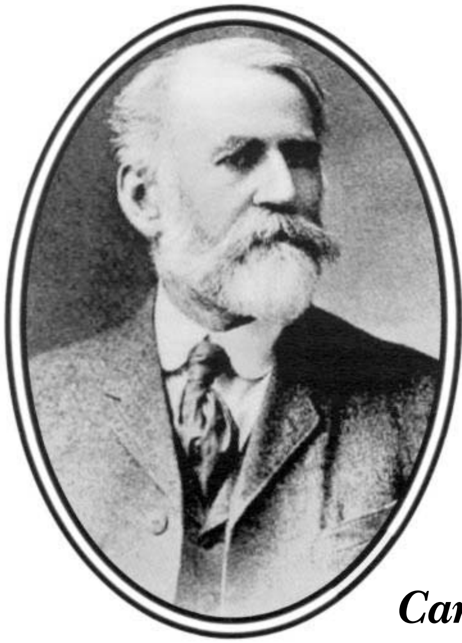


Dudley Allen Sargent: Health Machines and the Energized Male Body

Carolyn de la Peña,
The University of California at Davis

"I developed manhood."
—Dudley Allen Sargent

"Every man who has not gone through such a course, no matter how healthy or strong he may be by nature, is still an undeveloped man."
—Advertisement for *Sandow's Physical Development for Men*

Those who would argue that sports science began in the twentieth century have forgotten Dudley Allen Sargent. As a nineteenth-century fitness educator, inventor, and advocate, Sargent worked to codify a system of mechanized physical science whereby individuals, with the help of machines, would build their bodies to a state of maximum physical energy. Sargent, one of the first creators of systematic methods for mechanized physical training, helped to make possible the quantum advances in athletic performance that have resulted from twentieth-century machines such as the SB II racing bike or the Cybex training system. Yet this nineteenth-century innovator would have seen little resemblance between the results he hoped for and those of the systems in which we currently immerse our bodies. For while both nineteenth- and twentieth-century machine systems have stressed muscular development and scientific quantification, they have done so in the service of dramatically different ends.

We tend today to view machines as tools to improve physical performance. For casual users this means using specific machines to build arms that lift more and legs that run faster. For serious athletes, it means using machines as integrated systems in pursuit of bodies that continuously surpass human limits.[1] Sargent, on the other hand, sought machines to celebrate the limits of the human body rather than surpass them. For Sargent this meant developing a complex system of machines and measurements which, when combined, allowed every man and woman to reach a universal "perfect" muscular form. Sargent saw the ultimate goal of machine training as taking the body to a state of health and equilibrium. Only machines, he argued, could build a body of sufficient muscular strength to handle the increasing mental efforts of twentieth-century life. By exploring the philosophies of their inventor, the machines he created, and the bodies those machines helped generate, it becomes possible to argue that machines were once designed to make bodies fully human. If today we encourage bodies to increasingly resemble the machines that train them, it is not due to a technological imperative. By excavating the original intentions of this health machine creator we can better understand the unique twentieth-century relationship that has developed between human and machine.

Turning to Machines: Dudley Allen Sargent

In 1869 Sargent laced up his boxing gloves, climbed into the ring, and set about proving his manhood. He had already been hired by the president of Bowdoin College to serve as its new gymnasium director. The president, however, was not the one that Sargent needed to impress. For while he may, at only nineteen, have proven himself intelligent and experienced enough to win over the school's head administrator, it was the students who would have the final say over his employment status. They selected the strongest and quickest of their peers to put Sargent to the ultimate test: ten rounds of boxing after which only the victor could claim the loyalty of Bowdoin's troops. As his students crowded around the ring to watch, Sargent successfully proved his strength and agility by making short work of his student challenger after only a few rounds.[2] Everyone agreed: the question of whether he was qualified to teach had been settled.

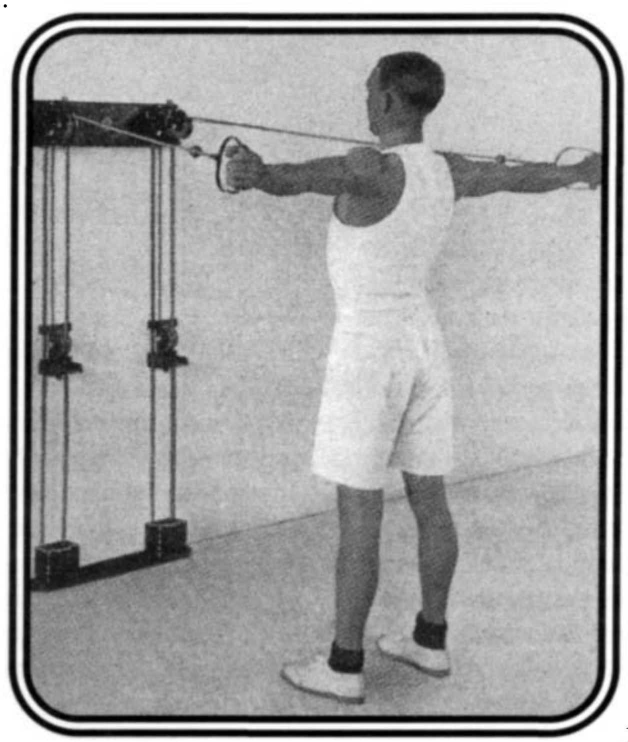
The story emphasizes the dramatic difference between the world of physical training that Sargent encountered when he began his career in the 1860s and the world of physical training that he would help create by the time it ended in the early twentieth century. Along with individuals like Swedish inventor Gustav Zander, Sargent helped change the definition of "strong" men from those who won boxing matches to those who won machine-generated, balanced physiques. For Sargent, this meant making a career out of augmenting the traditional gymnasium offerings of boxing rings, high bars, and standard rings with sleek, hand-built weight machines of his own design. Under his tutelage at Bowdoin, later at Harvard, or indirectly at one of the tens of other institutions that adopted the "Sargent system," students were led to believe that real, energy-enhancing strength could only be built with the help of machines.[3] With the help of Gustav Zander, whose developing machines were installed in resorts and health clubs at the turn of the century, this lesson extended far beyond university walls. Together these machines made their middle- and upper-class users a compelling, three-part offer: energetic redemption from physical obsolescence, integration into a mechanized modern world, and representation as efficiently "balanced" masculine physiques.

Little about Dudley Allen Sargent's early experience suggested he would, in the words of one historian, exert "a greater influence on the development of physical training in American colleges and schools than any other."[4] He was, however, fascinated with muscle building early on while growing up in the 1850s in the small town of Belfast, Massachusetts. Sargent's early experiences with physical conditioning encompassed several of the most popular mid-century systems. As a young boy, he first learned of physical development through a school hygiene program. While a teenager in the early 1860s, he came across Thomas W. Higginson's article 'Gymnastics' in the *Atlantic Monthly. [Ed. Note: at that time the term "gymnastics" referred to other forms of exercise than the floorwork, ringwork, and vaulting, etc. that comprise modern gymnastics.]* Higginson offered readers a description of various exercises, including the equipment necessary to perform them. Sargent, like many small-town readers, used materials like Higginson's article to educate himself about fitness; in his autobiography, Sargent remembered cutting out the article to save and study.[5] After acquiring elementary knowledge of both gymnastics and boxing techniques, Sargent organized his own boxing and gymnastic club in Belfast.

Like many nineteenth-century strongmen, Sargent soon brought his skills before an audience.[6] He organized his fellow Belfast gymnasts into a troupe to put on fund-raising performances and outfitted a local barn with parallel bars, a pommel horse, and rings to develop the muscle behind their maneuvers. Soon "Sargent's Combination," as he called his group, brought their feats to neighboring towns on an informal tour. At the age of eighteen, in 1867, Sargent decided to permanently take his talents beyond Belfast. He joined a variety show that he had seen travel through his town, reasoning that his own skills were at least as good as the featured tumblers. While on the road, he alternated between performing with various circuses and training at gymnasiums to build strength. By 1869, Sargent grew tired of circus life and what he called "the company of loafers."[7] Seeking a way to further his education and pursue his gymnastics interests, he took a job as the Director of Gymnastics at Bowdoin College.[8]

At Bowdoin, Sargent first had a chance to theorize about mechanized muscle building. He had ample time to ponder such theories, for few students ever entered the decaying former dining hall that then served as the gymnasium. Bowdoin's equipment, like that in most gymnasiums, had not been improved since the early nineteenth century: high bars, rings, and a horse made up most of the collection, reflecting the *Turnen* emphasis on upper-body athleticism.[9] The only grounded equipment was heavy pulley weights and a rowing machine. And while all students would have been able to use the rower, most of the equipment was usable only by those especially skilled in the high bars or of significant upper-body strength. The few weights that might have helped users build that strength were too heavy for most students to budge.[10] According to Sargent, Bowdoin's equipment was, for most students, "a form of torture."[11]

Ironically, Sargent came to believe that machines were necessary in physical training by eliminating them. With little budget and university support, Sargent tried to build a program the cheapest way possible, with Indian clubs and light dumbells.[12] While these lighter weights did allow more students to begin training, Sargent found that many students wanted heavy apparatus. They saw lighter equipment as "an admission of weakness," perhaps referring to its ubiquity in women's gymnastics at the time.[13] In addition, Sargent found dumbells and clubs unsatisfactory in training anything other than the upper body. With the money from his first raise, he bought adjustable machines to augment the gym's lighter equipment. These, he hoped, would be heavy enough to work student's muscles, yet light enough that even weak students could use them. Sargent further modified the heavy pulley system, adding another layer of higher pulleys that made lifting lighter amounts possible. He based his design upon experiments he had done back in Belfast to recruit town boys for his performances. By introducing a system of adjustable iron bars attached to a cord, weaker kids could gradually build the upper-body strength needed for his gymnastics feats. What had worked in Belfast worked at Bowdoin; after installing several of these "developing appliances," Sargent saw results that he claimed "seemed magical."[14] Students who had previously believed their strength was inferior now ventured into the gym to try Sargent's building machines. According to his own accounts, Sargent saw his class enrollment triple after installing his machines. By 1872, Sargent's success convinced the faculty to make gymnastic development, and by association machine training, compulsory for all students.[15]

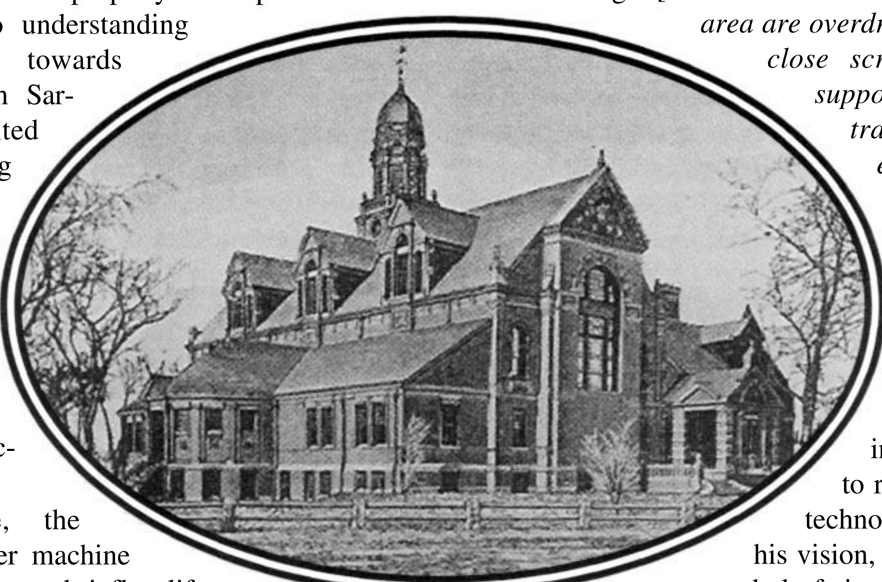


Sargent's basic chest-weight machine simply consisted of stacks of weights, two cables and two handles.

Bowdoin gave Sargent two important resources for his later career: a college degree and a philosophy of mechanized human development. Sargent received the first by taking classes part time, and the second by observing his own students over years of teaching. In a speech entitled "The Limits of Human Development," delivered as part of his junior oration, Sargent explained his new view of body development influenced by machines. "Perfection of man on earth," he explained, "whatever may be his condition hereafter, comes not from the surpassing development of his highest faculties, but in the harmonious and equal development of all."[16] By stressing balanced development, Sargent moved away from his earlier interest in feats of strength. During these first years of machine experiments, Sargent began to realize that his own training as a teenager, while physically impressive, was incomplete. His stress on upper-body development had been, as in the German *Turnen* system, about performance. Years of practice had left him able to swing from the trapeze and perform feats of strength to entertain a crowd, but it had left him "overtrained" and depleted internally. "I had learned how to work and develop my muscles," he recalled, "but I had not learned how to conserve my energy."[17] Performing feats of strength was a fine goal for a kid from rural America. But what good were extraordinarily strong biceps for the typical young man from America's privileged class? During his Bowdoin years, Sargent had a chance to rethink the purpose of muscular development from his students' perspectives. These future leaders of urban America needed bodies that built as much energy for mental and physical tasks as possible. After Bowdoin, Sargent would spend the rest of his life searching for a system of balanced muscular development and energy production.

Sargent's change in philosophy occurred in the 1870s and was first publicized by one of his supporters and friends, William Blaikie. A Harvard graduate and member of the school's rowing team, Blaikie enjoyed influence among the faculty and in New York, where he was an attorney. It was his book, *How to Get Strong and How to Stay So,* published in 1879, which established Sargent as the creator of a new machine system. Blaikie's description of the properly developed body is essential to understanding Sargent's turn towards machines. Although Sargent never credited Blaikie with giving him the idea for a new approach to physical fitness, Sargent's biographer has documented the close pace with which Sargent followed Blaikie's recommendations.[18]

For Blaikie, the Health Lift, an earlier machine that allowed users to briefly lift immense amounts several inches off the ground, was an improper application of machine technology to the body. It created "work of the grade suited to a truck-horse," he told readers, rejecting David Butler's claim that the lift trained all of the body's muscles equally. Like the truck-horse, "lifters" gained strong backs and legs, but remained underdeveloped. Blaikie knew this from his own experiments with the Health Lift: he lifted 1,000 pounds but was disappointed by his stiff back and "abnormally" developed inner thigh and upper back muscles. Blaikie believed that Butler had missed the promise of machine-based training: a perfectly contoured, symmetrically developed muscular physique. It was this perfectly balanced collection of muscles that could make the modern middle-class man healthier than his urban and rural laboring counterparts. By using scientific machines under scientific advisement in scientific studios, bodies could at last overcome the physical imbalancre that Blaikie felt resulted from any manual labor. "Scarcely any work in a farm makes one quick of foot," he explained, citing the reason why farmers often suffered from ill health. "All day, while some of the muscles do the work. . .the rest are untaxed, and remain actually weak."[19] Athletes, he believed, suffered equally from this imbalance-induced weakness. Blaikie used illustrations to show readers the shortcomings of what he called "poorly developed athletes." While the subjects' deficiencies are not readily apparent to a modern reader, Blaikie saw bodies drastically out of proportion with excessive shoulders, sunken chests, and weak legs. [*Ed. Note: Blaikie's arguments in this area are overdrawn and don't bear close scrutiny. His theory supporting mechanical training led him to exaggerate the negative effects of non-mechanized training.]*



Harvard's Hemenway Gym in the 1880s.

Blaikie's mechanical musings were designed to replace manual with technological strength. In his vision, the yeoman farmer, a symbol of vigorous national health since Jefferson, and the athlete, a hero of strength since ancient Greece, are rendered weak through the very accomplishments that once proved their strength. By insisting that the strength and energy come from balance and not performance, Blaikie created a system whereby doers would always be physically inferior to those who "trained." This would play out into a system of elitism under Sargent and his followers, as only those bodies with access to facilities, machines, and instructors could demonstrate proper energetic physical strength.

For Blaikie, earlier machine systems like Dr. George Barker Windship's Health Lift and David Butler's (later) Health Lift, by failing to take advantage of machine precision, had left users as weak as the unfortunate laborers and athletes. By not distributing weight equally over the body, they had not afforded the requisite heavy and light resistance for different muscle groups. He proposed alternatively Sargent's light pulley system that he knew from the Bowdoin experiments. Blaikie familiarized readers with Sargent's approach, giving them a detailed description of the machine and showing them a full-page illustration in his text. Only this kind of graduated weight training system could relieve what Blaikie saw as a "clogging," or "lack of complete action," in the body's energy.[20] By equating maximum muscular energy with gradual resistance and balance, Blaikie helped wed man's physical health to machine technology. One could have theoretically supplanted the machine in earlier health equipment technology such as the Health Lift. The first Health Lift "machine," for instance, was not really a machine at all but merely hogsheads in the ground that could be raised and lowered manually.[21] Sargent's system was different. He believed that once progressive resistance is required, only machines can do the job. Using this reasoning, manual labor, or even recreational sport, left the body unevenly developed. His position was that heavy weight lifting, by using the Health Lift or barbells, wasted the body's energy. According to Sargent, there was no way to "perfect man on earth" without apparatus designed for specific muscle groups.

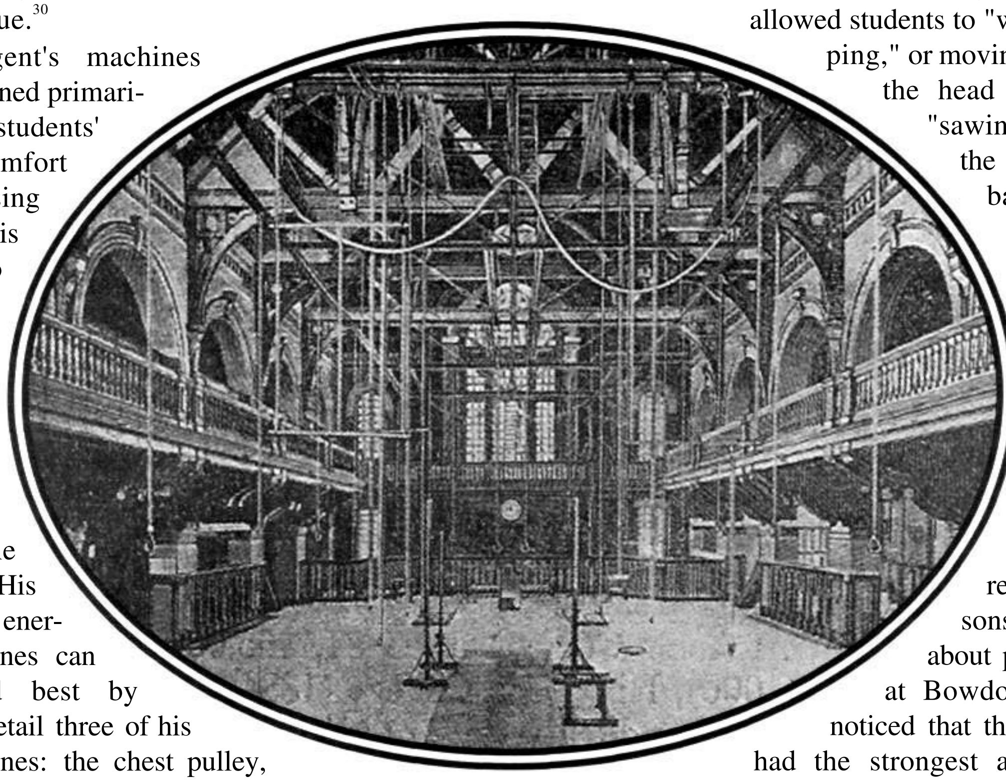
Harvard and the Hemenway: Building a System of Machine Energy

In 1879 Harvard's regents hired Dudley Allen Sargent as the first Director of Physical Education, a position that he would hold for over forty years. Given the task of forming a new gymnastics curriculum to teach inside a recently renovated building, Sargent created a system as new as the exterior facade. Prior to his arrival, the Hemenway had been like most American college gymnasiums: ignored.[22] There was little to attract a crowd; the equipment consisted of a few old-fashioned rowing machines, a heavy lifting machine similar to Butler's, and several older pulley weights.[23] It was, primarily, where gymnastic and boxing clubs met to practice; a place of vital interest to athletes but of little interest to many college men. At Harvard, Sargent had an opportunity to develop a complete system of mechanized fitness. The Hemenway's renovations had cost $110,000, nearly double that of other university gymnasiums. Its running track, rowing room, fencing room, baseball cage, and tennis courts made it one of the most impressive in the world.[24] The luxurious offerings reflected Harvard's desire to develop a fitness program that would both build the health of its student body and improve the performance of its athletes.

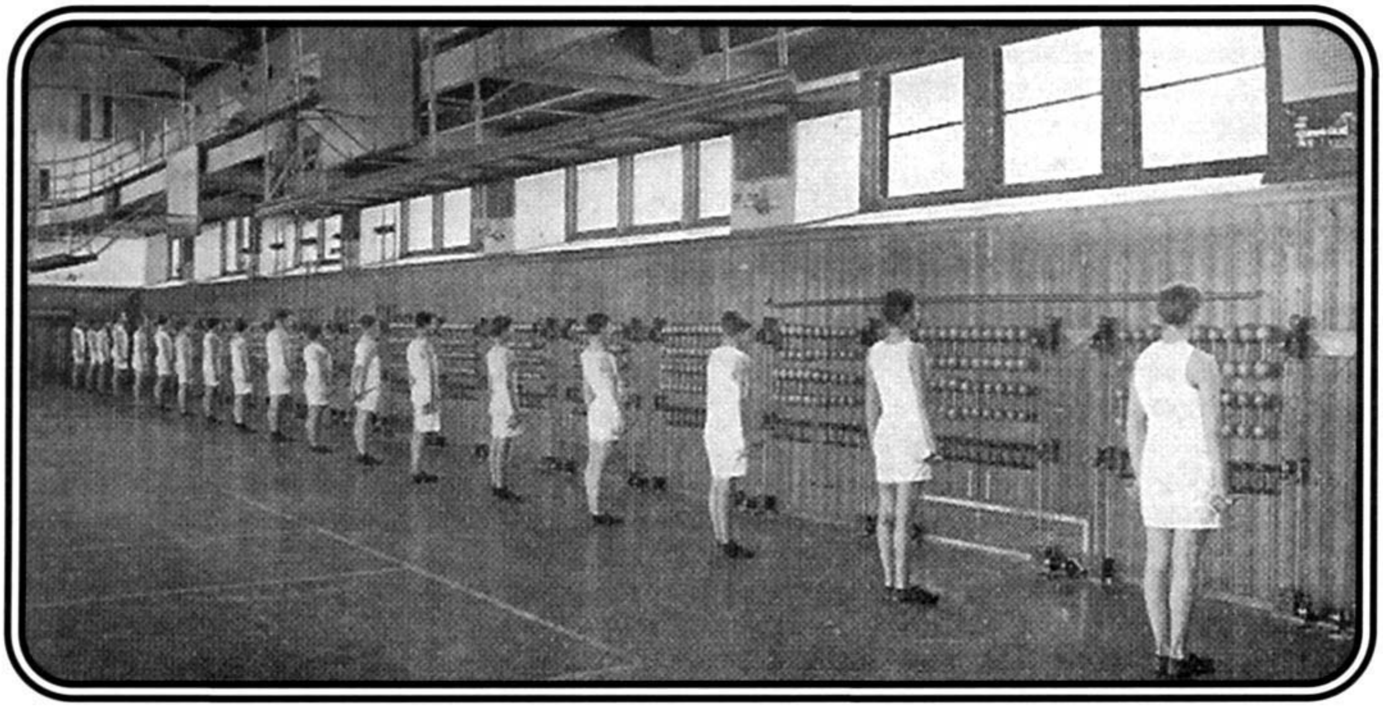
Harvard gave Sargent a surprising amount of leeway in constructing the training program. They knew of his work at Bowdoin and that experience, along with his brief stint founding and managing a New York gymnasium in 1878, was sufficient to make him one of the leading experts in his nascent field.[25] Sargent used Harvard's significant financial resources to design and build advanced versions of the machines he had first used for training back at Bowdoin.[26] In addition to offering standard gymnastics equipment such as parallel bars, the pommel horse, and Indian clubs, Sargent offered thirty-six different machines for physical training. The machines were tailored to train each part of the body individually. There were special apparatuses for building back, abdominal, chest, neck, arm, and leg strength. Even delicate areas of the body could be worked with machines designed to build finger power and head balancing skills. There were rowing machines for general exercise and machines designed to correct body deficiencies, such as one designed to correct "any erratic twist or turn in one or both feet."[27]

The machines at Harvard, while only one component of physical training, commanded attention from all who entered the Hemenway. There were fifty-six total, and they lined the walls with ample space left between them for users to adjust weight levels and move between equipment. Since much of the regular gymnastics equipment was hung from the ceiling, even users who did not work with Sargent's machines could see them from where they trained. Sargent's Hemenway equipment was striking for several reasons. First, he combined standing and sitting machines. Whereas earlier he had designed primarily chest pulley weights that stood close to walls, his new machines for head and finger strength, as well as those for lower body work, required users to sit on or inside of them. According to one observer, the machine for building calf muscles felt much like an "arm-chair," in which one sat comfortably and pushed a foot weight up and down.[28] Sargent also mechanized traditional gymnasium offerings; he built counter-weighted parallel bars to make lifting one's weight easier and put spring boards on iron pedestals which pivoted in their sockets for increased bounce. Sargent drew attention to these changes in traditional equipment, saying that although "all the old-style apparatus has been added," it had been "with improvements in form, structure, and arrangement."[29] These innovations allowed students, even those who were in the gym but not using the machines, to feel the effects of mechanized improvements in their physical performance. Additionally, by making improvements such as shaping the parallel bars to students' hands and installing polished ladder-rungs for easy grip, Sargent created a clean, efficient environment reflecting machine-age design and ergonomics a generation before such theories came into vogue.[30]

Sargent's machines were not designed primarily to increase students' physical comfort while using machines. His goal was to produce the healthiest students possible, and he believed this could be realized only by using machine technology. His theories about energy and machines can be illustrated best by exploring in detail three of his specific machines: the chest pulley, the abdominal pulley, and the inomotor. Sargent's most popular apparatus was his basic chest pulley machine. Not only did he have more of them in the Hemenway Gymnasium than any other machine; it was also the most frequently copied by his imitators. Peck and Snyder, one of the best known sporting-goods manufacturers in the 1880s, carried several examples of pulley weights. Professor D. L. Dowd's home exerciser, complete with a list of muscular exercises one could do, was similar to Sargent's machine.[31] Narragansett Machine Company produced pulley weights so similar to Sargent's that he sued them, in spite of his promise to Harvard that he would not patent his devices.[32] Sargent's basic pulley weight was a modified version of the boxes on sawdust that he had first encountered at Bowdoin. By dividing the block weights into iron bars and making these bars attachable to the pulley in desired increments, Sargent created a weight system that, as he put it, was "adjustable to the strength of the strong and to the weakness of the weak."[33] As with each of his machines, Sargent developed specific exercises for students on the pulley weights. With this standard chest pulley he recommended exercises that involved bending, lifting, and circling the arms. Rather than prescribing completely new movements, however, Sargent used those that mimicked natural movements from everyday life. These allowed students to "work" by "chopping," or moving the arms over the head and down, or "sawing," by moving the weight front to back. They could even engage in "swimming" by pulling their arms in circular motions.[34] Sargent's choice in exercise reflects early lessons he learned about physical energy at Bowdoin. There he noticed that the students who had the strongest arms and most overall strength were often those who did regular labor such as blacksmiths and lumbermen. His mechanized system thus attempted to reconnect students, most of whom were from the upper and middle classes, with manual labor.[35] It is significant that Sargent did not simply send his students out to chop wood. Because his focus was on *even development,* Sargent believed that machines could successfully build more muscular power than natural movements. As Blaikie had pointed out in his own work, physical labor led to overdeveloped muscles. One might not saw, row, swim, and chop all in an afternoon. According to Sargent, these pulley weights, by creating many light "jobs" that could be done in a short time, were the best means



Hemenway Gymnasium interior, circa 1890.



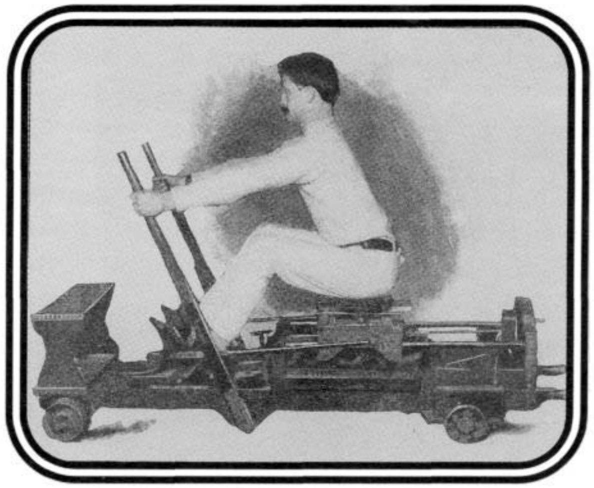
This 1914 class of male physical education students at the City College of New York prepares to do chest weight exercises. Notice the racks of dumbells that hang between each machine station.

for "giving one an all round development of the whole muscular system."[36]

With balanced development as his goal, Sargent needed machines that allowed students to work underutilized muscles. Thus he developed a series of involved pulley systems that could tax each part of the body. His abdominal machine reveals the construction techniques. Here he has taken the regular chest pulley system and attached it to a table with a backrest via a third pulley attached to a wheel. The result is a machine that uses ankle straps and arm handles to hook a user in, allowing the pulley weight to be lifted and lowered at will. Unlike the chest machine, the abdominal machine was not replicating natural movements. In the process of daily tasks, few laborers put such direct stress on their stomachs. These machines undoubtedly taught students the lesson that full physical development required machine technology. Moreover it made machines necessary in achieving that development while still conserving nerve force. For contemporary gymnasium users, this was a marked difference between Sargent's system and what had come before. As one observer described, most gyms actually hurt users because they required "too great [an] expenditure of nerve-power in the effort to keep the muscles up to their highest tension."[37] In other words, like many modern-day gym users, people tended to end training with less energy than they had before they began. Sargent's system, the observer argued, managed to exercise muscles without exhausting nerve-power. Even the weakest students, he explained, were able to develop strong muscles while preserving their delicate health, thanks to new machines like the abdominal pulley. *[Ed. Note: The argument that Sargent's machines could somehow stress the muscles sufficiently to make them grow in size and strength more effectively and safely than can be done using traditional free weights is fanciful and not supported by modern research.]*

Sargent's inomotor best reflects his belief in the compatibility of machine technology, physical health, and energy conservation. Patented in 1899 by Sargent, the inomotor, a combined vehicle and exercise machine, reflected twenty years of Sargent's active experimentation with machines. The device, which never enjoyed popular success, looked highly unusual, a bit like a vehicle's chassis without the protecting metal exterior. Inside, users manipulated a combination of levers and a sliding seat in order to do two tasks at once: move the vehicle forward and exercise their arms, legs and torso. In principle, the device worked like an exercise cycle: users moved their bodies in a series of movements in order to turn the wheels of a machine. The inomotor, however, offered something quite different—when the optional wheels were attached, the device actually moved.

Unfortunately for historians, Sargent sketched more than he wrote about the inomotor. It is impossible to know just how he saw the machine fitting into his system of stationary pulley devices. Yet we can hypothesize about it, thanks to Sargent's own proposal to modernize the Hemenway's offerings in the early 1900s. His idea, which was soundly rejected by Harvard's President and Fellows, was to make the inomotor the center of a new, dynamic mechanized training system.[38] The gymnasium's interior would be gutted, with fencing rooms and batting cages torn out to make way for a wide inomotor track. Here, students would literally "drive" themselves to fitness through a combination of physical movements. Sargent's vision would allow health machines to reach their fullest potential: not only would they "work" by allowing students to build their muscles through resistance to levers and pedals, they would also, by putting students' expended energy through an efficient "engine," increase the total amount of energy users possessed.



The Inomotor

It is easy to see why Harvard rejected Sargent's proposal. It is difficult to understand how his inomotor theory worked, even for the modern researcher who dedicates herself to the task. Certainly Harvard's President and Fellows saw the scheme as misguided if not illogical. Yet if we read Sargent's sketches and the limited writings he does provide on the machine's function, it seems apparent that he was actually trying to take mechanized muscle building to a level of energy production far beyond what stationary pulley devices could accomplish. For while Sargent believed that pulley weights developed the body's muscles equally, he saw a problem with the strength students received as a result. Students needed cardiovascular exercise in order to get their pulmonary and circulatory systems flowing over an extended period of time. This was more difficult with pulley weights, regardless of how fast students went from one machine to another, given the inevitable pauses between devices and weight setting. Yet cardiovascular exercise alone could not ensure balance, since, like all unmechanized activity, they expanded some muscles while neglecting others. The key seemed to be in finding a way to use machines to actually pump the body as a whole, building balanced muscle and speeding the heart all at the same time.[39] In his one essay describing the inomotor's efficacy, Sargent uses the analogy of an engine to describe a machine-trained student's heart.

> *A man in this condition is like a factory that has been accustomed to work but a few of its machines at one time, and has an engine adapted to that purpose. In case all the machinery is started up at once, the boiler cannot generate steam enough to supply each machine with its requisite amount of power, and consequently permits of little effective work being done by any one of them. The remedy for the factory is to build a larger engine, or generate more steam. In the case of an individual the remedy is to invigorate the heart and lungs and, if possible, give more nerve power.*[40]

Sargent had realized students could be well-trained at his system of individual machines, yet still lack the overall "boiler" or heart-pumping capacity to work each of the machines at the same time. While this was indeed a theoretical problem, as no student could actually work all the machines at once, it interfered with Sargent's vision of a perfectly developed, balanced physical being. The inomotor is the remedy here, a mechanical cardiovascular entity that he believed could actually give more "nerve power" to the body by invigorating the heart and lungs.[41] When students "drove" the inomotor, they expended their available energy to move its pedals and levers and send it in motion from point A to point B. Yet, unlike stationary machines which merely provided resistance and allowed students only to send energy out, the inomotor, through its engine which propelled the pedals and levers in an ever-faster motion, sent that energy back into students' bodies.[42] As it ran faster and faster, energy accumulated in the vehicle's interior, actually re-entering students' bodies, a unique by-product of the human-machine interaction. *[Ed. Note: Obviously, Sargent's theory flies in the face of both reason and the teachings of exercise physiology.]*

Sargent never got his vision of the inomotor gymnasium, although he did manage to place several stationary inomotors in the Hemenway where they remained until the early 1900s. Regardless of its ultimate success, however, the inomotor leaves little doubt that Sargent conceived of the relationship between men and machines as symbiotic. Thanks to a revision in university policy, Sargent was able to share this vision with far more students than the hundreds who might have voluntarily partaken of the Hemenway's offerings. While he was never able to make Hemenway training mandatory for students, Sargent did convince Harvard's administration to require all athletes and scholarship holders to go into the Hemenway, meet Sargent, get a physical examination, and be shown an exercise regimen. And while those students would not actually have to do the exercises they were given, they had to be taken through the exercises at least once, ensuring that all interacted with Sargent's machines. Further, each entering freshman had to visit the gymnasium at least once, where Sargent examined his strengths and weaknesses and gave him an exercise prescription, with, in Sargent's words, "specifications of the movements and apparatus which he may best use."[43] Even if each freshman entered the Hemenway only once, at least 250 a year received a personal introduction to Sargent's machines and how they could improve their health.[44] Individual accounts of students' opinions regarding the Hemenway's machines are difficult to locate; nonetheless there is evidence that students increasingly exercised with machines instead of with the traditional equipment. Participation in gymnastics exhibitions decreased dramatically after Sargent arrived, in spite of his own skill as a gymnastics teacher. They were discontinued by the late 1880s.[45] Additionally, President Charles Eliot used Sargent's own rhetoric about machines to praise the new gymnasium in 1883. By highlighting the Hemenway's "greater service to weak, undeveloped persons than to those already strong" and its training of athletes though "moderate and symmetrical muscular development," Eliot undoubtedly had Sargent's mechanized equipment in mind.[46] Existing evidence from students suggests that the Hemenway's equipment was an integral part of their lives. One recalled in 1919 that as a student in the 1880s he and his friends had "exercise[d] there almost daily." He particularly recalled how Sargent had measured their strength, "showed us where we were weak and assigned us to practice on his development apparatus."[47] Popular articles support this student's account of daily exercise. One in 1889 claimed that "at present the average student, with no thought of training for any contest, devotes an hour or so a day to exercise in the gymnasium, or to whatever may be his chosen game."[48]

These young men learned important lessons by frequenting Sargent's Hemenway. It is particularly significant that they were young men; most scholarship on Sargent has focused on how he trained women after opening an institute for women in Cambridge in 1881.[49] Sargent's most complete collection of physical machinery was designed for and used by young men from the middle and upper classes.[50] This has two important implications. It introduced men who would join the white-collar industrial class to a symbiotic relationship between machines and physical health. When young men used the Hemenway equipment, they were told that it was the graduated weights and complex systems of wheels and pulleys that built physical strength by conserving energy. Sargent's repeated emphasis on equating muscular balance with physical health bolstered his theory that only machine precision could guarantee correct development. Such lessons, even if learned on an unconscious level, may have made them more likely to believe in body-machine efficiency systems such as Taylorism. The Hemenway's machines also gave these men a new understanding of the body as a machine that their parents had not had. While the analogy of the "human engine" had been in place for decades, Sargent was the first to develop a system that attempted to prove its truth. By handing each Harvard student a card showing his weakness and next to that weakness listing which machine the student should use to fix it, Sargent taught them to think of their bodies as a system of parts to be repaired by machines. He strengthened this lesson through his emphasis on anthropometry. By measuring students with machines, he completed the circuit of mechanized diagnosis and development at Harvard.

Machines Measure Mechanized Progress: Sargent's Anthropometric System

After students arrived at Harvard, Sargent measured their hearts, lungs, sight and hearing.[51] He then made a detailed physical examination, taking over forty measurements of muscular power and body size. On the

Over the years, Sargent added more handles and pulleys to his basic machine and in this model even included a sliding seat. Advertisement for the Sargent Combination Pulley Weight from the 1914 Narragansett Machine Company's instructional booklet: *Chest Weight Exercises.*

basis of these, each student received a charted prognosis detailing which body parts were average, above average and below average. A machine prescription followed: Sargent gave each student his own individual training schedule, detailing which machines he should use to build deficient muscle groups. Ideally, the next examination six months later revealed that the student had moved closer to the average and had "remedied] defects." Should that not have happened, he received a modified training schedule in order to attempt a second machine corrective for underdeveloped muscles.[52] Harvard students thus approached training with a specific goal in mind: to increase their body size using machines.

As mentioned in one student's account of Hemenway training, Sargent measured each student's strengths and weaknesses. Some of this he did with birds-eye observations: he clocked students to see how far they could run and measured muscles with measuring tape to check development.[53] He also used tools such as calipers, which looked similar to bent tongs, to measure the depth and width of abdomens and chests. Yet these appliances were for external applications; they could only measure what one could see with the eyes. To accurately gauge internal measurements, Sargent used three machines: the spirometer, the manometer, and the dynamometer.[54] Each required the user to exert force upon an apparatus to produce a strength reading. The spirometer was a modified bucket and straw apparatus; users took in as much air as possible and exhaled into the mouth piece, giving a reading of lung capacity in the water displaced. The manometer worked in a similar fashion, except that users blew with one quick blast into the mouthpiece and measured the air pressure on the top dial. The dynamometers were among Sargent's favorite machines, if the number of illustrations in his publications is any indicator. They appeared in numerous guises: the back dynamometer, the hand dynamometer, and the chest dynamometer being most common. The dynamometers afforded the most intimate connection between student and machine. With the back apparatus, for example, one had to stand on one side of the machine while pulling up on the other. Like Windship and Butler's earlier Health Lift, to which it bears striking similarities, users bent slightly at the knees and then straightened their knees and backs to raise the "weight." The chest and hand dynamometers afforded an equally close connection between user and apparatus. With the chest machine, users held handles on both sides and pushed their hands towards each other. The result could be read in kilograms of force on the display dial. The hand machine worked similarly, only here it was the fingers that pressed in towards each other, forcing the machine's metal exterior to bend.[55] Other physical educators had developed previous measurement systems; Sargent's, however, was the first to intimately chart physical power by mechanized means.[56]

Sargent referred to his machine-measuring as anthropometry. The word, first coined in the eighteenth century, had been popularly used for several decades by the time Sargent began his late 1870s experiments at Harvard.[57] Historians who study anthropometry tend to focus primarily on its nineteenth-century role in "proving" racial inequality.[58] Anthropometry, while scientific when applied by most anthropologists with rigorous criteria, also had a chameleon-like character; it could be used to prove whatever its researcher set out to find. It easily lent itself to racist applications; findings often "proved" the inferiority of certain groups based on personal criteria masquerading as science.[59] Because of this classification, Sargent's general anthropometric system has been largely ignored, even though he was arguably the most well-known anthropometrist of his time.[60] And while physical education scholars discuss Sargent's system as part of the professionalization of their field, his absence in other fields reflects the continued absence of physical fitness from much "serious" scholarly inquiry.[61] Sargent, by virtue of his position at Harvard for twenty years, his summer school program enrolling thousands, his popular writings, and his role as a founder of the American Social Science Association, defined anthropometry for an educated American audience.[62] This definition offers an important corrective to anthropometry studies as only a racially determinist endeavor. Although it originally set out to evaluate a static body, anthropometry in Sargent's gymnasium was used to help the body grow in health and muscular size. Although Sargent presented a rigid standard of the ideal body, his system allowed students of all shapes and sizes to move towards his version of perfection, held back only by their will and the quality of their machinery. Sargent seems not to have subscribed to the view that physical ability was linked to race. As a system, his approach was less racist than it was perfectionist, with important consequences for class connotations of masculinity.[63]

Sargent's anthropometric studies were part of two cultural preoccupations, taking time measurements and conducting efficiency experiments. Taylorism is one of the best-known theories that contained the two; its promoters sought to measure the exact movements of industrial workers to determine the path of least resistance in manufacturing.[64] American scholars have fixated on Frederick Winslow Taylor, arguing, rightly, that his theories successfully distanced workers from their products, reducing what had previously been about craftsmanship to the speedy loading of pig iron.[65] Yet Taylor's project was part of a general climate of efficiency in the late nineteenth century. While many of the projects were designed to speed up industrial production, others were intended to understand the body's processes and extract the most energy possible from them. One historian has called these combined efforts an attempt to develop "a new calculus of fatigue."[66] Studies emerged in calorie counting or "scientific eating," researching how to receive the maximum caloric or "energy" content from meals.[67] By the late 1890s, in addition to Taylor in the United States, researchers in France, Germany and Italy were developing ways to best measure and utilize the body's energies. Much of this took the form of breaking down bodily processes, internal and external, into their constituent elements.[68] The most famous of these, Eadweard Muybridge, published a series of body-in-motion studies in the late 1870s.[69]

Unlike most of his contemporaries, Sargent was more interested in the measurements that bodies could aspire to rather than the ones they actually possessed.[70] He believed that these machine measurements were accurate gauges of students' strengths and weaknesses; yet the machines themselves also served as the best way to achieve symmetrical development. An illustration of this is Sargent's anthropometric chart for Eugen Sandow, an Austrian strongman famous in America. The chart, which included the standard forty measurements that Sargent took from each student, shows Sargent's "perfect symmetry" goal realized. Sandow is far to the right of the middle line, meaning his measurements are largely 90% greater than that of other individuals measured. Further, when connected, the individual measurements follow an almost perfect line reaching from the top of the chart to the bottom, excluding deviations in knee, shoulder, and elbow strength.[71] Many of Sandow's admirers cited this muscular symmetry as proving his physical perfection. For Sargent, the strongman's symmetry also proved the efficacy of training with machines.[72] Sandow was widely recognized as having "a machined figure," which could "be admired, imitated, and industrially reproduced."[73] Sandow courted this image, offering charts of himself in his books and showing readers how they might measure their own bodies in comparison. Further, he offered his own machine training system as an aid to such replication. Sandow's machine, a modified pulley-weight developer, was so associated with the performer that Marcel Duchamp, in his sculpture, *The Bride Stripped Bare by Her Bachelors, Even (The Large Glass)*, included a pulley machine he called a "Sandow," in order to create what Linda Henderson has called an "ideal human-machine analogy."[74] By publicizing Sandow's physique as ideal, Sargent reinforced the idea that the best machine-measured body was one produced by machine technology.[75]

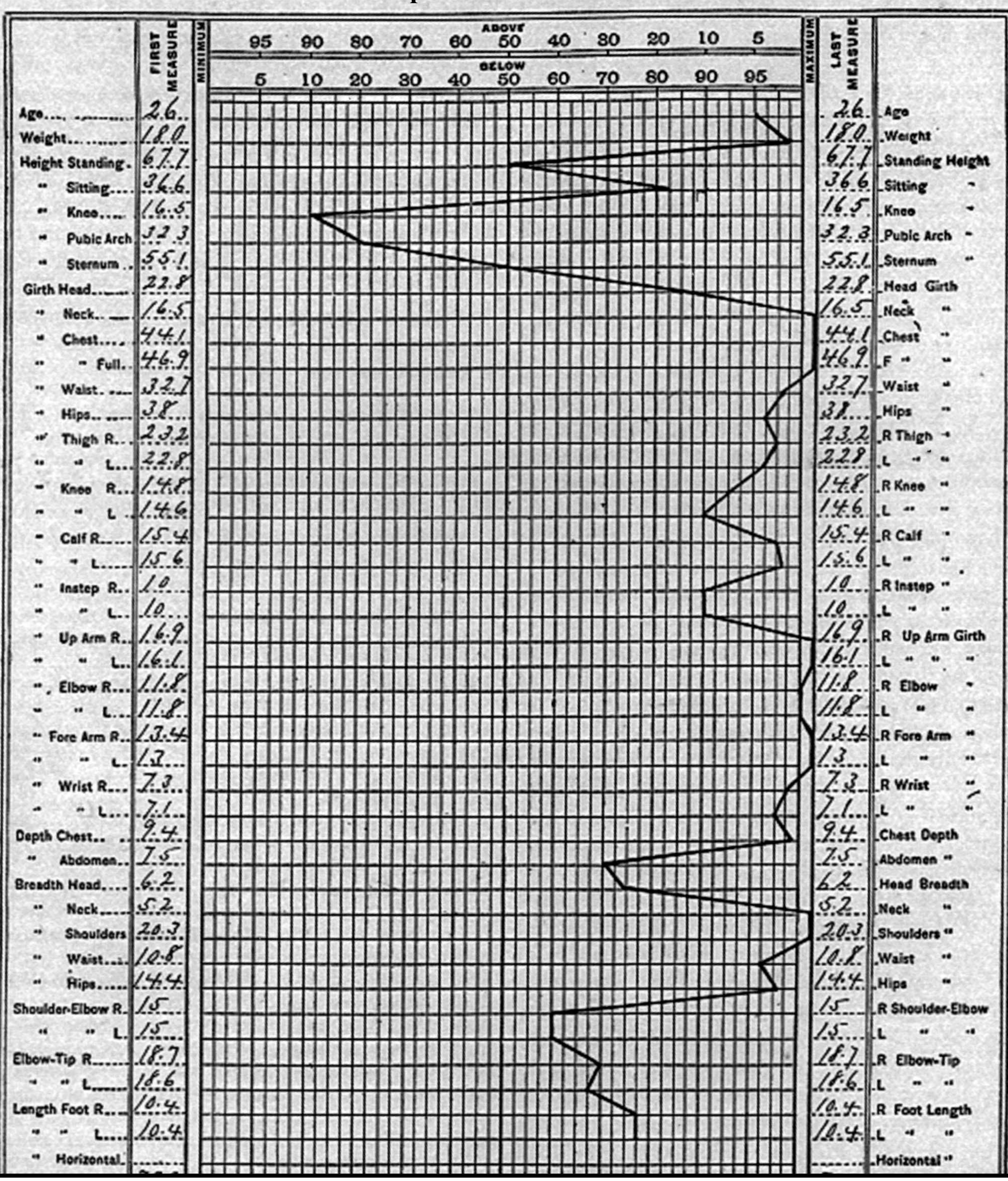
Sargent enjoyed wide influence during his fifty years in physical education. By his own estimation, he trained three thousand students from one thousand institutions.[76] His summer institute students in Cambridge included Booker T. Washington and prominent women like Helen Putnam of Vassar and Carolyn Ladd of Bryn Mawr.[77] Many Sargent students began systems similar to his at major universities. Edward Hartwell brought the system to Johns Hopkins, William Anderson brought it to Yale, and R. Tait McKenzie began a program at the University of Pennsylvania.[78] Luther Gulick, who guided YMCA training in the late nineteenth century, was also a Sargent student. Since YMCAs both bought Sargent's developing machines and adopted his measurement system, thousands of users learned to build bodies and gauge physical progress with Sargent machines.[79] Sargent also reached a wide popular audience through articles in *Scribner's Magazine*. In articles with titles like "The Physical Proportions of the Typical Man," he introduced anthropometry and mechanized training to readers, complete with physical charts, pictures of the measuring machines, and examples of ideal physiques.[80] The Columbian Exposition of 1893 further enhanced his popularity by featuring Sargent equipment. The display's location, inside a building where the words "Anthropology: Man and His Works" greeted visitors as they entered, highlighted the connection between man-made machines and crafted bodies. As visitors passed by the numerous ethnological exhibits listing cranium and skeletal measurements for ethnic groups, they likely considered how their own bodies might measure up. Sargent's exhibit allowed them to find out: they could step into an alcove and have their own anthropometric chart done. Chart in hand, visitors could then try out his machines for themselves, possibly re-measuring their muscles after a brief workout. This demonstrated the connection between healthy bodies and machines for an audience far beyond the walls of Harvard's Hemenway Gymnasium.[81]

If perhaps unaware of it, the majority of east-coast, middle and upper class Americans had some contact with Sargent's systems by the early 1900s. Many already knew of the machines by the time they visited the Chicago fair; according to one historian, Sargent's machines were widely sold in the United States after the Narragansett Machine Company marketed them in the 1890s.[82] According to Sargent's own estimation, by 1890 his machines were used by over one hundred thousand people in three hundred and fifty institutions across the country.[83] By 1910, physical training and physical evaluations had dramatically changed over fifty years. Previously, it had been commonplace for students to exercise on machines; anthropometric studies, if now designed for posture work or more eugenic "race building" data, continued to rely upon mechanized equipment to evaluate the physical form. Sargent's work effectively made machines co-conspirators in Americans' search for increased energy and physical health. No longer would individuals measure strength with boxing matches as they had at the beginning of Sargent's tenure in 1867. Along with sawing, rowing, and other manual tasks, boxing had come to seem an inefficient body builder to followers of Sargent's system. These traditional exercises may have made men appear strong—they may have even allowed men to do a great deal of work—but they did not build the regular scientific strength afforded by machines. [*Ed note: This belief was driven by faith, not fact.*] As Sargent told readers in his *Scribner's* article, it was not uncommon for exceedingly strong-looking men to fall into the 5% range once dynamometered. This weakness, Sargent observed, is

Opposite Page: A portion of Sargent's Anthropometric Chart for Eugen Sandow from *Sandow's System of Physical Training,* published in 1894.

ANTHROPOMETRIC CHART

Showing the Relation of the Individual in Size Strength Symmetry and Development to the Normal Standard



not apparent in the illustrations, nor would it be detected readily in the individual.[84] By making the strong body synonymous with machine training and measurement, Sargent made only those men with access to machines "developed" men. The Zander machines that appeared in American health spas in the 1910s would further solidify this connection between machines and physical strength, masculinity, and class.

Conclusion

Dudley Allen Sargent's health machine system offers important correctives to our understanding of American sport science and the history of technology. We commonly look to the early twentieth century, when college athletic programs, professional sports teams, and formal sports medicine training emerged, as the inception point for sport science. Yet while the field may not have begun to mature until this time, Sargent reveals that its birth was actually in the last decades of the nineteenth century. This man, though not a scientist in the formal sense, nonetheless codified a system of physical training based on machine-generated tension. And while his machines may have been technically primitive, his philosophies were not. It is important to remember that for their inventor, fitness machines were tools to excavate and build one's given internal energy—to make the human more human via the machine. By training the body with mechanized precision, Sargent hoped to create individuals who were alive to their fullest potential. If today our machine fitness systems seem to push beyond the boundaries of "human," creating bodies that are often more machine than "man," this was not the intention of their original inventors.

Further, exploring Sargent's machines reveals that stories of major technological inventions do not fully explain why Americans so eagerly welcomed new technologies into their lives. The late nineteenth and early twentieth centuries saw face-to-face contact replaced with distance communication, night replaced with day by artificial lights, horses and buggies replaced by speedy automobiles, and task labor replaced with time labor in regimented factories. And while these inventions give us important fodder in understanding how American life changed with the onset of new technologies, they overlook the small ways in which technology filtered into daily lives in a far more intimate fashion. Many of these intimate experiences came through the realm of sport. Historians have long explored connections between electrification and night baseball, steam travel and yacht racing, and mass manufacturing and sporting goods development.[85] They have spent less time looking at the ways in which some technologies actually became 'sports' in and of themselves, such as in machine-based resistance training.

The inventions of Sargent exposed American bodies—in health spas, city gymnasiums, and universities—to the benefits of mechanization in a way that was neither theoretical nor abstract. Individuals saw their biceps increase after using Sargent's lifting apparatuses. These lessons taught hundreds of thousands of individuals a powerful lesson about the benefits of an increasingly mechanized world. For individuals who saw machines as equally capable of regimenting life and improving health, it was likely difficult to be anti-mechanization. To understand why American technological enthusiasm has rarely waned over the last century, in spite of the dramatic and often unfortunate changes it has wrought, we would do well to give our health machines a second look.

Notes:

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1. For more information on how technology is used to surpass human limits in athletic performance see Blake, A. 1996, *Body Language: The Meaning of Modern Sport,* Lawrence & Wishart, London., pp. 140-150; Kearney, J. 1996, "Training the Olympic Athlete: Sports Science and Technology are Today Providing Elite Competitors with the Tiny Margins Needed to Win in World-Class Competition," *Scientific American,* vol. 275, no. 6, pp. 52-57; Heres, J. 1986, "Science and Technology in the Service of Sport," *Olympic Review,* vol. 222/223, pp. 268-270.
2. Bennett, B. 1947, *The Life of Dudley Allen Sargent and his Contributions to Physical Education,* dissertation, University of Michigan, p. 18.
3. Students who entered Harvard's professional engineering programs had this lesson reinforced academically as well. Under chemistry professor and President Charles Eliot, Harvard actively sought to improve professional training in engineering in the 1890s. For more information see the Harvard homepage or Bennett, *The Life of Dudley Allen Sargent,* p. 11.
4. In spite of Sargent's impact on physical training and health machines, there is no biography yet. One of the best sources for Sargent's life remains a fifty-year-old unpublished dissertation, Bennett's *The Life of Dudley Allen Sargent.* Other research on Sargent's contributions include Mrozek, D. 1983, *Sport and American Mentality, 1880-1910,* University of Tennessee Press, Knoxville; Cottrell, D. 1993, *Women's Minds, Women's Bodies: The Influence of the Sargent School for Physical Education,* dissertation, University of Texas at

Austin. For the quotation on Sargent's contributions see Bennett, B. 1948, *Contributions of Dr. Sargent to Physical Education,* State Teacher's College, North Dakota, p. 1. See also, Fred Eugene Leonard, *Pioneers of Modern Physical Training* (NY: YMCA Physical Director's Society, 1911), 95-103.

5. See Sargent, L. (ed) 1927, *Dudley Allen Sargent: An Autobiography, Lea* & Febiger, Philadelphia, p. 59.

6. For information on the popularity of European strongmen in America see Chapman, D. 1994, *Sandow the Magnificent: Eugen Sandow and the Beginnings of Bodybuiding,* University of Illinois Press, Urbana.

7. Sargent, *Autobiography,* pp. 60-61, 82.

8. Sargent was nineteen years old and had not finished high school when he took the job at Bowdoin. See Bennett, *The Life of Dudley Allen Sargent,* p. 16.

9. For a description of Bowdoin's early equipment see Bennett, *The Life of Dudley Allen Sargent,* p. 18.

10. Ibid.

11. Sargent blamed Windship's health lift for extending the life of heavy-lifting equipment. He claimed they were "like mushrooms after the rain," springing up "in parlors and offices and schools everywhere." As a result, we can infer that colleges like Bowdoin, Yale, and Harvard kept their own out-of-date heavy equipment because it was similar to Windship's. There is no evidence that they invested significantly in health-lift machines, as these machines had weights adjustable for even the weakest individual to practice. For information on Sargent's views of Windship see Sargent, *Autobiography,* p. 97; for the quotation on torturous machines see p. 95.

12. Sargent was not the first to bring systematic physical education to the college level. Colleges had hired trained physical educators since the early 1820s. Edward Hitchcock, Jr. is generally credited with being the first formal physical educator at the collegiate level. He was appointed Professor of Hygiene and Physical Education at Amherst College in 1861. For more information on Hitchock see Whorton, J. 1982, *Crusaders for Fitness: The History of American Health Reform,* Princeton University Press, Princeton, p. 282.

13. Sargent, *Autobiography,* p. 95.

14. Ibid., p. 108.

15. Ibid., p. 109.

16. Ibid., p. 30.

17. Ibid., p. 60.

18. Bruce Bennett believes that Blaikie reinforced Sargent's ideas about symmetrical development and mechanized training. It seems almost certain that Sargent's decision to open a gymnasium in New York came as a result of Blaikie's recommendation in *Harper's Magazine.* For Blaikie's call for a New York gymnasium see Blaikie, W. "Free Muscular Development," *Harper's Magazine,* May 1878, pp. 915-24. For information on the connection between Blaikie and Sargent see Bennett, *The Life of Dudley Allen Sargent,* p. 27.

19. Blaikie, W. 1879, *How to Get Strong and How to Stay So,* Harper & Brothers, New York, pp. 11-12.

20. Blaikie, *How to Get Strong,* p. 75. Sargent recognized that in rare cases, one could achieve a perfect body without machines. He often praised Eugen Sandow, an Austrian-born strong man, as having the perfect physique. And while Sandow used pulley weights, some even of his own design, he primarily lifted barbells. Sandow, however, was the exceptional individual born with evenly dispersed musculature. Most students required machines to achieve his measurements. *[Ed Note: Actually, what "students" or anyone else required to achieve Sandow's measurements was years of progressive resistance with free weights and/or machines for the entire body. To reach Sandow's rare level of aesthetically pleasing shape, one also needed the bone structure to suport his "evenly dispersed musculature. "]*

21. For more information on early Health Lift inventors George Windship and David Butler see de la Peña, C. T. 2001, "The Machine Built Modern Body," in *Powering the Modern Body: Theories of Energy Transfer in American Medicine, Science, and Popular Culture, 1875-1945,* diss., University of Texas at Austin, pp. 18-74.

22. According to Sargent, the student body "as a whole" ignored the Hemenway before he arrived. See Sargent, *Autobiography,* p. 167.

23. Sargent describes Harvard's old gymnasium as similar to Yale's. For a description of Yale's gymnasium when he arrived in 1873 see Sargent, *Autobiography,* p. 138.

24. Hartwell, E. 1884, "The Rise of College Gymnastics in the United States," in *Special Report by the Bureau of Education. Educational Exhibits and Conventions at the World's Industrial and Cotton Centennial Exposition at New Orleans, 1884-85,* p. 670. For a description of Hemenway's main hall, which measured 125 X 113 feet and the facilities within it, see Bennett, *Life of Dudley Allen Sargent,* p. 46. For a contemporary discussion of the gymnasium's features see "Athletics and Gymnastics at Harvard," 1883, *The Wheelman,* vol. 2, pp. 417-423.

25. He included thirty of his own appliances at the New York Institute that he began in 1878 and continued to run until 1879, even after beginning at Harvard. Most of these, as had his machines at Bowdoin, revolved around a system of pulleys and variable weights. He advertised his studio to men, women, and children, reflecting each machine's versatility. For more information see Bennett, *Life of Dudley Allen Sargent,* p. 28.

26. At Bowdoin he built an early exercise machine by using window weights pulled over wooden roller that students would lift with an iron handle. See Bennett, *The Life of Dudley Allen Sargent,* p. 33.

27. "Athletics and Gymnastics at Harvard," p. 422. For a complete list of Sargent's "developing appliances" at the Hemenway gymnasium see Bennett, *The Life of Dudley,* Appendix A, pp. 268-269.

28. "Athletics and Gymnastics at Harvard," p. 422.

29. Sargent, D.A. 1880, "The Apparatus of the Hemenway Gymnasium," *The Harvard Register,* 1, p. 45.

30. Corbusier is largely credited for codifying the machine aesthetic in design. See Le Corbusier, 1927, *Towards a New Architecture,* Payson & Clarke, New York.

31. See advertisement for "Professor D. L. Dowd's Home Exerciser'"from 1886, in *Sporting Goods: Sports Equipment and Clothing . . . and Ornaments,* 1976, historical reprint, American Historical Catalog Collection, The Pine Press, Princeton.

32. Narragansett of Rhode Island later became Sargent's official machine producer. Bennett argues that Sargent's no-patent agreement with Harvard prevented him from ever making significant money from his machine designs. For a discussion of this see Bennett, *The Life of Dudley,* pp. 140-145.

33. Sargent, *Autobiography,* p. 151.

34. For information on Sargent's prescribed exercises see Sargent, *Autobiography,* p. 151.

35. Archibald Maclaren from Oxford said that exercises should mimic natural movements in his 1869 book, *A System of Physical Education: Theoretical and Practical,* Clarendon Press, Oxford. For more information on Maclaren's ideas in relation to Sargent's see Bennett, *The Life of Dudley Allen Sargent,* pp. 34-35.

36. Sargent, D.A. 1900, "The Inomotor: A Fundamental Mechanism for a New System of Motor Vehicles, Testing Apparatus and Devel-

oping Appliances," *American Physical Education Review,* vol. 5, p. 312. Sargent explained in 1890 that actual labor produced "good physical results in certain directions" but only a system of exercises that resembled actual labor could "supplement the deficiencies of one's occupation" and "develop him where he is weak." Sargent, D.A. 1889, "The System of Physical Training at the Hemenway Gymnasium," in *Physical Training: A Full Report of the Papers and Discussions of the Conference Held in Boston in November, 1889,* ed. I. Barrows, Press of George H. Ellias, Boston, p. 62.

37. "Athletics and Gymnastics at Harvard," p. 420. For the praise concerning the abdominal machine see p. 422.

38. For information on Sargent's battle with the faculty over inomotor training see the letter from Sargent to the President and Fellows of Harvard College dated March 25, 1905 in the Harvard archives. Letter quoted in Bennett, *The Life of Dudley Allen Sargent,* p. 147.

39. Sargent described one young bicyclist who won several competitions but nonetheless died of consumption after graduation. Sargent attributed this to the student's unwillingness to train his arms and chest, as the student had once told him that "arms and chests do not win bicycle races." See Sargent, "The Inomotor,' p. 315.

40. Sargent, "The Inomotor," p. 314.

41. Speakers who came to the Hemenway also echoed the message that machines could positively impact nerve force. Dr. Walter Channing of Boston gave a lecture at the Hemenway on "The Relation of Physical Training to the Nervous System" in which he described the perfect operation of the "nervous mechanism." Although man had a tendency towards degeneracy, he explained, these evils could be corrected by systematic physical training. One assumes he meant the kind of systems available at the Hemenway. See Channing, W., "Value of Physical Training," unspecified source, Sargent archives, Harvard University.

42. Sargent described this by saying that "the momentum acquired by the rapid revolution of these wheels will flex and extend the arms, trunk and legs for a considerable time without any active efforts, thus improving the returning circulation of the blood and removing the cause of fatigue when it has been produced." See Sargent, "The Inomotor," p. 323.

43. *Harvard Catalog,* 1880-81, p. 216. Harvard faculty and staff could also use the Hemenway's facilities without charge, except for a small locker fee. See Bennett, *The Life of Dudley Allen Sargent,* p. 48. Harvard did not require physical education for freshmen until after Sargent retired in 1919. *Athletic Committee Minutes* 1, p. 69.

44. From 1879 to 1885 there were roughly 1000 students enrolled in Harvard each year. This number increased to 2000 by 1904. See Bennett, *The Life of Dudley Allen Sargent,* p. 78.

45. See Bennett, *The Life of Dudley Allen Sargent,* p. 49.

46. *Annual Reports of the President and Treasurer of Harvard College,* 1883-84, p. 31. Quoted in Bennett, *The Life of Dudley Allen Sargent,* p. 50.

47. Letter from Edward E. Allen, instructor at the Perkins Institution for the Blind, pamphlet in Sargent archives, Harvard University.

48. Barrett, W. 1887, "Social Life at Harvard," *Lippincott's Monthly Magazine,* vol. 39, p. 157.

49. For information on Sargent's work with women see Cottrell, *Women's Minds, Women's Bodies* and Bennett, *The Life of Dudley Allen Sargent,* chapter 9, pp. 98-117.

50. Sargent developed his machines at Bowdoin where he worked with young men. In addition, even his New York gymnasium where he admitted women and children as well was geared primarily towards men. He had more hours for men to use the facilities, remembering that at 8 o'clock businessmen and professional men came on the way to work for exercises. Women used the facility in late morning and after a break for consultations, children came in from 2 to 5 o'clock. Before supper was reserved for businessmen and a young men's group exercised from 8 to 10 o'clock. This left men at least five hours on the equipment while women had about two. See Bennett, *The Life of Dudley Allen Sargent,* p. 29.

51. Sargent first used this measuring system in 1873 at Yale when he used chins and dips to test efficiency of students in handling their weight, preliminary test for heavy gymnastics work. See Sargent, D.A. 1913, 'Twenty years' Progress in Efficiency Tests,' *American Physical Education Review,* vol. 63, p. 454.

52. See Bennett, *Contributions of Dr. Sargent,* p. 3.

53. There is little written about Sargent's measuring machines. One of the best accounts is Roberta Park's in her survey of physical trainers. See Park, R. 1992, "Physiologists, Physicans and Physical Educators" in *Sport and Exercise Science: Essays in the History of Sports Medicine,* ed. J. Berryman, University of Illinois Press, Urbana, p. 153.

54. These three machines are described in one of Sargent's popular articles in addition to his regular medical texts. See Sargent, D.A. 1887, 'The Physical Proportions of the Typical Man,' vol. 2, no. 1, p. 7. For a more specialized description of the equipment see Sargent, D.A. 1887, *Anthropometric Apparatus with Directions for Measuring and Testing the Principal Physical Characteristics of the Human Body,* Dudley Allen Sargent.

55. For more information on these three machines see Sargent, *Anthropometric Apparatus,* pp. 12-14.

56. Dr. Edward Hitchcock at Amherst measured students weight, height, finger reach, chest girth, lung capacity, and strength in 1869. According to Bruce Bennett, Hitchcock's system had little influence on other schools. See Bennett, *The Life of Dudley Allen Sargent,* p. 6.

57. Carl von Linneaus is credited as the first anthropometrist. He wrote *Systemanatural* in 1735. For more information see Haller, J.S. 1971, *Outcasts from Evolution: Scientific Attitudes of Racial Inferiority, 1859-1900,* University of Illinois Press, Urbana, p. 4.

58. Anthropology inherited much anthropometric equipment in 1865 after the Sanitary Commission's studies, as academics set out to posit their own arguments about racial superiority or equality, depending on their views. See Dillingham, 1910, "Changes in Bodily Form from Descendents of Immigrants," Immigration Commission, Washington, 61st Congress, Second Session. Senate document no. 208, Government Printing Office.

59. See Haller, *Outcasts from Evolution,* p. 30.

60. According to Roberta Park, Sargent was the most prolific anthropometry promoter between 1880 and 1900. He published charts and directions for taking measurements and actively sought to sell his "developing appliances." In addition, the "Sargent system" was one of only three that were extensively discussed at the 1889 Boston Conference on Physical Training. See pp. 150-152 in Park, R. 1989, "Healthy, Moral, and Strong: Educational Views of Exercise and Athletics in Nineteenth-Century America," *Fitness in American Culture: Images of Health, Sport, and the Body, 1830-1940,* ed. K. Grover, Margaret Woodbury Strong Museum, New York, pp. 123-168.

61. See, for example, Swanson, R. and Spears, B. 1995, *History of Sport and Physical Education in the United States,* McGraw-Hill, New York, pp. 183-184.

62. Sargent did his studies between 1880-1900, a time historians have defined as "the golden age of anthropometric measurements." See Bennett, *The Life of Dudley Allen Sargent,* p. 174.
63. Linking race to physical ability is still very much a controversial issue as revealed by the mixed reception of John Entine's recently published (2000) *Taboo: Why Black Athletes Dominate Sports and Why we are Afraid to Talk About It,* Public Affairs, New York. In the nineteenth-century, it was common to regard dark-skinned people as "pure" physical types against which white bodies could be measured. Sandow, the nineteenth-century Austrian strongman, compared himself favorably to his muscular, dark-skinned students. In 1905 he traveled to Dutch Java, Japan and British India and covered the story for his own *Sandow's Magazine,* 1905, vol. 117, pp. 343-44. He also discussed Indian fitness programs in the *Daily News,* 1905, vol. 19. For more information see Budd, M. 1997, *The Sculpture Machine: Physical Culture and Body Politics in the Age of Empire,* MacMillian, Houndsmill, p. 83.
64. For more information on Taylor and his program see Banta, M. 1993, *Taylored Lives: Narrative Productions in the Age of Taylor, Veblen, and Ford,* University of Chicago Press, Chicago. For information on the measurement and recording of time see Eichbert, H. 1982, "Stopwatch, Horizontal Bar, Gymnasium: The Technologizing of Sports in the 18th and Early 19th Centuries," *Journal of the Philosophy of Sport,* vol. 9, p. 45.
65. One of Taylor's early studies involved workers at Bethlehem Steel who were "taught" to load three times as much pig iron in a single day thanks to Taylor's scientific management system. See Taylor, F.W. 1911, *Principles of Scientific Management,* Harper and Brothers, New York. Part two discusses his actual experiments.
66. Rabinbach, A. 1990, *The Human Motor: Energy, Fatigue and the Origins of Modernity,* Basic Books, New York, p. 23.
67. For information on "scientific eating" see Whorton, J.C. 1989, "Eating to Win: Popular Concepts of Diet, Strength, and Energy in the Early Twentieth Century," in *Fitness in American Culture: Images of Health, Sport and the Body, 1830-1940,* ed. K. Grover, p. 95.
68. In the 1880s, the Frenchman Etienne-Jules Marey experimented with internal body energy through his "physiological time." He experimented with photography, inventing a portable inscriptor to measure the way body parts moved in accomplishing a task. He was able to analyze the time it took a nerve impulse to travel to a muscle and get a reaction, thereby recommending ways to make movements more efficient. For more on Marey see Rabinbach, *The Human Motor,* pp. 93-94.
69. Taking pictures at 1/500th of a second allowed Muybridge to remove the mystery behind the movement of beautiful bodies. Along with Thomas Eakins at the University of Pennsylvania, Muybridge made 100,000 negatives of individuals running, weight lifting, and doing the high jump to discover the secret behind fluid motions. For more info see Mrozek, *Sport and American Mentality,* and Rabinbach, *The Human Motor,* p. 101.
70. Some of the researchers gave bleak forecasts for the modern body based on their measurements. Marey's view was especially unfortunate: he believed humans were unable to learn efficient means of movement and, as a result, would suffer inescapable energy loss. See Rabinbach, p. 118.
71.Sargent explains the symmetry ideal in "The Sargent Anthropometric Charts: Descriptive Circular," Sargent archive, Harvard University.
72. One newspaper article that appeared after Sandow's 1893 Trocadero performance commented, "what a wretched, scrawny creature the usual well-built gentleman is compared with a perfect man. Sandow, posing in various statuesque attitudes, is not only inspiring because of his enormous strength, but absolutely beautiful as a work of art as well." In addition, Professor R. Lankester, director of the natural history branch of the British Museum, made a plaster Sandow for the museum's exhibit on the "perfect type of European man." For information see Dutton, K.R. 1995, *The Perfectible Body: The Western Ideal of Male Physical Development,* The Continuum Publishing Company, New York, p. 124.
73. Budd, *The Sculpture Machine,* p. 116.
74. Henderson, L.D. 1998, *Duchamp in Context: Science and Technology in the Large Glass and Related Works,* Princeton University Press, Princeton, p. 159.
75. While the dynamometer ostensibly was to measure force, students often were more fascinated by the machine's working than by its results. John Harvey Kellogg used the dynamometer in the early 1900s and commented that "the procedure is a fascinating one, and the machine itself, with its mode of operation, often proves more absorbing to the newcomer than his own performance." Kellogg, J.H., 1906, *The Battle Creek Sanitarium Book,* Battle Creek, Michigan, p. 105.
76. For a detailed list of Sargent's student enrollment see Sargent, *Autobiography,* p. 212.
77. Student list from *Harvard Catalog,* 1887-1888, quoted in Bennett, *The Life of Dudley Allen Sargent,* p. 86.
78. McKenzie carried on Sargent's traditions. He explained in 1905 that "A strong, healthy, symmetrical body for the mass of our students has been our primary object," See "The Physical Side of College Men," 1905, *The Illustrated Sporting News,* vol. 5, p. 4. Mrozek says he had a "virtual obsession with the symmetry of the whole figure." See Mrozek, *Sport and the American Mentality,* p. 72.
79. Whorton, *Crusaders for Fitness,* p. 284. For more information on the YMCA's use of Sargent's system see Smith, J.G. 1899, "History of Physical Training in New York City and Vicinity in the Young Men's Christian Associations," *American Physical Education Review,* vol. 4, p. 306.
80. Sargent, "The Physical Proportions,"pp. 3-17.
81. *Official Catalogue of Exhibits and Descriptive Catalogue, World's Columbian Exposition, Department M. Anthropological Building, Midway Plaisance and Isolated Exhibits* 1893, W.B. Conkey Company, Chicago, pp. 20-22.
82. Park, "Healthy, Moral, & Strong," p. 152.
83. Sargent, "The System of Physical Training at the Hemenway Gymnasium," p. 65.
84. Dudley Allen Sargent, "The Physical Proportions," p. 15.
85. See, for example, Betts, J.R. 1969, "The Impact of Technology on Sport in the Nineteenth Century," *Journal of Health, Physical Education, and Recreation,* vol 40, pp. 87-90.