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MAJOR THESIS

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THE NATIONAL INSTITUTE FOR HIGHER EDUCATION

A REVIEW AND EVALUATION OF RESISTANCE TRAINING AND ITS DEVELOPMENT.

A THESIS SUBMITTED TO:

THE FACULTY OF HISTORY OF ART AND DESIGN & C.S.
IN CANDIDACY FOR THE DEGREE

FACULTY OF DESIGN
DEPARTMENT OF INDUSTRIAL DESIGN

BY

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MAY 1981

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INTRODUCTION

This Thesis concerns itself with the development of resistance exercise and its equipment. Since it deals with isotonic resistance i.e. resistance throughout a movement, no attempt at a comparison between this and other forms of exercise will be made. Another reason for this is that all other forms of exercise are relatively new and are only adapted forms of the original isotonic method.

The aim of this paper is to give a brief evaluation of resistance weight training from the days of ancient Greece to modern times. It also concerns itself with the development of organised physical activity in socities. Group physical involvement could be described as, the starting point for any sport or group activity involving movement.

CHAPTER 1.

1.1. MAN AND MOVEMENT

At present day man indulges in no less than seventy eight different sports. In all of these, varying degrees of skill, fitness and suitability are required. Each sport has its own specialised equipment. As involvement of the human body is the most common denominator in all sport, equipment which aids the adaptibility and suitability of man to the sport it the largest area to work in.

Among the seventy eight sports at least fifty five involve excessive movements of the human body. Excessive in so far as, the movements are outside the range of every day movements both in strength, time of action, and speed of action. Movement requires work which in turn requires energy. The efficiency at which man can convert chemical energy into physical energy could be described as a level of fitness. Muscle fibre through its ability to contract and relax is the interface between energy and work. In the human body muscles are connected to a series of levers called the skeletal system. This controls the power and range of mans movements, as the muscles are proportioned to the levers they are acting on.

1.2 STRENGTH AND EFFICIENCY OF MOVEMENT

To illustrate the difference between muscle strength, and muscle efficiency one could take the example of a man lifting a child in the air. The weight of the child is being lifted against the pull of gravity, therefore the man is lifting against a resistance. The mans muscle strength may be described as the amount of force he is able to apply in lifting the child. The efficiency at which he lifts the child, is the amount of energy he requires to exert that force.

All of mans movements are subject to resistance. It may be in the form of external resistance i.e. air, water etc., or resistance by body weight. All are subject to the pull of gravity which could be described as an environmental feature of mans existance. Without resistance man would have no need of muscles. Because muscles are the motor that allow mans movement, the more efficiently the function the better man is suited to his environment.

1.3 RESISTANCE TRAINING

There are two basic aims of resistance training, one for strength, and the other for endurance. The characteristics of the two training methods imply that, strength training produces hypertrophy of the fibres in the muscle, where as endurance exercise increases the number of capillaries. The increase in the size of fibres, and in the number of capillaries is accompanied by a gain in strength. This is characterised by:-

(a) The ability to produce more powerful contractions. this is a gain of power.

(b) The ability to repeat contractions more rapidly. This is a gain of speed.

(c) The ability to produce the contractions for a longer period of time.
This is a gain of endurance.

The strength of muscles can only be developed by exercising them against gradual increasing resistance such as pulling or pushing, lifting weights, or moving the body at increasing speed.

The gains that can be made in strength are far more striking than the increase in muscle size. It is possible to increase the power of the muscle three times without a proportional increase in muscle volume. Likewise, depending on the training programme a greater amount of work can be achieved more efficiently.

1.4 MODERN RESISTANCE TRAINING EQUIPMENT

To date there are three basic forms of resistance training. The equipment used depends on the system in use. The three types may be defined as follows:-

(a) ISOMETRIC RESISTANCE

This is where the muscles are loaded statically. With no movement the resistance is that of the force being applied in either pushing or pulling. This type of training involves little or no equipment but does require a lot of will power because no indication of improvement is given. Usually the exercises are conducted under instruction, and the short exercise programme conducted every day.

(b) ISOTONIC RESISTANCE

Here the muscles are exercised against a fixed or variable resistance throughout a movement range. The movement range defines the muscles being used. Equipment used in isotonic training comes in a wide variety of formats, the most popular being the barbell or dumbbell. Here free weights of a set value are fixed to a bar which is held throughout the movement. Springs, Hydraulics and many other systems are used to replicate the resistance.

(c) ISOKINETIC RESISTANCE

Resistance is given throughout a movement range in one direction. The resistance given by the apparatus is just under the force applied so movement is possible. Isokinetic resistance is rather like a mix of isotonic and isometric methods. Equipment is low priced, but has a short life span, and is suspect in its accuracy and flexability.

CHAPTER 2.

THE DEVELOPMENT OF PHYSICAL EDUCATION STRUCTURES IN SOCIETY.

2.1 Although preceeded by Solo, Rhodesian and Neanderthal peoples, the Cro-magnon remains are the sources of most of the information we have of primitive peoples. Their education was mostly physical since they were both hunters and hunted. Except for those events necessary for survival, dance was probably the only activity in which most adult men participated. The equipment used for physical fitness were the tools of lifes existance. Other activities were very much dependant on the climate or nature of the society.

From the time of the Minoan period to the conquest of Greece by the Romans, sport and physical activity was intense. No country since has matched the Greeks enthusiasm. In the Far East physical activity was of a different nature.

2.2 India due to its hot humid climate was not conducive to vigorous activity. Furthermore, the basic religion Hinduism did not encourage such activities. Being protected by the oceans and mountains gave her a lesser military motive than her surrounding nations. The art of yoga may have been the only outstanding contribution to physical activity the Indian people have made.

Chinas climate, and due to the effects of the Pre-christian, and Chindinisty wars, had ample motive for learning combative sports. As early as 2600 B.C. there were evidences of a system of "Medical Gymnastics." These are the first adapted, and corrective physical education programmes in history. Sport activities in China ranged from Head butting, many forms of boxing, and Jiu-Jitsu and empty handed method of combat used by Chinese monks. Also played in China was a one goal game of soccer played with a ball made of eight conical pieces of leather. Japan developed most of her physical culture as a result of direct influence by the Chinese.

2.3 In the Middle East much of the males life was spent in military service, labour, or sport. Sports such as Wrestling, Bullfighting, Acrobatics, and some Ball games. Swimming was a wide sport, and is referred to in the Bible by the Prophet Isaiah.

" And he shall stretch forth his hands under him, as he that swimmeth stretcheth forth his hands to swim."..... (ISA. 23:11)

Persia served as a connection between Western culture, and the Far East. They in 1200 B.C., were the first to implement an organised education programme in physical activities, where at the age of six, boys were taken over by the state, and trained for the military. However, one of the weaknesses of Persia as a culture was its lack of general education, the emphasis was on physical education only.

2.4 Up until the end of the first olympic era, the Greeks and the Romans enjoyed a large variety of physical sports, and activities which mounted with increasing attrocity. Not until 394 A.D. in the reign of a christian emperor Theodosius, did the olympic contest as they had become, come to an end.

The Christian church emphasised the importance of the soul, and the unimportance of the mortal body. Christ and his disciples who I am sure led robust lives, were portrayed with emaciated bodies and haggard faces. During the Dark Ages only a nobleman received a good physical education. He had the choice of becoming either a Clergyman or a Knight. It was not until the Renaissance period did people like Milton, Alberti, and Montaign along with a host of others express the desire to return to the classical ideal. Their writings showed a concern for the need for physical education as well as for the training of the intellect.

CHAPTER 3.

PHYSICAL EDUCATION SYSTEMS

3.1 Around the same time as Milton and his fellow writers were expressing their distaste, at the state of Renaissance man, efforts were being made to make changes. In late 1640 in Germany The Turnverin Movement was initiated by Fredric Jahn. However Jahn was not to see his ideal come true. Jahn wanted to unify all the small states into one powerful nation, but unification threatened the rulers of the small states. Hahn was arrested for his political activity. Jahn designed apparatus from tree trunks and other simple materials which he used in his programmes.

Per Henric Ling (1614—1681) Founder of the Swedish system of Physical Education started his work because he sought benefits, to an afflicted arm through fencing. His later programme of strengthening exercises, free exercises, simple apparatus work, vaulting and fencing, was based on scientific principles of anatomy, and physiology. Equipment for his programme and his successors was designed to take care of large numbers of students at one time.

Englands contribution to formal systems of physical education did not pass its embryonic stage until after 1800. This probably being because the English regularly favoured sports over other forms, or systems of physical education. Gymnastics were not known in England until 1652, which saw the first publication of a book on vaulting by William Stokes. We shall take a look later in this paper at some of the early english equipment.

The Americans developed their physical education structures from other continents. Although forms of Basketball and Baseball were played in Central America, most of her developed activities were direct copies or adaptions of imported games.

3.2 On analysis of the foundations and structures of physical education it can be said that most of the early apparatus and sports were a direct result of the society's natural surroundings. Sport and organised physical activity developed in discipline in the same format of military code and rules. As both are expressions of physical strength, skill, and method, this is quite understandable.

This link between military and sport activities would suggest that the area of physical activity was almost totally male orientated. This may or may not be true when you consider that most of history has been written by the male. Little evidence of physical activities or sports designed for females is evident in the post christian period to the end of the dark ages. It is true that female gladiators fought in the arenas in Rome, but one can be sure that few of these women were Roman. Attitudes on women and sport vary from society to society. Even in the Renaissance period it was only women of noble stock who could participate.

CHAPTER 4

PHYSICAL EXERCISE AND ITS IMPLICATIONS IN SOCIETY

4.1 Up to one hundred and fifty years ago, it was unavoidable that almost everyone in the population frequently undertook exercise of a moderate degree. Without public transport walking was a regular exercise for everyone. Most of the population would also have been employed in work necessitating physical labour, sometimes of marked severity. The development of stream power in industry, and of electrification saw many changes in working life style. The introduction of public transport in cities and later in rural areas, along with the car caused a major change in the physical life styles of modern man. Instead of being the prerogative of the few to sit in carriages it is now the prerogative of the few to walk.

4.2 Due to technological developments less and less activity is necessary during work, and few people take part in exercise during leisure time. None the less even the small amounts of energy used up in leisure time frequently lead to the position where more energy is expended outside the work period than during the work itself. It is conceivable that at the present day most men could manage their daily routines fairly well with primitive stumps for legs. Backsides are becoming obviously better cushioned for their task of almost continuous sitting. We are at the beginning of an era where exercise, if it occurs to any worth while extent at all, will take on an entirely different aspect. Exercise will no longer occur at work, and it will therefore no longer be obligatory for more that a few. It will be restricted to sports and games, and being voluntary, is likely to be the choice of a small highly selected group. This of course is so unless some positive action is taken to try to reverse this tendency.

Large scale adaptions are required by man if this state of circumstances develops, and the life expectancy, even survival of many individuals may be severely impaired if the level of exercise continues to decrease. If man suffers a radical change in environment, he may find he is physically not equipped well enough to make the transition.

4.3 Since man has replaced to a large extent the physical work of his existance, he needs to replicate it to hold a good balance between mental health and physical health. Apparatus, Sports, and Physical Activities have been designed to replicate the physical work man has used his mental work to abolish. Ironic and all as it seems, the effort is to condense the work with maximum effect in the shortest time.

As people become less used to physical work, the need for motivation to exercise increases. Often an incentive like image portrayal, advertising or group participation is incentive enough, but pure physical training is often undesirable because it is found repetitious and boring. The saving grace in physical training is when the individual can actually see physical improvement, be it in the form of beating his fellow competitor or some form of apparatus.

CHAPTER 5.

THE DEVELOPMENT OF WEIGHT LIFTING EQUIPMENT.

5.1 Because physical activity is much a group orientated activity, it is welcomed by society. In the early stages of modern weight lifting the focus was on the strong man of the fair. These individuals were treated as freaks of nature. These showmen specialised mainly with spectacular equipment like iron bars, "unbreakable" chains and the like. It was their emulators who turned to more conventional equipment. They started training with solid dumbbells and barbells.

The next stage in the development of weight training equipment came when the barbells and dumbbells were hollowed out and loaded with varying amounts of shot. This meant that weights could be adjusted to the lifters requirements. This process as one could imagine was time consuming and tedious. As in most situations, once the problem was recognised the design solution could be formulated. This beak came with the development of disc weights.

5.2 The design of disc weights replaced the existing double sphere or bell shaped weights. With disc weights a barbell or dumbbell could be loaded to within a few pounds of the required weight in a matter of seconds.

Although weight lifting competitions were already in vogue, they wereusually open to all body weights. Therefore the big strong man still held the prizes. Not until 1827 when international weight ranges from bantam weights to heavyweights were established,did real competitive lifting begin. With competitive lifting recognised "Lifts" were broadening the gap between the athletic strongman and the professional strongman. The three olympic lifts were:-

The two hands clean and press,

The two hands snatch,

The two hands clean and jerk.

The athletic strongman required a high degree of technique and skill along with strength to perform these lifts well. This differed from the slow moving feats of sheer strength of the strongman.

5.3 The separation of these two areas having been well defined, the next stage in development began around the 1930's. This was the beginning of the "PHYSIQUE" Competitions, and although the initial impact on the weight lifting world was small, it stood to cause serious damage to the sport in later years. The main aim of the early body builders was to become really strong men. Most enthusiasts had a healthy interest in breaking weightlifting records.

Following the second world war, strength took second place in the United States where Americans became "Physique Mad." 'A body beautiful' became a national status symbol, and in many cases physiques were developed far beyond their corresponding strength. Full scale competitions were held with large money prizes to attract the muscle men. The prize went to the man with the finest physique, and not the strongest competitor. Here formed the trend that muscle mass was power. Appearance overruled functional efficiency. The craze soon spread, and the exaggerated behaviour of a small minority turned the public against weight training in most of its forms, and against weightlifting as a competitive sport.

5.4 The only possible good to come of this was the sudden surge in design of 'Pumping Iron' equipment. The scientific principals were the boast of the new manufacturer. America saw the beginning of the scientific approach to weight training. In 1941 Harold Zinkin the first "Mr. California" and runner-up in "Mr. America" recognised the need for a safe, compact weight lifting machine that would work every muscle in the human body. Zinkin applied his experience in physical therapy and training to the design of a machine that safely controlled the weights so as to avoid strain and the usual hazards connected with weight training. The potential of Zinkins design was recognised by Chuck Coker, coach to the American Decathlon Team. Coker took one of the first prototypes of this new universal machine and toured throughout the United States demonstrating its benefits.

5.5 As more knowledge was gained of the human body, and its conditioning potential it became apparent that research should be conducted in order that equipment be built to meet mans specifications, rather than forcing man to fit the machines specifications.

The Universal Equipment Company of Fresno was among the first to take this approach to design of resistance equipment. The selected Dr. Gideon Ariel, olympic discus thrower, who was a specialist in computer science and biomechanics, to carry out the research needed for the design of their new equipment. Out of Ariels work came the new generation of machines incorporating "Dynamic Variable Resistance" (D.V.R.), which was a new understanding in resistance training. Up until this point conventional equipment gave resistance in only one line, that of the pull of gravity. As the mechanics of the human body give either mechanical advantage or disadvantage, and uneven resistance was had throughout the movement. The D.V.R. system allowed almost non varying resistance throughout the movement range.

ILLUSTRATIONS

LIST OF ILLUSTRATIONS

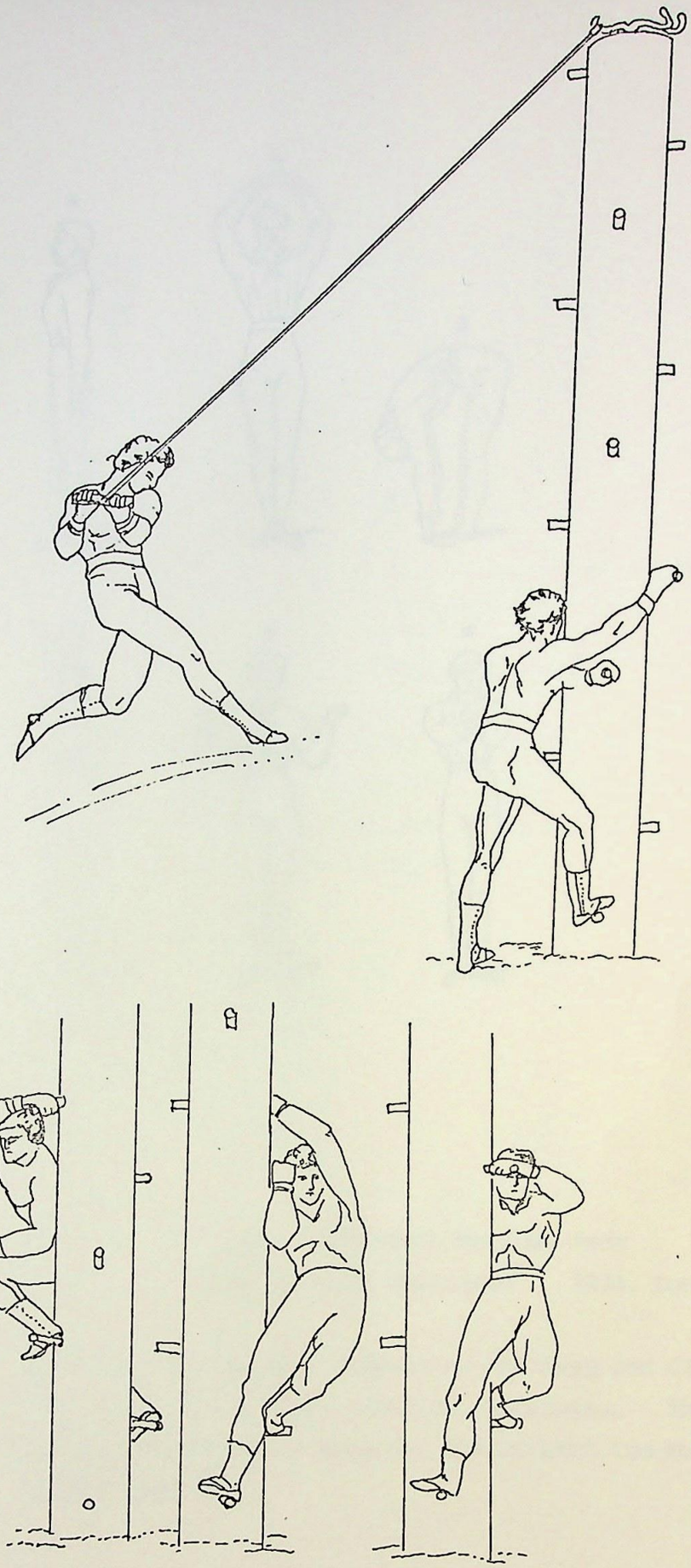


Fig. 1. Exercises on the Mast.
From Gymnastic Exercises by P.H. CLIAS, - 1825.

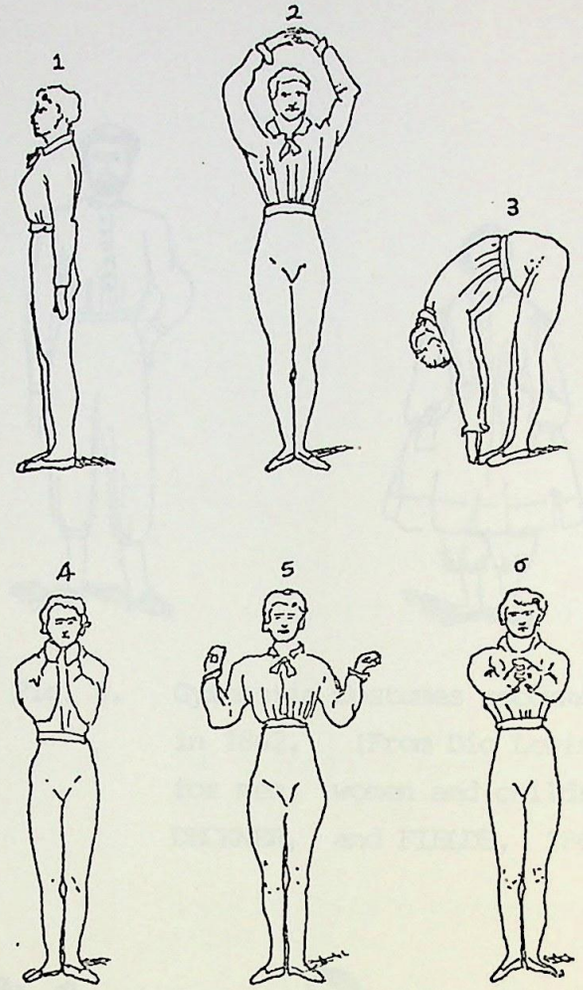


Fig. 2. A Copy of Extension Motions from "Walkers Manly Exercises" 1834. London

Theses exercises were adopted by the Navy and Caverly as part of their daily exercise programmes. The motions were used to warm up, and stretch the muscles before training.

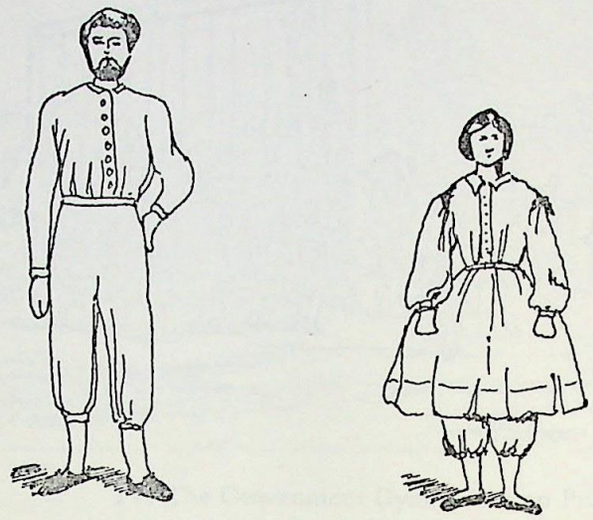


Fig. 3. Gymnastic Costumes recommended by DIO LEWIS in 1862. (From Dio Lewis, the new gymnastics for men, women and children, 8th ED, BOSTON, DECKNER, and FIELDS, 1864, P. 17)

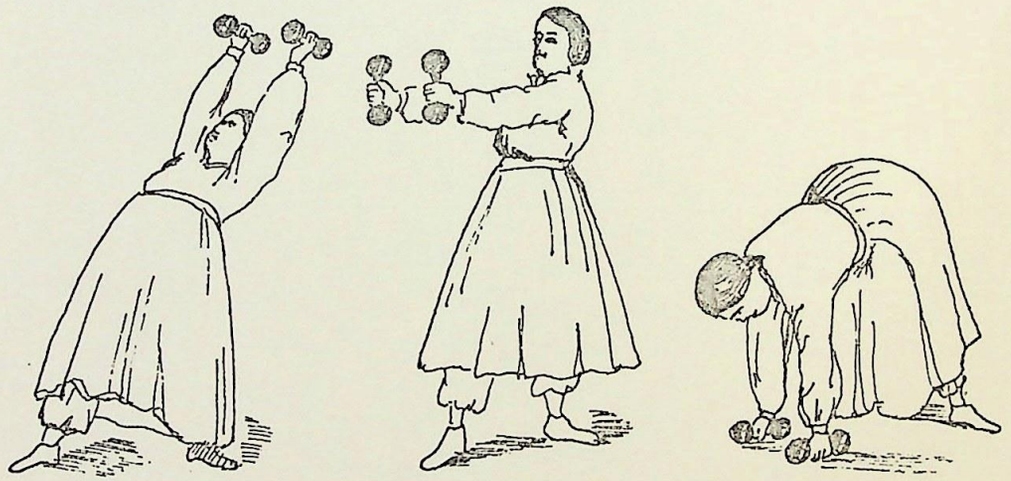
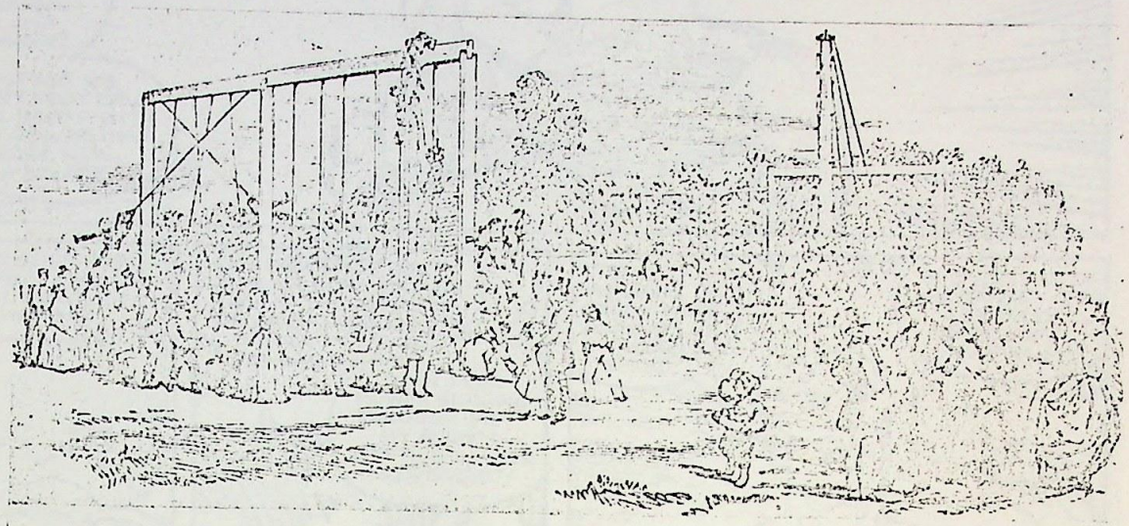


Fig. 4. Dumbbell Exercises for women devised by DIO LEWIS from "THE NEW GYMNASTICS," - 1866.



IV. The Government Gymnasium on Primrose Hill, 1848
Picture Post Library

Fig. 5. The Government Gymnasium on Primrose Hill, England. - 1848, (Picture Post Library)

Some of CLIAS'S Equipment can be seen in this illustration.

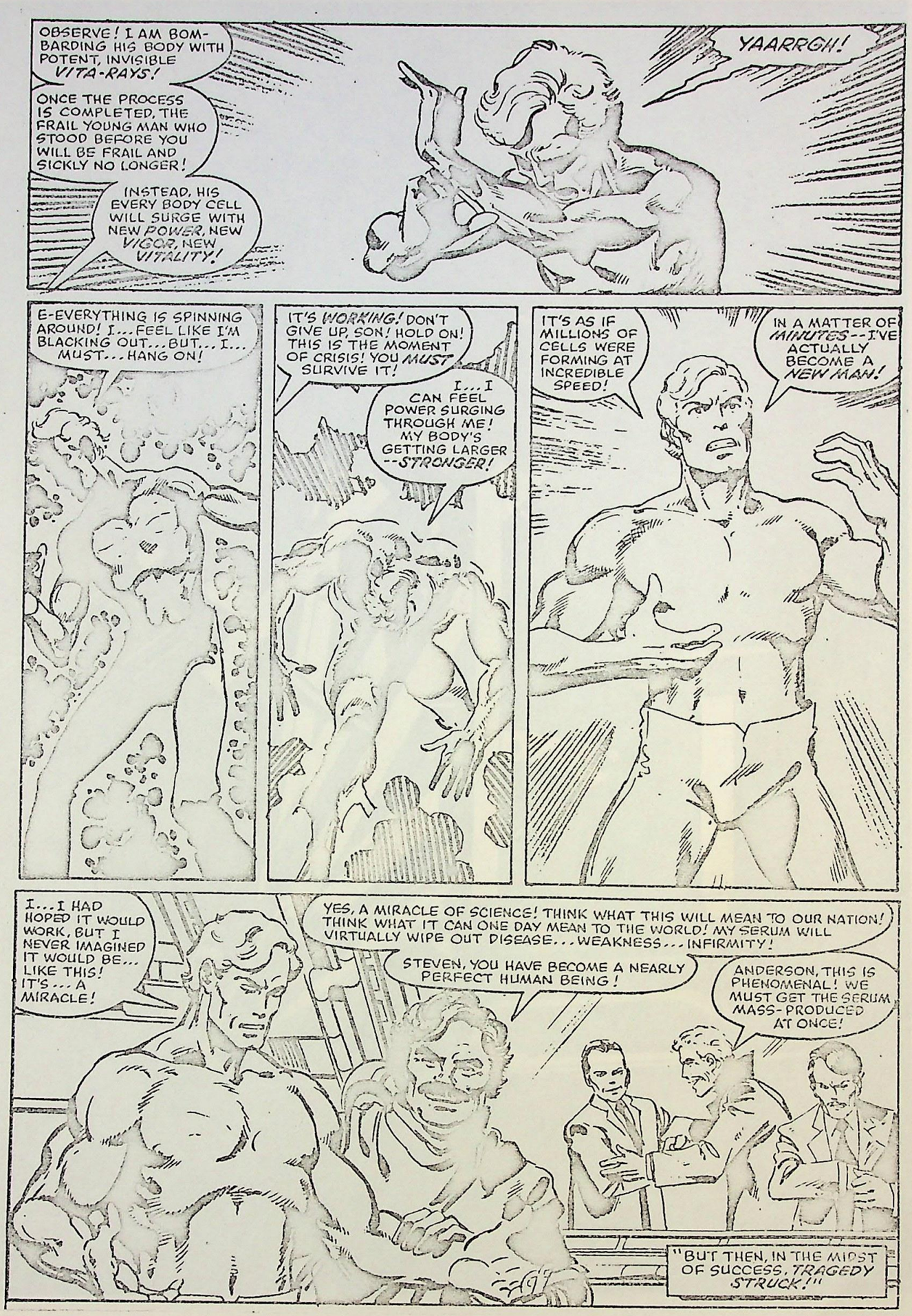


Fig. 6. "The Making of Captain America."
Marvel Comics U.S.A. - 1942

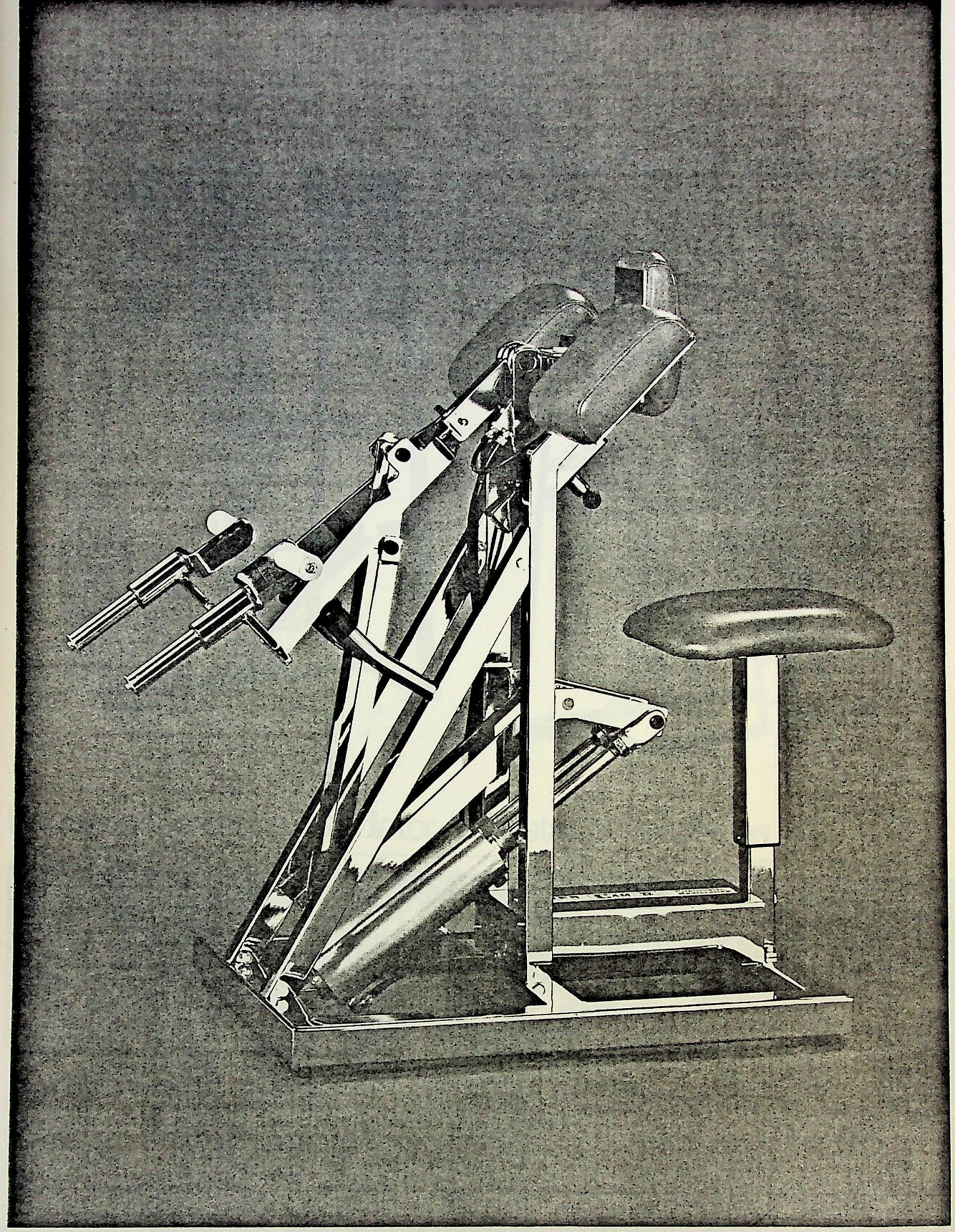
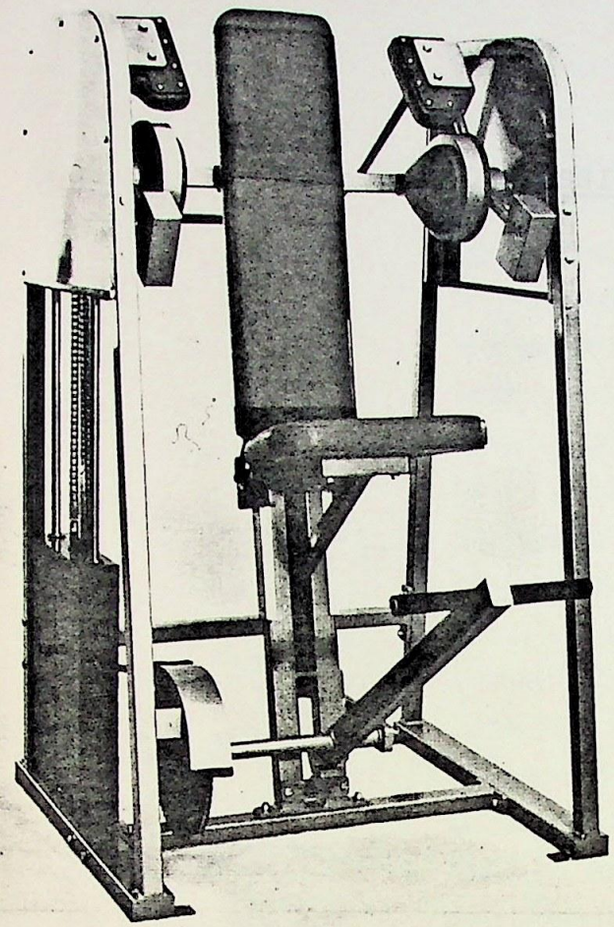
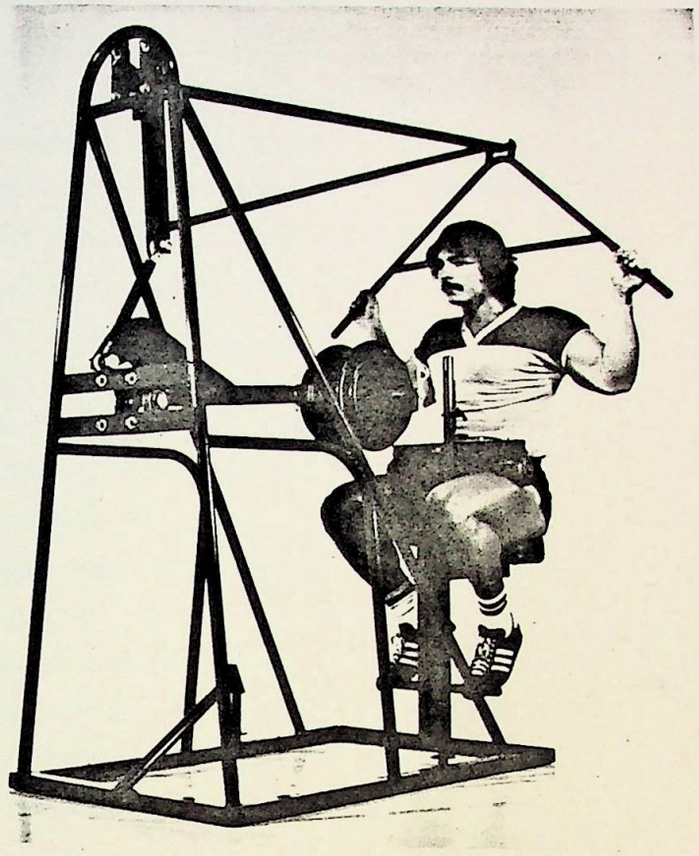


Fig. 7. Modern Resistance Exercise Equipment using Hydraulics (Keiser U.S.A. - 1981)

Nautilus



Corbin-Gentry, Inc.



Universal Centurion/Gladiator Multi-station Machines.

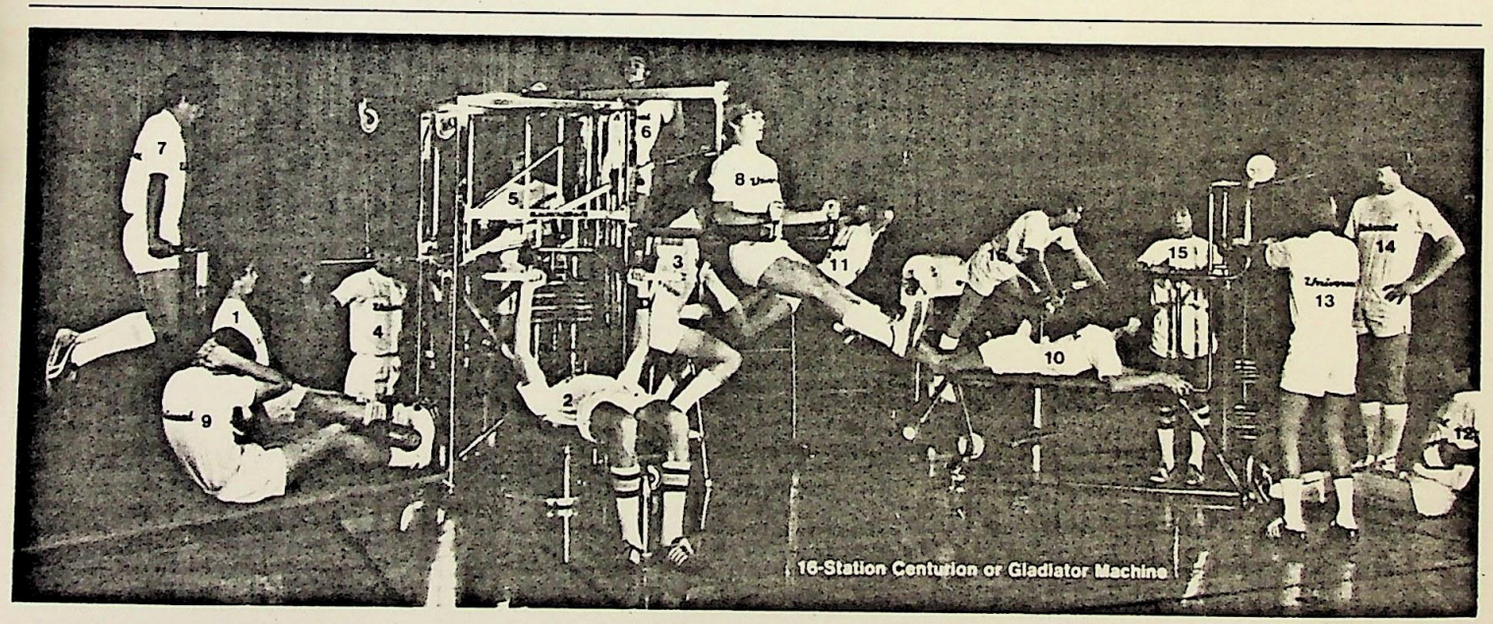


Fig. 8. Samples of Other Resistance Exercise Equipment

1970 - 1981

DISCUSSION

DISCUSSION

It can be said that design activity in resistance exercise equipment only saw its real developments at the beginning of the Industrial Revolution. As the effects of the worlds technological boom spread from country to country, so in passing did the area of resistance training. In some places its effect was great, and in others little. The classic example of a society going physique mad, can be seen in the United States, between the wars, and until present day, the trend still prevails. Not unlike a scientific breakthrough, the words of of the area, "Muscles, Strength, Vigour, Heman, Hero," could be seen in everyday society structure. The kids could read "Marvel Comics" with characters like "The Hulk" (who is now almost a reality) "Superman" and other muscle bound friends who ruled, or saved the world. Charles Atlas promise to fulfill every scrawney kids dream of being a muscle bound sex symbol in a matter of weeks.

Foodstuffs was another area that saw significant breakthrough in market size. The "Health Foods" and "Wonder Foods" used the new body beautiful image to aid their campaign. Americans placed full trust in the images of sailors eating spinage and being strong. After the depression the emphasis was on, make the children big and strong. The area developed a language of its own, and not unlike some slang words became part of modern language.

Even the portrayal of women changed. The Helen of Troy figure was no longer seen in vogue. Comics gave us "Superwoman" "Wonderwoman" and a host of other big chested, cat like figures. These cats, tended to look more like mountain lions, with big manes of hair, and bulging muscles. Under a smooth skin of satin, leather or whatever, they proudly marched to freedom from their oppression by man. For two generations women have been exposed to this medial presentation so it could be taken as a contribution to the state of present day revolutionary woman. Now that the female athlete has come into her own. The portrait is a healthy strong individual which vibrates a sexual animalism which had not existed until before christianity.

During the explosive growth of resistance training in the twentieth century, the scientific approach played an important role in the design of equipment. Not unlike other forms of science, the more knowledge man gains in the field, the more he sees how little he knows. Man has only begun to explore the limits of human performance. The result is that, what was once taken as simple fact has now turned into a complex science, with computerised biomechanical analysis of every muscle fibre. Without doubt this work will help man better understand the limits, and workings of human performance, but the concentration on too fine a work area will mean a neglect in other areas. There is a need to understand all aspects of work, exercise, and training, if man is to prepare himself for the future, be it space or a return to primitive surroundings.

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