

## SCIENCE FROM STRENGTH: THOMAS L. DELORME AND THE MEDICAL ACCEPTANCE OF PROGRESSIVE RESISTANCE EXERCISE

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On 26 February 1944, Dr. Thomas Lanier DeLorme reported for duty at Gardiner General Army Hospital in Chicago. DeLorme, a newly commissioned lieutenant in the Army's Medical Corps, was assigned to the Orthopedic Section at Gardiner, a hastily-created military hospital in what had been the Chicago Beach Hotel before the Army commandeered it.<sup>1</sup> Gardiner, filled to overflowing with wounded servicemen, was DeLorme's first posting as a full-fledged physician following his early graduation in April 1943 from New York University's College of Medicine (NYU) after the school decided his class could skip their last two months of medical training because of the war effort.<sup>2</sup> DeLorme received the Valentine Mott Award at graduation that spring, then served a short internship in New York before joining the Army Medical Corps on 1 January 1944. According to his wife, Eleanor Pearson DeLorme, whom he married in 1941, DeLorme had hoped to be assigned to a tank regiment overseas but was ordered to Chicago instead. However, in a perfect example of Merton's "Law of Unintended Consequences," that military directive would change the course of modern rehabilitation and help to create the science of strength training.<sup>3</sup>

After DeLorme began working at Gardiner in February he quickly realized that it was not a shortage of physicians that was primarily responsible for the enormous backlog of orthopedic patients at the hospital. Instead, according to DeLorme, the "urgent need" was to find a faster method to rehabilitate the patients so that



**Thomas L. DeLorme, in 1975, then a professor of orthopedic surgery at Harvard University's medical school.**

their beds could be made available to other soldiers who had also been injured in the war.<sup>4</sup> It was common during this era for rehabilitation patients to sometimes spend six to nine months in post-operative therapy, which meant that Gardiner and other military hospitals were filled to overflowing with long-term patients.<sup>5</sup>

Not long after he arrived in Chicago, DeLorme met Sergeant Thaddeus Kawalek of the Army Specialized Training Program, an elite unit being prepared to help Europe recover after the war. Kawalek, who was studying Russian at the Army's request, had suffered a non-combat knee injury and come to Gardiner Hospital where he subsequently had surgery. Although DeLorme was not originally assigned as his surgeon, Kawalek had noticed DeLorme's "solid, well developed" physique and was not surprised to learn, when they met post-operatively, that DeLorme was a regular weight trainer, just as he was. Kawalek had become a convert to lifting because of his love of sports; lifting, he said, had allowed him, despite his relatively small stature, to throw the shot in college, to participate in wrestling, and to be a sprinter on his college track team.<sup>6</sup>

As they shared stories about lifting, DeLorme told Kawalek of an idea he'd had. He'd been wondering, he explained, whether weight training could be used to rehabilitate injuries. According to Kawalek, DeLorme said he knew the idea went against all conventional therapeutic methods. Even so, DeLorme told Kawalek, he kept thinking that lack of strength was a major factor in slowing many men's recovery from injury.<sup>7</sup> After talking about it at length, Kawalek volunteered to allow

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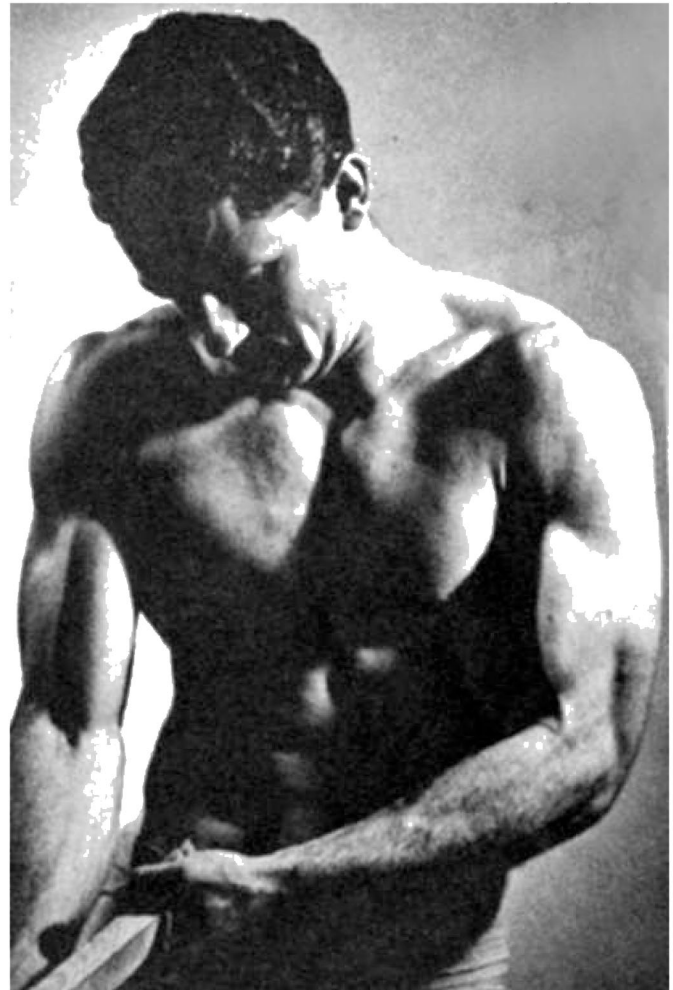
DeLorme to experiment on him. He later claimed, “I think it was because I had experience with weight training before I had my injury that he agreed to let me do it even though neither of us was certain it would work.”<sup>8</sup>

The program DeLorme designed to strengthen Kawalek’s knee primarily consisted of leg extensions using “iron boots”—a device sold by the York Barbell Company that resembled a thick iron shoe sole through which a small bar could be inserted and loaded with plates to increase resistance. Kawalek used the boots by sitting on the end of an examining table and extending his leg until it was parallel to the floor—and he also did some light work with pulleys. The results exceeded both their expectations. Kawalek recuperated much more quickly than normal patients at Gardiner who had similar knee surgeries; he not only regained full use of the leg, he could even run again. Kawalek, who later became president of the Chicago College of Osteopathic Medicine, reported that DeLorme’s superiors at Gardiner were very impressed by the rapid results and encouraged DeLorme to experiment with weighted exercises on other patients.<sup>9</sup>

While many American servicemen were introduced to weight training as part of their physical conditioning during World War II, the fact that DeLorme had been active in weightlifting was unusual in medical circles.<sup>10</sup> Most physicians in that era shared the views of widely-syndicated newspaper columnist Dr. William Brady, who advised that weightlifting should be shunned because “extreme effort is not desirable in any kind of physical training nor is it good for the heart.”<sup>11</sup>

DeLorme, however, knew from first-hand experience that weight training could be curative. Born in 1917, DeLorme attended high school in Birmingham, Alabama, where he was stricken with rheumatic fever and ordered to bed by his doctors.<sup>12</sup> Rheumatic fever, now relatively rare because of the advent of antibiotics, is an inflammatory disease brought on by strep throat or other streptococcus bacterial disease. In the 1930s and 1940s, there was an epidemic of rheumatic fever in the United States, and it was not uncommon for children to die, or at the least, suffer lasting cardiac damage because of the disease’s impact on heart function.<sup>13</sup>

For four months DeLorme was confined to bed rest, during which he dropped to less than 140 pounds, wasted by illness and lack of exercise.<sup>14</sup> However, as he lay in bed, following the best advice his doctors knew to give him, DeLorme began reading about medicine and



In 1940 the *Collegiate Digest*, a nationally syndicated weekly newspaper supplement, dedicated half a page to the exploits of the man they dubbed the “Bama Hercules.” This interesting physique study from that photo shoot reveals just how strongly built DeLorme was at this time.

resolved to go to medical school so he could help others once he was well again. He also spent time during his enforced bed rest reading *Strength & Health* magazine, and in those pages he found inspiration to fight the doctors’ pronouncement that his “weakened heart” would never permit him to do anything strenuous again.<sup>15</sup> “I was determined to prove the medicos wrong,” DeLorme later claimed, “and immediately upon leaving my sick bed I started a comeback campaign.”<sup>16</sup>

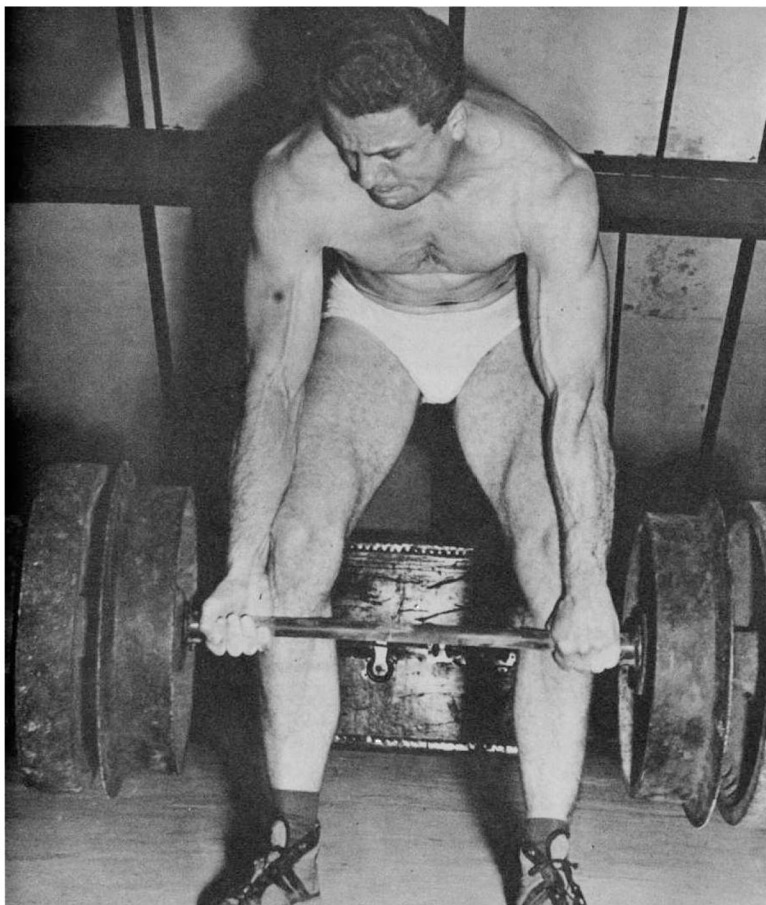
Like many young men in the Great Depression, DeLorme lacked the funds to purchase one of the York barbell sets he’d admired in the pages of *Strength & Health*. However, he proved to be a good junkyard scrounger and created his own weights out of small train



wheels and other mechanical parts.<sup>17</sup> By the end of 1936, not only was DeLorme engaged in regular and strenuous exercise against his doctor's advice, he was also competing in sanctioned weightlifting competitions, and registered a personal best of 250 pounds in the clean and jerk.<sup>18</sup> He was also credited with a 240-pound bent press, a 160-pound curl, and alternate dumbbell presses with 125 pounds in each hand.<sup>19</sup> As he continued training, DeLorme became increasingly serious about his workouts and told a reporter in 1939, "I have reached a mark of lifting 503 pounds of deadweight from the floor, which exceeds the Birmingham Y.M.C.A. record by 43 pounds. . . . I hope to win the Southern A.A.U. Championships and attain a raise of 700 pounds and then possibly go on to compete in the International Olympic Games."<sup>20</sup> While World War II would end his Olympic dreams, DeLorme enjoyed modest fame as a lifter within the state of Alabama. A front-page article in *The Birmingham Post*, in July of 1939, detailed DeLorme's use of weight training to recover from rheumatic fever, and according to the author, Bob Collins, "Today he is a picture of near-perfect in masculine build. . . . There isn't a sick tissue or organ in his body and instead of lying in bed and staring into a hopeless 'to be,' he now stands firmly on the foundation of a strong body, and looks toward a bright future."<sup>21</sup>

DeLorme's bright future began with his admission in the fall of 1939 to the University of Alabama's Medical School in Tuscaloosa. As he worked for his tuition money by waiting tables and helping with janitorial duties, DeLorme continued his heavy workouts and became so well-known for his strength that he was invited to give a lifting demonstration at halftime during one of the University of Alabama football games. In front of the crowded stands, he lifted the front end of a truck off the ground, using the same strong back muscles that had allowed him to deadlift more than 500 pounds.<sup>22</sup> One local newspaper dubbed him the "Bama Hercules," and claimed he "lacks only a leopard skin sarong to go to work as a circus strongman, for he can really tote a bale."<sup>23</sup>

By this time, DeLorme not only *was* strong, he *looked* strong. At just over six feet in height, he tipped the scales at 185 pounds, and photos from this era reveal



DeLorme was built well for the deadlift with relatively long arms and legs as seen in this photograph from the *Collegiate Digest*. However, the fact that he could deadlift over 500 pounds on this non-revolving, short-handled, barbell made from old narrow-gauge train wheels and other scrounged parts is nothing short of remarkable.

that he had built a remarkably lean, symmetrical physique along the lines of Tony Sansone. One newspaper account claimed, in fact, that he worked his way through his undergraduate years at Howard University by "modeling his perfect physique," and that he hoped to go to New York City during the summer of 1940 to see if he could find work modeling.<sup>24</sup>

At the end of his first year in Tuscaloosa, DeLorme transferred to NYU's Medical School where he excelled academically. Eleanor, his wife, reported that he could also have gone to Harvard, but chose NYU because he wanted to experience life in New York. There, he continued lifting weights, she claimed, because "He always worried about being too thin."<sup>25</sup>

DeLorme's second test of weight training as a rehabilitation technique began when Sergeant Walter Easley of Lake Charles, Louisiana, appeared in his door-



way one day to discuss the knee he had injured in a parachute jump. The impact upon landing had ruptured both Easley's anterior cruciate and medial collateral ligaments. Easley had been at Gardiner for more than six months when he met DeLorme, and while there he had followed the standard rehabilitation protocols then in use.<sup>26</sup> Before DeLorme arrived at Gardiner, physical therapy protocols generally consisted of rest, heat, and various exercises using a high number of repetitions with little to no resistance. Pennsylvania University professor R. Tait McKenzie, the first professor of physical therapy in the United States, advised, for example, in his 1923 book: "Exercises . . . should never be continued beyond the point of moderate fatigue, and some of them should be given with resistance."<sup>27</sup> McKenzie's idea of proper resistance clearly was to use very light weights. When free-weight or pulley exercises were utilized, patients were instructed to focus on the rhythm of the movement; the goal was a pumping effect of blood through the muscle, not hypertrophy. Similarly, another early volume on physical therapy, *Physical Therapeutic Technic*, warned, "in all treatment, care should be taken not to overtire the weakened muscles."<sup>28</sup> In order to avoid such "overtiring," clinicians were advised that there should be "a short rest" between repetitions and that "the exercises should be stopped at once on any sign of muscular tire."<sup>29</sup> The modern strength training practitioner can appreciate that, while better than complete rest, these rehabilitation protocols produced only minimal strength gains and, in all likelihood, did little to shorten periods of disability. Consequently, rehabilitation progressed much more slowly than in our modern era, and during World War II, veterans' hospitals were overwhelmed with hundreds of slowly-recovering orthopedic patients.

Easley was one of those patients. Although he'd participated religiously in the exercises recommended by his therapists, he told DeLorme that his doctors held out no hope of him ever returning to normal, and that he would have to wear a brace for the rest of his life. A farmer by profession, Easley knew the difficulties he would face working in a knee brace, and so he asked DeLorme if there was anything else he could try to improve the condition of his knee.<sup>30</sup> After examining Easley and noticing how atrophied the quadriceps muscle was on the injured leg, DeLorme told him about his theory that exercise with heavier resistance might be able to strengthen the muscles surrounding the knee to such an extent that the knee would be more stable.

Easley, facing life in a leg brace, knew he had nothing to lose, and so asked to try it. Accordingly, DeLorme set up an exercise room in the hospital and personally supervised Easley's training sessions. There were, of course, no weights or resistance machines at Gardiner, so DeLorme brought in his iron boots from home and pulled together some other odds and ends of equipment to create apparatus suitable for Easley's training therapy.<sup>31</sup>

Although it involved weight training, the routine DeLorme prescribed for Easley did not resemble a competitive weightlifting sets and reps protocol. DeLorme kept the number of repetitions relatively high, but Easley was instructed to lift the maximum amount of weight he could handle for seven sets of ten repetitions in each exercise and then to increase the resistance as he mastered the weight for the seven sets of ten.<sup>32</sup> With iron boots attached to his feet, Easley did leg extensions, and with primitive pulleys to let him exercise the knee through other ranges of motion, which included leg curls, he also did 70 repetitions on those exercises. Within a month, Easley saw significant improvement in the size of his quadriceps, and all the swelling and pain completely disappeared. At that point, Easley put aside his brace, DeLorme wrote, because "for all activities, even 'jitterbugging,' the knee was normal."<sup>33</sup>

As news spread about Easley's seemingly miraculous cure, other Gardiner patients who, like Easley, had lost hope that they would ever again regain normal function were eager to try DeLorme's new weight training program. And so, after gaining the permission of his commanding officer, Colonel John Hall, DeLorme began using what he was then calling "Heavy-Resistance Exercises" on other patients, and set up a true clinical trial of his new method. He took twenty men who had completed the conventional physical therapy program at Gardiner yet had not been returned to normal function. DeLorme put these men on a progressive resistance regimen and found that all twenty made significant gains in muscular strength and improved the functional use of their joints after following the heavy-resistance program. In his discussion of this early experimental work in the prestigious *Journal of Bone and Joint Surgery*, DeLorme pointed out that the key weakness of existing rehabilitation protocols was the narrow focus on restoring muscular endurance. The conceptual breakthrough driving his work, he explained, was that, "Rather than attempt to develop endurance in an atrophied, weakened muscle, it



seems more logical to restore muscle strength to normal, and then to build endurance.”<sup>34</sup> This observation would be borne out by later research and is now the standard order of progression in modern rehabilitation protocols.<sup>35</sup>

As the number of patients interested in his methods grew, DeLorme began training several assistants to help with the weight training treatments, one of whom was Private Easley. DeLorme later wrote that Easley had demonstrated “a rare degree of conscientiousness and faithfulness of purpose not only in overcoming his personal handicap, but also in helping other patients who later were to be entrusted to his care when he became an instructor in progressive resistance exercises in the physical therapy department of the Gardiner General Hospital.”<sup>36</sup> Another man enlisted to help with the training sessions was bodybuilder John Farbotnik, also at Gardiner to rehabilitate a combat injury. Farbotnik, who later won the 1950 Mr. America title, proved to be a terrific asset to the program at Gardiner and, according to *Strength & Health* magazine author Owen Lake, helped DeLorme with building equipment, implementing his training ideas, and running many of the exercise sessions.<sup>37</sup>

During 1945, DeLorme was promoted to captain and talked his superiors at Gardiner into allowing him to build a much larger physical therapy facility at the hospital, half of which was set aside for DeLorme’s heavy weight training methods. To outfit this new space, DeLorme took on the task of building much of the equipment for the room personally, and one of the first ideas he began experimenting with was for a multi-station exercise “table” equipped with pulleys. This device, still in use today, became known as the DeLorme Table and subsequently the “Elgin Table,” when a commercial concern began mass manufacturing them in the late 1940s for other physical therapy clinics.<sup>38</sup>

Well before Universal or Nautilus, DeLorme’s vision was to create an exercise machine that could work the entire body. The DeLorme Table had pulleys for leg extensions and leg curls, could function as a leg press, and was even fitted with pulleys for a variety of chest and shoulder exercises. DeLorme also began developing a series of “counterweight” machines that worked on the same principle as our modern assisted dip and pull-up machines, because he realized that some injuries left the muscles so weak that they couldn’t handle the weight of the limb to which they were attached. The new physical

therapy facility at Gardiner, in fact, rivaled many gyms of the modern era as it had dumbbells, barbells, and a free-standing leg press machine that could be loaded to 300 pounds.<sup>39</sup> Colonel John Hall wrote of DeLorme’s efforts in this period: “After many months of trying work, Captain DeLorme developed the section to maximum operating efficiency. A great number of patients are now handled. It is the opinion of the staff of this hospital and of the many visiting consultants that Captain DeLorme has placed in the hands of the Orthopedic Surgeon a new and valuable agent in promoting full recovery and restoration of function.”<sup>40</sup>

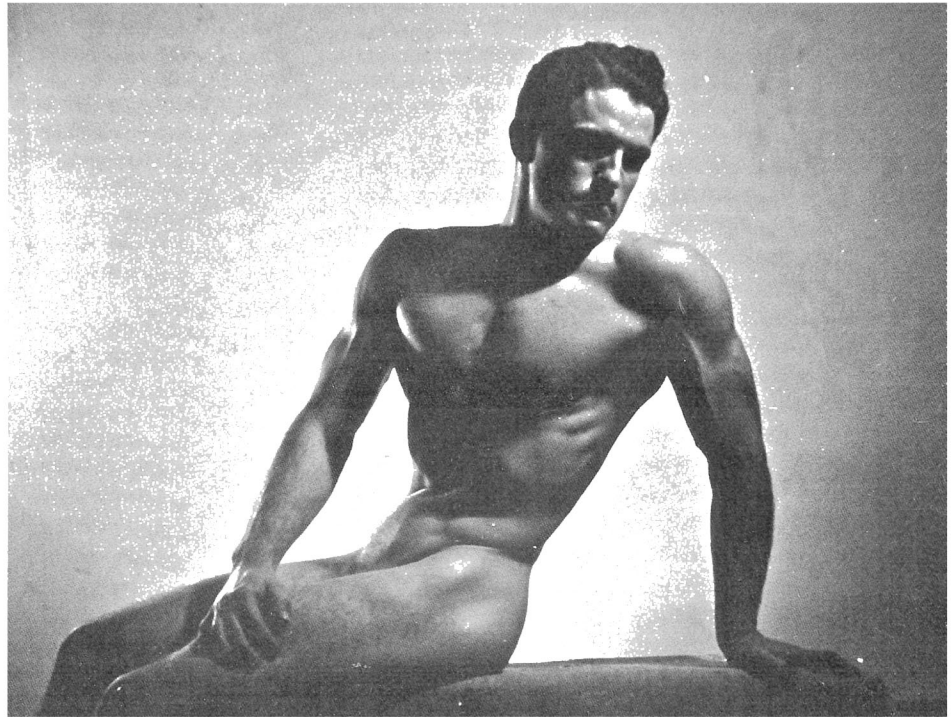
In May of 1945, DeLorme travelled to Battle Creek, Michigan, and gave a presentation on the work he was doing on heavy resistance exercise at Gardiner. The doctors and physical therapists attending the small conference at Percy Jones Military Hospital, all also members of the Armed Forces, were so impressed by what they heard that day that as soon as the conference finished, the entire group made their way to Chicago so they could see DeLorme’s methods for themselves. This would be the first of many visits by American, British, Canadian, and even Australian, medical personnel who came to Gardiner to learn DeLorme’s new methods of rehabilitation as the war began to wind down.<sup>41</sup>

In October of 1946, in *Archives of Physical Medicine*, DeLorme published his second scientific paper, the simply titled, “Heavy Resistance Exercises.” In it, DeLorme describes how to determine a patient’s one repetition max (1RM) and 10 repetition max (10RM), and he also discusses the effect of his heavy weight exercise program on the more than 300 patients he’d treated over the past 18 months. Explaining the basic concept of the methodology, DeLorme wrote, “Most injuries of the trunk and extremities result in atrophy of varying degree. When the local injury has healed, redevelopment of muscle power is the most important factor in restoring normal function to the extremity.” Continuing, DeLorme explained that the principle of heavy resistance and low repetition exercise was better for developing muscular power than such exercises as stationary bicycling and stair climbing, which primarily build endurance. “Rather than to attempt to develop endurance in an atrophied, weakened muscle,” he explained, “it seems more logical to restore muscle strength to normal and then to build endurance by means of low resistance, high repetition exercises.”<sup>42</sup> As to those doubters who worried that he was asking too much



of weakened muscles, DeLorme unequivocally wrote, “even extremely atrophied muscles should exert their maximum effort at regular intervals.”<sup>43</sup> DeLorme also addressed the idea of the specificity of exercise in the article and argued that exercises should be classified according to the “quality developed in the exercised muscle—namely power, endurance, speed and coordination.” Noting that there was some crossover, and that exclusively using power exercises also results in some improvement in coordination and endurance, DeLorme nonetheless warned of the need for educated professionals who can understand and discriminate between the different kinds of exercise and the effects they will create. And he prophetically speculated in his conclusion, “Although this program of exercise was developed primarily to expedite the recovery of injured soldiers in the war, there is a definite civilian need for a similar program.”<sup>44</sup>

DeLorme left Gardiner Hospital on 28 August 1945, following a visit from representatives of the Surgeon’s General Office who subsequently issued an order to all Army therapists to begin using DeLorme’s Heavy Resistance protocol with their orthopedic patients. At roughly this same time, Colonel Hall, the commanding officer at Gardiner General Hospital, recommended him for the Legion of Merit, citing DeLorme’s courage and innovation, the long hours of personal time he had spent creating the Elgin Table and other equipment, his training of other men to be technicians who could assist with the training sessions, and the fact that his work was revolutionizing military rehabilitation. Hall concluded his letter by stating, “Captain DeLorme’s interest and his untiring effort in applying his ideas and in developing his program have proven to be of great benefit to the Army Reconstruction program, in lessening the period of convalescence and in permitting many cases to return to duty more quickly, and others to receive maximum hospital benefits over and above those previously



This study of DeLorme, courtesy of Eleanor DeLorme, his wife, was taken in approximately 1939. As can be seen, DeLorme had a lean, elegant physique with an exceptionally small waist.

expected.”<sup>45</sup> In awarding the medal to DeLorme on 4 December 1945, President Truman cited the fact that “Captain DeLorme’s efforts and achievements reflect highest credit upon himself and the Medical Corps.”<sup>46</sup>

Although World War II officially ended in September of 1945, interest in DeLorme’s system continued to spread throughout the medical and military communities. On 21 June 1946, for example, Army Lieutenant Dorothy Hoag gave a talk on the DeLorme system at the 23<sup>rd</sup> Annual Conference of the American Physio-Therapy Association. Hoag, a registered physical therapist, was filled with praise for the DeLorme method, which she argued would not only strengthen the afflicted muscle groups but would also break down scar tissue and increase flexibility in the joint.<sup>47</sup> That same year, Sara Jane Houtz, Annie M. Parrish, and F.A. Hellebrandt published the results of their research with the DeLorme method in *The Physiotherapy Review* using as their subjects 16 healthy women, aged 25 to 48. These “normal” women followed DeLorme’s procedure to the letter, exercising for five days straight and then taking two days off. The women did approximately 70 repetitions in the biceps curl and leg extension during four of the training sessions and on one day a week tested themselves to determine their limit for ten repetitions to decide what





This photograph of DeLorme testing a patient's knee was used as an illustration of how NOT to test knees in his groundbreaking book titled *Progressive Resistance Exercise: Technic and Medical Application*, published in 1951.

weight to use in the following week. At the end of the study the researchers concluded, "Strength may more than double in four weeks of systematic training," and speculated that—in addition to increasing muscular strength—that strength training seemed to also help the women with their non-sedentary jobs. Although they were not sure of the physiologic mechanisms at work, they discussed the possibility that lifting must impact motor learning and, further, that it seemed to create a "significant extension of the psychological end-point of fatigue."<sup>48</sup> What's more, the Navy began using the system at its hospital in Jacksonville, Florida, in late 1945, and a report on that work appeared in *The Physiotherapy Review* in 1947.<sup>49</sup> And in the popular bodybuilding magazine *Muscle Power*, exercise physiologist Phillip Rasch wrote a lengthy report on DeLorme's work and its impact on the scientific community entitled, "In Praise of Weight Training: The Medical Profession is Waking Up!"<sup>50</sup>

After leaving Gardiner and the Army in the fall of 1945, DeLorme moved to Boston where he was appointed as Baruch Fellow in Physical Medicine at Massachusetts Institute of Technology. He also began an affiliation with Massachusetts General Hospital, the

teaching and research hospital affiliated with Harvard University's Medical School, which would last for more than 40 years.<sup>51</sup> For the next several years, the majority of the subjects DeLorme worked with, however, were not injured servicemen but victims of poliomyelitis, the crippling illness that became an epidemic in the 1940s and 1950s. DeLorme's interest in polio had begun at Gardiner when several servicemen were admitted with the disease. DeLorme reasoned that since not every muscle fiber in an individual muscle was generally affected when the disease struck, strengthening the few unaffected fibers might enable polio patients to regain some degree of function. DeLorme's hunch again proved correct, and the impressive results created by resistance training for his polio patients brought DeLorme to the attention of Henry Pope Sr., who founded the Pope Foundation in 1934 to promote research on polio after his own daughter developed the disease.<sup>52</sup>

With financial support from the Pope Foundation, DeLorme set up a study to test his heavy weight exercises on 30 polio patients while still at Gardiner. The successful results of that work brought him to the attention of Dr. Arthur Watkins, head of the newly formed Department of Physical Medicine at Massachusetts General Hospital, who invited him to move to Boston so they could conduct research together.<sup>53</sup>

Once in Boston, DeLorme and Watkins, with additional funding from the Pope Foundation and the March of Dimes, opened the Pope Memorial Exercise Clinic and continued exploring the use of resistance exercise in polio patients.<sup>54</sup> By this time, polio had become an international epidemic and the popular press was eager to report news of any possible therapies. In January of 1947, the *Daily Boston Globe* ran a lengthy feature article detailing the amazing results DeLorme had achieved by using resistance exercise with 40 polio patients. DeLorme is described in the piece as a "powerful 212-pounder" who had developed a series of machines so that muscles could be stressed individually, resulting in a therapeutic facility that looked, the author claimed, "like a well-equipped gymnasium."<sup>55</sup>

On 17 June 1947, DeLorme and his new col-



leagues presented a paper to the American Neurological Association in Atlantic City that resulted in another extensive report, this one in the New York *Herald Tribune*.<sup>56</sup> And then, in September, DeLorme and resistance training made the news again, following the presentation of a paper delivered to the American College of Surgeons in New York. DeLorme told the assembled physicians that his new method was “based upon centuries-old maxims of weight-lifting and is in direct contrast to principles previously used.” He then went on to explain that although his study was not yet complete, he felt comfortable asserting that the evidence collected to date indicated “that normally innervated muscle fibers can be hypertrophied and strengthened.”<sup>57</sup> In 1948, DeLorme and his colleagues spoke at the first international conference on poliomyelitis and made national headlines once more when they demonstrated to the assembled experts the resistance training techniques they had been using with their patients in Boston. At the conference, held at the Waldorf Astoria Hotel in New York, DeLorme and Watkins showed a new version of the counter-weighted pulley machine that DeLorme had first invented at Gardiner, and told the audience that “as long as there are healthy muscle fibers left,” it was possible “to double their power in a few weeks by a few minutes of this method of exercise.” What this meant for polio patients, the reporter optimistically explained, was that some of them might be able to discard their crutches or braces even if they’d been afflicted years earlier.<sup>58</sup>

By this time, DeLorme had substantially changed his ideas about the most efficacious method of training. In an article for the *Archives of Physical Medicine and Rehabilitation* entitled, “Technics of Progressive Resistance Exercise,” DeLorme explained that he would no longer be referring to his method as “heavy resistance exercise,” because the term “bears false implications” and suggests that “only great poundages are used.” From this point forward, DeLorme announced, he would refer to his system as “Progressive Resistance Exercise,” a statement that marks the first time weight training activities were described by that title in any scientific journal. Surprisingly, the term was coined not by Thomas DeLorme, but by his wife, Eleanor, who suggested it when DeLorme expressed concern that so many physicians seemed uncomfortable recommending “heavy weightlifting” to their patients.<sup>59</sup>

DeLorme’s “Technics of Progressive Resistance Exercise” also heralded another significant change for

the field of strength training. Instead of continuing to recommend seven sets of ten repetitions in each exercise, DeLorme explained that he and Watkins had been experimenting with fewer sets. “Fewer repetitions,” DeLorme noted, “permit exercise with heavier muscle loads, thereby yielding greater and more rapid muscle hypertrophy.”<sup>60</sup> The new model they recommended was three sets of ten. One set was to be done at 50% of the patient’s 10RM, one at 75%, and finally one at 100% of 10RM. Once a patient could perform more than ten repetitions on the final set, the weights were “progressed” accordingly. DeLorme further explained that this method allowed the muscle to be properly “warmed up” before being asked to exert maximum power for ten repetitions. Although this article was written to help health practitioners use strength training techniques in the fight against polio, the new three sets of ten model quickly moved beyond rehabilitation and became a “norm” for fitness and sport training as well. In fact, one recent online article describing the overwhelming prevalence of the model of three sets of ten aptly described DeLorme’s protocol as “permanently etched into the collective subconscious of the fitness community.”<sup>61</sup>

In the years that followed, DeLorme and his colleagues at Massachusetts General Hospital published several additional studies that helped promote the scientific acceptability of progressive resistance exercise. In 1948, “The Response of the Quadriceps Femoris to Progressive Resistance Exercises in Poliomyelitic Patients,” reported that training with iron boots using three sets of ten had resulted in more than half of their polio patients doubling their strength in less than a month.<sup>62</sup> In 1949, “The Use of the Technique of Progressive-Resistance Exercise in Adolescence” appeared, in which DeLorme and his colleague, Roswell Gallagher, lent support to the idea of using weight training to prepare for sport. “It is obvious to most of us who deal with adolescents,” they wrote, “that strength needs to be developed as well as endurance, coordination, flexibility, and skill; and that if injuries are to be avoided, some games demand considerable strength about the joints.” Continuing, they argued that, “most activities will be performed more successfully and with less fatigue when greater strength and endurance are present.”<sup>63</sup> In 1950, DeLorme released a report based on his earlier work at Gardiner on 201 patients suffering from both knee injuries and leg fractures in which, again, progressive resistance exercise provided more therapeutic effectiveness than less stren-



uous methods.<sup>64</sup>

DeLorme and Watkins then released, in 1951, one of the most important books in the history of strength training: *Progressive Resistance Exercise, Technique and Medical Application*. Published by the well-regarded academic publisher Appleton-Century-Crofts in New York, the book introduced thousands of American doctors, therapists, and physical educators to the idea that weight training had a solid, scientific basis and, further, that it had the blessing of some of the most prestigious medical physicians in America.<sup>65</sup> Exercise physiologist Phil Rasch, however, rightfully points out that what DeLorme and Watkins were recommending was precisely what some in the weightlifting community had been trying to tell the medical establishment for the previous quarter century. “We do not begrudge Dr. DeLorme the credit which he so richly deserves,” Rasch wrote, but it does seem that somewhere there might have been found space for mention of such names as Liederman, Calvert, Berry, Jowett, Hoffman and perhaps other pioneers who so long preached the exact dogma for which Dr. DeLorme is now praised. Now at long last the medical profession has caught up with the weight trainers.”<sup>66</sup>

Even so, DeLorme had done more than just “catch up” with the likes of Bob Hoffman and other pioneers. His understanding of muscle function coupled with his practical knowledge of weight training allowed him to go further than Hoffman and others had at this point, and to create an exercise system that would enhance muscle growth and strength in nearly everyone who tried it. In comparison, the same year that *Progressive Resistance Exercise* appeared, Hoffman encapsulated his advice on proper training in a course entitled, *York Advanced Methods of Weight Training*. In his course, Hoffman includes no discussion of warming up, no testing to determine 1RM, and the advice he gave regarding the organization of training was, “. . . the bodybuilder usually begins with 6 repetitions of a weight he can correctly handle, rest[s] the next day, then increase[s] the repetitions to 7, then 8, rest[s] a day, then 9, etc. When the maximum number of repetitions is reached, usually 12 to 15, add 5 pounds for upper body movements, 10 pounds for lower body movements, reduce the repetitions to 6 and start the single progressive system again.”<sup>67</sup> There is no discussion of how many sets to do per exercise.

One of the most significant articles to come out

of this phase of his work at Massachusetts General Hospital was his 1952 article in *Archives of Physical Medicine* entitled, “Effect of Progressive Resistance Exercise on Muscle Contraction Time.” DeLorme undertook the study, he explained, because Progressive Resistance Exercise was being widely used in physical therapy programs at this time yet almost no one had undertaken studies of its true physiologic impact. Except for exercise physiologist Peter Karpovich at Springfield College and masters student Edward Chui at the University of Iowa, almost no one in exercise science circles was paying attention to the physiology of strength in this era even though—as DeLorme noted in his introduction—knowing whether heavy exercise “slows [athletes] down,” “throws [their] timing off,” and makes them “muscle bound” should be of great interest to trainers and to coaches of athletes as well as to athletes themselves, dancers, and anyone else “whose efficient performance is dependent upon rapid movement.”<sup>68</sup> In findings that will hardly surprise contemporary readers, DeLorme and his colleagues found no evidence after four months of training that progressive resistance exercise adversely affected contraction time, even though the trained muscles significantly hypertrophied.<sup>69</sup>

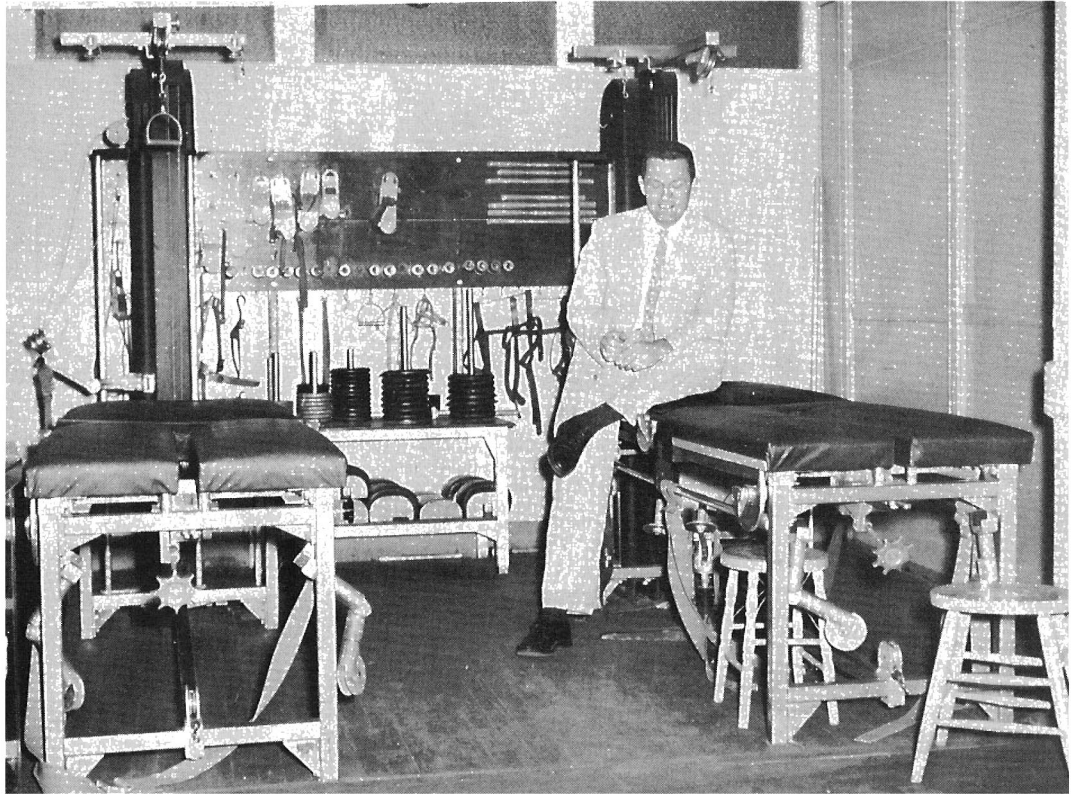
Following this article, DeLorme appears to have shifted his research focus away from resistance exercise. He first looked at fatigue in two studies that appeared in the early 1950s, and then he participated as part of a team investigating wrist injuries in the military.<sup>70</sup> Later, he also published “Ergograms, Electronic and Voluntary in Various Neurological Disorders,” in 1955.<sup>71</sup> During these years, according to his wife, Eleanor, DeLorme began working more as an orthopedic surgeon in private practice, and in 1958 he decided to become the Medical Director of the Liberty Mutual Insurance Company’s research laboratory.<sup>72</sup> Liberty Mutual Insurance was one of the primary providers of workmen’s compensation insurance in the United States at that time, and the company decided that it should invest in research designed to help employees get back to work following injuries.<sup>73</sup> According to Dr. Melvin Glimscher, one of DeLorme’s colleagues at Massachusetts General, the Liberty Mutual Research Center in Boston set new standards in rehabilitation care and research. While working there and continuing his medical practice, DeLorme became particularly interested in patients whose limbs had been accidentally amputated, and he began working on the question of whether such limbs could be reattached. The



first step in this process was to find a way to keep the limb viable, and so DeLorme began a series of experiments to find the best method of keeping limbs alive through blood perfusion and other means.<sup>74</sup> According to Eleanor, the police in Boston had standing orders to bring to DeLorme any limbs they recovered from accidents, and he often used his own blood for the experiments.<sup>75</sup> Glimscher wrote of this work, “To explore this, and to have the strength and dedication to spend so many hours, at all hours of the day and night . . . was unbelievable. I often went to the lab to see him and

see how he developed the techniques which, in time, the general surgeons eventually came to utilize to sew back entire upper extremities.”<sup>76</sup> Again, DeLorme’s research transformed the world of medicine. In 1962, because of his work, doctors at Massachusetts General Hospital performed the first successful limb reattachment in history when they reattached the arm of a 12-year-old boy that had been run over by a train.<sup>77</sup> Several years later, DeLorme assisted Melvin Glimscher and other scientists from Massachusetts Institute of Technology and Harvard’s Medical School in developing what became known as the Boston Elbow, the first prosthetic device able to read electromyographic signals from the skin’s surface and use that data to control the speed and direction of the artificial limb.<sup>78</sup>

Although DeLorme’s primary research interests gradually shifted to more medical matters, he agreed to collaborate in 1962 with Frank Sills and Laurence Morehouse on the editing of *Weight Training in Sports and Physical Education*, a textbook for physical educators and coaches published by the American Association for



This photo, from the June 1959 issue of *Strength & Health*, shows DeLorme sitting on one of the tables he designed to assist in the rehabilitation of soldiers during World War II. The tables, later manufactured under the brand name “Elgin Tables,” were actually multi-station resistance training machines with a variety of pulleys attached to them.

Health, Physical Education, and Recreation (AAHPER). The book contained 14 chapters and included an article on the history of weight training by Phillip Rasch, Laurence Morehouse’s “Principles of Weight Training,” F.A. Hellebrandt’s “Scientific Basis of Weight Training,” and additional chapters on training for women and girls, training for adolescents, training in high schools, training and safety issues, and so on. In addition to editing the volume, DeLorme contributed the chapter entitled “Measurement and Evaluation of Weight Training,” which describes how to conduct a 1RM strength test, and how to use other metrics needed by coaches and trainers. AAHPER’s involvement in the publication of this textbook marked a new level of academic acceptance for strength training, and one of the most interesting sections of the book is the discussion of how strength training programs were then being employed at five prominent American universities.<sup>79</sup>

After moving to Boston in 1946, DeLorme made up for some of the medical training he had been denied by the war effort and took advantage of Massachusetts



General's relationship with Harvard Medical School. He studied neurology and surgery there, and he also did residencies at Children's Hospital in Boston and the West Roxbury Veteran's Hospital.<sup>80</sup> Orthopedic surgery became DeLorme's medical specialty in the later years of his career, and he is credited in that field with several innovations in spinal surgery for ruptured discs, as well as for having participated in the development of an artificial hip.<sup>81</sup> According to Eleanor, DeLorme developed an immense practice as an orthopedic surgeon, working from both Massachusetts General Hospital and, later, from Milton Hospital in Milton, Massachusetts, where he and Eleanor raised their three sons, Tom, Charles, and Stuart. DeLorme became head of the staff at Milton Hospital in 1975 and in the newspaper story describing his election as president, it notes that by this time he was also a professor of orthopedic surgery at Harvard Medical School.<sup>82</sup>

According to DeLorme's second son, Charles, who began training with his father at age 11, DeLorme remained a serious lifter throughout his life. In the basement of their home in Milton, they had a gym with more than 3000 pounds of weights, flat and incline benches, squat racks, dumbbells ranging from 20 to 85 pounds in weight, and one of the first Elgin Tables ever manufactured. They also, Charles reported, had an old desk turned on its end that they used as a dipping station, and he remembers seeing his father do dips with 150 pounds attached to his body on several occasions. Dips, according to Charles, were one of DeLorme's favorite exercises and he continued doing them as part of an overall program of weight training well into his seventies.<sup>83</sup>

Eleanor DeLorme also went on to have a distinguished career in academic circles. After remaining at home during her children's early lives, she enrolled at Wellesley at age 52 and then did graduate work at Harvard in Art History. She subsequently taught at Wellesley for more than 25 years, and is widely recognized as an authority on Napoleonic France.<sup>84</sup> After 1960, the DeLormes frequently travelled to France to allow Eleanor time for her own research, and they eventually owned a second home there. Together they collected antiques from the French Empire period that were shipped home to Massachusetts, and they visited the sites where Napoleon and his court lived two centuries ago. These travels resulted in Eleanor's first book, *Garden Pavilions and the Eighteenth-Century French Court*, for which their son, Tom DeLorme, took most of the pic-

tures. Her travels throughout France inspired her to continue working on this historical era, and in the years since that first trip, she has published two additional books and many papers on Napoleonic France.<sup>85</sup>

It is interesting to speculate where the field of strength training might be today had Thomas DeLorme not been sent to Gardiner General Hospital during World War II. Thomas Kuhn's seminal work, *The Structure of Scientific Revolutions*, argues that paradigm shifts in science generally take about a generation to be fully embraced by a discipline because when a new theory emerges, such as DeLorme's idea of using weight training in rehabilitation, there is normally a lengthy period of resistance and counter-argument by scientists adhering to older models.<sup>86</sup> However, in 1945, the military—driven by the exigencies of war—dramatically accelerated the process of scientific acceptance by mandating that all military rehabilitation units immediately begin using DeLorme's new system of Progressive Resistance Exercise. Then, with the onset of the polio epidemic in the late 1940s, DeLorme demonstrated the seemingly miraculous power of progressive resistance exercise to strengthen weakened muscle again, and because of the extraordinary circumstances of the epidemic, his methods found rapid acceptance within the broader medical community. Melvin Glimscher, a friend and colleague, wrote of DeLorme's work on progressive resistance exercise: "It was like a miracle. Patients who could not walk developed enough muscles to stand and walk and kept increasing their ability to get around, take care of themselves, feed themselves, [to] use their hands and feet, to write, to paint, to use tools, and so forth. . . . Eventually an entire system of equipment and exercises and the proper way to deal with this was developed, which became a *worldwide standard*, referred to simply as Progressive Resistance Exercises . . . it was the application of his technique that has returned millions of patients back to their family and friends. . . ."<sup>87</sup>

Eleanor DeLorme observed, following her husband's death in 2003 at age 86, that "Tom was like a meteor that flashed across the sky. In everything he did there was brilliance."<sup>88</sup> We would argue that a significant aspect of DeLorme's brilliance was not just the idea of "doing lifting," but his ability to provide strength training with a solid, scientific foundation. One of DeLorme's most important contributions is, of course, his insight into the potential of resistance exercise to substantially—and often dramatically—improve physi-



cal function. Just consider how many millions of men and women have regained more function in their injured limbs, and had their rehabilitation time considerably shortened, because of DeLorme's introduction of progressive resistance exercise to the field of rehabilitation. But not to be overlooked is his major contribution to the field of strength coaching: his introducing the academic and medical worlds to the idea that strength training is itself a science that can, and should, be researched and reported in scientific journals and not solely in popular muscle magazines. This is what he did before anyone—before Peter Karpovich, before Edward Chui, before anyone else—and this fact, coupled with the imprimatur of authority vested in him by his medical degree as well as by the ways in which he used that degree to “strengthen” the work on resistance exercise, ultimately did more than we will ever fully understand to encourage coaches and physical educators around the world to discard the myth of the muscle-bound lifter and embrace the use of strength training in sports.<sup>89</sup>

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