have hurt myself like some have done. I did seem to get a boost from it, but from what I've read I imagine the gains may've come from a placebo effect since all the guys in the gym had made such big gains by using it. I guess I'd have to say that those kinds of drugs didn't fit my views as a Christian. I just know that I felt a lot better about myself once I stopped" (12).

As a sports scientist, Berger understood that such things as anabolic steroids could confound the results of a training study, and so he was pleased to have gathered his data for the research that made him famous prior to the steroid era. The research was done at the University of Illinois and was the basis for his dissertation, The Effect of Varied Weight Training Programs on Strength and Endurance. The research that fed the dissertation was important for several reasons. By the 1950s, it was, of course, common knowledge that the lifting of heavy weights would increase muscle strength, especially if the training loads were increased as strength increased. Prior to Berger's study, however, which hit the professional big-time in 1962 via an article in the Research Quarterly-""Effect of Varied Weight Training Programs on Strength"-research designs did not clearly identify the independent contribution of sets or repetitions to increases in strength (1). In contrast, Berger's study systematically varied the sets and repetitions in order to determine their effect, if any, on strength increases. What is more, previous studies failed to include statistical designs appropriate for the examination of the independent effects of sets and repetitions, as well as their interacting effects. Berger applied a factorial analysis of variance (ANOVA) to determine the effects of 1, 2, and 3 sets; and 2, 6, and 10 repetitions (and their interacting effects) on strength increases (n = 177; Dr. Richard A. Berger, personal communication).

The statistical results showed that 3 sets and 6 repetitions were closer to the optimum combination than were the other variations studied in the development

of strength among college men over a 12-week period. The lift used was the free weight bench press because it was easy to standardize and simple to learn. The 177 subjects were freshmen and sophomores in 9 weight training classes at the University of Illinois. The subjects were divided into 9 groups and were designated both by Roman numerals (signifying sets) and Arabic numerals (signifying repetitions), so that the 9 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 1 more repetition than the number designated for his group, the training load was increased accordingly. Conversely, if a subject could not perform the required number of repetitions, he would be assisted just enough by a spotter so that the appropriate number of repetitions 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 3 weeks.

All 9 of the groups made statistically significant gains in the 1RM bench press, and all 9 made significant gains in all 4 testing phases. It is beyond the scope of this article to address the various tasty nuggets found within Berger's famous study. However, it should be noted that by using analysis of covariance to test for significant interactions between sets and repetitions, Berger was able to demonstrate that the III-6 group, using 3 sets of 6 repetitions, "was more effective in improving strength than any other combination of sets and repetitions per set" (page 181, vol 33, #2). Berger continued to mine this particular field for several more years and to publish his results in Research Quarterly (1-4, 8). His efforts increased our understanding of this increasingly important form of training in ways that were, we might be forgiven for saying, statistically significant.

Berger also made important and early contributions in 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 1 study, college students in a beginning basketball course weight trained the muscles used to extend the arms in shooting baskets. After 10 weeks, shooting accuracy at 15 ft was significantly improved in the study group compared with a control group of students (9). In another study of 66 college men, both static and dynamic tests of leg strength were significantly related to leg power with correlation coefficients, respectively, of 0.61 and 0.71 (6). In yet another study, when 49 college men did barbell squats 3 times weekly for 7 weeks, significant improvements occurred in vertical jumping (5). Other studies by Berger have reported significant relationships between general body strength and the AAHPER youth fitness test (0.54) and Barrow's test of motor ability (0.59), which

contains events such as sprinting, softball throw or medicine ball put, and agility run (7). 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 25 years, retiring in 1993. During his teaching career at these 2 institutions, he was the main advisor for more than 100 Master's theses and doctoral dissertations. When Berger left Lubbock, where he could drive to the university weight room in less than 10 minutes, and moved to Philadelphia, where it took him at least 45 minutes to make the drive, he retired as a competitive weightlifter. This decision was also influenced by his growing responsibilities as a father of 8 young, active children. He still trained with weights, he is quick to add, and he continues to this day, lifting 3 times each week on 7 exercises chosen from a group of 15 that make up his basic program. Number of sets? Three, of course. His repetitions? Five or, usually, 6, and occasionally as many as 10. For many years Dick played a lot of handball, too, and he won the intramural championship at both Texas Tech and Temple. He also went through a period during which he ran 10 miles twice per week, but now he concentrates on fast walking in his neighborhood in order to stay fit for the frequent hiking trips he and his wife enjoy. This past summer, in fact, they took 7 of their grandchildren on a 6-week hiking trip in Spain (12).

All in all, Dick Berger has had an enviable career. President of the Physical Fitness Council of the AAH-PER from 1973 to 1974 and an associate editor of the Research Quarterly from 1965 through 1968, he has published over 100 articles focusing on strength research and its application to sports training, testing and measurement of physical performance, statistics, physical rehabilitation, personality, and work physiology. He has also published 3 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. Listen to his words: "What I really like is 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" (12).

### References

1. BERGER, R. Effect of varied weight training programs on strength. *Res. Q.* 33:168–181. 1962.

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- 2. BERGER, R. Optimum repetitions for developing strength. *Res.* Q. 33:334–338. 1962.
- 3. BERGER, R. Comparison between resistance load and strength improvement. *Res. Q.* 33:637. 1962.
- BERGER, R. Comparative effects of three weight training programs. *Res. Q.* 34:396–398. 1963.
- BERGER, R. Effects of dynamic and static training on vertical jumping ability. *Res. Q.* 34:419–425. 1963.
- 6. BERGER, R. Relationship of power to static and dynamic strength. *Res. Q.* 37:9–13. 1966.
- BERGER, R. Comparison between the Strength Index test and the Predicted Dynamic Strength Test in predicting motor performance. *Res. Q.* 38:507–509. 1967.
- BERGER, R. Effect of maximum loads for each of ten repetitions on strength improvement. *Res. Q.* 38:715–718. 1967.
- 9. BERGER, R. Effects of strength improvement on accuracy in a gross motor task. *Am. Correct. Ther.* 27. 1973.

- HOFFMAN, B. 1962 Senior National AAU Championship. Strength Health. September 13, 1962.
- 11. HOFFMAN, B. Best seniors ever. Strength Health. October 18, 1963.
- 12. Interview with Richard Berger. June 24, 2001.
- 13. RADER, P. Contest results. Iron Man Lift News. 6(8):6. April 1960.
- TODD, J., AND T. TODD. Significant events in the history of drug testing and the Olympic movement: 1960–1999. In: *Doping in Elite Sport: The Politics of Drugs and the Olympic Games.* W. Wilson, ed. Champaign: Human Kinetics, 2001. pp. 65–128.
- 15. TODD, T. The history of resistance exercise and its role in United States education. Doctoral dissertation, University of Texas at Austin, 1966.
- TODD, T. Al Roy: Mythbreaker. Iron Game History. 2 January:8– 11. 1992.
- 17. TODD, T. The myth of the musclebound athlete. *NSCA Journal*. 7(3):37–41. 1985.