

# A Close Look At Back

by Arthur Jones

Many coaches are convinced that squatting with heavy weights is a shortcut to ruined knees—most bodybuilders are equally convinced that good results from training will never be produced without squats. But just what is the real truth of the matter?

First, we need to establish just what occurs during a squat—just what muscles are involved, and how much of the work is performed by each of the various muscle groups that contribute to the strength required in a squat.

Look carefully at picture number 1, a subject standing upright in the finishing position of a squat—with an unloaded barbell on his shoulders and standing next to a vertically-mounted steel measuring tape.

Compare that first picture to picture number 2, the same subject in the low position of a squat.

Note the three pieces of tape that indicate the points of rotation that are involved in a squat—one “axis of rotation” at the ankles, another at the knees, and a third at the hips.

If you enlarged these pictures (as we did) and carefully measured the distances and degrees of rotation involved, then the following figures would be produced.

1—The distance (the vertical distance) from the ankle to the knee is 18 inches—and the rotational movement around the ankle joint is  $20\frac{1}{2}$  degrees. If we multiply the degrees of rotation by the “moment-arm” (the distance from ankle to knee), a figure of 369 will be produced. Indicating that 369 “units” of the work are being performed by the muscles of the calves.

2—The distance from the knee joint to the hip joint is 15 inches—and the rotational movement around the knee joint is 109 degrees. So the frontal thigh muscles are thus contributing 1,635 “units” of work to the squat.

3—The distance from the hip joint to the barbell is  $24\frac{1}{2}$  inches—and the rotational movement around the hip joint is 140 degrees. So the muscles of the hips and back are contributing 3,430 “units” of work.

Thus a total of 5,434 “units” of work are performed—with the division of labor being as follows: The calf muscles contributed a bit less than 7 percent of the work. The muscles of the frontal thigh performed approximately 30 percent of the work. And the muscles of the hips and back did by far the largest part of the work—approximately 63 percent of the work.

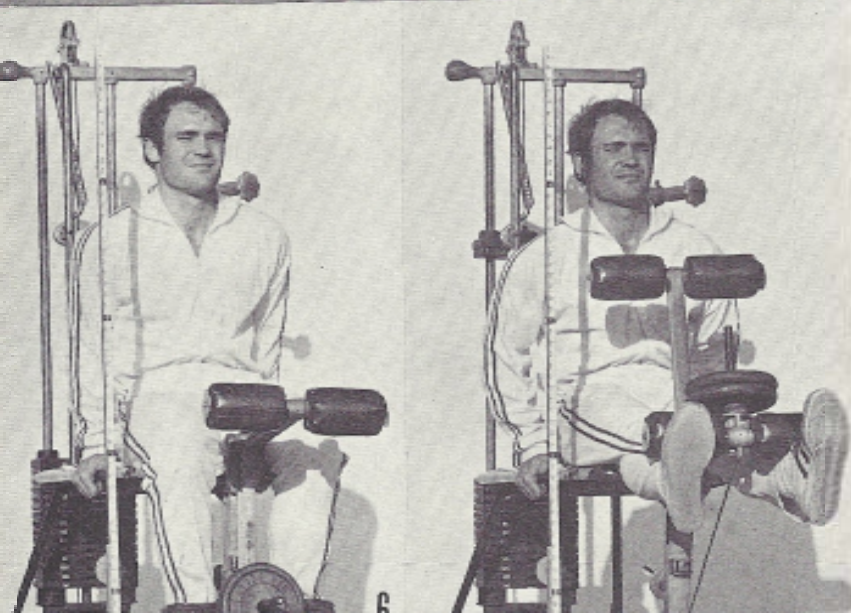
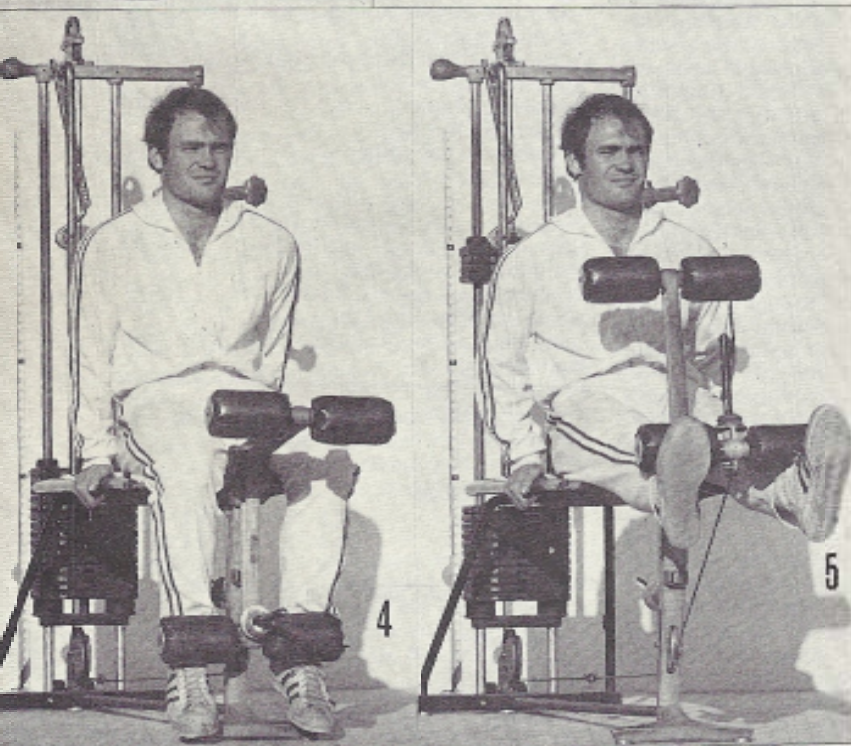
A surprising result? Did you expect to find that the frontal thigh muscles did most of the work?

Well, the truth of the matter is that this particular subject was chosen as an example of a man who does use his frontal thigh muscles to a much higher than average degree in a squat. This subject has long thighs and a short torso—so, when he squats, his frontal thighs are involved to a greater than average degree.

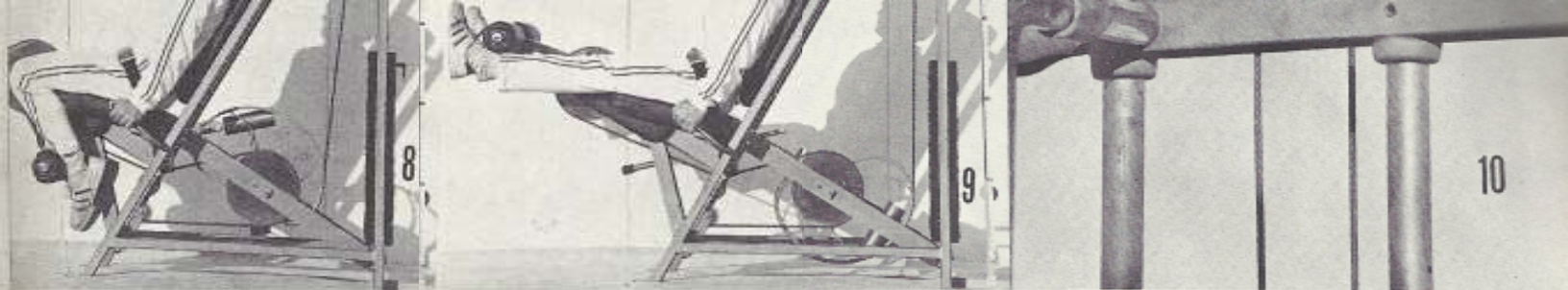
Casey Viator, a subject with an almost opposite build—and a far better than average squatter—has a long torso and short thighs; and his frontal thigh muscles contribute only approximately 16 percent to his squats—while his hip and back muscles do about 80 percent of the work.

So it should be clear that the frontal thigh muscles are NOT the muscles that are important in a squat.

But—just in case any doubt remains in your mind—I will







## And Leg Training

"foot pounds" of work, for more than ten repetitions performed in approximately as many seconds. 750 foot pounds per repetition—one repetition per second.

In a thigh extension machine, he can move 200 pounds a distance of 22 inches—a total of 366 foot pounds of work in each of an equal number of repetitions. Which might seem to indicate that his hip and back muscles are just slightly more than twice as strong as his frontal thigh muscles—except for the fact that the thigh extensions are performed much slower.

"Then," you might be tempted to ask at this point, "if the frontal thighs are relatively unimportant in a squat, why do squats make these muscles so sore?"

Simply because, by comparison to the muscles of the hips and back, the frontal thighs are weak. Thus, in squatting, the thighs are exposed to a workload that requires a rather high percentage of their strength—while the hips and back are not worked nearly as hard. The load is well within the ability of the hips and back—while straining the frontal thigh muscles.

So, as should now be obvious, the squat is a rather good exercise for the frontal thighs—but a poor exercise for the much stronger hips and back. Or, at least, this is true in the case of a proportionately developed subject.

But—as should also now be obvious—the frontal thigh muscles are really not as important as most people seem to think; the potentially much stronger muscles of the hips and back are actually of far greater importance in any physical activity involving strength of the legs.

In picture number 3 we have a comparison of a Universal Thigh Extension Machine and a Nautilus Super Thigh Extension Machine—both machines are shown in the "finishing" position, with the thighs straight and the frontal thigh muscles contracted.

Such machines are designed to develop the muscles of the frontal thigh, and thousands of Universal Thigh Extension Machines are now in use all over the country—so we will now have a close look at the actual function of such a machine.

In picture number 4, a subject is shown in the "starting" position in a Universal thigh extension machine.

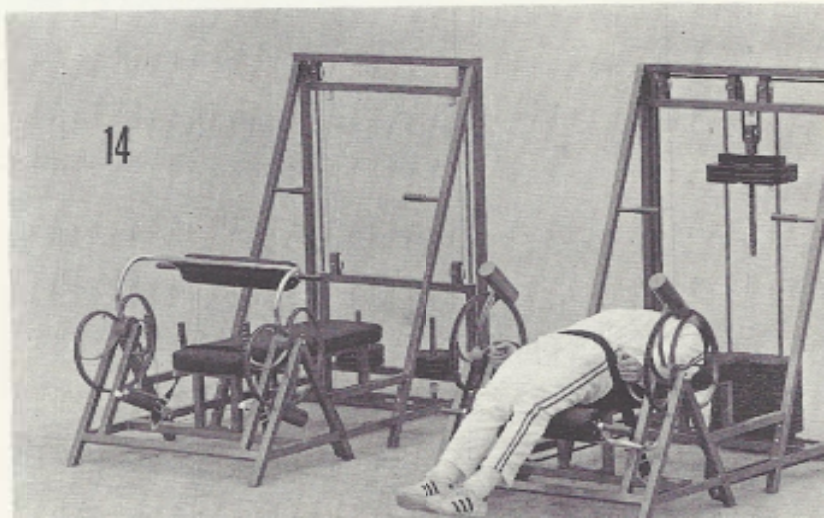
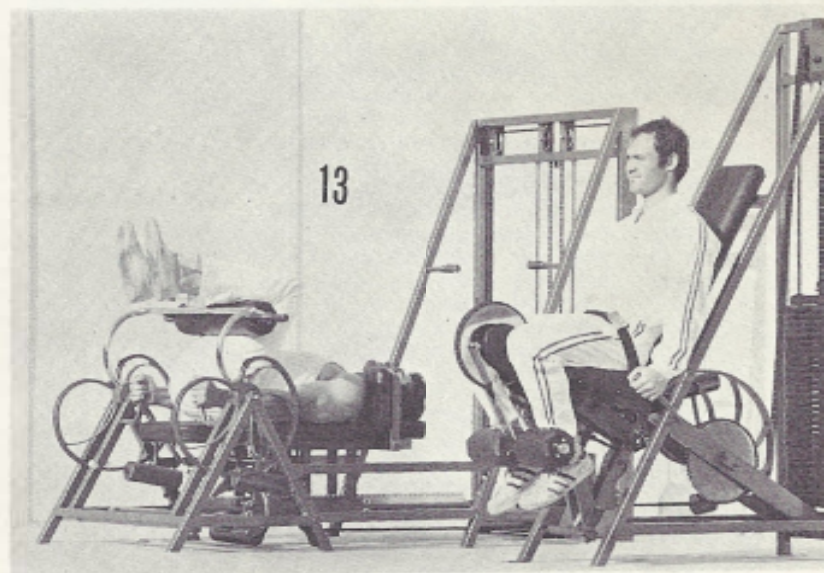
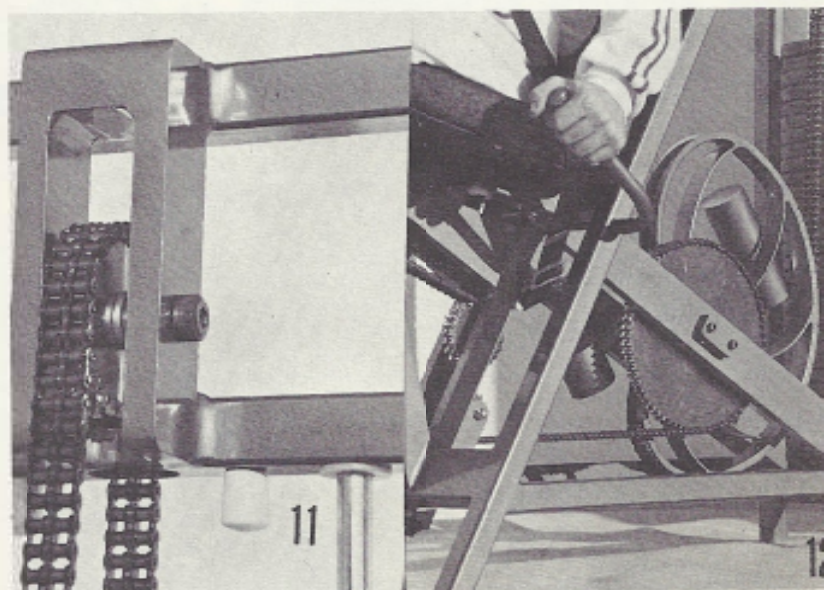
In picture number 5, the "finishing" position in the same machine is shown.

Note the steel tape next to the weight stack in both pictures—which makes it obvious that the weight moved a vertical distance of about 23 inches.

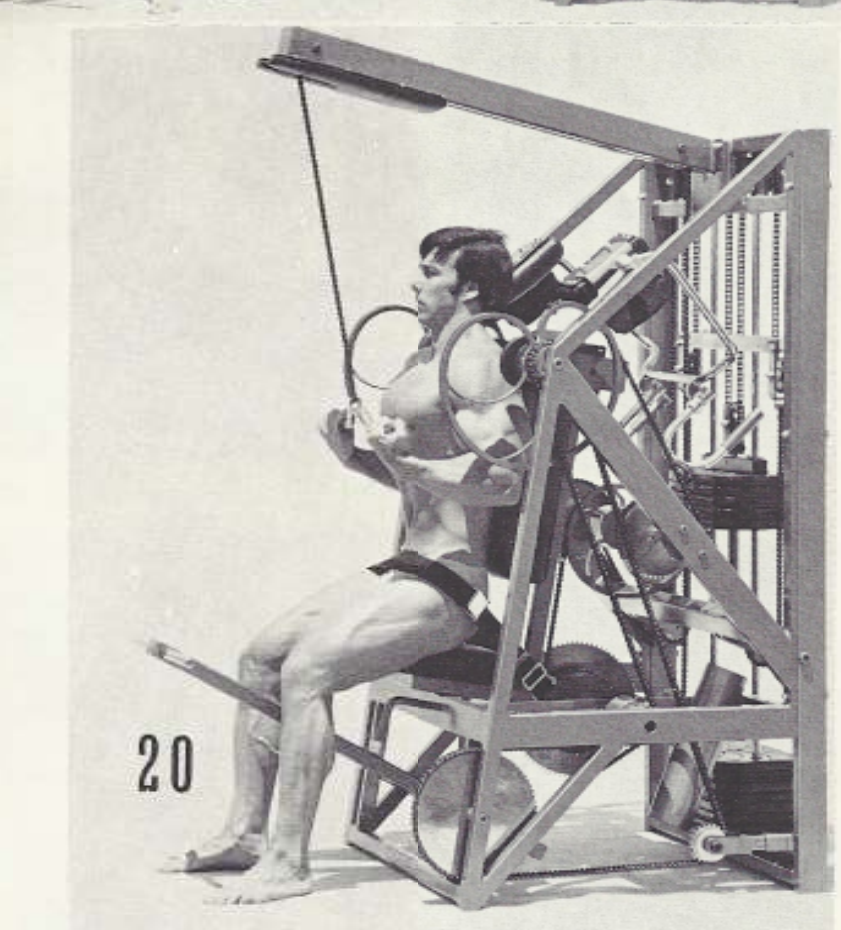
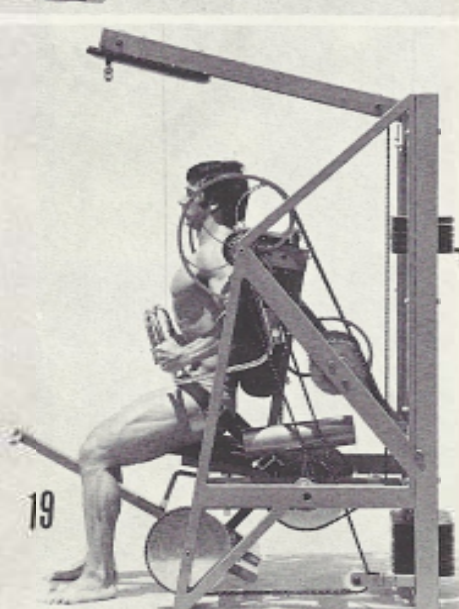
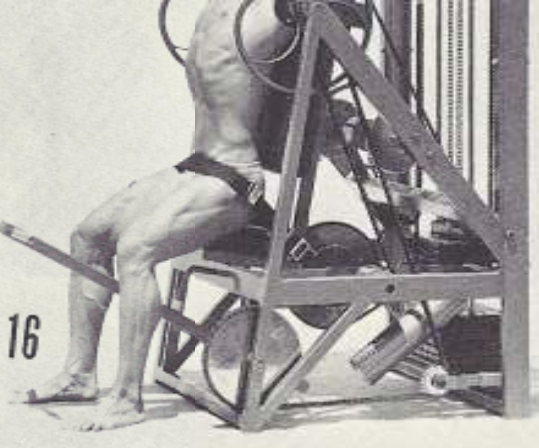
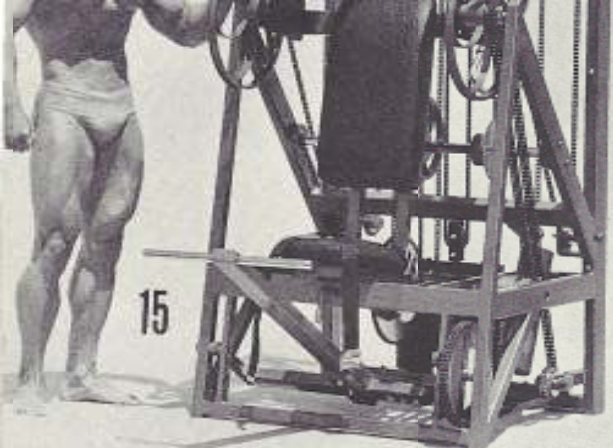
Also note the fact that the weight is driven by a cable that runs approximately horizontally under the seat, near the floor—which makes it obvious that the resistance is highest at the start of the movement and lowest at the finish of the movement. In effect, the resistance starts out heavy and gets lighter as the movement takes place.

In picture number 6, we have added additional resistance in the form of a barbell plate—this weight being placed on a pin in front of the ankle pads, a pin provided for that purpose. If a subject can use more than the total of only 150 pounds that is provided in the built-in weight stack, then additional resistance must be provided in this manner.

In picture number 7, the finishing position is shown—and, by comparing pictures number 6 and number 7 to the steel tape that has been moved forward in both pictures, it can be seen that the added resistance moves a distance of only about 17 inches.







that starts heavy and gets lighter, or you can have resistance that starts light and gets heavier, take your pick. But which is right?

NEITHER.

In picture number 8, a side view of a Nautilus Super Thigh Extension Machine is shown. Compare this to picture number 9, the same machine in the finishing position. The full "stroke"—as is clearly shown by the steel tape that is in both pictures—is approximately 28 inches—and the full "range of movement" is 134 degrees. The weight-stack is a built-in solid 300 pounds—twice the built-in resistance in a Universal machine, and with a longer stroke. The Universal machine provides approximately 3,450 "inch pounds" of resistance—the Nautilus machine provides more than twice as much, more than 8,400 "inch pounds."

But of even greater importance, notice the special "spiral pulley" (or cam) that constitutes the heart of all Nautilus machines—this cam provides exactly controlled and balanced resistance, a type of resistance that varies throughout the movement, providing exactly the right amount of resistance in every position. Automatically variable resistance, balanced resistance, full range resistance, constant resistance, double-direct resistance. **TOTAL RESISTANCE.**

In picture number 10, we see the redirectional pulley and bracket at the top of a Universal machine. A cast aluminum pulley and bracket.

In picture number 11, we see the same part of a Nautilus machine—with a solid-steel double sprocket, solid cold-rolled steel bracket supports constructed from  $\frac{3}{4}$  inch by 2 inch material.

The Universal machine uses a  $\frac{3}{8}$  inch bolt as an axle—the Nautilus machine uses a  $\frac{3}{4}$  inch special, hardened-steel shoulder-bolt as an axle.

The Universal machine uses a thin cable to drive the weight—the Nautilus machine uses a double chain with a strength of 7,400 pounds.

In picture number 12, we see the details of the "heart" of the Nautilus machine—note the special cam, the double sprockets (solid steel, chromed), the precision counterweights that remove all random torque, the  $\frac{3}{4}$  inch by 3 inch solid-steel "works box" and the overall fine finish of the machine.

We call this a "double balanced, closed circuit" machine—which simply means that the random torque of the movement-arm of the machine is exactly balanced-out, totally removed. Before you can regulate something, you must control it—so we start by perfectly balancing the special spiral pulley and its related parts, this being done by the small counterweight shown in several of the pictures. Then we add a second, much-larger counterweight that exactly balances the weight of the ankle pads and the rest of the movement-arm of the machine.

The result is a machine that is **PERFECTLY** balanced—all of the resistance is provided by the built-in weight stack, and this resistance is **EXACTLY** regulated by the special spiral pulley. If the weight stack is removed, then the movement arm will remain in any position in which it is placed—it literally weighs "nothing", since its mass is exactly balanced out by the large counterweight.

provided by the main weight stack. The added resistance starts out at its lowest point and gets steadily heavier as the movement takes place.



large crowds. I can remember some very large crowds at some of our past National Championships when we had several world champions active.

We have a man coming up now; in fact he is supposed to appear at the Sr. Nats, who could catch the interest of the public. He is a man of sensational power — a great power lifter who has turned to Olympic lifting — Jon Cole, who after 7 workouts on the Olympic lifts, made a total of 1200. Now this is pretty good in the 242 class. His style is very rough and how far he goes will depend on his desire to develop perfect style. It is very difficult to attain perfect style once you have started competitive lifting with bad style. That is why many nations will not permit a man to enter competition or to even lift heavy weights until he has developed perfect style. This often takes as much as two years. Cole's future depends upon his willingness to take time to perfect his style and the willingness of the powers that be to allow him time for this. Heavy competition immediately is not the answer. Clarence Bass also reports very good lifting for Dick Green, an officer in the US Air Force, who, while weighing 192, made 325, 280, 400 and just failed with a 300 snatch. This is not world championship caliber yet, but for a man we have not heard of before, it is great, and he has potential for becoming a world champion. Bass is working to try to get the Air Force to do something to permit this man to develop his full potential. There are a lot of other fellows around who also have great potential, such as Dr. Dave Martin of Denver, who as an 181 pounder made 285, 280, 370. He is coming up sensationally, and these lifts represent a gain of 15 pounds in each lift above his best of the past. There are many fellows whom I could mention, but this is an example of what we have to work with if we will get going right away.

You can see from all the above that we have a lot to talk and think about at the Sr. Nats this year.

The Senior Nationals will be held at the Masonic Temple Auditorium, 500 Temple Ave., Detroit, Michigan, June 10 and 11. The Committee meetings and clinics will be held all day the 9th, and some of these will be held at the Temple, we understand, but most of them will be at the official Hotel, the Detroit Hilton, 1565 Washington Blvd., in Detroit. At the present we do not have all the details of the location of all clinics. You should be able to obtain this information on your arrival. The Mr. America contest is scheduled to be held the evening of the 10th at 8 p.m. There will be pre-judging and this will be open to the public (for a fee) and will probably be open at about 10:30 a.m. Pre-judging will start at 9:00 a.m., but there will be nothing of interest to the public at first, since it will consist of interviews. It is very unfortunate that the pre-judging has been scheduled at the same time that lifting is in session. This is especially true since they are allowing the public to view the pre-judging. This means that officials will be needed for both the lifting and the Mr. America. Sometimes there are enough qualified men on hand for both, but there have been times when it was almost impossible to find what was needed. In addition to this it will

organizing committee can schedule the pre-judging at a different time. We had discussed this at our national committee meetings and we thought it had been agreed that the Mr. America would not be scheduled during lifting again. It could have been scheduled for the 9th, even tho it is a busy day; it wouldn't have conflicted with events to which the public is invited. Since the Mr. America is being held on Saturday night, the physique men still would not have had to be on hand more than two days if they didn't want to.

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ELSEWHERE you will find a report of the invitational meet in Mexico. The USA was fortunate and won the team title altho the Cubans did not show up with their strong team. The US lifters did well with some exceptions who bombed out. LaFontaine, Quinn, Holbrook, Rouff and Binney came through for nice wins. Binney did a good job as team Captain. Bob Hise was the coach, with Chairman Robert Crist as manager. It was reported that most of the men were cooperative and tried real hard. Some of them were "out on the town" a night or two before they had to lift, which is, of course, against the rules. We would recommend that these men be passed over next time a team is scheduled to be taken out of the country. Bob Crist emphasizes the need for an assistant manager. He says that one man just can't keep track of all the lifters. "You got to bed," he says, "thinking everyone is tucked in, and the next morning find that some of them were out most of the night." People who contribute money to send these fellows, don't appreciate that kind of conduct of the men who are sent. Since we anticipate the raising of large sums of money to send teams in the future, it must be understood by the lifters that this is not a pleasure trip, but a team effort where they are expected to be under rigid discipline and to do their best in every way. There are others waiting for the chance to make the trip, who are willing to do what is expected of them. The following officials made the trip and we have good reports of them all doing an excellent job. Dr. Boyd Bowden went along as team physician. He paid his own way. Frank Bates went along as one of the representatives. He also paid his way. Bob Crist was team manager, Bob Hise Team Coach, and Dave Matlin as the other representative. All the latter people were financed from the fund. We think this was a very worthwhile effort and will benefit the game in many ways, but hope to repeat this effort many times in the coming year.

#### FRIENDS OF WEIGHTLIFTING

The following people have made contributions to the Weightlifting Fund which helped send the team to Mexico City. This fund will continue to build for future promotion, etc. We appreciate the contributions, many of them unsolicited, indicating that you people really do care about the game and want to help. Keep them coming, and we will try to use the money wisely and profitably.

Clarence Bass and Father .....	\$300.00
Los Angeles YMCA .....	\$300.00
Denver YMCA .....	\$ 25.00
District of Columbia A.A.U. ....	\$100.00

Allen Pohlen .....	\$ 10.00
Dr. Richard You .....	\$ 20.00
Peary Rader .....	\$300.00
Mid-Western Weightlifting Club .....	\$ 15.00

Send your contributions to: Weightlifting Fund, Peary Rader, Chm., Box 10, Alliance, Nebraska 68001.

THE FIRST large Age Group Clean and Jerk Contest was held in Alliance, Nebraska April 1. A few comments are in order, tho we will not give details. To say that the meet was popular with the kids would be putting it very mild. These kids were really thrilled. They lifted like men and made some very fine lifts. The entry list was not as large as we would have liked, but we predict the next one will bring in a flood of fellows. The meet was easy to run off, and very fast. Medals were given for second and third place, showing a clean and jerk on them. Trophies were given for first place, since this was an area contest of importance for several states, but we recommend medals or ribbons for most such meets, since you will have so many entries with all the classes and three age groups. We were curious about the use of 5 attempts, and questioned the boys about it. Even tho some of them were about worn out for their 5th attempt, they all were in favor of 5 attempts. It is to be noted, however, that only two fifth attempt efforts were successful, which would perhaps indicate that the 5 attempts were not really of much value. When talking of the methods we can use to popularize lifting we cannot ignore Age Group lifting. This is likely to be the biggest factor in the future of American Lifting. Get these kids competing and you get their parents interested. They will make up most of the audience, and a very enthusiastic audience they will be.

The special medals are promised for us by the Sr. Nats and we hope to have samples there for you to see, and you may order what you want or need. We also hope to have the booklet ready for guidance of those promoting age group clean and jerk contests. It appears that the medals will run about \$1 each post-paid. This will be a nice medal with a ribbon and a presentation box. We hope to have small ones without ribbons or boxes for about 50c each. Each medal will have on it a man doing a jerk, with the words "Clean and Jerk". The medals will be in gold, silver and bronze, for first, second and third places. More about this later.

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IN CONNECTION with the Age Group Clean and Jerk Contest, we also held a Mid-America Snatch and Clean and Jerk contest. This was an open meet and it was probably the first of this type in the U.S. that we know of, tho they have been having them in Europe in recent months. Again, the enthusiasm exceeded our expectations. Even the lifters who have good presses liked it, and said they would like to see all our contests held without the press. The officials, of course, were very enthusiastic about the meet, and there were no unhappy lifters because of questionable officiating. What a real relief; what a breath of "fresh air" in lifting meets. The speed with which

(Continued on page 47)

high muscles, then this machine will do so far better than any other exercise device in existence. So much better that its results must be experienced to be appreciated.

How much better? Well, following are the preliminary results produced in one program using Nautilus equipment—a program carried out by William Andrews in Atlanta, Georgia.

Following a full month of training during which no attempt was made to estimate rates of progress, the results listed below were produced in a period of exactly two months. Progress was NOT based on strength increases produced during the first month—since it was felt that the first month

overcoming initial muscular soreness. Thus the "starting" levels of ability were recorded at the beginning of the second month of training—and the rate of progress was based on strength increases produced during a period of two months, the second and third months of training.

During that two months of training, out of a total of 75 subjects, 28 subjects improved their strength as follows—two by 65 percent, two by 60 percent, three by 55 percent, six by 50 percent, three by 45 percent, five by 40 percent, two by 30 percent, three by 25 percent, two by 20 percent.

These subjects were high school athletes from several Atlanta schools—and the above listed results were produced