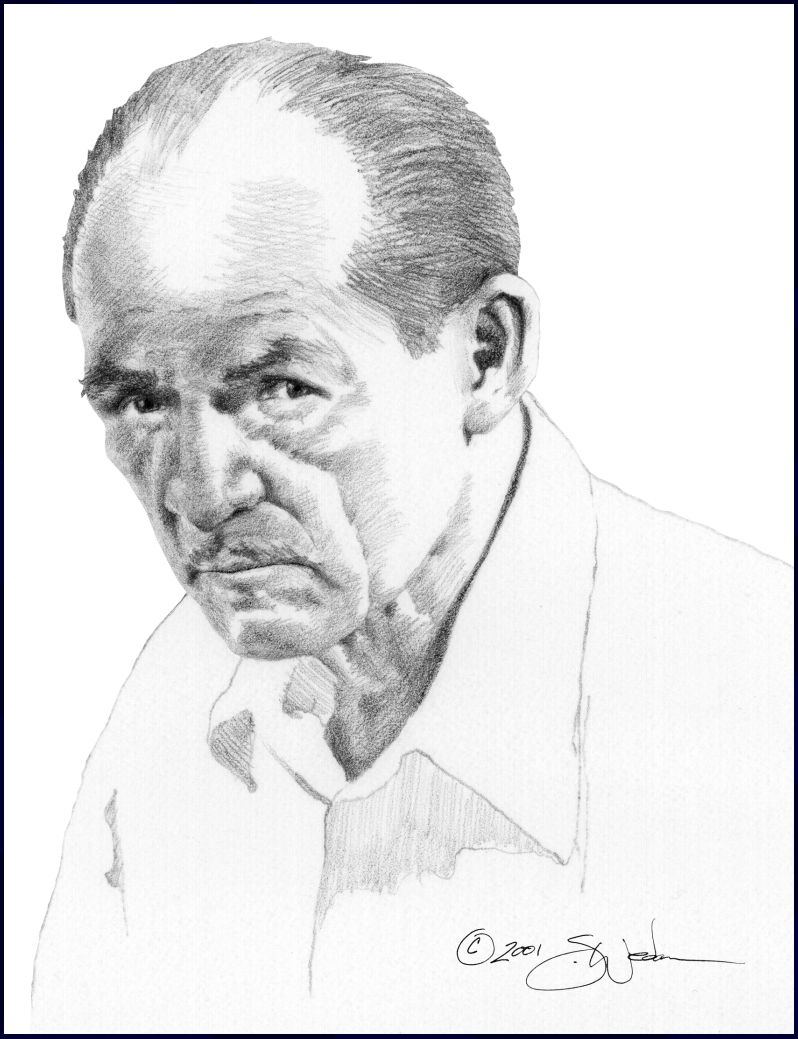
NAUTILUS

TRAINING PRINCIPLES

BULLETINS NO. 1 - 3



BY ARTHUR JONES

Edited by Drew Baye

Nautilus Training Principles: Bulletins No. 1–3
by Arthur Jones

Editing, foreword and layout by Drew Baye

E-mail: drew@baye.com

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All web addresses and phone numbers were accurate at the time of publication. Please send notification of changes to drew@baye.com. Any changes will be posted on www.baye.com and corrected in future editions of this book.

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Foreword

Arthur Jones' Nautilus Bulletins may be the most important books ever written on exercise, both for the ideas themselves and their influence on others who would advance and refine them over the following decades. His advice to "...work **harder**, but very briefly and infrequently" was revolutionary at a time when many bodybuilders were working out twice daily, six days per week and is the foundation of any productive exercise program.

Although over the years Arthur changed his mind about some things he wrote in the Bulletins—for example he later recommended training with fewer exercises less frequently—the general principles hold true and they should be read by everyone with a serious interest in exercise.

My goal when editing this edition of the Nautilus Bulletins was to organize and layout the material for an upcoming annotated edition, with one table of contents and index for each of the three Bulletins, as well as minor changes to formatting and punctuation for better readability. I decided to make this edition available separately for those interested in Arthur's original writing without comments from myself or others.

No changes have been made to Arthur's words; only to typography, formatting and layout. The Nautilus Bulletins were originally composed on a typewriter with limited typographical and formatting options requiring the use of typographic effects like WRITING IN ALL CAPS for emphasis where **bolding** would now be used or using hyphens in place of en and em-dashes. These types of things as well as the layout of numbered lists and tables have been changed to improve readability.

Select quotes appearing at the end of chapters did not appear in the original Bulletins and have been added to break up long blank spaces in the e-book version resulting from starting each chapter on a right page in the print version. This decision to keep the print formatting for the e-book was made to maintain consistent page numbers between the two.

The Appendixes were added to organize information appearing in multiple chapters into one place for convenience.

Permission to publish these Bulletins was given to me by Arthur during a phone conversation on October 11, 2006, while discussing the contents of and a situation involving the previously unpublished third Nautilus Bulletin.

Permission to use the cover illustration of Arthur Jones was given to me by Steve Wedan via e-mail on November 11, 2010. To view more of Steve's art or purchase his artwork on prints or apparel visit www.athletic-art.com

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"...work **harder**, but very briefly and infrequently"

NAUTILUS

TRAINING PRINCIPLES

BULLETIN NO. 1

Chapter 1: An Introduction and a Brief Background

While the author may be widely known in the field of physical training only as a result of the recently announced developments which are the subject of this Bulletin, quite a number of readers will probably recognize the name in connection with another field—since, for the past fourteen years, motion-pictures produced by the author have been in constant distribution throughout the world. Included in these credits were the following series of films produced for television, "Professional Hunter," "Wild Cargo," "Capture," "Call of the Wild," and major portions of four other series, as well as several theatrical and special films for television. The most recent film produced by the author was seen on CBS network on Friday, August 28, 1970 at 7:30 in the evening—titled "Free to Live: Operation Elephant," a one-hour, color special on a major conservation project, the capture and relocation of African elephants.

Before becoming involved in film production, the author was an airline pilot and conducted a large-scale import-export business in wild animals, birds, reptiles and tropical fish—an occupation which eventually led to the production of films based on conservation themes.

Eight members of the author's family—father, mother, brother, sister, paternal grand-father, uncle, cousin and brother-in-law—are medical doctors; or were, when still living. And the author has devoted a great deal of time to research programs in closely related areas—work dealing with both wild animals and human subjects.

Such work in the field of weight training dates back approximately thirty years—and while such research has certainly not been constant for that period of time, several years were spent in such studies; with, until very recently, no thought regarding the commercial possibilities that might result.

As recently as a year ago, it was the author's intention to publish the results of his experimental work in this field without taking credit under his own name; Bill Pearl was primarily responsible for causing a change of plans in that regard. He said, "…if you don't take credit under your own name, somebody will try to steal the credit for anything worthwhile that you have produced."

Since no commercial considerations were involved in the development of the new Nautilus training equipment, absolutely no publicity was given to this research program until long after everybody involved was satisfied with the results that were being consistently produced by a high percentage of the trainees using this equipment in experimental training programs; an as a natural result, many people are probably left feeling that the recently announced results are based upon hasty conclusions—whereas, in fact, the background of research data upon which these conclusions are based is literally enormous.

Secondly, since there is really no practical ground upon which a reasonable comparison between the new equipment and previously-existing types of conventional training equipment can be based, it is extremely difficult to even attempt to draw such comparisons.

How, for example could you fairly compare the barbell to any type of training equipment that existed previously? By comparison to any earlier equipment intended for the same purpose, the barbell was literally; a great leap forward, a major breakthrough, capable of producing more in the way of muscular mass and/or strength increases in a few months than any other method of training could produce in a lifetime.

And not the same sort of breakthrough has occurred again; and just as the barbell was an almost complete departure from earlier types of equipment, the Nautilus equipment is also something entirely new. Nautilus machines are not an improvement in equipment; instead, they represent a new approach to the whole idea of progressive weight training.

Rather than attempting to design exercises based on the use of conventional training equipment, the problem was approached from an entirely different direction; totally new equipment was designed to meet the needs of human muscular structures.

And in many respects, that was one of the most difficult parts of the problem; since it was first essential to establish just what was required for stimulating increases in muscular size and strength. And since very little in the way of serious work has been done in this field by the scientific community, there was almost nothing to refer to for guidance.

High degrees of results were obviously being produced by training with barbells and conventional pulley devices, but there was certainly nothing even approaching agreement insofar as the best method of training was concerned.

The production of any given result—regardless of how spectacular it may appear—proves nothing beyond the ability of a particular method to produce a certain result, eventually; and it certainly does not follow that the same degree of results could not have been produced by some other method.

So, rather obviously, in the almost complete lack of anything dependable in the way of guidelines, it was necessary to study the physics of both conventional forms of exercise and the functions of muscular structures.

In the following chapters, a brief—non-technical—outline of the basic physics involved will be attempted; but since this is actually a rather complicated subject, it must be remembered that a full explanation is impossible within the limits of length that must be observed in this bulletin.

For those who might be interested in greater details, a much longer account, a book titled “The Ultimate Development,” by the same author, will be available, in a few months. In a total of 99 chapters, the subject of physical training is covered in detail.

Chapter 2: Basic Physics of Conventional Exercise Methods

Almost all conventional exercises are based upon resistance provided by gravity; but even when springs are used as a form of resistance, the result is much the same—such resistance is unidirectional. And while it is possible, with the use of pulleys, to control the direction of resistance—it still remains almost impossible to provide resistance in more than one direction while using conventional training equipment.

There are a few exercises involving conventional equipment that can be performed in such a manner that this limitation regarding the direction of resistance can be overcome—at least for all practical purposes; but since these exercises form the subject of a later chapter, I will ignore them for the moment.

This limitation in direction of resistance is probably the greatest limiting factor affecting most exercises; since it thus becomes impossible to involve more than a small percentage of the total number of fibers contained in a particular muscular structure in any conventional exercise.

Because, while the resistance is provided in only one direction, the involved body parts are rotating; in effect, you are trying to oppose a rotational form of movement with a reciprocal form of resistance—an obvious impossibility. Impossible, at least, with conventional training equipment.

While performing a curl, for example, the movement is rotational throughout a range-of-movement of approximately 160 degrees; at the start of the curl, the movement is almost perfectly horizontal, straight forward—at about the midpoint, the movement is vertical, straight up—at the end, the movement is approximately horizontal again, but in the opposite direction.

Yet, during the entire movement, the resistance was always vertical, straight down. Thus, in practice, although the resistance remains constant, it seems to become heavier as the movement progresses from the starting position to the midpoint—and after the midpoint, seems to become lighter. In the normal finishing position of the curl there is literally no resistance—having reached that point, it is then possible to hold that position almost indefinitely, with absolutely no work being demanded on the part of the bending muscles of the upper arms.

This occurs because during a curl the moment-arm of the weight is constantly changing as the movement progresses; **Direct** resistance is provided only at the infinitely-small point where resistance is being moved vertically.

A careful scrutiny of conventional exercises will clearly show that this is almost always the case; direct resistance is provided only within an extremely limited range-of-movement, literally an infinitely small range of movement—and in many conventionally exercises, there is no direct resistance at any point.

If the normal strength curve of human muscles exactly matched the apparently changing resistance provided by an exercise like the curl, then the movement would feel perfectly even; that is to say, no point in the movement would seem to be any heavier than any other point. But since, in fact, the strength curve does not match the change in resistance, some points do feel heavier than other points; so-called “sticking points” are encountered, where the weight feels very heavy, as well as points where there is little or no resistance.

Just as jumping is not the best means of moving forward, since it involves the expenditure of effort in a vertical as well as a horizontal direction, trying to provide a rotary movement with constant resistance by using a unidirectional form of resistance is impractical at the very least. In such a case, resistance will only be—can only be—provided during part of the movement.

And even a casual thought should make it obvious that the maximum range-of-movement during which an increasing rate of resistance is even possible is a rotary movement of 90 degrees; after 90 degrees of rotary movement, the resistance must start decreasing. During the first 90 degrees of movement in a curl, for example, the direction of movement is constantly changing from horizontal to vertical, and the weight will thus seem to get heavier—but after 90 degrees of movement, the direction of movement starts changing from vertical to horizontal, and the weight will seem to grow lighter.

Direct resistance will be provided only at the point where the involved body parts (the hands, in a curl) are moving directly upwards, meeting resistance coming from an exactly opposite direction.

If, at that point of direct resistance, the weight is too heavy, then you cannot progress to that point in the movement; but if the weight is light enough to permit a full-range movement—even though heavy enough to require an all-out effort at the point of direct resistance—then you have provided balanced resistance only at one point in the curl. Thus you will be working the muscles properly during a range-of-movement of something less than 1 degree, out of a possible range-of-movement of about 160 degrees.

However, for all practical purposes, the situation is not quite that bad; in fact, you will be providing useful resistance during a range-of-movement of approximately 20 degrees. But still, what about the other 140 degrees of movement?

Now, regardless of the position you assume for the exercise, it remains impossible to produce more than 90 degrees of worthwhile movement; but it is possible to select “which” 90 degrees of movement you choose to exercise. But that subject also comes up in more detail in a later chapter, so I will skip it at this point; except to point out that some positions are far more advantageous than others, since they involve working the muscles in their strongest positions rather than in their weakest positions.

Now—it should not be assumed that the apparent change of resistance that is encountered in conventional exercises such as the curl is always a disadvantage; on the contrary, in many cases it is a distinct advantage.

Returning to the example of the curl, it should be noted that the bending muscles of the upper arms are in their weakest position at the start of the movement, when the arms are straight; and as the arms start to bend, the level of strength increases rapidly. Thus, in this instance the apparently increasing resistance is a very decided advantage; because the resistance is increasing at the same time that the strength of the working muscle is increasing—even if, as happens to be the case, not in proportion.

But still, any increase is better than none; since the muscles need more resistance as the arms are bent—and an incorrect rate of increase is better than no increase.

“But,” you might ask, “why do the muscles need more resistance as they contract?”

Because of the shape of the muscles—and because of the manner in which they function.

The well-known “all or nothing” principle of muscular-fiber function states that individual muscle-fibers perform work by contracting, by reducing their length—and that they are incapable of performing

various degrees of work; that is to say, they are either working as hard as possible, or not at all. When a light movement is performed, it does not involve a slight effort on the part of a large number of muscular fibers; instead, only the exact number of fibers that are required to perform that particular movement will be involved at all—and they will be working to the limit of their momentary ability. The other, unworking fibers may get pushed, pulled, or moved about by the movement—but they will contribute absolutely nothing to the work being performed.

Thus, as should be obvious, in order to involve all of the muscle fibers in the work, the resistance must be so heavy that all of the fibers are required to move it.

However, in practice, this is extremely difficult to do; because all of the individual muscle fibers cannot be involved in the work unless the muscle is in a position of full contraction.

It should be plain that the muscle could be in no position except its shortest, fully-contracted position if all of the muscle fibers were contracted at the same time; the individual fibers must grow shorter in order to perform work, and if all of the fibers were shortened at the same time, then the muscle as a whole would have to be in a position of full contraction—no other position is even possible with full muscular contraction. Not, at least, unless the muscle is torn loose from its attachments.

But it does not follow that even a position of full contraction will involve the working of all of the individual fibers; because only the actual number of fibers that are required to meet a momentarily imposed load will be called into play.

Thus, in order to involve 100% of the fibers in a particular movement, two conditions are prerequisites; the muscle (and its related body part) must be in a position of full contraction—and a load must be imposed in that position that is heavy enough to require the work of all of the individual fibers.

And in almost all conventional exercises, there is literally no resistance in the fully contracted position—at the very point in the exercise where the greatest amount of resistance is required, literally none is provided.

In the top position of the squat, when the leg muscles are fully contracted, there is no resistance on these muscles—in the top position of the curl, when the bending muscles of the arm are in a position of full contraction, there is no resistance—in the top position of the bench press, when the triceps are in a position of full contraction and the pectorals and deltoids are as close to a position of full contraction as they get in that movement, there is no resistance. Dozens of other examples could be given, but those three should be enough.

But what does the shape of a muscle have to do with this?

While I have never been able to find anything in scientific journals regarding the order-of-involvement of individual muscular fibers in the performance of work (although my being unaware of such studies does not indicate that they have not been done), the very shape of a muscle seems to make this point clear; or, at least, when the shape is considered in connection with other, easily proven, factors.

If a muscle is exposed to rotary, perfectly direct resistance, then it is immediately obvious that the strength of the muscle markedly increases as the position of the muscle changes from one of full extension to one of full contraction; which observation indicates that more fibers are involved in the work when the muscle is in a position of full contraction—or, at least, they are if resistance that will require their assistance is imposed.

And since a muscular structure is thickest in its middle, this extra thickness indicating the presence of a greater number of strands of muscle fibers in that area, it logically follows that this thick midsection of the muscle is the last part called into play in a maximum-possible effort—and that it cannot be called into play unless the muscle as a whole is in a position of full contraction; thus it seems that muscular contraction starts at the ends of a muscle and gradually moves inward towards the middle of the muscle.

In spite of an almost complete lack of scientific studies of the effects of exercise, it is self-evidently true that exercise does produce increases in both muscular mass and strength; and if this is true in spite of the fact that only a small percentage of the actual total number of individual muscle fibers are performing any work at all in conventional exercises, then it logically follows that a form of exercise which involved working all of the fibers would produce an even greater degree of results. Or, at least, that has been the apparently logical assumption that most of our research work has been based upon.

And now we come to the physics of compound exercises...

Most human movements are compound movements, involving the use of several different muscular structures; and in conventional forms of exercises, this becomes another limiting factor.

If, for example, you are trying to exercise your torso muscles, it is necessary in conventional exercises to also involve the work of your arm muscles; and since the torso muscles are far larger and stronger than the arm muscles, the arms fail at a point in the movement where the torso muscles are not being called upon to work as hard as they are capable of doing.

Various forms of chinning exercises, for example, provide a much higher order of work for the bending muscles of the upper arms than they do for the muscles of the torso; you can prove this very easily to your own satisfaction with a simple test involving a few previously-untrained test-subjects. Have each of these subjects perform four sets of regular chins, with a four-minute rest between set, and with each set being carried to the point of failure.

Forty-eight hours later, if they have worked as hard as possible, most such subjects will be so sore that they cannot fully straighten their arms; but this soreness will be almost entirely restricted to the arms—and to the ends of the arm muscles at that. There will be little or no soreness in the torso muscles—and certainly nothing to compare to the soreness in the arms.

Pullovers? Well, in this instance, while it may appear that you are working the torso muscles without involving the arms, a moment of consideration will make it obvious that the arms are still the limiting factor; in bent-arm pullovers, you are limited to an amount of weight that your triceps muscles are strong enough to keep away from your head—and in straight-arm pullovers, the strength of the elbow tendons is the limiting factor.

And in both forms of pullovers, the previously mentioned limitation in regard to worthwhile range-of-movement is very much in evidence; not more than 90 degrees of worthwhile rotary movement is possible—and yet, the latissimus muscles have a total range-of-movement in excess of 240 degrees.

Upon close examination, it will be immediately apparent that all conventional exercises for the torso muscles are limited in somewhat similar ways; using conventional methods, it is simply impossible to provide full-range resistance, or actually-heavy resistance, for the torso muscles. Yet in spite of these obvious limiting factors, great degrees of improvement in the size and strength of these muscular structures can be produced by conventional forms of exercise—eventually.

Years ago, I asked myself, "...what would the results be if such restrictions could be removed, if all of the muscles of the body could be provided with full-range, rotary form, omni-directional, direct, balanced, automatically varying resistance?" And now we are well on the way to getting an answer to those questions.

But make no mistake about one point; barbells and conventional pulley devices are extremely productive if used properly—by comparison to any earlier method of training, the barbell is almost literally a miracle machine. But it is so productive in spite of the limitations listed above, not because of any inherent advantages; and this is simply another indication that some other method of training, without these limitations, and with the inherent advantages of having been designed to provide the known requirements for stimulating muscle growth, would be even more effective.

The use of a barbell is limited by simple, unchangeable laws of physics; barbells cannot provide the required rotary form of resistance—full-range movements are impossible with a barbell in all but a few exercises—barbells do not provide the necessity for automatically varying resistance, resistance that changes during the actual performance of each repetition—barbells provide almost no direct resistance in most exercises, and literally none in many other exercises—barbell resistance cannot be balanced to the strength of a muscle in various position.

"But make no mistake about one point; barbells and conventional pulley devices are extremely productive if used properly—by comparison to any earlier method of training, the barbell is almost literally a miracle machine. But it is so productive in spite of the limitations listed above, not because of any inherent advantages; and this is simply another indication that some other method of training, without these limitations, and with the inherent advantages of having been designed to provide the known requirements for stimulating muscle growth, would be even more effective."

Chapter 3: The Functions of Muscular Structures

While most experienced bodybuilders are convinced that they have little if anything to learn regarding the functions of their most important muscular structures, I have yet to meet a bodybuilder who was aware of the prime function of even the most commonly mentioned muscle in the body, the biceps of the upper arm. But in all fairness, I must also point out the fact that only one medical doctor that I have questioned on the subject—out of a total of over one-hundred doctors—knew the correct answer, and this one well informed individual was a specialist in reconstructive surgery.

The prime function of the biceps is supination of the hand, twisting the hand—in the case of the right hand, in a clockwise manner; and the bending function is strictly secondary. One simple test will quickly prove this in an undeniable manner; bend your forearm back against the upper arm as far as possible, while keeping the hand twisted into a pronated ("goose-necked") position—then place your other hand on the biceps of the bent arm. You will note that the biceps is not flexed, even though the bending function of the biceps has been completed; that is to say, although the arm is bent as far as possible, the biceps has only performed part of its function—and the least important part at that. Now twist the hand of the bent arm into a supinated position—and as you do, you will feel the biceps flex. Full contraction of the biceps results in twisting the hand and forearm—and the biceps cannot fully flex unless this twisting takes place.

For that reason, you can curl more in a normal, palms-up position than you can in a reverse curl, palms-down position; simply because, in the reverse curl position, the biceps is prevented from twisting into a position of full contraction—it is thus impossible to involve all of the available muscle fibers in the work being performed, and the muscle is incapable of performing as much work.

The difference in apparent strength that is so obvious when the normal curl is compared to the reverse curl demonstrates the fact that twisting the forearm increases the bending strength of the arm—or, at least, the momentarily usable strength. This can be demonstrated by comparing usable strength available for twisting a leverage bell in various positions; it will be immediately apparent that you can exert a greater twisting force with a bent arm than you can with a straight arm.

In the last chapter we noted that muscles increase their usable strength as they change their position from one of full extension to one of full contraction; and now it should be clear that this apparent variation in strength (or this actual variation in usable strength) is not quite as simple a matter as it might seem at first glance. In the case of the biceps muscle, for example, bending the arm increases bending strength—but it also increases twisting strength—and twisting the arm increases twisting strength—and also increases bending strength.

The above has been intended as only one example of the actual functions of muscular structures; my point being that actual functions and "supposed" functions (or commonly accepted functions) are worlds apart.

And just how do you propose to exercise a muscle in the best-possible manner if you are not even aware of the function of the muscle?

Another example? Well, consider the function of the pectoral muscles—an apparent paradox. If you will perform a one-arm chin (or attempt one), it will be obvious that the pectoral muscles are involved in pulling the arm down and backwards, towards the torso from the front; but if you then perform a parallel dip, it will be equally obvious that the pectoral muscles are then pulling the arms down and forwards. But since a muscle cannot "push" a body part, and can only perform work by pulling, how is it possible for a muscle (the pectoral in this case) to perform work in two apparently opposite directions—first moving the upper arm backwards, and then moving it forwards?

The answer, of course, is that it cannot work in opposite directions; but it can appear to do so in some instances. The contracted position of the pectoral occurs when the upper arm is close to and slightly in front of the body—and when the arm is moved into any other position, then the pectoral will assist in returning it to that fully contracted position, from any direction.

Yet another example. The latissimus muscle; most bodybuilders perform exercises for the latissimus muscles with a wide grip—under the sincere, but badly mistaken, impression that such a wide hand spacing provides more "stretch" than would be afforded by a narrower grip.

Secondly, all conventional forms of chinning and "pull-down" exercises for the latissimus muscles involve working the upper arm muscles; and as noted previously, the weakness of these arm muscles prevents the trainee from working the torso muscles as hard as he should for best results. This being true, then why do most bodybuilders work their latissimus muscles with the arms in their weakest possible position?

We have already seen that the arms are strongest (for bending) when the hands are twisted into a supinated position; this being so, then why make the arms any weaker than necessary—when they are already too weak for the production of best results even in their strongest position? Yet most bodybuilders do exactly that; they work their latissimus muscles while keeping the arms twisted into their weakest possible position.

By simply giving the hands the maximum possible twist in the direction of full supination, the bending strength of the arms will be markedly increased; and it will then be possible to work the latissimus muscles much harder than it would have been with the hands in a pronated position. When the elbows are forced back in line with the shoulders—as is done in behind-neck chinning and pull-down exercises—then the fully supinated position of the hands requires a parallel (palms facing one another) grip. You can have such a bar made in a welding shop for a few dollars—and its use will markedly increase the degree of results you can produce in behind-neck type chinning or pull-down exercises; the hand grips should be perfectly parallel, and should be spaced not more than 25 inches apart.

Another example? The major muscular structures of the thighs and buttocks; these muscles are commonly exercised by attempting to apply resistance that is almost exactly 90 degrees out of phase with the direction of the movement of the body parts being moved by these muscles. In the squat, the weight is pressing down in line with the spinal column; yet neither the thigh nor buttocks muscles are capable of exerting force in an exactly opposite direction—instead, the frontal thigh muscles move the lower legs forwards, and the buttocks muscles move the torso into line with the thighs (or vice versa, the thighs into line with the torso).

In effect, the frontal thigh muscles require a thigh extension for direct exercise—and the buttocks muscles require what I will term a "torso extension" for direct exercise.

A careful review of the above examples will clearly; indicate that most of the major muscular structures do not perform the functions that most bodybuilders think they do—and literally dozens of other examples could be given to prove the same point. So, to be logical about the matter, you must determine the actual function of a muscle before attempting to select an exercise that is intended to develop that muscle.

The biceps muscles bend and twist the arms, so exercises must be provided for both functions—or, if at all possible, one exercise that provides proper resistance for both functions simultaneously.

The pectoral and latissimus muscles move the upper arms—what happens to the hands and forearms is of no concern to the torso muscles, or would be of no concern in a properly designed exercise; but if you must involve the arm muscles in torso exercises—as you must in conventional exercises—then at least do so only with the arms in the strongest possible position.

My real point in this chapter is this; move the involved body part that is of momentary concern into a position where the muscle that moves that member is in a position of full extension—then note the position of the body part. Next, move the body part into a position that results in full contraction of the involved muscle—and again note the required body-part position.

Then try to design an exercise, or an exercise position, which provides resistance over as much as possible of the entire range of movement—but if full-range resistance is impossible, as it will prove to be in most exercises using conventional equipment, then concentrate on providing the resistance in the contracted position.

A moment's consideration of the above paragraph will thus make it obvious that the so-called Scott curling bench is a step in the wrong direction; rather than being an improvement over the regular barbell curl, it actual reduces the overall production of results.

But if the slant had been in the opposite direction, so that the upper arms were held in a position almost parallel with the floor, but with the biceps side of the arm down instead of up, then the exercise would be provided where it would do the greatest amount of good—the resistance would be available in the strongest position of the arms, instead of being limited to the weakest position of the arms.

An almost impossible position to get into? It certainly is, but it can be done—and it can best be done while using a dumbbell, working first one arm and then the other. And after having worked both arms in that fashion, then immediately perform one set of about ten reps of the regular two-hand barbell curl—carried to the point of utter failure.

Perhaps the above points will start your thinking in a logical direction. But don't fall into the all too common trap of doing a particular exercise because you like it—or of avoiding exercises that are difficult. In general, the harder an exercise is, the better its results will be; don't look for ways to make exercises easier—look for ways to make them harder.

“In general, the harder an exercise is, the better its results will be; don’t look for ways to make exercises easier—look for ways to make them harder.”

Chapter 4: Indirect Effect

Throw a stone into a pool of water, and it will make a splash—and a wave will run to the far end of the pool; the larger the stone, the larger the splash—and the larger the wave. A very similar effect results from any form of exercise—I have named this "indirect effect". When one muscle grows in response to exercise, the entire muscular structure of the body grows to a lesser degree—even muscles that are not being exercised at all; and the larger the muscle that is growing—or the greater the degree of growth—the greater this indirect effect will be.

Until quite recently, this effect was most pronounced as a result of the practice of full squats. It has been repeatedly; demonstrated that the practice of squats—as a single exercise—will induce large-scale muscular growth throughout the body; and while nobody yet understands why this happens, there is no slightest doubt that it does happen. The results are extremely; obvious; for example—if a six foot man weighing 150 pounds is put on a regular schedule of heavy squats, he may gain 50 pounds of muscular bulk within a year, as a direct result of this one type of exercise. But all of this growth will not occur in the legs and the lower back—the areas of the body being worked—in fact, a very marked degree of growth will also occur in the muscles of the shoulders, the chest, the neck, and the arms. While such an individual might have 13 inch upper arms at the start of such a training program, it is almost impossible for his arms to stay that small; by the end of the program, his arms would probably be at least 15 inches. And in almost all cases, the bulk of this arm-size increase will be in the form of muscular fiber—rather than fatty tissue; the strength of the arms will increase in proportion (but not in direct proportion) to the size increase—in spite of the fact that no exercise is employed for the arms at all. All other muscular masses of the body will show the same effect—to a greater or lesser degree.

While it is certainly possible to build an obvious degree of disproportionate muscular size through the employment of an unbalanced program of exercises—and a training program limited to squats would be just that—there seems to be a definite limit to the degree of such disproportionate development that the body will permit; for example, it is difficult to build the size of the arms beyond a certain point, unless the large muscles of the legs are also being exercised.

It is very common for young men on a weight training program to ignore the development of their legs entirely—while concentrating on their arms and the muscles of the torso; on such a program, the arms will grow up to a point, but then additional growth will not be forthcoming—or at least not until heavy exercises for the legs are added to the training program, and then the arms will almost always start growing again immediately.

Apparently having reached a maximum permissible degree of disproportionate development, the body will not permit additional arm growth until the legs are also increased in size. Or perhaps some other cause/effect relationship is responsible—but the results are obvious, regardless of what the actual causative factors may be. It is not necessary to understand the effect to be aware of its results. While the actual percentile of effect from this factor is not known, it is obvious that it varies within a certain range—apparently depending primarily upon two conditions:

1. The larger the mass of the muscle that is being exercised, the larger the degree of results from indirect effect will be, and

2. The greater the distance between the muscle that is being exercised and the muscle that is not being exercised, the smaller the degree of results will be.

Thus it is obvious that heavily working the arms would have the largest indirect effect on nearby muscular masses, the pectorals, the latissimus, and the trapezoids—and the least effect on the muscles of the lower legs; and it is equally clear that the degree of in-direct effect produced by building the arms would not be as great as that resulting from exercise for the much larger muscles of the thighs or the upper back—all other factors being equal.

From these observations, a number of conclusions are rather obvious;

1. For good results from exercise, it is essential that the training program be well rounded—that some form of exercise be included for each of the major muscle masses of the body.

2. Greatest concentration should be directed towards working the largest muscles in the body, and

3. The training sequence should be arranged in such a way that the muscles are worked in order of their relative sizes.

In practice, this last point requires that the thighs be worked first, the latissimus muscles second, the trapezoids third, the pectorals fourth, the upper arms fifth, and the forearms last. Smaller muscles—such as the deltoids—should be worked in conjunction with the larger muscles whose functions they assist; or immediately afterwards, where such simultaneous exercise is not possible through the utilization of some form of compound exercise.

The first two conclusions indicated above are quite obvious, and require no additional explanation—but the third conclusion, the order of performance of exercises, may not be so obvious. It is generally agreed—and long experience has well proven—that the greatest degree of growth stimulation is provided by exercise that works a muscle well inside its momentary reserve of ability; but it is sometimes literally impossible to reach the required condition of induced momentary exhaustion while working a large muscular mass if the system has been previously exhausted by exercises intended for other, smaller muscles. Thus it is important to work the largest muscles first—while the system is still capable of working to the desired degree; secondly, since the largest muscles will also cause the greatest degree of overall indirect effect, this is another important consideration in this sequence of exercise.

Chapter 5: Frequency and Extent of Exercise

The subjects of this chapter are perhaps the most controversial issues in the field of physical training today; while there is some agreement on the types of exercise that are most effective, there is nothing approaching agreement on the subject of just how much exercise is required for best results or how frequently it should be repeated. The old expression, "A thousand different experts, a thousand different theories," is almost literally true in this instance.

At least in part, this situation arises from the fact that almost any amount of the right type of exercise can produce striking results in a very high percentile of test subjects; thus, almost any individual will show marked improvements in both muscular mass and strength within a short time after being placed on a weight training program—and this result will be produced in most cases regardless of the actual amount of exercise employed, at least for a while.

But while this is clear evidence of the effectiveness of such methods of exercise, in at least one important respect it is an unfortunate situation—because it has led to a commonly practiced habit of overworking, as opposed to proper training; "if some exercise is good, more is better", seems to be a common—though badly mistaken—theory.

During the Second World War, a number of very large-scale experiments were conducted in this field, and insofar as I have been able to determine, the results of these experiments were unanimous in at least one major conclusion; "there is a definite limit to the 'amount' of exercise that will produce beneficial results—carried beyond that point, exercise will reverse its own previous results, leading to losses in weight, condition, and stamina."

Yet, since then, it has been clearly shown that it is almost literally impossible to overwork insofar as "intensity of effort" is concerned; and to many people, these seem to be paradoxical conclusions—where, in fact, no paradox exists. The problem apparently is one of nomenclature, a simple—if widespread—misunderstanding of terms; "amount of exercise" has been confused with "intensity of effort."

And confused it has been, on an enormous scale—and thus we see thousands of examples of individuals training as much as twenty or more hours weekly, sometimes for periods of several years, in attempts to better their progress; where, in fact, far better results would have been produced in the vast majority of cases if such training had been limited to a maximum of not more than five hours of weekly exercise. And in the author's opinion, best results will be produced in at least ninety percent of all cases if training is limited to less than four hours weekly.

But—because such marathon training programs will produce a marked degree of results if continued long enough—it is almost impossible to convince people who have fallen into such training habits that even better results would have been produced by a much briefer workout routine.

A recent article described the training routine that one young man has followed for a period of seven years, four hours a day, seven days a week—twenty-eight hours of weekly training; and his results, in the end, have been fairly good—if not spectacular. But it is the author's contention that far better results would have resulted in far less time from the practice of a training routine that required only about

fifteen percent (15%) of the weekly time that this individual spent training—and if even the same degree of results could have been produced in one third of the elapsed time, then it is obvious that only five percent (5%) of this subject's training was actually required.

The actual requirements for exercise vary on an individual basis, of course—but do they vary on such a scale, on the order of two-thousand percent (2,000%), as was indicated in the above example? I think not. On the contrary, I think that this individual has merely developed a tolerance to this amount of exercise—and I cannot believe that it is an actual requirement.

Within the author's own personal experience, there have been literally hundreds of examples of individuals that have shown far better results than those produced by the above mentioned subject—while practicing a total of less than three percent (3%) of the number of exercise movements that have been employed by that subject within a period of seven years.

This being true—as it is—then what is the possible excuse for such extensive training programs? "Misdirected effort," seems—to the author—to be the only possible answer. Yet such misdirected effort is being employed on a vast scale—in tens-of-thousands of cases.

But what do the results of research indicate? Twenty years ago, in the course of experiments conducted by the author upon his own person, the greatest degree of results came from a program limited to four hours of weekly training—three weekly workouts of exactly; one hour and twenty minutes each.

And while I am fully aware that the results produced by one such case are of no real significance, this experience was at least enough to convince me that the then most common practiced training programs would be improved if reduced insofar as weekly training time was concerned. This conviction was primarily based upon the fact that I had previously been training more than twice as much, and that my progress had been at a standstill for several weeks—but then, almost immediately after reducing my training by approximately sixty percent (60%), I started to gain in both size and strength.

On a much reduced training program, my progress was far faster than it had ever been previously—and I very quickly reached new levels in both muscular size and strength, levels which I had previously considered impossible for me as an individual.

That experience occurred at a time when I had been training for almost ten years—during which span of years I had tried almost literally "everything" in my attempts to better my progress. Nothing was involved except a reduction in the amount of exercise that I was doing previously; otherwise, the training program remained unchanged—I performed exactly the same exercises in exactly the same way, reducing only the number of "sets" of each exercise and the frequency of workouts.

But while one such example proves almost nothing by itself, this personal experience was enough to trigger my thinking into a new direction; since then, almost all of my interest has been directed towards attempts to determine the exact length of training time that is required for the production of best possible results in most case. Twenty years later, the weight of evidence is simply indisputable; "in almost all cases, best results from heavy exercise will be produced by the practice of a very limited number of compound exercises that involve the major muscular masses of the body, and such training should be limited to not more than five hours of weekly training in any case and to about four hours in most cases."

In practice, best results are usually produced by three weekly workouts of less than one and one-half hours each.

Chapter 6: Intensity of Effort

Thirty years ago, it was noted that, "...the foreman of a crew of manual laborers will almost always be the strongest man in the crew—and he is the strongest because he is the foreman, rather than being the foreman because he is the strongest."

Yet, in almost all cases, the foreman performs far less work than any of the other men in the crew. A paradox? No—on the contrary, simple proof of the effectiveness of heavy exercise for the production of muscular size and strength. The foreman works only when the combined efforts of the other men in the crew cannot produce the desired result—he helps to lift the heavier than normal load; thus his exercise is brief and infrequent, but intense and irregular—and those are the exact requirements for producing the best results in the way of muscular size and strength.

Twenty years ago, the author noted an even more striking example of clear proof of the same theory; the relative sizes of the two arms of an individual that has been training with weights for a period of time long enough to produce marked results. In almost all cases, the left arm of a right-handed weight trainee will be larger than his right arm—usually to a marked degree.

Why? Simply because the left arm of a right-handed man must work harder to perform its share of an equally divided workload; it does not work more, nor differently—it works harder, with a greater intensity of effort. And it responds by growing larger than the right arm.

A right-handed man lacks some degree of "feel" in his left arm—his balance and muscular control are both less efficient in his left arm, and this remains true to at least some degree regardless of the length of time that he has been training both of his arms in an apparently identical manner.

The left arm works harder, so it responds to this increased intensity of effort by growing larger—and in tests of strength that do not involve balance or muscular coordination, the left arm will almost always be stronger as well as larger.

But when I have pointed this out to individual weight trainees—as I have done on repeated occasions—the response had almost always been along exactly the same line; "...well, in that case, I'll do an extra set of curls for my right arm—then it grow larger too."

Having missed the entire point, they assumed that "more" exercise was required—when in fact, this situation is clear proof that all that is required is "harder" exercise.

Intensity of effort is almost the entire answer in itself; lacking the proper intensity of effort, little or nothing in the way of results will be produced by any amount of exercise—at least not in the way of muscular size or strength increases. But given the proper intensity of effort, then very little in the way of exercise is required for the production of best possible results.

And although this has been pointed out repeatedly; to almost literally all of the several million weight trainees in this country, it still remains a largely misunderstood point; the usual practice is to do more individual exercises and more "sets" of each exercise, in the mistaken belief that such an increase in the amount of exercise will also produce an increase in the intensity of effort—which it obviously will not.

In fact, in almost all cases, the exactly opposite effect results; because it is difficult to perform seemingly endless sets of exercise while continuing to exert the maximum momentary level of intensity in each set—and as a result, the workout quickly degenerates into a form of rather hard manual labor.

But such workouts do product results—if continued long enough; another apparent paradox? Perhaps, to some people—but no actual paradox exists in this case either; the results that are produced are a direct result of only one or two sets out of each workout—regardless of the actual number of sets that are being performed. The other sets are literally wasted effort; worse than that, the additional sets beyond the minimum number required actually retard the progress that would have been produced if the workout had been greatly shortened.

"Best results will always be produced by the minimum amount of exercise that imposes the maximum amount of growth stimulation." And any other exercise that is added to the training routine will actually retard progress—in many cases reducing it by as much as ninety percent (90%), and if carried to extremes, additional exercise will result in losses in both strength and muscular size.

But just what is the minimum amount of exercise that will impose the maximum amount of growth stimulation? And that, of course, is the problem. A problem that will probably never be solved to the complete satisfaction of everybody concerned, and the problem that has led to the presently existing great confusion on the subject of just how much exercise is best.

But while it is perfectly true that the exact answer to that question remains unavailable, it is not true that no information on the subject exists; on the contrary, a great deal of very well proven information has been available for many years—and the last few years of research have given us at least a "practical" answer, if perhaps not a perfect one.

Fairly recently, new and rather surprising discoveries were made in connection with the actual mode of functioning involved in muscular contraction; and these true but largely misunderstood disclosures quickly led to the proliferation of theories which produced several forms of so-called "static exercise." One of these—isometric contraction—made the proposition that no actual exercise was required for the production of the maximum possible degree of muscular size and strength; all that was required—according to this theory—was the application of a high percentile of the existing strength level against an unmoving resistance, in a number of various positions.

In theory, the results should have been nothing short of spectacular—but in fact, the results were anything but spectacular; a spectacular failure, perhaps.

Yet the theory behind such exercise is basically sound—as far as it goes; unfortunately; the conclusions that were drawn from the facts that provided the basis of that theory ignored several other well established facts. A "cold" muscle is literally incapable of working within its existing level of reserve strength—and unless an imposed workload is heavy enough to force the involved muscles to work well inside their momentarily existing reserve levels of strength, then very little in the way of results will be produced.

Before it is even capable of anything approaching a maximum effort, a muscle must be properly "warmed-up" by the performance of several repetitions of a movement that is much lighter than its existing level of strength is capable of handling. If not, the muscle will "fail" at a point far below its actual strength level—but such effort, even if carried to the point of muscular failure, will not provide much in the way of growth stimulation; because it is not heavy enough to force the muscles to work inside their existing levels of strength reserve.

Thus, with static exercise, a man can repeatedly work to the point of muscular failure—while producing little or nothing in the way of worthwhile results.

But this does not mean that the theory behind such static exercise is totally worthless; on the contrary, some aspects of this type of exercise are worthy of great consideration, and should be included in any sort of training program. Maximum efforts should be made against an unmoving resistance—in every set of almost every exercise; but only after the maximum possible number of full movements have been performed, when the muscles are so exhausted from the immediately preceding repetitions that they are momentarily incapable of moving the resistance—in spite of a one-hundred percent (100%) effort.

Then—and only then—should such maximum efforts be made; and they should be made because—without them—it is literally impossible to induce maximum growth stimulation.

It is simply impossible to build muscular size or strength by performing that which you are already capable of easily doing; you must constantly attempt the momentarily impossible, and such attempts should involve maximum possible efforts—but only after the muscles have been properly “warmed-up”, and only after they have been worked to the point of momentary exhaustion immediately before the maximum possible effort leading to a failure is attempted.

“Best results will always be produced by the minimum amount of exercise that imposes the maximum amount of growth stimulation.”

Chapter 7: Cam Action

The strength of a muscle depends upon its position—muscles are weakest in their extended positions, and strongest in their fully contracted position; a muscle works by shortening, exerting a pulling force as it contracts—and its strength level increases as it changes position from an extended to a contracted position.

Yet almost all forms of exercise totally ignore this basic characteristic of muscles—and one result is that muscles are overworked in some positions while not being worked enough in other positions; in most cases, the muscle is prevented from working anywhere close to its true strength level—because the resistance employed, if light enough to start a movement with, is far too light to properly work the muscle in its strongest, fully contracted position.

Obvious results are produced by exercise in spite of this shortcoming, but this is merely another proof of the potentially enormous benefits that such exercise is capable of producing; and if this limitation is removed, then even better results can be produced—far better results.

If a man is capable of starting up from the bottom position in a full squat with 300 pounds of resistance added to his own bodyweight, then he can probably do a very "limited range" partial squat with at least 1,000 pounds—yet a thousand pounds would literally crush him helplessly to the floor if he made the mistake of bending his legs more than a few degrees under such a load.

The correct answer to that problem is quite simple—after the fact; but it required many years of research to produce any sort of an answer. An answer that is only now being placed into common practice. The resistance must vary throughout the movement, changing in proportion to the strength of the involved muscles in various positions.

Quite simple—after you have heard it; but so is a wheel—after you have seen one, and yet it took several thousand years of need before something as simple as a wheel was even thought of.

The varying strength of a muscle, however, is not entirely determined by its position—although that is an important consideration; an even more important factor is one I have named "cam action". Muscles work by moving in approximately straight lines, and almost all forms of resistance also impose their forces in approximately straight lines, but muscles cause movement by acting upon body parts that move in a semi-circular fashion. Thus, in order to raise a weight in a straight line, the involved body parts must be rotated—the only other possible method of raising a weight, and in this case it won't rise in a straight line, is by rotating the weight itself. In all cases, "something" must rotate—either the weight or the involved body parts; and in practice, this rotation is usually shared—the body parts rotate to some degree, and the weight rotates to some degree.

Thus, in practice, we encounter so-called "sticking points" in most exercises—a point in the movement where the resistance seems much heavier than it does at other points; and we also encounter points of little or no resistance—where the weight seems to weigh almost nothing.

Parts of these areas of seemingly varying resistance can be attributed to the variations in a muscle's strength in different positions, but cam action is responsible for a large share of these effects.

Fortunately, this problem has been solved—completely. Exercises now exist that are capable of working all of the major muscles of the body in an exactly rotary fashion.

But solving this problem led to another problem; once it became possible to eliminate cam action, then the effects produced by the variations in muscular strength in different positions still remained—removing cam action greatly improved the situation, but a perfect form of exercise had still not been achieved.

Doing away with cam action produced exercise movements that were actually perfectly smooth—the resistance was exactly the same in all possible positions; but it still didn't "feel" even—it felt too heavy at the start of a movement, and too light at the end of a movement.

But now this problem has been solved as well—completely solved; the actual resistance must vary throughout the movement—in exact proportion to the changing strength of the involved muscles. When this is done properly, the movement "feels" perfectly smooth—there are no sticking points, and no areas of light resistance.

Chapter 8: Full Squats—Pro and Con

Recently, there has been a tremendous amount of controversy on the subject of full squats. According to some people, the practice of full squats is an almost certain road to destruction of the knee tendons—and according to others, full squats are the best single exercise in existence. So, just what is the truth of the matter?

Well, to begin with, just what is a full squat? In power-lifting circles, squatting is limited to a point where the tops of the thighs are parallel with the floor—but to a man with heavy legs, that is a full squat; in fact, many of the heavier power-lifters have difficulty going that low—the backs of their thighs are solidly compressed against the backs of their calves long before they reach a parallel position. And that is exactly; why parallel squats are included as one of the three basic power-lifts—instead of full squats. Other-wise, there would have been endless controversy between the lighter men and the heavier men about how low a squat was supposed to be.

Competitive lifting is a dangerous sport—and this is true of both Olympic-style lifting and power lifting, but for different reasons; in practicing the fast lifts, in Olympic lifting, the suddenness of movement is probably the most dangerous factor—such sudden movements, under heavy loads, impose tremendous G forces on both the muscles and tendons. In performing a clean and jerk with 400 pounds, a man may momentarily expose his muscles and tendons to a force that is actually ten times as heavy as the weight being employed; and such forces sometimes tear out tendons or seriously injure muscles.

In performing power lifts, the danger comes from another source—from prolonged exposure to a force that may be more than the skeleton is capable of supporting, regardless of the strength of the muscles involved. At the moment of this writing, at least a few individuals are squatting with over 800 pounds—and since most of these men weight at least 300 pounds, this means that they are actually supporting over 1,100 pounds on their feet, and most of that amount on their spines. In the author's opinion, the human skeleton simply was not designed to support such loads for prolonged periods of time; for any purpose except power lifting competition, all of the benefits that can be provided by squats can be derived without using more than 400 pounds, and in most cases without using more than 300 pounds.

There is no slightest question about the effectiveness of squats; they are certainly one of the most result producing exercises in existence—and, until quite recently, they were the most result producing single exercise in existence. But it is not necessary to do heavy, single attempt squats in order to derive benefit from them; on the contrary, the most result producing version of squats is the practice of sets of from fifteen to twenty repetitions—with the occasional practice of slightly heavier squats on the 10/8/6 system. In that system, you perform three sets of squats in each workout—selecting a weight that will barely permit ten repetitions in the first set, and then increasing the weight approximately ten percent and trying for eight repetitions in the second set, and then increasing it another ten percent and trying for six repetitions in the final set.

If two sets—or a maximum of three sets—of squats are practiced two times weekly, and if a weight is used that will barely permit the performance of between fifteen and twenty repetitions, then this work will stimulate enormous overall growth, while increasing endurance, improving condition, and building great strength in both the legs and lower back as well as building a lesser degree of strength throughout the body from the previously mentioned "indirect effort."

Then, during the third weekly workout, if the 10/8/6 system of squatting is used, this will build almost the ultimate degree of overall bodily strength that can come from squatting—and without the danger of extremely heavy squatting.

Insofar as the "depth of squatting" is concerned, squats should be carried to the point where the backs of the thighs first start to contact the backs of the calves, and at that point the squat should be stopped by muscular action—instead of by bouncing the thighs off of the calves. Performed in that manner—the correct manner indicated here—there is no slightest danger from the performance of squats; not to the knees, at least—and very little danger of any kind if common sense precautions are observed. On the contrary, squats will do more to prevent knee injuries than any other exercise—or any other combination of exercises.

The greatest single disadvantage that squats have is the fact that they are brutally hard if they are practiced in a manner intended to give much in the way of results; and many weight trainees are simply not willing to work as hard as squats force them to. Such people—who exist in their thousands—have been quick to spread the rumors about the supposed danger to the knees from squats; because, then, they have an excuse for not performing them.

Joints are not damaged by normal movements—on the contrary, such movements are required to maintain the normal functioning of joints; held in one position for a period of several days, a joint becomes literally incapable of movement—held in one position a few months, a joint may well become permanently incapable of movement.

And while squatting—as a form of sitting—is much out of style in most parts of this country at the moment, it still remains, world-wide, by far the most common means of sitting; such figures are literally impossible to come by with any degree of accuracy, but if accurate figures were available, I would be more than willing to bet that knee injuries are far more common in this country—where squatting is almost never practiced—than they are in areas where squatting is still done as a routine matter of course.

So—by all means—include squats in your training program, and carry them to the lowest safe position, whatever that may be in any particular case; do them smoothly, under full control at all times, and stop at the bottom by muscular action—that is all that is required, and exactly the same rules apply to every other exercise you can think of.

If you still remain unconvinced, then ask yourself just why I am so anxious to convince you of the value of squats; after all, it makes no slightest difference to me whether you do squats or not—or "how" you do them, if you do them. Squats are not something that I can sell you, nor did I invent them—they are simply a very good form of exercise that cannot be duplicated insofar as benefits are concerned by any other single exercise.

Do them, or don't do them—but if you don't, then you probably will suffer from knee injuries, especially if you play football.

Chapter 9: Compound Exercises versus Specialization

A compound exercise is one that involves more than one muscle—the standing press is a good example, involving the major muscles of the shoulder girdle and the upper arms, the trapezoids, the deltoids, the upper (minor) pectorals, and the triceps; the bench press is a bad example—although it too involves several muscles, the deltoids, the triceps, and the pectorals.

The standing press is a good example because it provides good—if not quite direct—workloads for several major muscles; the bench press is a bad example because it provides reasonably direct work only for the anterior portion of the deltoids, and a lower order of even less direct work for the triceps and pectorals—the primary problem with the bench press apparently being that of direction of movement, the resistance is being moved in a direction that is almost never encountered in any sort of normal activity—and thus the body has never developed great strength for movements in that direction.

But if that is true, then why is it possible for a man to press more on a bench than he can in a standing position? The average, untrained man can't—on the contrary, the average man can press considerably more in a standing position than he can on a bench. In fact, there is actually very little difference between the strength levels of trained individuals if they have been following a well rounded program; an Olympic lifter can usually press about as much one way as he can the other, and it is not uncommon for a man to be able to press more in the standing position than he can on the bench.

In the case of power lifters, it is not surprising that the bench press shows a higher level of strength—since such men specialize on bench presses for years, while doing little or nothing in the way of standing presses.

At the moment, the existing records are approximately 450 pounds in the standing press and 600 pounds in the bench press—a ratio of four to three in favor of the bench press; but such a comparison is actually meaningless, because the range of movement is so much greater, and the speed of movement is so much faster in the standing press. In order to measure power, three factors must be considered—resistance, distance, and speed; and in a comparison between standing presses and bench presses, two of these factors—distance and speed—are totally ignored.

But even a rough estimate that takes all of the necessary factors into consideration will quickly show that far more power is being generated in a standing press of 450 pounds than in a bench press of 600 pounds; which is not surprising, since the body is then working in a far more efficient direction.

The bench press is primarily popular simply because it is far easier than the standing press—and because a man can handle more weight in this movement, especially if he employs "cheating" methods, which are more difficult to do and impossible to conceal in a standing press; but insofar as its ability to develop useful strength, the bench press is an exercise of very limited value—the returns are not in proportion to the effort required.

An equal amount of time and energy devoted to the practice of standing presses will result in at least three times as much benefit—useful strength will be built in a direction of movement that can be employed in almost any sport, especially putting the shot and boxing.

While it might be thought that bench presses would provide the proper direction of movement for boxing, a moment's consideration will make it obvious that this is simply not true—in the last few inches of movement just before landing a heavy blow, a boxer is leaning far forward and his upper arm is in approximately the same position that it is in during the last part of a heavy press. Almost exactly the same position is used in putting the shot.

Many coaches recommend the practice of presses on an incline board for building power for the shot put—but this is a mistake, the direction of movement, the angle involved, is almost exactly the same in a standing press as it is in an incline press—at the point where the greatest power is being produced. Thus standing presses and incline presses both develop power in almost the same direction; but standing presses do so in the performance of a natural movement, much in the same way that the strength will later be utilized in putting the shot—and this is not the case with incline presses. Secondly, standing presses involve all of the muscles of the body—causing the development of balance and muscular coordination, this is not the case with the incline presses.

Quite frankly, the author considers incline pressing a dangerous practice—especially if this exercise is practiced in conjunction with leg presses; to the exclusion of standing presses and squats. It is easily possible to build great strength into the shoulder girdle and upper arms by doing incline presses—and leg presses will also build great power in the thighs and buttocks; but if such power is built in this fashion, a literally dangerous situation has been created—because a man with such development will have created a chain with a dangerously weak link, his lower back. If he attempts to use either or both forms of strength in the performance of a normal activity, he is almost certain to injure his lower back—and it is not impossible to literally break the back if such effort approaches a maximum effort.

Bench presses, incline presses and leg presses are all useful exercises, but they should never be practiced to the exclusion of standing presses and squats—and stiff-legged deadlifts, for the lower back, should always be included in any sort of training program.

Up to this point in this chapter, all of the exercises that I have mentioned are compound exercises—some good ones, some fair ones, and some poor ones; but in most cases, even a poor compound exercise is better than a good isolation movement—because a compound exercise, in addition to developing strength, also leads to great improvements in muscular coordination and balance—a result that does not come from the practice of isolation.

An isolation movement is an exercise that involves only one muscle—or one isolated part of the body; examples are—concentration curls with a dumbbell, thigh extensions, triceps curls and wrist curls. Such movements have their places—especially in the field of restorative surgery and in bodybuilding; but they are of almost no use in a training program designed for athletes—especially football players.

Brief treatment of minor injuries by the use of isolation movements is acceptable practice but only if such treatment is very brief, and only if it quickly leads to the practice of compound movements; otherwise, in almost all cases, such movements will create a situation where additional injury or re-injury is almost certain. This happens because the prolonged employment of isolation movements will lead to the development of isolated areas of strength that are badly out of proportion to the strength of the surrounding tissue.

As supplemental exercise to the employment of compound exercises, isolation exercises are frequently justified—but only in that capacity in the vast majority of cases. There are exceptions, of course; one such exception is the wrist curl—an exercise that will build size in the forearms and strength in the wrists, and without any slightest danger from too much strength in an isolated area. But such exceptions are just

that—exceptions; and most isolation movements should be avoided like the plague by athletes during their normal training program.

As a general rule, exercises should be selected that involve several major muscular masses of the body in a compound movement—and where a choice exists, such exercises should involve the greatest possible range of movement. That is one of the main faults in the bench press, the range of movement is too restricted.

If a proper selection of exercises is made, then only a few movements are required to develop almost the ultimate degree of strength and muscular size. The best barbell exercises? In no particular order, they are: squats, stiff legged deadlifts, standing presses, heavy barbell curls and some form of pullover, either stiff-armed or bent-armed. If other equipment is provided—as it should be—then these can be supplemented with various forms of chinning movements and parallel dips.

In the vast majority of cases, the best results will be produced by the employment of from four to six of the above exercises—but if all of the above exercises are being used in the same workout, then not more than two sets of each exercise should be employed, three times weekly. All of these exercises are heavy movements—if performed properly—and too many sets of such exercises will lead to a condition of overworking; results will still be produced if such overwork is not carried to extremes, but far better results will occur much more quickly if a properly designed training program is provided.

“If a proper selection of exercises is made, then only a few movements are required to develop almost the ultimate degree of strength and muscular size.”

Chapter 10: Irregularity of Exercise

For the purpose of physical training, if weeks didn't exist, then it might have been necessary to invent them—because the vast weight of evidence clearly shows that a seven day cycle of training is almost perfect for the production of best results from physical training. This is primarily true, it seems, because it provides needed irregularity of training.

The human system very quickly grows accustomed to almost any sort of activity—and once having adapted to such activity, then no amount of practice of the same activity will provide growth stimulation, although it will help to maintain levels of strength that were built previously. Thus it is extremely important to provide as many forms of variation in training as are reasonably possible; but in practice this does not mean that the training program needs to be—or should be—changed frequently. On the contrary, the same basic training routine will serve a man well for his entire active life.

Another apparent paradox? Only an apparent one; in the first place, the "double progressive" system of training provides a great deal of variation in training—secondly, the three-times-weekly training schedule provides even more variety—and finally, if the training program is varied somewhat one day weekly, then all of the variety that is need is well provided.

In the "double progressive" system of training—and this is the basic principal behind all forms of worthwhile exercise—no two workouts should ever be exactly the same. Basically, the system works as follows; a weight is selected that will permit the performance of a certain number of repetitions—but then all possible repetitions are performed with that same resistance, with a constant attempt to increase the number of repetitions being performed. Then, when a certain number of movements become possible, the resistance is increased by a certain percentile—and this will have the effect of reducing the number of possible repetitions.

Some sort of progress should be observed in almost every workout, either the number of repetitions or the amount of resistance should be increased—or both. Even though the movements remain almost exactly the same, the workload is constantly increasing—exactly in proportion to the increases in strength that are being produced; such increases literally must be in proportion—nothing else is even possible.

Thus great variety is provided by this system of training; but caution must be observed to avoid falling into a pattern of performing your workouts in a routine fashion—without really making each set of every exercise a truly maximum effort.

Even more variety of training is provided by the three-times-weekly schedule; a first workout is performed on Monday, then two days later a second workout is performed on Wednesday, then two days later a third workout is performed on Friday—thus, on Sunday, the system is expecting and is prepared for a fourth workout, but it doesn't come. Instead, it comes a day later, on Monday of the next week—when the body is neither expecting it nor prepared for it. This schedule of training prevents the body from falling into a "rut"—since the system is never quite able to adjust to this irregularity of training, and great growth stimulation will be produced as a direct result.

Then, if the actual training program itself is varied insofar as the number of sets and/or the number of repetitions are concerned during one of the three weekly workouts, all of the variety and irregularity of training that are required will be produced.

Yet many thousands of weight trainees—especially bodybuilders—practice six or seven weekly workouts; and in almost all cases, such workouts quickly degenerate into a form of rather hard manual labor—and although some results will be produced, they will not be anything on the order of the results that would have resulted from a properly designed and executed training program. It thus takes such trainees four or five years to produce exactly the same degree of results that could have been produced—and should have been produced—by less than a full year of proper training.

A properly planned and executed training program is nothing short of brutally hard work—results will be produced almost in direct proportion to the actual intensity of effort above a certain point, and no results will be produced by any amount of work below a certain intensity of effort—and I think that most trainees are simply not willing to work as hard as is required for best results.

Where at all possible, it is usually desirable to inspire a sense of competition; but in practice this frequently leads to very poor training habits—emphasis should be placed on form, and no credit should be permitted for the employment of “cheating” methods.

While cheating methods should be used—and are of great value if used properly—they should only be employed at the end of a set of exercise movements that have been performed in near perfect form; at that point in the exercise, cheating makes it possible to induce even more growth stimulation than would otherwise have been possible—but if cheating methods are employed to the exclusion of movements performed in good for, then very little in the way of growth stimulation will be induced, and, secondly, it will then become literally impossible to measure the progress of individual trainees with anything approaching accuracy.

And it is essential to carefully observe the progress of all types of physical training—because the requirements for exercise vary to a rather great degree among any group of individuals, although nowhere close to the degree that a lot of people believe. Increasing the workload may produce literally striking results in some individuals, either increasing the rate of growth enormously or stopping it cold in its tracks—and such results can be produced by a variation of less than fifty percent in the workload; thus it is obvious that constant and careful attention must be paid to the true rate of progress of all trainees—and this is only possible when performances are measured on a realistic basic, which is simply impossible if cheating methods are permitted during strength tests, or it they are practiced and recorded during regular workouts and used as the basis for computing rates of progress.

So practice cheating methods—but only after all possible movements have been performed in good form—and then record only the properly performed movements for record keeping purposes.

Chapter 11: Inducing Growth Stimulation

Maximum degrees of growth stimulation can be—and should be—induced by "the minimum-possible amount of exercise"; the minimum amount required to produce certain effects—and once these effects have been produced, then additional amounts of exercise will actually reduce the production of increases in strength and/or muscular size.

At the start of a barbell curl, for example, the arms are in a straight position and the bending muscles of the arms are in extended positions—in that position, the strength of the muscles involved in performing a curl is extremely low; the individual muscle fibers are extended and the muscles as a whole are also extended. Secondly, in that position, it is **impossible** to involve more than a very low percentile of the total number of available muscle fibers in the work of starting the curl.

Muscle fibers perform work by contracting, by reducing their length—and in order to contract, they must move; and while it is perfectly true that a certain amount of "slack" exists in muscular structures, and in their attachments, it is nevertheless also true that no significant amount of power can be produced by a muscle without movement. Thus, in effect, as a muscle fiber performs work it contracts (reduces its length), and in so doing it exerts a pulling force—and movement of the related body-part is produced; without such movement of the related body-part, then no significant amount of power can be produced.

If all of the fibers in a particular muscle were contracted at the same time, then obviously the muscle as a whole would be reduced to its shortest-possible length; but this cannot happen unless the related body-part is moved into its position of full contraction as well. If a muscle did contract fully, and if the related body part did not move into its position of full contraction, then the muscle would be torn loose from its attachments; **nothing else is even possible**.

Thus, as should also be obvious, it is impossible to involve all of the fibers of the bending muscles of the arms in the performance of curls in any position except a position of full body-part contraction—which, in the case of the curl, means that the arms must be fully bent, fully supinated, and slightly raised.

With a barbell, it is impossible to perform a curl in such a manner that all of the muscular fibers of the bending muscles will be involved in the exercise; but if all of the related factors are clearly understood, and if exercises are performed in a proper manner (which they seldom are, even by very experienced trainees), then you can at least involve a far higher percentage of the total number of available fibers than you otherwise would.

At the start of the first repetition of a set of ten repetitions of the barbell curl, your muscles are fresh and strong—but in that starting position, you can involve only a very few of the actual number of fibers, simply because most of the fibers cannot perform work in that position; and, secondly, "only the actual number of fibers that are required will be involved in any case"—because, individual muscle fibers perform on an all-or-nothing basis.

You **could** increase the percentile of fibers that are involved, by performing the movement as fast as possible; but this is neither necessary nor desirable—because fast movements performed at a time when the muscles are fresh are extremely dangerous, there is great danger of tearing the muscle attachments loose. And secondly, with fast movement, there is always a tendency to "swing" the weight by overall

bodily motion rather than moving it by purely muscular action on the part of the muscles that you are attempting to exercise.

So the first repetition should be performed as rapidly as possible in perfect form; and if any doubt regarding form exists, then the first repetition should be done at a pace somewhat slower than that which would be possible under the circumstances.

But in any case, regardless of how you perform the first repetition, you will be involving only a very small percentage of the total number of muscle fibers available; this is true for several reasons—at the start of the first repetition, it is impossible to involve more than a relatively very few of the total number of fibers, because most of the fibers cannot work in that position—secondly, since all of the fibers are fresh an strong, only a few will be required to move the weight, the number actually needed will be involved, and not one more—and thirdly, at the point in the exercise where it is possible to involve a high percentage of the total number of available fibers, there is no resistance available, and without resistance no exercise is possible.

If you are using a weight with which you can perform ten repetitions of the barbell curl, then a properly performed first repetition may involve only four or five percent of the total number of available fibers—the other ninety-odd percent of available fibers are in no way involved in the exercise.

During an immediately following second repetition, the situation is a bit better; by that point, the previously worked fibers are no longer as fresh and strong as they were during the first repetition, their momentarily-existing strength level has been reduced, and they will not again be capable of raising the weight without the assistance of other fibers—and such assistance will be provided, but only to the degree that is actually required.

Thus, repetition by repetition the percentage of involved fibers becomes greater ; until, finally, by the tenth repetition, you may be using as many as fifteen percent of the total number of available fibers—at which point, the exercise will seem quite hard, and at which point most trainees will call a halt to their efforts.

But at that point in the exercise, very little—or actually nothing—in the way of muscle growth stimulation has been induced; the muscles are already capable of performing at the level being demanded—as was clearly demonstrated by the fact that you could per-form ten repetitions, and did—and thus the muscles are not being forced to work inside their momentarily-existing levels of reserve strength. In effect, the muscles can perform the work being demanded of them—and the can do so without exhausting their reserve; therefore there is no need for them to grow—and under such circumstances, they won't grow, or will do so only very slowly at best.

But if—instead of stopping at the tenth repetition—if you had continued with the exercise, forcing the muscles to work much harder than normal, requiring them to work well inside their reserves of strength, then muscle-growth stimulation would have resulted.

How many more repetitions should be done?

As many as possible, regardless of the actual number this may prove to be; the set should be terminated only when it is impossible to move the weight in any position, when the bar literally drops out of your exhausted hands.

Even then—with a barbell—you still won't be involving **all** of the available fibers; but you will, at least, be involving as high a percentage as it is possible to do with conventional forms of exercise—and you will be inducing as much in the way of muscle-growth stimulation as it is possible to do with a barbell, or any other type of conventional training equipment.

And if you are training in that manner, then only two such sets are required—three times weekly—in most cases, and never more than three such sets in any case; doing a larger number of lighter sets **will not** produce the same degree of results—and doing a larger number of properly-performed sets would exhaust your recovery ability so much that losses would be produced instead of gains.

Watching a man working out properly is almost frightening—and it is frightening to some people; the intensity of effort is so great that the subject's entire body is shaking, his face will turn dark red—or even purple—and both breathing and heart action will be increased at least one-hundred percent, and frequently far more than that.

Most people are simply not aware that such effort is even possible, and many that are aware of the possibility are totally unwilling to exert such effort; but, for maximum growth stimulation, that is exactly what is required. Left to their own devices, most trainees will make very little progress—because they probably won't work hard enough to induce much in the way of growth stimulation; so, for best results, workouts must be carefully supervised—and it is highly desirable to give a demonstration of the proper intensity of work, in order that new trainees can be made aware of the very possibility of such levels of effort.

Psychological considerations are extremely important as well; if at all possible, the trainee should be able to see the weight that is being moved—and if this movement produces a reasonable level of sound, so much the better. Likewise, the trainee should be fully aware of the actual amount of resistance being moved—and it is important that the poundage figures be as high as reasonably possible.

In designing some of the new exercise machines, it would have been easily possible to vary the leverage to such a degree that ten pounds of actual weight would have taxed the strength of a very strong man; but instead we have employed an almost exact one-to-one leverage ratio, in order that the weight being moved will almost exactly the same weight that would have been used in similar barbell exercise—thus the trainee feels that he is doing something worthwhile, and his progress will be in meaningful jumps.

Such considerations far outweigh the small advantage that would have resulted by employing different leverage—such as the lowered requirement for barbell plates or other form of resistance. Under different leverage conditions, ten pounds may "feel" as heavy as two-hundred pounds—and it will—but the trainee will show much more willingness to work at the necessary level of intensity if he is forced to move two-hundred pounds instead of ten pounds.

“Maximum degrees of growth stimulation can be—and should be—induced by “the minimum-possible amount of exercise”; the minimum amount required to produce certain effects—and once these effects have been produced, then additional amounts of exercise will actually reduce the production of increases in strength and/or muscular size.”

Chapter 12: Secondary Growth Factors

Regardless of how much growth stimulation is induced, little in the way of results will be produced unless the requirements of several other factors are also provided. Basically these factors are as follows:

1. nutritional,
2. provisions for adequate rest,
3. the avoidance of overwork, and
4. psychological (various)

Most of these factors have been mentioned in the preceding chapters, and it now remains necessary only to view them together; but it should be clearly understood from the start that—in the author's carefully considered opinion—nothing even bordering upon any form of fanaticism is required by any of these factors. Yet such fanaticism exists on a wide scale in weight training circles today; primarily, I think as a direct result of commercialized fraud—the carefully calculated encouragement of fanaticism, performed for the sole purpose of selling worthless products.

Literally thousands of weight trainees are almost entirely existing upon diets of nearly pure protein, others completely stop or greatly curtail their sexual activities, and quite a number are taking various forms of so-called "growth drugs." And none of these things can be justified in any slightest degree. Maximum possible gains from any sort of training program can be produced while living a completely normal life; and, in fact, there is great weight of evidence that supports the contention that a normal existence is actually a requirement for best possible gains.

A man on a program of heavy physical training will obviously require enough extra calories to supply the energy required by such training—or, at least, he will if he hopes to maintain his existing bodyweight; and if he wishes to gain additional bodyweight, then he will require even more in the way of nutritional factors. But such requirements can come—and, indeed, should come—from a fairly normal diet; such a diet should be well rounded in makeup, and should contain enough protein for meeting the requirements of the moment. Absolutely nothing else in the way of a special diet is required.

There is little or no evidence to support the need for supplementary vitamins—if a well balanced diet is provided; indeed, the great weight of available evidence clearly indicates that such vitamin intake is of absolutely no value.

Where additional protein is required—in the case of a trainee that wishes to gain weight rapidly as a result of his training—this can easily and cheaply be provided from commonly available sources; raw eggs, powdered, non-fat milk solids (powdered milk), and soy powder will provide enough protein for any possible requirements. Two or three daily "milkshakes" made according to the following recipe will provide enough protein for a 250 pound man that is anxious to gain weight rapidly—if taken in addition to a well rounded, normal diet.

1. Four raw eggs
2. One-half cup of soy powder

3. One and one-half cups of powdered milk, non-fat
4. Enough chocolate powder to provide suitable taste
5. Enough skim milk to bring mixture to proper liquid state.

Mixed in a blender, the above mixture provides a very heavy load of well balances protein—at a very low price. For a trainee that wishes to gain weight as rapidly as possible, three such milkshakes should be consumed daily—one shortly after a normal breakfast, a second immediately after work or school, and a third just before retiring for the night.

While the soy powder is the cheapest ingredient in the above mixture—costing only about 40¢ per pound retail—it should be limited to the above ratio; taken by itself, soy protein is not complete, and cannot be utilized by the body properly unless it is mixed with elements provided by the milk and eggs.

But—for some people—soy powder presents a problem; should it be found that it is causing excessive amounts of intestinal gas, then discontinue its use—and in that case, replace it in the mixture with an addition half-cup of milk powder.

Unflavored gelatin is another good source of protein at a low price, but it is a bit difficult to consume in large quantities—simply because, if mixed with cold water, it almost instantly solidifies, and if mixed with hot water it is unpalatable for most people.

Far too much freely available literature exists on the subject of making up a well rounded diet for me to devote any space to it here, so I will simply refer you to any one of several thousand books on the subject. But some care should be exercised in order to make certain that such books do not contain commercial bias.

The requirements for adequate rest are no more involved than those dictated by common sense and good health habits; some people require more sleep than others—so get as much as is normal for you as an individual. Your results will obviously be less if you make a common practice of getting too little rest—but excessive amounts of sleep probably retard your progress also; so simply continue with your normally practiced good habits in regard to sleep.

Other activities should continue as before; better progress will almost always be shown by an individual that is regularly employed in some sort of full-time activity, such as a normal job or a normal load of schoolwork. But—to many weight trainees—the above statement probably borders on heresy; such people thinking—as thousands of them do—that activities should be strictly limited to workouts, eating and sleeping.

Insofar as other sports activities are concerned, their effect upon training progress can be either good or bad; so it becomes a simple matter of “first things first”. It will be almost impossible for a man to gain bodyweight rapidly if he makes a daily practice of running several miles; but if such running is a necessary part of his training, then it obviously should be done. The same rule is equally applicable to any other sort of activity—do that which is necessary, or desirable, and the weight training program will markedly increase your strength and improve your overall condition even if it doesn’t result in great increases in muscular size or bodyweight under such conditions.

However, many coaches make the mistake of trying to get all things out of the same individual—and this, of course, is literally impossible; if it is considered desirable for a particular athlete to gain forty pounds of bodyweight for football, then such an individual should not involve himself in a heavy program of track

activities. Some running should be done weekly—at least twice weekly—by all trainees, but this should be limited to the amount that will maintain the required amount of endurance for running and the existing degree of speed, or it should be, at least, if it is desirable for such subjects to gain weight rapidly.

In the case of overweight or "out of condition" subjects, then almost any amount of running should be employed until such time that the subject has removed the surplus fatty tissue he is carrying; but it should be realized that such an individual will almost never have much in the way of an existing endurance or energy level at the start of such a program—and thus great care must be exercised in order to prevent such a subject from working himself to the point of nervous exhaustion.

It is neither necessary nor desirable to work any individual to a point of such muscularity that no visible fatty tissue remains on the body; on the contrary, better performances will almost always be provided by subjects that show at least some slight degree of fatty tissue in some areas of the body.

Removing the last traces of such fatty tissue almost always involves overwork—and if this is carried to extremes, such overwork can, and probably will, lead to nervous exhaustion. In this respect, individuals vary, of course, but do not expect a well conditioned athlete weighing over 200 pounds at a normal height to show no traces of fatty tissue.

The arms, the shoulders, the chest, and the legs can—and should—show a rather high degree of muscularity, but some slight amount of fatty tissue should remain in the area of the waist and the buttocks.

If such a condition does not exist to at least a reasonable degree—if an extreme degree of muscularity is evident over the entire body—then it is probable that such an individual is being overworked, and the extent of his workouts should be reduced until such time as he is obviously gaining weight.

Psychological factors required for best training progress have already been briefly touched upon, and this is far too complicated a subject for me to attempt to explore it in depth here.

"A man on a program of heavy physical training will obviously require enough extra calories to supply the energy required by such training—or, at least, he will if he hopes to maintain his existing bodyweight; and if he wishes to gain additional bodyweight, then he will require even more in the way of nutritional factors. But such requirements can come—and, indeed, should come—from a fairly normal diet; such a diet should be well rounded in makeup, and should contain enough protein for meeting the requirements of the moment. Absolutely nothing else in the way of a special diet is required."

Chapter 13: The Limits of Muscular Size

In a recent medical article read by the author, it was stated that the average individual's size, by weight, consists of forty percent muscular tissue; in effect, that an average 150 pound individual would have a total muscular mass of approximately 60 pounds. But even if true, such a ratio of muscular mass to total weight can be demonstrated by the employment of what can only be called rather dubious means. Perhaps—if you include such body parts as the heart, the muscles of the head, feet, hands, skin and internal organs—you might be able to demonstrate such a ratio.

But if consideration is given only to the muscles that are directly employed in performing normal muscular activities, then it will be found that the actual ratio of muscular bulk to total weight is very close to fifteen percent (15%)—little more than a third of that indicated above. An average individual weighing 150 pounds at a height of 5 feet and 11 inches will have approximately 20 pounds of such muscular tissue; thus, if his body weight can be increased to 170 pounds, in the form of additional muscular tissue, this will literally result in a doubling of his muscular bulk.

But if such is true, then why won't his strength be doubled as well? In at least some aspects it probably will be; but as a general rule, strength does not increase in direct ratio to increases in muscular bulk—for a number of reasons. For one thing, bodily leverage is changed as the muscular bulk increases—and almost always to your disadvantage. Secondly, the human circulatory system is not capable of properly supporting muscular bulk beyond a certain degree of development.

Strength of muscle is almost entirely dependent upon its bulk, but it is extremely difficult to accurately estimate the bulk of a muscle; size is frequently confused with muscular bulk—and while great size is obviously required for great muscular bulk, it does not follow that great size presupposes great muscular bulk.

Secondly, most people have no slightest idea of the real relationship that exists between measurements of the circumference of various body parts and the actual muscular bulk contained within those same body parts. The average 150 pound individual previously mentioned might have a 12 inch upper arm measurement—flexed; but increasing that measurement by only two inches, to 14 inches, will literally double the muscular bulk of the upper arm. Thus an increase in the circumference of only about seventeen percent (17%) will produce an increase in muscular bulk of approximately one-hundred percent (100%)—or a doubling of bulk.

While that may sound like a gross overstatement, in fact, it may well be an understatement; if you would stand a man like Bill Pearl, at the weight of 210 pounds, alongside our average 150 pound individual of the same height, the comparison between their arms would be ridiculous. And in total overall muscular bulk, Pearl will obviously display at least four times as much bulk as the smaller man—though only 60 pounds heavier.

Then why isn't he four times as strong as the smaller man? I repeat, in some ways he will be—and he will be far stronger than the lighter man in all ways, everything else being equal. But what degree of this size is useful? That, of course, depends upon how you define "useful." But for most purposes, all of it—any reduction in size would also cause a reduction in strength—and in any activity requiring all-round great strength, all of this size will be useful.

Speed of movement? That, of course, depends upon several things; upon the overall bodyweight, upon the individual's initial potential insofar as speed of reflexes and bodily proportions are concerned, and upon his individual training history. But in almost all cases, it will be far greater than you would probably expect. Some years ago, during the Olympic Games, careful measurements of the speed of movement of most of the athletes involved clearly proved that a weightlifter was the fastest man competing in any sport, and that almost of the weightlifters were faster than the other athletes.

As I said in an earlier chapter, it is expecting far too much from any form of physical training to expect it to produce a super athlete that will be a champion in all sports; this is literally impossible, because the basic requirements for sports are far too varied for such a possibility to be realized. And it is equally obvious that no form of training can produce a champion athlete in any sport—from just "any" individual.

Until quite recently, any form of weight training was looked upon almost in horror by most coaches; if you had stated, thirty years ago, that almost all athletes would now be using weight training, you would have been considered totally insane—and a great deal of that earlier prejudice still exists. At the present moment, almost all coaches have at least heard from reliable sources that weight training is good for athletes—but, knowing little or nothing about it from personal experience and having heard all sorts of highly biased stories about it, many of them are "not quite sure" about it; some obviously are afraid of weight training—primarily, I think, because they know so little about it.

This situation is changing, but a lot of this bias will still exist fifty years from now—or a thousand years from now.

So you can reasonably expect some degree of improvement in any athletic activity from weight training—and in many cases, enormous improvement will be produced; but do not expect miracles. Critically decide exactly what results you are most interested in, and then follow a weight training program that is designed to give the most in the way of the type of results that you are after.

Chapter 14: Reciprocity Failure

Why do some trainees produce good results from weight training, while others—using apparently identical program and exactly the same equipment—experience such slow rates of progress that they eventually stop training in disgust?

A tricky question, obviously—and one that cannot be answered in general terms that apply in all cases; but in most cases, the real culprit is a factor that most bodybuilders never heard of, reciprocity failure—which might be defined as the failure to produce expected results. Which definition is not quite as meaningless as it may appear at first glance—although it is one that will require careful explanation.

To readers well versed in the technicalities of photography, the term may be familiar in another context, and my first attempt at an explanation will be based on an example from that field.

Correct exposure of film depends upon several factors; the so-called “speed” of the film being used, the type of light source, the length of time that the film is exposed, and the relative size of the lens aperture, as well as other factors which are of no importance in this example. But in practice, the average photographer is usually concerned with one or two of the above factors; the length of exposure and the size of the lens aperture—or “shutter speed” and “f stop”.

If one of these factors is changed, then the other must be changed in exact proportion; if exposure time is doubled, then the aperture must be reduced in area by fifty percent—and so on. And in almost all cases, if this relationship is maintained, the result will be the same insofar as exposure is concerned. More time, less light—or more light, less time; the same exposure in either case.

But the formula doesn’t always work. As either end of the scale is approached, it will be observed that actual exposure will always be less than that which was expected from the combination of exposure time and lens aperture being used; never more—always less. If extremely long exposure times are used, then the resulting exposure will be less than that which was indicated by the formula; and if very short exposure times are used, the result will again be underexposure. And this result will be produced in spite of the fact that the formula being used is accurate; or, at least, is accurate within a certain area.

When such a result is produced, it is called “reciprocity failure”. The produced result failed to live up to expectations—even though the formula used was correct.

And a very similar factor is encountered in bodybuilding—or in physical training of any kind. Thus, in practice, we find that doubling the length of a workout will not give as much in the way of results—and that a set of one repetition will not produce ten percent of the results of a set of ten repetitions.

But, many weight trainees seem to think that merely doubling the number of sets, or the number of exercises, will also double their rate of progress; such thinking has led to the recently proposed “total tonnage” theory, a theory which suggests that the only factor of importance is the total amount of weight lifted during a workout—but a theory which, in fact, is so ridiculous that it doesn’t even deserve rational consideration or discussion. And please don’t write me to state that “...nothing is undeserving of ration consideration.” What about the theories of the Flat Earth Society, the people who still don’t believe that this planet is a sphere?

However, for the benefit of those readers who might not have much background in physics, I will point out that the Total Tonnage theory ignores the factors of vertical distance of movement, and speed of movement—without which factors, no reasonable discussion of power or strength is even possible. And it also ignores the factor of reciprocity failure—which the inventor of the Total Tonnage theory probably never heard of, and certainly doesn't understand.

So much for theory; but just how does this factor apply to physical training in a practical manner?

In simple terms, it can probably best be understood in much the same context that applies in the previously mentioned example from photography; within a certain range—on a certain scale—then the production of results can be calculated with a rather high degree of accuracy, but the upper and lower limits of that scale must be understood and allowed for. In practice, in very simple terms, this means that either "too much" or "too little" exercise will have much the same final results—and that in both cases, these results will be poor.

It also means that the production of best-possible results depends upon a clear understanding of this scale; the trainee must be aware of the limitations—and must stay inside the bounds of most-productive work.

And while a complete understanding of this factor is not going to result even if you memorize this entire bulletin, a practical understanding probably will be reached by readers who take the trouble to read it carefully and with an open mind.

Chapter 15: Strength and Endurance

The subject of this chapter will probably arouse as much heated controversy as any of my other major points of emphasis—even though it is certainly not a new idea; and while it is not my intention to create such opposition to any of the points I am attempting to explain, I feel that an effort to avoid controversy—by writing only on subjects most likely to be widely accepted—is outright dishonesty. Secondly, such a style of writing—or such a selection of subjects—would necessarily avoid many points of importance; all of which are essential to an understanding of the factors involved in a training program capable of producing good results.

Point #1—There is no slightest evidence which indicates a difference between strength and endurance; accurately measuring one of these factors clearly indicates the existing level of the other. That is to say; if you know how much endurance a man has, then you should also know how strong he is—or vice versa. But such a relationship between strength and endurance is meaningful only in individual cases; it does not hold true for the purpose of comparing the performance of one individual to that of another—thus you cannot fairly compare one man's endurance to another man's strength. Secondly, I am using the term "endurance" only in the sense of "muscular endurance", the ability of a muscle to perform repeatedly under a particular load—I am **not** momentarily concerned with cardiovascular endurance, which is an entirely different matter.

Point #2—By training for endurance, increases in strength are produce in direct proportion to increases in endurance—and vice versa.

Point #3—Accurate measurements of muscular mass clearly indicate existing strength levels within a very narrow range of variation—if all factors are taken into consideration. But again, such measurements are only meaningful in individual cases—not for comparison purposes.

Point #4—Increases in muscular size make strength gains possible—but do not produce such strength gains in direct proportion; and increases in strength force increases in muscular mass, when strength reaches a certain point in relationship to existing muscular mass then no additional strength increase is possible until after an increase in muscular size, and such a size increase will invariable occur if all of the requirements for such growth are provided.

Great misunderstanding in regard to the above points exists primarily because attempts to measure strength and endurance levels have almost invariably been based on different scales; but when the same scale is applied to both measurements, the above mentioned relationships will be obvious. The following example should make this clear.

If you have been training for a period of time and have reached a point where you are capable of a bench press of 300 pounds, and are also capable of performing ten repetitions in the bench press with 250 pounds, you would probably look upon the best single-attempt as an indication of your strength level and the best performance for ten repetitions as an indication of your endurance level; and if so, you would be basically correct in your opinions.

But if you then stopped training for a period of several weeks, and upon resuming training wanted to measure both your strength and endurance after such a layoff, you would probably make an

understandable error in the latter measurements—by applying different scales; an error which would lead you to believe that your endurance had decreased more than your strength.

Whereas, in fact, if such measurements were accurately made, it would be obvious that both strength and endurance had decreased in exact proportion.

After such a layoff, you might find that your best single-attempt was one with 270 pounds and that your best performance with 250 pounds was only repetitions. And such results could easily lead to the mistaken conclusion that your endurance had decreased by sixty percent while your strength had decreased by only ten percent.

But you didn't use the same scale for both measurements; while you decreased the single-attempt weight by ten percent, you left the endurance-attempt weight unchanged. If, instead, you had decreased the weight used for the endurance-attempt by the same percentage—in this case to a weight of 225 pounds—then you would still have been able to perform ten repetitions.

Or, taking the reverse approach to the same situation, you might be led into an apparent result that would be so ridiculous that it would be obviously incorrect to anybody; if both test weights remained unchanged, and if you performed four repetitions with 250 pounds—but failed with 300 pounds—would that then indicate a decrease in endurance of sixty percent, and a decrease in strength of one-hundred percent?

Similar examples could be given to establish the validity of the other points listed above, but restrictions of space make this impractical in this bulletin.

Chapter 16: Speed as a Factor

Using normally applied methods, it is literally impossible to accurately measure strength and the figures produced by most currently practiced methods of testing strength have little or no significance. Strength is the ability to produce power—and while it is extremely difficult to measure strength directly, we can measure power; and having done so, a reasonable estimate of strength can be made. “How much can he press?” is a meaningless question—unless we also consider “how far does he press?” and “how fast does he press?” Both of which points—distance and speed—are generally ignored in strength tests.

During a recent workout, one of our test subjects was accurately tested while generating slightly over three horsepower; disregarding the power required for raising a good part of his own bodyweight, he raised 275 pounds a distance of over two feet in less than one third of a second.

Such accurate measurements of strength require a logical approach to the matter and the use of very sophisticated equipment capable of measuring both the distance and speed factors with great accuracy; but—for most applications where measurements of strength are required—such methods are certainly not practical, and they are never inexpensive. Thus, for practical measurements of strength, another—far simpler—method is required.

Apart from actual competitive lifting, the only real need for strength tests exists as a factor required for properly charting training progress—where a subject’s performances are compared to his own previous performances. This can be done with a far greater degree of accuracy if such comparisons are not made on the basis of “single attempt” lifts. Relative levels of strength should be determined by comparing a set of several repetitions to another set of exactly the same number of repetitions—but both sets must be maximum possible sets, involving the performance of as many repetitions as possible, stopped only when another repetition is impossible.

But—since maximum possible sets will not always produce the same number of repetitions—it is thus impossible to compare every set of each exercise with every other set of the same movement; accurate comparisons are possible only when maximum possible sets result in the exact same number of repetitions.

In practice, it has been found that comparisons should be made only when maximum possible sets result in ten repetitions—or twenty repetitions, as the case may be. Within a given week of training, at least one such set will usually be performed in every exercise being practiced—and thus it is possible to judge the progress of individual trainees on a fairly regular basis.

But it is important that first sets of a particular exercise be compared only to first sets of the same exercise—and second sets to second sets, etc. Comparing a first set of squats performed during workout with a second set of squats performed during another workout would produce no reasonable basis for comparison.

For the greatest degree of accuracy from such methods of strength measurement, it is best to compare the last performed set of an exercise with the last set from another workout—assuming that both workouts involve the same number of sets, and that the sets being compared involved the same number of repetitions. Or, at least, this will produce greater accuracy of results when you are dealing with well

conditioned test subjects. However, when dealing with poorly conditioned subjects, then comparisons should be made on the basis of first sets; many such subjects will perform quite well during a first set, but then display a very great drop in strength when performing a second set of the same exercise.

While it is not necessary to measure the time required to perform a set of an exercise—so long as it is performed at a reasonable pace—it is necessary to consider the time involved for the performance of all the sets included in the workout. A first set should be followed by a second set of the same exercise at an interval of exactly four minutes, and a third set should be performed four minutes later—thus the total time for all three sets will be eight minutes plus the time required to perform the third set, a time somewhat over eight minutes and probably well below nine minutes, depending upon the type of exercise being performed and the number of repetitions employed.

With well conditioned, experienced subjects it is not necessary to actually measure this time factor; such subjects will almost always perform second and third sets a very nearly the exact time specified—having become accustomed to working at a particular pace, they will "feel" when they are ready for another set, and the variation in time will usually be less than ten seconds.

But inexperienced trainees must be timed—and must be informed when to perform the next set of an exercise; if meaningful results for charting progress are desired.

Apart from the above described significance of speed as a factor for measuring strength, it is of even more importance for producing the best results from training. Every repetition of every set of most exercises should be performed as fast as possible—consistent with proper form and safety considerations; which latter point can be disregarded if the selected resistance is proper for the movement being performed.

Insofar as safety is concerned, no additional element of risk will be introduced if the weight is heavy enough—but if the weight is too light for the movement being performed, then some danger of injury will be added. For example; in performing standing presses with a barbell—or any other kind of presses—if the weight is too light, and if the lift is performed with maximum possible speed of movement, then the elbow tendon attachments may be damaged seriously. Exactly similar injuries occur with rather great frequency in baseball—when a pitcher "throws his arm out."

A fast lift involving too little resistance will tend to keep moving at the high point of the movement, and the resulting jerk can cause damage. But if the selected weight is heavy enough, then little or no danger will exist—the bar will stop at or very near the proper high point regardless of how fast the subject attempts to press it.

I will return to this point in more detail in later chapters dealing with the proper performance of exercises; but it should be remembered that best training results will always be produced when exercises are performed with as much speed as possible under the proper conditions. Quite contrary to the stereotyped opinion that most people have of weightlifters—thinking of them as slow, ponderous individuals slowly raising a great weight—well conditioned weightlifters perform at a speed that must be seen to be appreciated; but they literally must do so—the production of much in the way of power is impossible without speed of movement.

Note: The following chapter—"Accurately Measuring Power Production"—is included for the purpose of carefully detailing the method required for such measurements; for most readers, it will be of little or no interest, and no significant points will be missed if the chapter is skipped. However, for anybody that is concerned with such accuracy of measurement, the next chapter will probably prove of great interest—

detailing, as it does, the only method we have been able to devise for accurately measuring power production by humans.

"Every repetition of every set of most exercises should be performed as fast as possible—consistent with proper form and safety considerations"

Chapter 17: Accurately Measuring Power Production

While it is quite simple to determine the resistance employed in strength tests, accurately measuring the time and distance factors is anything but a simple procedure; for anything approaching meaningful accuracy of measurement, two high-speed, synchronous motion picture cameras are required—and it is extremely advantageous if both cameras can be mounted a rather great distance from the subject being tested. The greater the distance, the greater the degree of accuracy of measurement—and an infinite distance would be required for absolute accuracy.

However, for all practical purposes, a distance of 48 feet has proven to be sufficient for a high degree of accuracy. Both cameras should be immovably mounted on sturdy tripods, and should be locked into perfectly horizontal angles of tilt—the lower camera should be placed in line with the estimated low point of the lift, and the higher camera should be at the estimated high point of the lift; both of which points can be estimated in advance with very little error.

For clarity of detail, lenses of the longest possible focal length that will cover the required area should be employed—it being essential to cover only two small areas, not the entire area involved in the lift. It must be understood that the focal length of the lenses will have no slightest effect upon the accuracy of the results produced; perspective—and apparent distortion—are both determined by camera position. All lenses will give exactly the same perspective from a given camera position; contrary to very popular belief, wide-angle lenses do not depict distorted perspective—they merely make it possible to film from a very close position, and the close position is totally responsible for the apparent distortion. Long focal length lenses—telephoto lenses—merely show a larger image than would normally be possible, and the apparent "compression of space" is more noticeable because of the larger image; such apparent distortion exists in an exactly equal degree in pictures made with a lens of any focal length.

Both cameras should be running and "up to speed" well before the lift is attempted—and a "clap-board" must be employed for slating the scenes being filmed, and this should be done even when filming without sound; the individual frames of the two scenes being filmed must be perfectly synchronized in order to accurately measure the time factor—and this cannot be done if some method of synchronization is not employed.

In order to accurately measure both the time and distance factors, two accurately placed "position indicators" will be required; one of these should be exactly the same distance above the floor as the center line of the lowest camera's filming axis—and the other should be in line with the higher camera. Brightly colored, horizontally mounted steel rods are the tools of obvious choice; they are inexpensive and show up well in the filmed scenes.

Four such rods should be used; two low-mounted rods and two higher rods—two rods being required for each of the two "position indicators". As an additional part of the position indicators, a clearly contrasting tape measure or ruler should be vertically mounted between the two horizontal rods most distant from the camera position. This distance measuring device—tape or ruler—should be perfectly accurate, and should be mounted to one side of the centerline of the filmed scenes; otherwise, it will be hidden by the body of the test subject and no measurement of distance will be possible. It must be remembered that most commercially manufactured tape measures are not perfectly accurate—most of

them are “short” by at least one-eighth of an inch per foot of length; readings produced by use of such a tape will overstate actual measurements.

Looking through the lenses of the cameras—assuming that you are using true reflex cameras, as you should—only one of the steel rods will be visible from each of the two camera positions; from the high position, you should see only the nearest of the two highest mounted rods, the more distant rod should be completely hidden from view by the closer rod. If it is not, then the rods are not mounted properly in relation to each other—or in relation to the camera. From the lower camera, only the closest of the low mounted rods should be visible. But one end of the measuring device should be clearly visible in the high-camera scene, and the other in the low-camera scene.

While the above description sounds rather involved, it has proven to be a very simple matter to set up such a measuring procedure in a matter of less than ten minutes—once all of the required tools are available. In practice, the most difficult problem proved to be locating synchronous motors for high-speed cameras; almost all synchronous motors for motion picture cameras operate at exactly 24 frames per second in this country—and at 25 frames per second in Europe—and while motors that are capable of filming at speeds of at least 186,000 frames per second are available, if certainly not inexpensive, most such motors do not operate at synchronous speeds.

Thus, if measurement of the time factor with a degree of accuracy surpassing that which is possible with time segments shorter than one forty-eighth of a second is required, it will be necessary to include a clock with a very large dial and a sweep second hand—a hand that completes a full sweep of the dial during each second—and it will be necessary to film with lenses of shorter focal length, in order to include the clock in both scenes. But finding such clocks is not very easy, either.

When filming at 24 frames per second, each second is actually being divided into forty-eight parts—or at least it is if a camera with a rotary, 180 degree shutter is employed; the shutter is closed half of the time—while the film is being transported between frames—and open half of the time, while the exposures are being made. Thus, although you will actually have only 24 frames to work with for each full second of time covered, it is easily and accurately possible to interpolate both time and distance factors during the times when the shutter was closed.

For example: if the subject was moving in a particular frame—and still moving in the next frame—then it is reasonable to assume that he was at the midpoint of both time and distance during the time that the shutter was closed; if the bar of the barbell was forty inches off the floor in one frame, and forty-two inches above the floor in the next frame—then it is probable that it was at a height of forty-one inches during the time that the shutter was closed.

If a greater degree of accuracy is desired, then the only tool that I am aware of that is capable of doing the job is a high-speed camera with a synchronous motor—but such accuracy will never be purchased inexpensively; apart from the initial cost of such cameras and camera motors, such filming consumes file at an enormous rate—some high-speed cameras require 300 feet of film, out of a roll of 400 feet, just to “come up to speed”, and this first 300 feet of film will never be of any value, since the camera will not yet be operating at synchronous speed, and since the resulting scene will be overexposed because of both improper and constantly varying exposure factors.

Secondly; if your test subject hesitates even momentarily about executing the lift, the filming will be wasted—because, once up to speed, the last feet of film remaining in the magazine may be used in a matter of two or three seconds, or less.

The two higher rods of the position indicators should be located exactly six feet apart—and the two lower rods should be separated by the same distance; the lift should be performed between the rods, with the subject facing either towards or away from the cameras. For squatting, the subject should have his back to the cameras—for fast lifts involving the arms, the subject should be facing the cameras. These positions are best since they permit an unobstructed view of the barbell from the camera positions.

The subject should be situated so that the bar of the barbell being lifted is as close as possible to the midpoint of a horizontal line drawn from the near position indicator rod to the most distant rod; in effect, the barbell should be three feet beyond the nearest position indicator rod and three feet closer than the most distant rod—as measured from the camera position.

This placement of the barbell is important for accurately measuring distance factors; the bar of the barbell will actually be somewhat lower than it appears to be from the low camera position—when it is above the lower position indicator rod—and higher than it appears to be when viewed from the high camera position, when it is lower than the high position indicator rod. But if the barbell is properly placed, then it will be easily possible to accurately interpolate the height of the barbell at all times during the lift.

To facilitate such interpolation, it has been found that a camera to nearest position indicator rod distance of exactly forty-eight feet should be used; but when using long focal length lenses, it must be remembered that such measurement should be from the nodal point of the lens being used—and that such measurement must be made after the lens has been focused properly. Otherwise—since most such measurements are made from the film plane of the cameras—an error of as much as a foot may be inadvertently introduced into the formula required for correct interpolation of results.

"Quite contrary to the stereotyped opinion that most people have of weightlifters—thinking of them as slow, ponderous individuals slowly raising a great weight—well conditioned weightlifters perform at a speed that must be seen to be appreciated; but they literally must do so—the production of much in the way of power is impossible without speed of movement."

Chapter 18: “Warming-Up” Properly

Muscles are literally incapable of performing at a level even closely approaching their momentary ability unless they are properly “warmed-up” in advance by the performance of lighter, exactly similar movements; in effect, you cannot warm-up properly for the performance of heavy bench presses by performing standing presses—you must perform several sets of bench presses with a resistance well below the weight you intend to employ for a maximum attempt.

That much, at least, is clear to practically everybody engaged in weight training; but it does not follow that warming-up procedures are properly understood by the majority of trainees. On the contrary, training progress is usually held well below an optimum rate by the practice of incorrect warm-up procedures.

Warming-up for competitive lifting is one thing—but warming-up for training purposes is an entirely different matter; and the correct procedures have very little in common when one is compared to the other. In a weightlifting contest, you are not concerned with trying to build size or strength as a result of the lifts performed that day; your only concern is an attempt to lift the maximum possible amount of weight for one repetition in good form—thus your warm-up must prepare your muscles for a maximum-possible single effort, while leaving them as fresh as possible.

But in training—where you are concerned with building as much size and/or strength as possible, as a direct result of the lifts performed that day—the correct warm-up procedure will be almost exactly opposite to that which you should employ on the day of a weightlifting competition; in this instance, each set of every exercise should be a maximum possible set—and should leave your muscles totally, if momentarily exhausted.

Quite obviously, if such training is done—as it certainly should be—then it will be literally impossible for you to lift as much for a single attempt as you could have done if you had warmed up with lighter, less than maximum-attempt sets. Thus many trainees avoid such a system of training—because it prevents them from attaining a maximum level of performance for one repetition during each workout; they feel that greater growth stimulation has been provided by one maximum repetition—and that the higher the resistance employed, the greater the growth stimulation.

However, in fact, quite the opposite is true; with such a system of training, only one set of each exercise will provide any growth stimulation at all—and that will usually be far less than maximum growth stimulation. And the other sets have been completely wasted; worse than that, they have exhausted part of the recovery ability while providing nothing in the way of growth stimulation.

If, instead, two or three sets of each exercise are employed, and if these sets employ a reasonable number of repetitions, and if each set of each exercise is carried to the point of absolute failure—then maximum growth stimulation will be provided, with minimum depletion of the recovery ability. You certainly will not be able to lift as much for a single attempt during your training workouts if this system of training is used—but you certainly will build the maximum possible degree of both muscular mass and strength; then, later, in a contest, your strength for a single attempt will be greater than it would have been as a result of any other type of training.

I am not saying—and I do not mean to imply—that maximum attempts for a single repetition should never be attempted in training; on the contrary, they should be—but only on a very infrequent basis, and certainly never more often than once a week. For best results, such attempts should not be performed more frequently than once every two or three weeks—or even once a month.

In practice, best results are usually produced by the 10/8/6 system of repetitions and sets; in this system, a weight is selected that will permit not more than ten repetitions during the first set, and then the resistance is increased for the second set, to a point that will permit not more than eight repetitions, and in the third set the resistance is increased to an amount that will permit six repetitions. But in all cases, all possible repetitions are performed in each set—and the weight is increased at the time of the next workout if it was possible to perform the designated number of repetitions with the weight selected.

Thus, in practice, a subject usually will actually perform only about 8/6/4 repetitions—or possibly 7/5/3 repetitions; when he actually performs 10/8/6 repetitions, then the resistance is increased again.

For single attempts, however, a careful warm-up is extremely essential for several reasons—the most important ones concerning safety; if a maximum attempt is made with a “cold” muscle, greater danger of injury exists. Secondly, if the resistance being employed is at or very near the actual level of strength for one attempt, then such an attempt will always fail—because a cold muscle cannot perform much if any above about eight-five percent of its actual strength level.

Chapter 19: Superstitions and Myths

Perhaps the heading of this chapter is misleading—since it is not my intention to discuss superstitions and myths "about" weight training; but, rather, the false beliefs that are so common among weight trainees themselves. Insofar as mention of the literally hundreds of false beliefs about weight training, I will limit my remarks to the few brief mentions made in preceding chapters and the even briefer attention that will be given to such ideas in following chapters; without single exception, such beliefs are totally false and highly prejudicial, and none of them deserve more than passing attention—in any case, thirty years of experience has taught me that attempts to combat prejudice usually have the opposite effect from that desired, so I do not intend to give even more widespread circulation to such ideas or waste my time jousting with windmills.

But while such common beliefs deserve little or no attention, the same is certainly not true in the case of many of the equally false beliefs being circulated among the ranks of present-day weight trainees—people who should know better, but for the most part do not. Many of these beliefs are nothing short of outright fanaticism, and some of them are actually dangerous—yet they are commonly practiced by tens-of-thousands of weight trainees and are supported by no small number of self-appointed "experts", these latter almost always being people with direct commercial interests in the field.

As a result of some of these beliefs—and the fanaticism that they inspire—literally millions of people have been denied the very worthwhile results that weight training could have afforded them; many people—probably most people—treat the whole matter of weight training as a joke, looking upon it in the same light in which rational people view astrology or some way-out religious cult.

While, in fact, there is nothing at all "mysterious" about weight training; on the contrary, it is a perfectly simple, well proven method for inducing physical improvement—by far the most effective method of exercise ever devised. And perhaps that is the reason for its undoing in the eyes of the average man—it is simply too effective; by comparison to the possible results producible by any other method of physical training, weight training produces such large degrees of results that they sometimes appear literally unreal.

But in no small part, the widespread skepticism of weight training is due to the actions and statements of many weight trainees; the very people who should be most interested in promoting something of great value—but who, on the contrary, seem to be determined to cast it in the worst possible light. But of even more direct importance to themselves—since most weight trainees have no commercial interests in the field—such people give widespread acceptance to training ideas that greatly retard their own progress.

Many such trainees pride themselves on their knowledge of anatomy—while having no slightest idea of the actual functions of even the largest of the muscular structures in the body.

For bodybuilders, such lack of knowledge—and such willingness to practice worthless training methods, or methods of far less value than might be desired—is of no real importance to anyone besides themselves; but to others—to athletic coaches interested in employing weight training as supplemental training for sports—the same lack of knowledge can be of very real significance. Training time and training energy is always at a premium in any sport, and it should be employed only in the best possible ways—athletes have neither time nor energy to waste on anything less than the best possible methods

of training; weight training is the best possible method of supplementary training for any sport, by far the best—but the best systems of employing this method are certainly not common knowledge among bodybuilders.

I have asked literally hundreds of bodybuilders, "…why do you use wide-grip bench presses?" And the answer has invariably been the same, "...because they stretch my pectorals more than narrow-grip bench presses." But in fact, they do not; on the contrary, wide-grip bench presses actually prevent any stretching of the pectorals—the pectorals attach the upper arms to the front of the chest, and in order to stretch the pectorals it is necessary to move the upper arms as far back as possible, and with a wide grip on a barbell it is literally impossible to move the upper arms far enough back to stretch the pectorals at all.

Exactly the same thing applies to wide-grip "chinning" movements; theses are practiced because they supposedly stretch the latissimus muscles—while in fact, they actually prevent any such stretching.

The list is almost endless, I could give hundreds of other examples of similar false beliefs; but my point is this—out of the literally hundreds of commonly practiced barbell exercises, only a few give the results that most weight trainees think they do. And most of these few really productive exercises are avoided by most body-builders upon one pretext or another, probably because they are simply too "hard".

A bodybuilder reading this bulletin will probably find no mention of many of his favorite exercises; for the good and simple reason that there are other, far better exercises for the same body part—exercises that will actually produce the results that he thinks he is getting in another way. Variations in training are of value if for no other reason than the fact that they prevent boredom—but such diversity of training should be contained within the actually very narrow limits of a few very productive exercise; if not, then results will be far less than they should have been.

In later chapters devoted to exact training programs, the selected exercises have been included only because they are by far the most productive exercises for the particular purposes stated—without single exception, no other exercise will produce as much in the way of results from an equal amount of training time.

The very fact that some poorly chosen exercises and systems of training are capable of producing fairly high degrees of results is no excuse for their employment—much better results can be produced in far less time if training is restricted to better exercises and better systems. And while no system can possibly produce the best results in all cases, a logical approach to the matter will clearly indicate any slight changes that might be required in some individual cases—and the information required for making such judgments is clearly spelled out in the chapters on the proper performances of exercises and the chapter on planning workouts. Close attention should also be given to the priority of exercises.

Chapter 20: The “Instinctive Training” Theory

According to a recent theory of training—the “instinctive training” theory—your instincts will invariably guide you into the proper path and pace of training; and while it is certainly true that an experienced trainee will eventually develop a “feeling” in regard to his workouts, this has absolutely nothing to do with instinct.

On the contrary; for anything even approaching the best possible results from training, it is absolutely essential to work in direct opposition to your instincts. If you followed your instincts, you would do quite a number of things—eat as much as possible, sleep whenever possible, defecate, fornicate, lie, brag, steal, run away from danger or fight if simply forced to or if faced with an obviously inferior foe in possession of something that you desired, and avoid any form of physical labor—but you wouldn’t lift weights.

The process of education is nothing more or less than an attempt to overcome the instincts—and it is seldom if ever totally successful; while heavy physical training may—and frequently will—result in a feeling of great personal satisfaction, such a feeling is entirely due to conditioned reflexes, not to instinct.

During the actual performance of any form of exercise—with the possible exceptions of fighting or running away from danger—the instincts are almost literally screaming at you to stop; and if you follow those instinctive urges, then exercise will always be terminated far short of the point that would have produced any worthwhile results.

The body will do almost anything in a effort to maintain the status quo—and it is fully capable of anticipating needs with a great degree of accuracy; instinctive hunger pangs proceed the actual need for additional food by as much as several hours—and when any form of exercise is undertaken, the body quickly recognizes the trend and attempts to stop the exercise long before a point of exhaustion is reached.

A very commonly observed symptom following the large scale loss of blood is a total aversion to any activity that might possibly result in additional blood loss; the body cannot then stand much more blood loss, and does everything possible to prevent it. And it is not necessary for a blood loss to be on an actually dangerous scale for this symptom to manifest itself; the body attempts to maintain a definite, but unknown percentile of reserve—and when this reserve is threatened, the system will try to prevent additional utilization or loss.

An exactly similar situation exists in regard to reserves of strength; when a particular workload closely approaches these reserves, the system will rebel against the imposition of any additional workload. But unless a workload does fall well inside the momentarily existing levels of reserve strength, then no demand for additional muscular growth or strength increases is imposed upon the system.

So attempting to follow your instincts will get you literally nowhere in physical training.

Obviously there is a limit beyond which you should not go, but this limitation applies only to the actual “amount” of exercise—not the intensity of effort; maximum intensity of effort is an absolute

requirement for the greatest possible degree of growth stimulation—but it must be achieved without totally exhausting the body's recovery ability.

Chapter 21: Growth Drugs

As of the moment—the fall of 1970—the use of drugs is an unexploded bomb lurking just beneath the surface of all forms of physical training; according to currently wide-spread attitudes, it is a crime to drug a race horse in order to increase its ability—but it seems to be perfectly all right to drug athletes in order to improve their performances.

At a recent physique contest in London, one of the leading entrants was asked which of several brands of high-protein diet supplements he used, whereupon he replied, "…protein? With Dianabol, who needs protein?" Dianabol is the trade name of one of the anabolic steroids, the so-called "growth drugs."

While there seems to be no doubt that the use of such drugs is justified in certain types of cases, there is no possible excuse for their use by a healthy person—and great weight of evidence that strongly counter-indicates such use.

Basically, most of the so-called growth drugs are synthetic forms of male hormones—and massive doses of such drugs may temporarily increase the recovery ability of the body in certain areas; but the body responds to such treatment by immediately reducing its own natural production of such hormones—in an attempt to reestablish the formerly existing chemical balance. Thus any resulting increase in recovery ability is extremely short in duration—and additional doses of the drug must be given at ever increasing levels at very frequent intervals.

Eventually, if such treatment is continued for a long enough period—and in many cases this period is quite short—the body may actually lose its ability to produce such hormones naturally, and a man could literally be turned into a eunuch.

But totally apart from the obvious dangers involved, a great diversity of opinion exists within the medical profession as to the actual growth effects—if any—that are caused by such drugs; many doctors are of the firm opinion that any observed effects are directly due to placebo effect.

Yet such drugs are being used by literally thousands of athletes in this country—and probably by hundreds of thousands; within the last year, a high school football coach strongly recommended the use of such drugs to the author—and bitterly defended their utilization when questioned regarding the justification or propriety of such use. Nor does there seem to be any shortage of doctors that are willing to issue prescriptions for such drugs to healthy high school athletes on the recommendations of coaches.

Eventually, such drug usage will emerge in a major scandal—and the sooner, the better; but in the meantime, an unknown amount of potentially very serious damage is being done to large numbers of young athletes.

Viewed as simply another attempt to "win at any cost", such drug utilization moves directly in the face of good sportsmanship; but in the light of the very real dangers involved, it borders on outright madness.

Worse than that, there is no slightest evidence to indicate that the results—if any—produced by the use of such drugs cannot be duplicated without such use; although they have been widely considered as such, the ever mounting records in weightlifting are certainly no proof of the effectiveness of such drugs.

In the Olympic lifts, the greatest degree of recent improvement has been in the performance of the standing press—but most of this has been directly due to great relaxation in the rules governing the performance of this lift; as of the moment, most of the leading heavyweight lifters are capable of "jerking" very little if any more than they can "press".

In fact, the performance of the press has degenerated to such a degree that serious consideration was given to the idea of dropping it as one of the three Olympic lifts.

In power lifting, great strides have been apparent primarily because of the fact that this is a very recently introduced sport; but some individuals were fully capable of executing such lifts in good form with very near present world-record poundage's as long as fifteen years ago—long before the use of growth drugs.

The present record in the bench press is 617 ½ pounds—but Douglas Hepburn lifted almost 600 pounds in good form well over fifteen years ago; and he did so at a bodyweight far below that of most of the presently-active heavyweight power-lifters.

Insofar as muscular size is concerned, very few men have ever even approached the muscular size attained by John Grimek nearly thirty years ago.

When I mentioned the possibility of serious damages resulting from the use of growth drugs, the coach that was defending their use stated that such cases of damage were extremely rare and that, in any case, all such cases were due to "overdoses." But in fact, such cases of serious damage are far from rare—although they have not been greatly publicized, for obvious reasons—and the entire effect, if any, from such drugs is entirely dependent upon "overdoses". In a healthy individual, the system is fully capable of maintaining a very delicate chemical balance—and the use of growth drugs is intended to momentarily disturb this balance, as it must, if results are to be produced.

Chapter 22: Ranges of Movement—Flexibility

With two minor exceptions—both of which are totally unimportant for any sort of normal activity—an obvious increase in the ranges of movement possible for an athlete should follow as a direct result of weight training, regardless of the actual muscular bulk that is developed; in fact, it can be clearly shown that increases in muscular bulk almost presuppose increases in flexibility—because the type of heavy exercises that are required for building great muscular bulk also produce increased ranges of movement.

Partial, limited-range movements simply will not build anything even approaching the maximum possible degree of muscular mass; thus, for producing great muscular bulk, full-range, extremely-heavy movements are required—and such exercises literally force the body parts into positions far outside the normal range of movement possible for an untrained individual.

Extremely heavy power-lifters are not an exception—instead, they are another matter altogether; a very great part of the actual bulk of many of these men is not muscular bulk, it is fatty tissue—which can and will restrict freedom of movement. Such men have—indeed, must have—great muscular bulk, but most of them also have an equal bulk of fatty tissue, both subcutaneous and intramuscular.

Near the end of the last century, in the infancy of modern weightlifting, most lifters were extremely heavy men—many of them weighing over 400 pounds—and almost all of them had enormous waist and upper-thigh measurements; a man of that weight will display obviously restricted movement—unless he is nearly eight feet tall—and he would do so regardless of just what that bulk consisted of, but it is totally impossible to create such bulk in the same areas so long as a reasonable degree of muscularity is maintained.

At or about that same time—around 1890—the term “muscle bound” was probably originated; but it should have been called “fat bound”, since such a condition of restricted movement has absolutely nothing to do with muscle. About thirty years ago, John Grimek—one of the bulkiest muscular men in history—remarked on the subject, “...you can lift weights and be called ‘muscle bound’, or not lift weights and actually be muscle bound.” Grimek was—and probably still is, past the age of sixty—capable of touching both elbows to the floor from a standing position without bending his knees, performing full splits, and many other movements far outside the ranges of possible movement displayed by the average man. Yet his muscular bulkiness was so great that it almost defies description, and literally had to be seen to be believed.

An exceptional case? On the contrary, almost all really bulky, muscular men show far more than the average degree of flexibility; a man that has practiced heavy pullovers will usually be able to put both elbows behind his head at the same time, regardless of how big his arms may be—and a man that has practiced heavy stiff-legged deadlifts will be able to reach far below his feet without bending his knees—and those are the type of exercises that are required for building great muscular bulk. Such great flexibility is not displayed “in spite of the great muscular bulk”, on the contrary, such flexibility is possible “because of the muscular bulk”—or, at the very least, it is a direct result of the same type of training that is required for building a large degree of muscular mass.

The average individual will find it impossible to do a full squat while keeping his heels on the floor—because his Achilles tendons have lost much of their flexibility from prolonged inactivity; but many

weightlifters can touch their buttocks to the floor behind them while keeping both feet perfectly flat on the floor—and some weightlifters can touch their buttocks to the floor behind them while almost touching their knees to the floor in front of them, while keeping both feet flat on the floor—and a few weightlifters can touch both buttocks and knees to the floor simultaneously, while keeping their feet flat on the floor.

The two exceptions mentioned at the start of this chapter? In some cases—but not in all cases—it is possible to build the size of the legs and/or arms to such a muscular size that the range of bending movement will be slightly reduced; such a man might not be able to squat quite as deeply as he could at a lighter weight—or might not be able to bend his arms as far as he could when it was far smaller—but the actual reduction would never be more than a few degrees, and would never prevent such a man from engaging in any sort of normal activity.

With most individuals, such a reduction in the ranges of movement is not even possible—and in most of the cases where it is encountered, such a reduction in flexibility is caused by obviously abnormal proportions, a result of heredity, and in no case is it of any slightest importance.

A given individual will almost always increase his flexibility in proportion to his increases in muscular bulk—although obviously not in direct, one-to-one proportion, since it is possible to increase muscular bulk on the order of four-hundred percent (400%) and such an increase in range of movement is literally impossible.

Chapter 23: Average Expectations from Training

"How much can I gain—how fast?" An impossible question, obviously—far too many factors are involved for even the possibility of an accurate answer; yet averages do exist, and if careful consideration is given to all of the factors, at least some sort of reasonable goal can be established for most new trainees.

Taking one group of thirty-six test subjects, their average starting measurements were as follows—as contrasted to the average sizes that I expected them to reach if they stayed in training for a period of eighteen months:

Body Part	Starting	Expected After 18 Months	Gain
Bodyweight	167.19	195	27.81
Normal Chest	37.5	45	7.5
Rib Box	33.25	37.5	4.25
Waist	32.2	32.5	0.3
Right Thigh	21.73	25.5	3.77
Left Thigh	21.98	25.5	3.52
Right Calf	14.93	16.75	1.82
Left Calf	14.88	17	2.12
Right Upper Arm	12.96	17	4.04
Left Upper Arm	12.67	17.25	4.58

But in order to reach any significant conclusions on the basis of the above figures, it must be remembered that they are "averages." In order to reach the average expected size after eighteen months of training, the lightest subject—with a starting bodyweight of 136 pounds—would have to gain 49 pounds; and the heaviest subject—with a starting bodyweight of 267 ½ pounds—would have to lose 72 ½ pounds. At the end of the first eight weeks of training, the lightest subject had gained 13 pounds of bodyweight—and the heaviest subject had lost 10 pounds.

It must also be remembered that the above group of trainees were high school athletes for the most part—almost the entire football squad of a large high school was included; thus the average bodyweight was well above that which would be encountered in a group of subjects selected at random—and the ratio of rib-box size to normal chest size was different from that to be expected in a similar sized group of non-athletes. Having engaged in sports requiring endurance for running, most of these subjects reflected a result of that training in the size of their lungs.

Although more than fifty percent of the subjects had taken part in a very limited weight program the previous year, only one of them had much in the way of training experience with weights; this one subject—with approximately eight months of training experience—was stronger than any other subject in the group, and far stronger than the average for the group as a whole. During initial strength tests, he was able to perform 21 repetitions with 260 pounds in the full squat—and the second strongest subject in the group was able to do only one repetition with 255 pounds, with the average performance being far below that. Yet this one experienced subject's bodyweight—174 pounds—was only 6.81 pounds above the average weight of the group, and was far below the weight of the larger subjects in the group.

In the immediately preceding eight months of training, this subject had gained 41.5 pounds of bodyweight and had increased his upper arm size by almost exactly three inches—an increase in the actual bulk of muscular tissue in the upper arms of well over one hundred and forty percent (140%). At the end of that period of training, his strength performances were as follows:

Exercise Repetitions and Resistance

Full squats: 21 with 260 pounds, 9 with 290, 5 with 330

Full squats on one leg only: 5 with 135, 50 with 65

Bench presses: 7 with 215

Standing presses: 5 with 155

Parallel dips: 7 with 95, 18 with 50

Regular grip chins on bar: 3 with 75, 18 with 50

Strict barbell curls: 8 with 130

Barbell wrist curls: 17 with 120

The above performances were recorded when the subject weighted 174 pounds at a height of 5 feet, 8 inches—he was then 17 years and 5 months of age.

Insofar as flexibility was concerned, a comparison between this subject and any other subject in the group was almost ridiculous; his ranges of movement were far greater in every respect—in some cases by as much as 90 degrees of movement. Without bending his knees, he was capable of touching a point more than ten inches below his feet—and his range of elbow movement exceeded 240 degrees, as contrasted to an average range of movement of approximately 150 degrees. In spite of his far larger than average leg size, he was easily and comfortably able to sit with his buttocks, the entire surface of the backs of his thighs, the entire surface of the sides of his calves and the inside surfaces of his feet all in solid contact with the floor—and this position was in no sense a forced position. No other subject in the group could come anywhere close to assuming this same position—not even as a forced position.

In spite of having done no running at all for a period of over two years—and very little at any time in his life—this subject was among the fastest in the group in the 100 yard dash, and among the leading five percent of subjects in the 660 yard run.

While the above described gains and performances are certainly worthwhile results from only eight months of training, this particular subject fell far below expectations; being almost totally lacking in incentive, he simply refused to push himself in training—and avoided training entirely if at all possible. Many subjects are capable of doing much better, some simply cannot do as well—and incentive is not the only factor involved, although it is an extremely important one, perhaps the most important one.

If a healthy—but underweight—subject trains properly and is provided with the nutritional requirements, he must gain weight; but the rate at which he gains will depend upon many other factors as well.

During the first eight weeks of the above mentioned test program, another subject gained 18 pounds—from 138 pounds to 156 pounds—while increasing his muscular bulk and strength enormously; during that period, he added two full inches to his upper arm size—a 100% increase in muscular bulk—while increasing his strength in the standing press from one repetition with 80 pounds to one repetition with

155 pounds, and ten repetitions with 130 pounds. In the same period, his squatting strength increased from eight repetitions with 130 pounds to twenty repetitions with 230 pounds—and he added more than four inches to the size of his normal chest.

In all of the cases mentioned above, these results were obtained from a maximum of four hours of weekly training—and in most cases, from less than three hours of weekly training.

"In spite of having done no running at all for a period of over two years—and very little at any time in his life—this subject was among the fastest in the group in the 100 yard dash, and among the leading five percent of subjects in the 660 yard run."

Chapter 24: Professional Medical Attitudes on Training

Throughout the medical profession a whole, a widespread—although by no means unanimous—attitude of doubt exists on the subject of physical training of any kind; and even if understandable, this is regrettable—leading, as it does, to a great number of confrontations between coaches and doctors. Part of this situation has arisen from the fact that the field of medicine has simply grown too broad for much more than a general knowledge outside the rather narrow limits of various subfields of specialization; but in no small part, it is also due to a prejudicial attitude not unlike that of the average layman.

While a few doctors have made rather limited attempts to investigate the possibilities of exercise, most of these efforts have been narrow in scope and shallow in depth—and very little in the way of widespread attention has been called to the few published reports that have been produced; as a result, it is extremely difficult to find any published reports on such investigations—and almost impossible to find any such reports with real significance.

Part of this apparent lack of interest is obviously a direct result of the presently widespread concentration upon attempts to discover specific chemical treatments for every sort of illness or injury; but it is also a result of the fact that a number of practitioners of fringe branches of medicine have attached themselves very firmly to some types of physical training—and members of the American Medical Association have shied away from exercise in a rather natural, if unjustified reaction to the statements of people that they look upon as quacks.

In many cases, such an attitude is perfectly justified—within the last six months, I read an article by a man calling himself a doctor, in which he made the flat statement that colds were not a result of "germs", that colds were attempts on the part of the body to rid itself of mucus that resulted from eating the wrong type of foods; he then went on to say that such mucus would eventually work its way out through the top of the head, and would then be called dandruff.

In the face of such published statements as that, it is certainly easy to understand the attitude of the average doctor; but in this case, the baby has almost literally been thrown out with the bath water—since most doctors seem to be totally unaware of the possibilities from physical training. And while such ignorance is at least understandable in this age of greatly specialized medicine, the average doctor is not at all hesitant about giving his opinions on the subject—obviously considering himself an expert, even though totally unaware of any of the significant developments that have taken place in the field of physical training during the last fifty years.

Nor is that an exceptional attitude—on the contrary, it is a far too typical attitude; and in a high percentage of cases, doctors are almost violent in their opposition to exercise of any kind. There are exceptions, of course, but one encounters them very rarely indeed.

To at least some degree, this attitude is changing—but it is changing very slowly; another two centuries of such change might produce a situation where the average doctor would admit that exercise was not "entirely bad."

In spite of simply enormous evidence that such treatment is almost the worse possible type of treatment, the average doctor still favors total immobilization of injured body parts—which, in some

types of injuries, is the treatment of obvious choice; but which, in the case of most minor muscular injuries, is exactly the opposite approach to full recovery.

More than this, the average doctor still supports the same myths and superstitions encountered in the average layman—in regard to physical training, at least; and in most cases, their advice will be very brief on the subject of exercise, "…don't."

I can offer no constructive advice on this situation—except to say that great care should be used when selecting a physician. In any sport involving violent body contact, numerous minor injuries will inevitably result—and as any coach knows, many good athletes will play an entire season with some sort of minor injury. And while I am certainly not suggesting that anyone should engage in violent activity while suffering the effects of a serious injury, I am trying to clearly say that many muscular injuries can and should be exercised.

Chapter 25: The Significance of Muscular “Pumping”

During the performance of any type of muscular work, the involved muscles demand increased circulation—for two primary reasons, in order to provide the additional fuel requirements, and for removal of the larger than normal amount of waste products being produced; in all cases, this increased circulation will result in temporary enlargement of the working muscles—and in any sort of work that can be maintained for a prolonged period of time, a point of balance is quickly reached where the increased circulation can meet the requirements of the muscles without leading to a condition of extreme “pumping”.

But when several repetitions of a near maximum intensity of effort are performed consecutively, such movements will quickly produce a condition of extreme muscular congestion—and eventually the muscles will fail, simply because the circulatory system is unable to meet the momentary requirements. A pumped upper arm may temporarily measure a full half-inch more than it normally does—an increase in size that is far out of proportion to the increase in circumference, an increase in bulk on the order of about twenty percent (20%).

When pumped to that degree, an arm will feel stiff and very heavy—which is not surprising, since its actual weight has been greatly, if temporarily increased; flexibility will be temporarily reduced and the arm will hang in a slightly bent attitude when relaxed. In most cases, the degree of apparent muscularity will be reduced—the muscles will look much larger, and will be much larger, but will appear round and smooth, less defined than they normally do. However, in some cases—particularly in an individual with an extreme degree of muscularity—a pumped muscle may actually appear more defined than it normally does.

In most forms of normal work an exercise, the effects of pumping usually occur without being noticed—for example, very few people are aware that their lower legs are usually at least a half-inch larger at night than they are early in the morning; as a direct result of pumping, the calves markedly increase their size during the course of the day. Nor is this a result of poor circulation—it is a result of normal circulation; the calf muscles are working, and require increased circulation—during the night, when they are not working, the circulation requirements of the calves are greatly reduced, and the size of the calves is reduced accordingly.

Insofar as pumping is concerned, weight training exercises are in no way different from any other form of exercise—the number of repetitions performed and the relative intensity of effort are the only involved factors; but in most forms of exercise, movements are discontinued long before any great degree of pumping is produced. For this reason, many new trainees feel that weight training exercises are “somehow different” from other forms of exercise—simply because, for the first time within the limits of their experience they notice the effects of pumping. Their limbs feel “tight” and heavy—and many such new trainees are immediately convinced that they are already becoming “muscle bound”, as a result of their first workout. But rather than being something to avoid, muscular pumping is a very clear indication that worthwhile efforts are being expended; if no noticeable degree of pumping is produced by an exercise, then it will do very little in the way of building muscular size or strength. However, although a very noticeable degree of pumping is an unavoidable result of any really productive exercise, it does not follow that even an extreme degree of pumping indicates correctness of performance of an exercise. It is

easily possible to produce a really extreme degree of pumping—from exercises that will do little or nothing in the way of building either size or strength.

Fairly light movements performed in sets of very high repetitions—especially if such movements are restricted to partial-range movements—will produce the maximum possible degree of muscular pumping; but will do little or nothing in the way of building size or strength.

Two or three sets of about ten repetitions of a heavy movement will produce almost—if not quite—the same degree of pumping; while also inducing maximum growth stimulation.

Assuming an upper arm measurement of 16 inches prior to a workout, a man would probably pump his arm to a measurement of 16 ½ inches during the course of a proper workout; but two hours later—measured properly and accurately—his arm would be somewhat smaller than it was before the workout, probably about 15 7/8 inches. Measured "cold" (without being pumped) twenty-four hours later, his arm would be back to its normal measurement of 16 inches—or slightly larger, if growth resulted from the workout.

Accurate measurements of various body parts will clearly prove that measurements vary rather widely during the course of an average day—even when you are not training; for example, your upper arms are slightly larger than normal when you first get out of bed in the morning—and slightly smaller for an hour or more after you have eaten a heavy meal. Temperature will also affect your measurements—your arms are usually a bit smaller on cold days, and larger on hot days.

Thus—for any sort of accuracy—measurements should always be taken under precisely the same conditions; but in practice, that is very difficult to do. For that reason, pumped measurements have a very real significance—because the conditions will always be, or should always be, exactly the same at the end of each workout.

Secondly, as long as your training program remains unchanged, your pumped measurements will clearly indicate future growth in advance; if your upper arm normally pumps only one-half inch during a workout, and then shows an increase of three-quarters of an inch as a result of the same type of workout, this is a clear indication that your arm will grow during the following forty-eight hours.

The ability to pump a muscle to a particular size precedes the growth of a muscle to the normal size that would usually be required for the pumped measurement indicated.

Among the ranks of bodybuilders, a great number of outright myths and superstitions on this subject are currently being accepted as a proven fact; for example, many bodybuilders sincerely believe that they can maintain a permanent state of "semi-pump" as a result of their workouts—which, of course, is a literal impossibility.

To at least some degree, such a patently false belief is probably due to outright fraud in some commercial advertisements; various products are offered that will supposedly "promote circulation" and "maintain a pumped condition." And, quite obviously, the two conditions are mutually exclusive—with normal circulation, no degree of pump will be evident—and when any degree of pumping is evident, it is simply an indication that the circulatory system is momentarily unable to meet the requirements of working muscles, or muscles that have been working until a short time earlier.

Chapter 26: The Significance of Muscular Soreness

When a muscle that has not been accustomed to heavy workloads is worked intensely—or for a prolonged period of time at a normal level of intensity—then some degree of muscular soreness will usually result; in some cases, this can be literally crippling in its effects—for as long as a week.

There are a number of rather involved theories regarding the actual physiological causes of muscular soreness; but a detailed understanding of the physical and chemical factors involved is not necessary if we are aware of the cause/effect relationship concerned.

Extreme degrees of muscular soreness almost never result from the execution of a single movement—probably because the muscles involved in the movement are not warmed-up enough to make a maximum effort, and thus are momentarily unable to work hard enough to cause much in the way of soreness, even though the movement may be carried to the point of muscular failure.

But some soreness will result from such a movement—and if properly understood, such soreness can be a valuable clue to training progress. Most bodybuilders sincerely believe that the bench press is a direct exercise for the pectoral muscles—and if an untrained individual performs several sets of bench presses, his pectorals will certainly become sore; but if, instead, the same individual performs only about three heavy sets of one repetition each, little or no soreness in the pectorals will result. Instead, the anterior portion of the deltoids will become sore—with the possibility of a very slight amount of soreness, simply an “awareness”, in both the pectorals and triceps. And while the bench press is not a direct exercise for any of the muscles of the body—in no sense of the word direct—it will thus be clearly demonstrated that the deltoids are receiving the most nearly direct work from this exercise.

Similar tests can be conducted in order to determine the effects of most types of exercises—with little or no possibility of error; for example—recently, in an attempt to demonstrate the effectiveness of a new type of exercise for the latissimus, we made use of several previously untrained individuals. Some of these subjects performed only regular chinning movements—others performed only behind-neck chinning movements—a few executed “pulldowns” on a conventional latissimus machine—and so on; the entire spectrum of possible exercises for the latissimus muscles was covered, and a few individuals performed one heavy set of each of the various exercises.

Forty-eight hours later, none of these subjects reported much in the way of muscular soreness in the latissimus muscles—and quite a number of them did not even experience an awareness of their latissimus muscles; however, without exception, all of the subjects were sore in other areas—especially in the arms. In many cases, this degree of soreness was so great that the subjects were almost unable to use their arms for several days.

Another group of subjects performed several sets on a new type of latissimus machine—and without exception, these subjects were sore in the latissimus muscles; other areas of soreness occurred in gradually reducing degrees in the pectorals, the trapezius and the abdominals—which is exactly the result we anticipated. Several subjects reported soreness in the triceps muscles of the upper arms, but they were in understandable error in this belief; the apparent triceps soreness that they reported was actually soreness of the latissimus attachments at the points where these muscles join the upper arms—directly below the mass of the triceps muscles.

In this last group of subjects, no actual arm muscle soreness of any kind was reported—in strong contrast to the results produced in the other groups.

Thus, should you have any question about the effectiveness of a particular exercise, it is quite easy to make use of muscular soreness as a means of testing the exercise; simply avoid any sort of exercise for that particular muscular area of the body for a period of at least ten days, then perform only three heavy sets of one repetition of the exercise in question. Within forty-eight hours, you will have a clear answer to the question.

If a muscle is being exercised regularly, it will quickly become so accustomed to heavy workloads that it will be almost impossible to induce even a slight degree of muscular soreness; thus, if muscular soreness is produced in an area of the body that has been trained for as long as a week, this is a clear indication that you have not been training hard enough—or that you have been performing the movements improperly.

Chapter 27: “Break-In” Training

Extreme degrees of muscular soreness can be—and should be—avoided by following a carefully outlined “break-in” program of training for at least a week; and in some cases, as much as ninety days of break-in training may be required. Although, in such cases, prolonged break-in training will not be required because of any considerations due to muscular soreness.

During the first week of training—if at all possible—a trainee should exercise daily for a period of about thirty minutes; during that first week of training, only one set of one exercise should be performed for each of the major muscle masses of the body—and these sets should be terminated before reaching a point of muscular failure. However, it is necessary to work the muscles fairly hard—no amount of light movements will prepare the muscles for the heavy workloads that will follow in the normal course of training.

At least some degree of muscular soreness is almost unavoidable, but it is neither necessary nor desirable to work a new trainee so hard that he will become extremely sore; but should extreme soreness result, then it is absolutely necessary to work the muscles quite hard until such a time that a normal condition returns. If a muscle is worked hard enough to produce an extreme degree of soreness within twenty-four hours, then that muscle should be worked heavily every day until no traces of soreness remain; if not, then the subject will probably be crippled for at least a week.

But while that is certainly true, it is almost impossible to convince a new trainee that he should heavily work a muscle that is already extremely sore; he will tend to feel, rather naturally, that hard work got him into that condition—and when you suggest even harder work as a cure, it may appear that you are suggesting pouring gasoline on a fire as a means of extinguishing it.

But if extreme muscular soreness results within twenty-four hours after a workout—and if no exercise is performed on the second day—then a literally crippling degree of soreness will result on the third day, and the fourth day will usually be far worse.

The worst form of muscular soreness involves the attachments of the tendons and ligaments, and in extreme cases it may be literally impossible to straighten the arms or stand in a normal manner with your heels flat on the floor; in such cases, more exercise—heavy exercise—is the only possible solution. Without additional exercise, normal activity may be impossible for as much as ten days or two weeks. But such a situation can be—and should be—avoided; if a new trainee suffers that sort of results from his first workout, you have probably seen the last of him—although he might be tempted to come around a month or so later and burn your house down, with some possible justification.

Some years ago, a man I knew suffered such a degree of muscular soreness as a result of one hard workout that he spent the next five days in the hospital—and was unable to resume his normal activities as a flight instructor for a period of more than a week after he got out of the hospital; and this man was in fairly hard muscular condition at the time of his first workout—or at least thought he was.

But, if he had returned for a second hard workout on the following day, then most of the prolonged effects would have been avoided—and his degree of soreness would never have approached the point

that it actually reached. But trying to tell him that had no slightest effect—with the results mentioned above.

Thus—since new trainees usually cannot, or will not believe that heavy exercise is capable of reversing the effects that were caused by previous heavy exercise—it is best to avoid any sort of training that might produce extreme soreness.

During the first week of training, a new trainee should perform the following basic program of exercises—every day for five consecutive days:

1. Full squats 1 set, 20 repetitions
2. Standing press with barbell 1 set, 10 repetitions
3. Regular grip chinning on bar 1 set, 5 repetitions
4. Bench presses with barbell 1 set, 10 repetitions
5. Regular grip curls with barbell 1 set, 10 repetitions
6. Stiff-legged deadlifts 1 set, 15 repetitions
7. Calf raises on one leg 1 set, 10 repetitions
8. Sit-ups with bent knees 1 set, 10 repetitions

The actual resistance employed should be light enough to permit the designated number of repetitions without exhausting the working muscles—and the first week of training should be conducted under careful supervision, in order to assure that the trainee is performing the exercises properly and is not working to a point of exhaustion.

During the second week of break-in training, the same basic exercises should be employed in the same order—but only three workouts should be performed, on Monday, Wednesday, and Friday, or Tuesday, Thursday, and Saturday. And two sets of each exercise should be performed during each workout; the first set of each exercise should be performed exactly as that exercise was performed during the first week of training—with the resistance previously used—and the second set should employ approximately ten percent (10%) more resistance, and should be carried almost to the point of momentary exhaustion. The actual number of repetitions performed during second sets of the exercises will depend upon the recovery ability of the individual trainee—but in most cases it will be found that the subject will be able to perform about as many repetitions during second sets as he performed during first sets.

After two weeks of such break-in training, most subjects will be ready for a regular training program—but exceptions will occasionally be encountered; most such exceptions will involve trainees that are either extremely overweight or very thin—and great care is required in the supervision of the training of either type of individual.

While a thin individual may appear to be in good muscular condition, such subjects will almost never have much in the way of recovery ability, and if they are worked too heavily during the first two or three months of training, losses in strength and muscular size may be produced; in such cases, keep the trainee on a basic program of one set of each of ten exercises—movements designed to involve the largest muscular masses in the body—until such time that the subject is obviously gaining weight at a rate of at least one pound per week.

The number of repetitions in each set should be limited to about ten—with the exception of squats, which should be performed for twenty repetitions; but after a normal break-in period, each set of each exercise should be a maximum possible effort, leading to a point of momentary muscular failure.

Unless a thin subject is suffering from an undetected illness, he should gain at least thirteen pounds during the first three months of training—at a rate of one pound per week for thirteen weeks; and if so, then his training program can be increased to two sets of each exercise during each of three weekly workouts after the first three months of training.

But some thin subjects will respond to almost any sort of training in literally spectacular manner—they may gain twenty or thirty pounds during the first month of training; and in such cases, their program can be intensified after they have gained twenty or more pounds of bodyweight.

With overweight subjects, the situation is very similar—with the obvious difference of the weight problem; such individuals desperately need to burn up as many calories as possible, but are almost never in condition to stand much in the way of heavy exercise without a prolonged period of break-in training.

Their diet should be reduced to the minimum point that is capable of maintaining a reasonable level of energy—while providing daily nutritional requirements in the way of protein, vitamins, and minerals; and they should be encouraged to start in a daily program of jogging in addition to their regular workouts. But nothing spectacular in the way of results should be expected—such an individual may require a full year of regular training to reach a condition of reasonable muscularity.

With badly overweight subjects, as many as four sets of ten basic exercises should be practiced—as soon as they are able to perform that number of sets without becoming totally exhausted; repetitions should be on the high side, from fifteen to twenty in each set—and as many as fifty in each set of squats.

"…if extreme muscular soreness results within twenty-four hours after a workout—and if no exercise is performed on the second day—then a literally crippling degree of soreness will result on the third day, and the fourth day will usually be far worse."

Chapter 28: Age as a Factor

Insofar as age is considered as a factor in the production of the best possible rate of gaining in strength and muscular mass as a result of heavy exercise, it will almost always be found that an individual will gain most rapidly at an age of about twenty-five to thirty—at a point well after he has reached physical maturity.

An immature individual may well—and usually will—require several years of training to produce the same degree of results that can be produced by the same individual within a year if training is delayed until after the age of twenty-five.

Over twenty years ago, I helped produce the most striking physical improvement in an individual that I have ever witnessed; this man was a regular army officer then over thirty years of age—and he increased the size of his normal chest by six full inches in a period of three weeks, as a result of only eight workouts, while gaining twenty pounds of solid muscular bodyweight.

From all available evidence, it seems perfectly clear that almost anyone can greatly profit from heavy exercise up to an age of at least sixty—and in fact, it seems that an individual past the age of forty has more to gain than a younger person.

However, certain factors are obviously determined by age; for example, during the Second World War, a large number of wounded servicemen were treated for facial injuries with skin transplants—and in most cases, the skin for these transplants was removed from the buttocks or upper thighs.

Now, twenty-five years later, it is obvious that this was a mistake; many of these individuals are now clearly displaying heavy deposits of fatty tissue in areas where such deposits are not normal.

Thus it appears that skin from an area that normally shows increasing deposits of fatty tissue with advancing age is not changed by being moved to another area of the body—and this is clear proof that such fatty deposits are simply an unavoidable result of age.

While some individuals can—and will—display a high degree of muscularity at any age, other individuals will find it almost impossible to remove all of the fatty deposits from some areas of the body when they are past the age of about forty.

"…almost anyone can greatly profit from heavy exercise up to an age of at least sixty—and in fact, it seems that an individual past the age of forty has more to gain than a younger person."

Chapter 29: Time as a Factor

Time is a necessary factor in any measurement of power—and strength is the ability to produce power; thus time must be considered in measurements of strength—and it must also be considered as one of the most important factors involved in training. If a given training program is performed over a period of two hours, the results will be far different from those that would have been produced if the same program had been performed in one hour.

A trainee should start breathing much more rapidly than he normally does within the first minute of his workouts, and his breathing should not return to normal for at least ten minutes after his workouts have been completed. If not, his training pace is much too slow—and worthwhile results will not be forthcoming as fast as they should be.

Very few bodybuilders are willing to work at such a pace, and as a direct result, many such individuals are actually in rather poor physical condition—in spite of their muscular bulk; most such trainees are under the mistaken impression that fifteen or twenty hours of weekly training are required for building great muscular mass, and they cannot—or will not—work at a fast pace for such long periods. But in fact, a greater degree of results can be produced by only about four hours of weekly training—if such training is conducted at the proper pace.

But, personally, I have about reached a point where I no longer even try to convince bodybuilders of this simple fact; most of them are absolutely—if mistakenly—convinced that nothing less than five or six weekly workouts of three or four hours each will produce much in the way of results. And while such individuals never fail to be literally amazed at the results which we consistently produce from a small fraction of that weekly training time, most of them simply refuse to believe the truth even when it is carefully explained to them.

Personally—if twenty hours of hard weekly training were required for the production of the best results—I would consider any possible results badly overpriced, and simply not worth the cost; but in fact, such prolonged training will actually retard progress—rather than promoting it.

The weight of all available evidence clearly proves that the best results will always be produced by less than five hours of weekly training—and in most cases, by less than four hours of weekly training; but such training must be intense, and fast paced. The only allowable periods of rest during a workout should occur between the performances of consecutive sets of the same exercise—and if the workout is properly outlined, even those rest periods can be avoided in many cases, and should be avoided whenever possible.

Nor is this merely a matter of saving time—in fact, the saving of training time is the least important consideration; for building overall condition—improving the heart action, breathing, circulation, and muscular endurance—a fast pace of training is an absolute requirement. If exactly the same training program is performed in twice the proper amount of time, then some—but not much—muscle growth stimulation will be induced, but practically nothing in the way of improved condition will result. The muscles will grow—very slowly—but breathing, the heart action, the circulation, and endurance will remain almost unchanged. And while several years of such training can—and probably will—produce a great degree of muscular size, such an individual would probably be in very poor physical condition.

Far faster muscular growth—and simply enormous improvements in condition—could have been produced, and would have been produced, by performing exactly the same training program in half the time.

Obviously, there is a limit to the speed of training; since it is impossible to perform a second set of an exercise immediately following a first set of maximum-possible intensity. But a properly conditioned individual should be able to perform a second set of an exercise within a period of four minutes following the start of the first set—and a third set four minutes later; and his performance should increase set by set—he should perform better in the second set than he did in the first set, and even better during the third set.

In many cases, it is possible to alternate exercises between various body parts—and in this way rest periods can be almost entirely eliminated; in some cases, this type of training is an absolute requirement for the production of best results—this being true in regard to the chest, the lower legs, and the forearms. No other type of training for those body parts will produce anything even approaching maximum possible results—regardless of how long such training may be continued.

The largest muscles of the upper body should be exercised immediately after a set of heavy exercise for the thighs—while the rate of breathing is still very high; with no slightest rest between the leg work and the upper body movements. The calves and forearms should be exercised without rest for a period of several minutes—as soon as a set of one exercise is completed, a set of another exercise for the same body part should be started. And every set of every exercise should be carried to the point of absolute—if momentary—muscular failure.

In later chapters devoted to exact training routines, a time factor will always be included as an essential part of each training program, and close attention should be given to this factor; if it is not, then results will be far below what they should be.

Chapter 30: Developing Speed and Flexibility

While speed is not a result of flexibility—great speed of movement is impossible without extreme flexibility; thus training for speed must involve training for increased freedom of movement and increased ranges of movement.

Freedom of movement is primarily determined by two factors—the existing power-to-weight ratio, and the muscular fiber to fatty tissue ratio.

Ranges of movement are primarily determined by two other factors—the type of exercises employed, and the amount of resistance used in such exercises.

In both cases, several other factors are involved as well—but these are factors that little or nothing can be done about, so they need not concern us hers; most such factors are hereditarily determined—neuromuscular reaction time, bodily proportions, tendon attachment points (which effect leverage), and other factors.

Short of outright starvation, it is literally impossible to remove the last visible trace of intramuscular fatty tissue—but this is neither necessary nor desirable; however, excessive amounts of such tissue must be removed if great freedom of movement is desired. And the removal of such tissue will be a long step in the direction of improving the power-to-weight ratio—although it is only one of several required steps.

Fortunately, the additional steps required for removing excess fatty tissue also result in power increases—as well as increasing possible ranges of movement. And the exercises that are required for building great strength also produce increases in ranges of movement. Thus it is easily possible to concentrate on one goal—the building of a very high power potential—while also increasing both freedom of movement and ranges of movement.

Having improved all three factors—power, freedom of movement, and ranges of movement—as much as possible within the limitations imposed by bodyweight restrictions, speed of movement will then be at its optimum level. At least insofar as directly involved physical factors are concerned; thus additional improvement will depend upon improvements in “form” and the development of conditioned reflexes, so-called “muscle memory.”

While it is certainly true—as I have tried to make clear in preceding chapters—that there is no significant difference between strength and endurance, that most such “differences” are merely apparent differences which fail to stand up to the light of careful investigation, it does not follow that exactly similar results will be produced by light forms of exercise and heavy forms of the same exercise.

To a large degree, this is true simply because the resistance employed in light exercises is not sufficient to force the body parts into positions that will produce increases in the existing ranges of possible movement. For example; when performing bent-arm pullovers on a flat bench with a light weight, the elbows will seldom be forced much if any beyond the forehead—and little or no improvement in the possible range of movement will be produced. Likewise, since the involved muscles will not be working throughout their entire possible range of movement, it will be impossible to induce a maximum demand for either muscular mass or strength increases.

However, if a much heavier resistance is employed in the same exercise, then the elbows may be forced to a point well behind the head—and much greater increases in power, freedom of movement, and ranges of movement will be produced.

An even more striking example is immediately apparent if we consider the stiff-legged deadlift; many heavy individuals find it impossible to touch their toes with their finger-tips without bending their knees—and no amount of light exercises will do much to correct this condition. However, after a few months of practice of heavy stiff-legged deadlifts, most subjects can reach a point at least several inches below their feet—and some subjects can touch their elbows to the floor from a standing position without bending their knees.

And the practice of the movements required to build such great flexibility will simultaneously result in great increases in both power and freedom of movement—the muscles will become stronger because they are being worked over a greater range, and the fatty tissue which previously restricted freedom of movement will be removed to a great degree.

Thus—directly contrary to widespread popular opinion—it is obvious that vary heavy movements are actually a requirement for developing speed of movement, rather than a practice to be avoided. A particular individual might be quite fast in spite of the fact that he has never practiced any sort of heavy exercise—but the same subject would have been markedly faster if he had engaged in heavy exercises.

During one of the Olympic games, careful testing of the involved athletes clearly proved that a weightlifter was by far the fastest man competing in any sport—and that most of the weightlifters were considerably faster than the non-weightlifters.

Great power is literally impossible without great speed of movement; and the higher the power-to-weight ratio, the faster the resulting speed—all other factors being equal.

Chapter 31: Muscular Proportions

Except for bodybuilding purposes—for physique competition—serious attempts to build or maintain perfect muscular proportions are neither necessary nor desirable; a large part of the time and effort expended by bodybuilders is directed towards the attainment of ideal proportions—but trainees involved in any active form of sport should confine their efforts entirely to the development of the muscles that will contribute directly to the performance of their chosen sport. And let the resulting muscular proportions be what they may.

This is not meant to imply that the muscles developed by bodybuilding activities are useless—but in many cases, such development will contribute little or nothing to the performance of a particular sport; and thus the time that would be required for building such development can almost always be used to far greater advantage in other ways.

It is expecting far too much to expect a leading bodybuilder to also be a champion athlete in every form of active sport; but it is also expecting too much to expect a champion athlete in any sport to possess a perfectly proportionate physique.

Certain muscular structures can be developed rapidly and easily—some others require far more time and effort; and when considering a body part that is difficult to develop, such development is not justified unless it contributes directly to the performance of the subject's chosen sport. Nor is maximum possible development of even the muscular structures that are easy to develop justified—unless such development is required.

Regardless of the recovery ability of an individual, definite limits exist insofar as his available energy and recovery ability are concerned—and both of these factors should be utilized to the greatest possible advantage; if energy is wasted—or if the subject's recovery ability is exhausted—in efforts to develop muscular structures that will not contribute directly to the subject's sports activities, then maximum possible benefit from supplemental training will be impossible.

In later chapters devoted to exact training programs, I will detail a number of exact workout schedules—and for best possible results, these should be followed without any slightest change in almost all cases. But if results are less than those expected, then such programs should be reduced—rather than increased—before any other type of alteration is undertaken; when less than optimum results are produced by any schedule of heavy exercise, then it is almost always due to overtraining rather than to undertraining.

Many subjects will be tempted to add some of their favorite exercises to these schedules; but if they do, then overall results will almost always be reduced—because these schedules are carefully designed to induce maximum possible degrees of growth stimulation in a minimum of training time, and such results cannot be produced unless the recovery ability is disturbed as little as possible.

Secondly, as the subjects become conditioned to a schedule of heavy exercise, there will always be a natural temptation to increase the number of sets or the number of exercises—and in some cases this is desirable; but in the vast majority of cases, such increases should be avoided—once well conditioned, the subjects have a feeling of almost boundless energy, and they feel like utilizing this energy in longer

workouts, but this is always a mistake. After all, the purpose of training is to increase the athlete's stores of energy while increasing both his strength and muscular efficiency—and if this energy is wasted in workouts of increased length or frequency, then a condition of overtraining will soon result, and progress will be greatly reduced.

Once properly conditioned, an athlete should be able to complete a hard workout—and then, after not more than thirty minutes rest, go through the entire workout again at the same pace without reducing his number of sets, number of repetitions, or number of exercises, and without reducing the amount of resistance by more than five percent (5%). If he cannot do so, then he is overtraining; overtraining insofar as the "amount" of exercise is concerned—not insofar as "intensity of effort" is concerned.

But I certainly do not mean that he should repeat his workouts immediately—merely that he should be capable of doing so.

Chapter 32: Layoffs from Training

In an earlier chapter on the requirement for irregularity of exercise, I mentioned the fact that training should never be permitted to degenerate into a rut—wherein the subject merely goes through the motions without really extending himself; such training will never produce much in the way of worthwhile results, and if continued long enough will usually lead to a loss of interest in training of any kind.

Thus, in the vast majority of cases, best long-range results will be produced if infrequent, irregular—but rather prolonged—layoffs from training are permitted; but such layoffs should not be scheduled in advance—for a number of reasons. If a subject is looking forward to a scheduled layoff from training, then his incentive will usually be greatly reduced—and if he is forced to take an unscheduled layoff, then he will normally return to training with greatly increased enthusiasm.

But totally apart from psychological considerations, although the responsible physiological factors are not at all clear, it is obvious that the system requires rather prolonged—if infrequent—breaks in training. In most cases, such layoffs from training should involve at least a week of almost total inactivity—and in some cases, a month out of training will do more for progress than six months of steady training without a break.

Any degree of strength/endurance that may be lost during such a layoff from training will usually be reestablished within a very short period of time after training is resumed—and in almost all cases, progress towards higher levels of ability will immediately follow.

In fact, best possible performances in many types of sports activities can sometimes be produced only after a layoff; power lifters, for example, are well advised to avoid training entirely for several days prior to a lifting meet. A longer layoff might—and probably would—result in reduced performance levels, but a few days out of training may make it possible to lift more than would otherwise have been possible.

The same sort of results can be observed in any sports activity that requires brief but very intense effort—pole vaulting, shot putting and short dashes are examples of such activities.

In almost all cases, if a month of constant training fails to produce marked degrees of improvement, then the need for a layoff is indicated; and in most such cases, the most desirable period out of training is a full week—or, in fact, a period of ten days, since training would normally be terminated on a Friday and would not be resumed until Monday of the second-following week.

Upon resuming training, at least some degree of muscular soreness can be expected—but another period of break-in training is not normally required. Individuals differ to some degree in their reactions to exercise after a layoff, but in most cases training should be resumed at the same levels at which it was terminated.

Except in cases involving injuries or illnesses, layoffs from training should never exceed a period of a full month—within that period of time, any normal physiological requirements for a break in training will have been fully met; and additional periods out of training will merely reduce the existing levels of ability without compensation.

"…if a month of constant training fails to produce marked degrees of improvement, then the need for a layoff is indicated…"

Chapter 33: "Sticking Points" In Training

Progress as a result of training should be both steady and rapid—and it will be if all of the involved factors are clearly understood and allowed for; but viewed on a short-range scale, occasional "sticking points" will be encountered where additional progress seems impossible.

In almost all cases, such sticking points are a direct result of overtraining—and many of them can be overcome by a brief layoff from training; but in some cases, another answer to the problem is required—one of several possible answers.

Upon encountering a stubborn sticking point, many subjects eventually assume that they have reached the maximum level of their individual potential—but that is almost never the correct answer to the problem; the potential levels of attainment are actually so high that very few individuals ever even closely approach them.

Insofar as strength is concerned, it is literally possible to build the power of the muscular structure to such a point that the skeleton is unable to support the loads that the muscles can easily lift. **But building such great strength does not require exposing the framework of the body to such dangerous loads.**

Digressing for a moment to the latter point, I want to clearly point out that maximum possible squatting strength—for example—can be produced without ever performing a squat with more than 400 pounds; although it will be necessary to "support" much greater loads in various positions if such strength is to be used without resulting damage to the tendon attachments.

When a subject is capable of rapidly performing 20 repetitions in the full squat with 400 pounds, then his squatting strength for one repetition is about as high as it will ever be, regardless of the system of training he follows; and if not, then it can be built to a maximum level of strength by continuing the practice of full squats with 400 pounds until such time as 30 or 40 repetitions become possible. But in all cases, a point will eventually be reached where the ability to perform a certain number of repetitions with 400 pounds will clearly indicate the ability to squat once with a maximum-possible amount of resistance.

And—while such training will almost entirely remove the potential hazards imposed by squatting with very heavy weights—it will also produce literally enormous increases in "wind", in cardiovascular efficiency, in overall muscular mass, and in overall muscular strength.

Now returning to the initial subject; when a sticking point is encountered that does not respond to a brief layoff from training—or is encountered immediately following a layoff—then one of two possible methods will probably produce results.

If the subject's strength level has not already reached a point where additional resistance would be unwise because of safety considerations, then the resistance should be markedly increased; for example, if a subject has been "stuck" at a point of 10 repetitions in the curl with a resistance of 100 pounds—then the weight should be increased to 120 pounds (by twenty percent). Such an increase in resistance will probably reduce the subject's ability to the point of about three or four repetitions—but if all sets are

performed as maximum possible sets, then progress will usually be almost immediately apparent; and in most cases, the subject will soon be able to perform ten repetitions with the increased resistance.

However, if the subject's strength level is already so high that additional large-scale increases in resistance are unwise because of danger to the framework of the body, then it is usually advisable to discontinue that particular exercise entirely for a while—and in such cases, the exercise should be replaced with a somewhat similar movement. For example: if the subject is stuck at a certain number of repetitions in the bench press with 350 pounds, then it might be advisable to discontinue bench presses entirely for a period of several weeks—while replacing them with a similar exercise, bench presses performed with dumbbells, or incline bench presses.

But if none of these methods—layoff, markedly increasing the resistance, or substituting a similar exercise—produce the desired result, then overtraining should be suspected; another layoff is not usually indicated or desirable—but the length and/or frequency of workouts should be reduced. If three sets of each exercise have been practiced, then reduce the number to two sets—and/or reduce the weekly workouts from three to two.

And if results are still not forthcoming, the fault will usually be directly due to the maturity factor—or, if the subject is above the age of twenty-five, then nutritional factors should be suspected.

But such total failure to produce continuing progress is almost never encountered in practice—and when such cases are encountered, the subject is usually suffering from an undetected illness or is not devoting the proper intensity of effort to his workouts.

Chapter 34: Confidence

Apart from intensity of effort, confidence may well be the most important factor for the production of the best rate of training progress; without confidence in his ability to produce good results, a trainee will seldom be able to produce them—and never in proportion to the efforts expended.

It is not the author's intention to go into the possible causative factors behind this situation—nor is it meant to be implied that these factors are identified or understood; quite the contrary, while a very large number of theories exist on this subject, the author has little if any confidence in any of the theories that have come to his attention—and absolutely no intention of becoming involved in a detailed recounting of such theories.

But—beyond any shadow of a slightest doubt—it is clear that lack of confidence in a particular mode of training can, and probably will, reduce the results produced by such training to a marked degree; a similar, if opposite effect is well established in the field of medicine—the placebo effect.

In some cases I completely agree with the methods practiced by coaches in attempts to inspire confidence, and in a few cases I do not agree with the methods being practiced—but my personal likes or dislikes are of no slightest importance; results are what count, and any reasonable method—and some apparently unreasonable methods—that will produce the required results should be practiced.

I could almost literally hammer this point into the ground, with hundreds of examples of cases where confidence—or a lack of confidence—greatly influenced the production of results from physical training; but no amount of repetition can make the above points any clearer.

"Apart from intensity of effort, confidence may well be the most important factor for the production of the best rate of training progress; without confidence in his ability to produce good results, a trainee will seldom be able to produce them—and never in proportion to the efforts expended."

Chapter 35: The Significance of Measurements

So many outright lies have been stated on the subject of bodily measurements during the last few years that I am almost tempted to skip the subject entirely—and I would do so except for the fact that a few points should be established in this regard.

But before I do so, I want to say that the largest muscular upper arm that I ever measured—and certainly one of the largest muscular arms in the world—was the left arm of Bill Pearl; which was 18-5/8 inches measured "cold" and perfectly accurately. Yet many bodybuilders—with arms that are obviously much smaller than Bill Pearl's—claim upper arm measurements of as much as 23 inches; and 19 inch upper arms—if you are to believe current claims—are almost as common as dirt.

The size of the average man's head is between 22 and 23 inches, and I have yet to see a man with muscular arms that even began to approach the size of his head—nor do I ever expect to. But I mention the size of the head in relation to the size of the arms very pointedly—because the apparent size of an individual will depend to a great degree upon the size of his head, and this is especially true when you must judge a man's size by photographs; a man with a larger than average head will always look far smaller than his actual size, and vice versa.

But quite contrary to very common belief, photographs do not make an individual look "heavier" than he or she actually may be; in fact, if any apparent distortion of size is created, the photographed individual will almost always look much smaller than true size. This is especially true when you are dealing with photographs of athletes with great muscular size—while such an individual may appear quite large in a photograph, if so, then he will usually appear to be almost a giant in person.

It seems to be almost literally impossible to photograph a very heavily developed bodybuilder in such a manner that a true impression of his size is given—while such an individual may be very impressive in photographs, he will be almost unbelievable in person. And this is especially true when the accurate height and bodyweight of an individual are given in connection with a photograph.

But in spite of their almost unbelievable muscular size, the actual measurements of such individuals will seldom even closely approach those quoted for them—or by them. On a man of average height, a 16 inch muscular arm is very impressive—a 17 inch upper arm is so large that it may make the individual appear freakish if the rest of the body's muscular proportion is not in proportion—an 18 inch upper must be seen to be appreciated—and a 19 inch upper arm approaches the impossible insofar as size is concerned. True—I once saw a man with upper arms that were over 20 inches in reasonable muscular condition; but he wasn't an average individual—he was just under a full nine feet tall and weighted over 500 pounds.

If such a man weighed as much as he should in order to present a reasonably proportioned appearance, his upper arms might measure as much as 25 inches—but he would have to weigh something on the order of 800 pounds to retain such reasonable proportions at that height.

And that is my entire point, measurements should be in proportion to the height and weight of the individual—totally without regard for what their actual size may be; if not, then an individual will present a freakish appearance. But in fact, some bodybuilders go to great lengths in their attempts to create just

such a freakish appearance; some years ago, in northern California, it was quite the “thing” for heavily developed bodybuilders to wear as many as seven carefully tailored, very thick sweaters—merely in an attempt to overstate their already enormous size.

But if clothes are properly cut and fitted, then even the largest bodybuilder can pass through a crowd unnoticed; fairly recently, in New York, my son was waiting in the lobby of a well lighted building when one of the heaviest developed individuals in the history of the world walked by him at a distance of five feet, completely unnoticed—even though my son knew the man, was expecting him, and was looking for him. In well fitted clothing he simply did not stand out, in spite of his literally enormous size.

Then, a few minutes later, another—but much smaller—bodybuilder entered the same lobby, and all eyes were immediately turned in his direction; he appeared enormous—and he also appeared to have escaped from the set of a Frankenstein movie, still in costume as the monster. All he really required in that direction was a bolt through his neck—he already had on a hair coat. Yet such an outrageous appearance was a total creation of his selected costume; and this was clearly proven by the fact that the other, actually much larger, bodybuilder passed unnoticed.

If it appears that the author looks with disfavor upon the antics of such people as the Frankenstein-like character mentioned above, then the reader has gained the proper impression; but while the opinions of the author are of very little importance to anyone apart from himself, the actions of such characters are of great—if totally negative—importance. Because many people judge the entire field of weight training by such individuals.

And while it has taken the commercial airlines a great number of years to live down the reputation established by the early day barnstorming pilots—without which there would probably never have been any airlines—it now appears that the field of weight training may be forced to go through an even more prolonged period of living down the antics of some bodybuilders, without which the field of weight training could do quite well.

Apart from considerations which will be carefully explained in a later chapter dealing with charting progress, the coach I charge of a class of weight trainees would probably be well advised to do everything possible in the direction of discouraging interest in measurements; too closely watched by an individual trainee, the normal fluctuations in bodily measurements can lead to great discouragement.

If at all possible, it is usually far better to try to concentrate the trainee’s entire attention on attempts to better his performances, and if this is done properly, then the matter of measurements will take care of itself quite nicely—when the subject can curl 200 pounds in good form without body-swing, then his arms will be as large as they need to be for any possible purpose connected with any sport just short of wrestling bears.

Chapter 36: Charting Progress

Without becoming involved in almost endless detail, the subject of this chapter is perhaps the most difficult aspect of weight training to clearly explain—and without such a full explanation, some of the points involved may appear to contradict other points established earlier. However, in fact, no such contradiction exists—regardless of possible appearances.

When the actual progress of an individual trainee is carefully charted over a period of a few months, several rather surprising results will become immediately apparent; for example, while strength levels will increase in a series of gentle curves, increases in size of the involved body parts—and thus apparent increases in muscular mass—will result in a stair-step pattern.

A much clearer understanding of these separate—but interrelated—patterns of growth can be gained by a study of actual charts of human growth. And if this is done, it will be noted that strength increases seem to come in an almost straight, but slightly down-curving line—if such increases are viewed over a long period of time; but a closer view will reveal the fact that the line was actually curving back and forth to a slight degree.

And upon closely viewing increases in the size of the involved body parts, it will be immediately apparent that such increases came in sudden spurts followed by plateaus, in stair-step fashion.

And upon carefully comparing these two different factors of growth, on the same scale, it will be seen that strength increases curved upwards—increasing their rate of progress—immediately following an increase in size of the involved body part, and then gradually curved back into a reduced rate of increase.

From all available evidence, the cause/effect relationship involved seems to be perfectly clear; strength increases at a faster rate immediately after an increase in size makes such a strength increase possible—but then reduces its rate of progress as it nears the maximum strength level for a particular size.

Likewise, there seems to be no necessity for a size increase so long as the existing strength level is lower than that which is possible at the existing size.

Thus, in effect, size increases permit strength increases—and strength increases force size increases.

From the above, it might appear that this disproves a previously established point—the relationship between size and strength; but in fact, it is actually proof of the previously established point. I have never stated—nor have I meant to imply—that there was an absolutely rigid relationship between existing size and strength levels; on the contrary, an obvious range of variation is clearly demonstrable. And while this range is normally so slight that it can and should be totally disregarded, and while it is rigidly limited on the “upside”—there is literally no limit to this range on the “downside.”

This is to say; once a muscle has attained the maximum possible level of strength for a particular size, it literally cannot increase in strength until and unless an increase in size is produced. However, even a moment of consideration will make it immediately apparent that the strength of a muscle can “decrease” literally to the point of nothing—without the necessity for any decrease in the size of the muscle.

A sudden and violent sickness can reduce a man's strength almost to the point of zero—with little or no decrease in the size of his muscles; but if his strength is at its maximum level for a particular size, then nothing short of an increase in size can produce an increase in strength. And even then, an increase in size will not "produce" an increase in strength—it will merely make it possible.

In earlier chapters, rather than risking getting bogged down in far too much technical detail, I simply skipped any mention of quite a number of factors that are really of no importance—if they are understood, as they are; but in so doing, I have created a risk of appearing to contradict myself—while in fact, no such contradiction exists.

Additionally, quite a large amount of confusion exists in regard to many of these factors as a direct result of the extremely poor methods of measurement that are almost always employed. Since it is almost literally impossible to measure the actual existing strength level with anything approaching total accuracy, quite a number of people have based their conclusions upon measurements of no slightest significance or even accuracy.

But when accurate measurements are possible—using the methods detailed in an earlier chapter—then a careful comparison of such measurements will produce evidenced upon which significant conclusions can be based.

In a previous chapter, I pointed out the inadvisability of permitting a trainee to direct his attention into the importance of measurements; and that evidence still stands—but it does not follow that trainees should not constantly be aware of their progress insofar as strength is concerned.

On the contrary, such an awareness is almost an absolute requirement for good results from training—since an attempt should be made to improve upon previous performances during every workout.

Secondly, a constant awareness of the actual progress of a trainee is an essential requirement for the person directing that training; without such an awareness on the part of the coach, an individual trainee can—and many trainees will—produce little or nothing in the way of training progress. In most such cases, a failure to progress properly will be a direct result of insufficient intensity of effort. But—regardless of the causative factor—the coach needs to be made aware of such training failure as soon as possible after it occurs. Properly charting the progress of all trainees will provide such an awareness.

While almost any number of possibilities exist for charting purposes, it is usually better to employ a system of charting that will provide the required information in a minimum amount of time and without involving unnecessary detail. In the author's view, such a system should totally disregard measurements except in isolated instances—and should be based entirely upon performances; as the ability increases, the measurements will keep pace.

Because of the general unavailability of accurate strength testing methods, progress should be charted on a basis of performances of sets of a particular number of repetitions—eight, ten, fifteen, twenty, or almost any possible number of repetitions except one repetition.

For most purposes, the ideal number seems to be ten repetitions; but regardless of the number selected for charting purposes, sets involving any other number of repetitions should be disregarded entirely—at least if any degree of accuracy is desired.

Chapter 37: The Pre-Exhaustion Principle

To begin with, I want it clearly understood that I make no claims that the subject of this chapter is either new or original; on the contrary, the principle I am about to describe has been mentioned in print (although not under the name I am giving it here) several times during the past few years—however, by and large, I think the very great value of this principle has been overlooked. I do not know the name of the originator of this principle, but he took a long step in the direction of improving the results that are possible from weight training.

Quite a number of examples of the proper application of this principle could be given—but I will restrict myself to three such examples; however, once the basic idea is clear, it should be possible for almost any trainee to use this principle to very great advantage in dozens of ways.

In general terms, the primary purpose of the application of this principle is to overcome one of the serious shortcomings of almost all conventional exercises; properly used, this principle makes it possible to work a particular muscular structure—almost **any** muscular structure—much harder than is normally possible. In almost all conventional exercises involving the functions of two or more muscular structures, a point of failure is reached when the weakest involved muscles are no longer able to perform; and in such cases, very little in the way of growth stimulation is provided for the stronger muscles involved in the same exercise.

For example; in the squat, a point of failure is usually reached when the lower-back muscles fail—and this normally happens long before the much larger and far stronger frontal thigh muscles have been worked as hard as they should be for the production of best-possible results.

But—by "pre-exhausting" the frontal thigh muscles—this problem can be solved; this can best be done in the following manner. First, perform one set of about twenty to thirty repetitions of leg presses—but continue until it is literally impossible to move the weight in any position, regardless of the number of repetitions that are momentarily required. Second, **instantly** follow the leg presses with a set of about twenty thigh extensions—with no rest at all between the leg presses and thigh extensions, and again continuing the set to a point where additional movement is utterly impossible. Third, **then do your squats—instantly**, with no rest at all following the thigh extensions, not even so much as two seconds of rest.

You will find that very little weight is required for the squats—probably only half (or even less than half) of the normal amount of weight that you use for squatting; in many cases, as little as 135 pounds will be all that is required for a man that usually squats with well over 300 pounds for 15 or 20 repetitions.

But regardless of the fact that the weight being used is actually very light, when you do reach a point of failure in your squats it won't be because your lower back failed before your thighs were properly worked; your thighs will be worked far harder than they ever were before—and when you fail, it will be because your thighs are exhausted.

In effect, you have removed the "weak link" of lower-back involvement in the squats; by pre-exhausting the frontal thigh muscles before squatting.

Another example; performing dumbbell "side raises" immediately prior to behind-neck presses. In this case, perform a set of about ten repetitions of **strict** side raises with dumbbells; keep the palms of the hands turned down towards the floor, rather than permitting the palms to rotate forward—maintain a solid "lock" in the elbows, don't permit the arms to bend at all—keep the arms well "back" in line with your shoulders, if held far enough back the arms will "lock-up" in the shoulders at a point just above level—move smoothly and without body-swing—and continue with partial repetitions, following about ten full repetitions, until you are simply unable to move the dumbbells away from your sides.

Then—**instantly—**do a set of about ten repetitions of behind-neck presses; with a fairly narrow (slightly wider than shoulder width) grip. And, again, carry this exercise to the point of utter failure.

And now the final example; pullovers immediately followed by pulldowns. In this instance, do a set of as many as fifty repetitions of stiff-arm pullovers, carried to the point of failure—performed on a decline (head lower than feet) bench if you have one available. Then, immediately perform a set of about twelve repetitions of behind-neck "pulldowns"—using a fairly narrow (25 inches wide) grip, and with a bar designed to provide a parallel grip, a grip such that the palms of your hands are facing each other when your elbows are forced back in line with your shoulders.

Done properly, that cycle will "pre-exhaust" your latissimus muscles without tiring your arms—then, during the brief period while your arms are actually stronger than your upper-back muscles, you can take advantage of that momentary condition to use the strength of the arms to work the latissimus muscles much harder than would otherwise be possible.

But—**in all cases**—the "recovery time" of the pre-exhausted muscles is very brief indeed, usually something on the order of three seconds, or less; thus, for best results, you must move **instantly** from one set of an exercise to the next set of another exercise, with no rest at all, not so much as two seconds of rest.

This principle can be applied to almost any compound exercise; simply decide which muscle you wish to concentrate on, then pre-exhaust that muscle by the performance of an isolation type exercise, and then instantly involve the same muscle in a set of compound movements.

Obviously—when using this system—you **will not** be able to use anywhere near as much weight as you normally would in the particular compound exercises involved—in the above examples, these were the squats, the behind-neck presses, and the pulldowns; but you certainly will do far more in the way of stimulating muscle growth.

How many such cycles?

At first, not more than one—later, probably two cycles during each of three weekly workouts; but never more than three such cycles in any workout—and in that case, you would probably be well advised to practice those particular exercises only twice weekly.

And while I promised only three examples, it may be a good idea to add a few more; barbell curls, immediately followed by regular-grip chinning—triceps curls, immediately followed by parallel dips—stiff-arm supine lateral raises, immediately followed by barbell rowing motions. The list is almost endless.

Remember—during a workout, you are trying to build strength, not demonstrate it; the actual amount of weight is of no slightest importance—so long as it "feels" heavy to your muscles.

Try this principle—and try to understand it clearly; once you do, it can be used to simply enormous advantage in workouts conducted for any purpose.

“Remember—during a workout, you are trying to build strength, not demonstrate it; the actual amount of weight is of no slightest importance—so long as it “feels” heavy to your muscles.”

Chapter 38: The Harder It Seems—The Easier It Is

In the author's opinion, the subject of this chapter is the most important single point raised in the field of physical training during this century; and it is certainly a point that was never raised previously—simple as it is, undeniably true as it is, important as it is, it was apparently totally overlooked because it runs directly counter to widely accepted belief. "The harder a particular repetition seems, the easier it actually is; and, the apparently most-dangerous repetition is actually the safest repetition, by far the safest."

Yet, in spite of the simple, undeniable truth of that statement, literally millions of weight trainees have wasted billions of hours of training time—because, without single exception that I have ever encountered, or even heard of, apparently all of them sincerely believe exactly the opposite.

In a set consisting of one repetition, there is no basis for comparison; the one repetition is "all things"—it is the easiest repetition, and the hardest, and it is also the safest repetition, and the most dangerous.

But in a set consisting of two or more repetitions—where there is a basis for comparison—then, in all cases if anything even approaching proper form is being maintained, the first repetition is the hardest repetition, and it is by far the most dangerous one. And I want it clearly understood that this has absolutely **nothing** to do with the fact that you may or may not be properly warmed-up; the warm-up—or lack of a warm-up—has nothing to do with the matter.

Secondly, it should be clearly understood that the type of equipment being used has nothing to do with the matter either; nor does the particular exercise being performed—nor the amount of weight being used.

Remember, we are concerned here with actualities—not with appearances; we are interested in facts, not opinions.

Keeping it clearly in mind that the following would be equally—that is to say, "perfectly"—true in any possible example, regardless of the exercise involved, no matter how many repetitions were used, and with any possible amount of weight, let us examine what actually happens during the performance of a set of curls with 100 pounds; as opposed to what "seems" to happen. In this example, we will assume that you are capable of performing nine full repetitions—but then fail during an attempt to perform the tenth repetition, in spite of an all-out effort.

The first repetition will seem quite easy, and it will move rapidly; the second will appear to be a bit harder, and will move slower; by the time you reach the ninth repetition, you will be moving very slowly, and that final full repetition will seem very hard; the tenth repetition will not move, and will appear to be impossibly hard.

So much for appearances; now let us see what actually happened. In all ten repetitions the barbell weighted the same, 100 pounds; and during the first nine repetitions the "distance of movement" was the same, approximately two feet.

Now it should be obvious that "something less than 100 pounds of force" was generated during the tenth repetition; because, any amount of force in excess of 100 pounds would have caused movement in the

tenth repetition—and since movement was not caused, it is thus clear that less than 100 pounds of force was involved.

And, in the ninth repetition, where movement was produced, it is also obvious that "more than 100 pounds of force" was produced. Even though the movement was actually quite slow—requiring something on the order of three seconds for full movement.

If we measure the actual amount of force being produced in the ninth and tenth repetitions we will find that it works out to about 110 pounds of force in the ninth repetition, and about 80 pounds of force in the tenth repetition.

But in the first repetition movement was faster, far faster—the full movement required only about one-third of a second; the weight was moving nine times as fast during the first repetition as it was during the ninth repetition—and nine times as much force was required to move it that fast, and since nine times 110 equals 990 it should be obvious that the first repetition was much harder than the later, seemingly harder but actually easier repetitions.

In the above example, the first repetition involved the production of approximately twelve times as much power as the tenth repetition did—and it was at least 144 times as dangerous as the tenth repetition; because the danger factor can only be calculated by squaring the differential of force application.

But, in fact, since the first repetition involved not only much more speed of movement but, as well, far greater acceleration factors, it is obvious that the actual danger factor was far greater than a ratio of 144 to 1 would indicate; it was probably something on the order of at least 1000 to 1—that is to clearly say, the first repetition was probably at least one-thousand times as dangerous as the tenth repetition.

Then why did the tenth repetition "seem" so much harder?"

Because, at that point in the exercise, your muscles were exhausted—and the 80 pounds of force that you were able to generate in a failing attempt to move the last repetition represented 100% of your momentary ability; whereas, during the first repetition, you were fresh and strong, and at that moment you were probably capable of generating something on the order of 3000 pounds of force—and thus the 990 pounds that you actually were required to use represented only about a third of your momentary ability, and felt quite easy for that reason.

Yet out of a totally invalid fear of injury—most weight trainees avoid the last, seemingly hardest repetitions; thinking that, by so doing, they are avoiding the danger of injury—whereas, in fact, all they are avoiding is the production of best-possible results.

And if a full understanding of the above leaves you feeling a little embarrassed for not having previously been aware of such an obvious point, such a plainly self-evident truth—then remember that millions of people watched a wheel come up out of the east and go down in the west every single day for thousands of years before it occurred to one of them to punch a stick through the middle of a similarly-shaped object and attach it to a sledge.

Thus, in fact, "...the harder a particular repetition seems, the easier it actually is; and, the apparently most-dangerous repetition is actually the safest repetition, by far the safest."

Chapter 39: Conclusions

There has been a great deal of repetition in the earlier chapters—it was intended that there should be; in large part, most of the preceding could be summed up in a very few words, "...work **harder**, but very briefly—and infrequently."

If the reader expected this bulletin to be a long description of the new Nautilus training equipment, then it may prove a disappointment—and for that reason, one of the following chapters will be devoted to a brief outline of the principles incorporated into the new types of equipment; however, the major value of the new equipment is provided by the fact that it makes harder exercise possible—and if the main points outlined in this bulletin are clearly understood, and properly applied, then a rather large part of the value provided by the new types of equipment can be derived from conventional training equipment.

In some cases it is possible to obtain any possible degree of results without the use of any new types of equipment; and in a few other cases the new equipment produces better results primarily because it forces the trainee to perform his exercises in a proper style.

It should be clearly understood that "style of performance" of an exercise—almost **any** exercise—is of utmost importance; and I would like to add that I seldom encountered a weight-trainee who performed any of his exercises in a proper style.

Performed in a proper manner, a total of only eight basic conventional exercises are capable of producing almost any degree of possible results—and far more quickly than most people would believe; these exercises are:

1. standing presses with a barbell or with heavy dumbbells
2. full squats
3. stiff-legged deadlifts
4. heavy barbell curls
5. regular-grip chinning
6. parallel dips
7. barbell wrist-curls
8. one-legged calf raises

But in practice, most trainees avoid most of the above listed exercise—or attempt to replace them with other, "easier" movements which they hope will provide the same degree of results; probably because they are simply not willing to work as hard as they should for the production of best results.

If, over a period of two or three years of training, the above eight exercises are alternated with a few other basic exercises, then **any** degree of results that are possible with conventional equipment can be produced; these exercises are:

9. leg presses
10. thigh extensions
11. thigh curls
12. pulley triceps-curls
13. behind-neck “pulldowns” performed properly, with a narrow, parallel grip
14. shoulder shrugs
15. standing side-raises with dumbbells
16. the proper use of a “gripping” machine
17. incline and decline presses with heavy dumbbells
18. stiff-arm “pullovers” on a decline bench
19. behind-neck presses
20. sit-ups on a decline bench
21. leg-raises on a steep incline bench
22. “high pulls”—or front rowing with a barbell
23. side bends with a dumbbell
24. bent-forward rowing with a barbell

But it should also be clearly understood that attempting to use all of the above listed exercises at the same time would be a major error; in most cases, not more than ten exercises should be practiced—and best degrees of results will almost always be produced if sets are limited to two, performed three times weekly.

Many people have expressed interest in a “calf machine” based on the Nautilus principles; and while it would be easily possible to build such a machine, I have refused to do so—because it is not required. For the purpose of developing any possible degree of size and/or strength into the major muscles of the calves, all that is required in the practice of one-legged calf raises while holding a dumbbell in one hand.

Properly performed, barbell wrist-curls will build literally huge forearms—and thus it might appear that no new types of equipment would be required in this case either; however, in fact, it seems to be almost impossible to teach people the proper style required—or to get them to practice a proper style once it is understood. So, in this case, the new equipment is a requirement—because it forces the trainee to perform the movements properly.

If only a few actually very simple points are understood—and applied in practice—then almost all trainees can reach their individual limits of muscular size and strength very quickly, and as a result of brief, infrequent workouts; these points are listed below.

1. In order to involve all of the fibers of a particular muscle in an exercise, the muscle must be exposed to heavy resistance while in its position of full contraction. No matter how hard a muscle is worked in any other position, you are not involving the total number of available fibers.

2. But simply working a muscle in its position of full contraction is not enough; while in that position, it must be worked to a point of momentary failure.

3. This should be done in the performance of sets of at least six full repetitions and not more than twenty full repetitions; but in all cases, additional partial repetitions should also be performed until a point is reached where any amount of movement is impossible.

4. Workouts should be designed to include every major muscular structure in the body, with emphasis on the largest muscular masses.

5. Workouts should be outlined in such a fashion that the muscles are worked in their order-of-size; the largest muscles should be worked first, etc.

6. Exercise movements should be performed as rapidly as possible consistent with safety considerations while maintaining proper form.

7. The entire workout should be completed in not more than one and one-half hours; a total weekly training time of four and one-half hours.

8. If a “split routine” involving six weekly workouts is used (and the author’s experience indicates that it seldom should be), then no single workout should exceed one hour in length—and total weekly training time should still be limited to about four and one-half hours.

9. In almost all cases, two sets of any one exercise are all that are required for maximum muscle-growth stimulation; and any additional exercise will reduce the production of results. In no case should more than three sets of any particular exercise be practiced.

10, “Bulking up” by the purposeful addition of fatty tissue is always a mistake; very recent evidence indicates that fat cells, once added (and fat cells, unlike muscle fibers, **can** be increased in number), can never be removed—apparently the **size** of such cells can be reduced, but the actual number of cells will not be reduced by anything short of surgical removal.

Such fatty tissue will add little or nothing to the performance ability of any athlete (with the possible exception of long distance swimmers, and the value is questionable even in this instance); but attempts to remove all remaining visible traces of fat will almost always produce a condition of over-training and result in actual reductions in performance ability.

"If only a few actually very simple points are understood—and applied in practice—then almost all trainees can reach their individual limits of muscular size and strength very quickly, and as a result of brief, infrequent workouts…"

Chapter 40: The Nautilus Principles

To begin with, why the name "Nautilus"?

Well, according to Webster's, the Nautilus is a type of shell fish with a "smooth, spiral, chambered shell", and since this is almost an exact description of the spiral pulleys (or cams) that we developed for the purpose of regulating the required variations of resistance provided by the new exercise machines, I thought the name was unavoidably appropriate.

1. Anybody who has ever used a barbell is aware that the exercises provided by the use of such a piece of equipment are not "full range" movements; at some points in most barbell exercises, there is no resistance at all—at the start of a curl, at the end of most forms of curling, at the top position in a squat or a press of any kind. If you can "lock out" under the weight in any position, then you do not have full range resistance; in such a case you are providing exercise for only part of the muscles that you are trying to work.

Full range resistance can be provided **only** by a machine which rotates on a common axis with the body-part that is moved by the muscles being worked; a "rotational" form of resistance must be provided—and it must rotate on the proper plane. When this requirement is met, then it becomes possible to provide a type of exercise that is "full range" for anybody, and that actually exceeds the range-of-movement that is possible for most people.

2. Barbells and other conventional types of training equipment provide resistance in one direction only—unidirectional resistance; but since the involved body-parts rotate, it is thus impossible to provide more than a literally infinitely small range of direct resistance—and in many conventional exercises, there is no direct resistance at all.

Since the "direction of movement" of the involved body-parts is constantly changing, the "direction of resistance" must change in exact accord, automatically, simultaneously, instantly; again, this requirement can only be provided by a rotary form of resistance.

When the bodily "axis of rotation" that is involved in the exercise is rotating exactly in line with the axis of the rotary resistance, then omnidirectional resistance is provided—literally "all directional" resistance. If your hand, for example, is moving straight "up"—then the resistance is straight "down"; if your hand if moving directly towards the east—then the resistance is exerting its force directly towards the west. The resistance is always exactly 180 degrees out-of-phase with your direction of movement; the resistance is always trying to do exactly the opposite of what you are trying to do.

And while the importance of such "direct" resistance may not be immediately obvious to people unversed in at least basic physics, I think that the following example will make this point quite clear. Your car may weigh 4,000 pounds—and you may be able to push it forwards on level ground; but that does not mean that you are capable of "lifting" such a weight. With omnidirectional resistance, you are ALWAYS lifting the weight—regardless of the direction in which you may be exerting force. If your hands are going "up"—the weight is also going up; if your hands are going "down"—the weight is still going up; if your hands are going in a horizontal direction—the weight is being moved up; no matter what you do, so long as you are producing power for the purpose of causing a body-part movement from a position of extension in the direction of a position of contraction—then you are raising the weight.

The only conventional forms of exercise equipment that come anywhere close to providing this "direct" resistance are thigh-extension machines, thigh-curl machines, so-called "butterfly" machines, and the curling machines built by a man named Clark in San Diego, California; if there are any other types of equipment available that provide this feature, then I am simply not aware of them.

From the above, it should be clear that incorporating a "rotary" form of resistance into an exercise machine provides quite a number of valuable characteristics—full range resistance, direct resistance, and omnidirectional resistance.

3. Barbells do not provide variation of resistance—although, because of certain basic laws of physics, some effective variation of resistance will be encountered in most barbell exercises; for example, in a curl with a barbell, there is literally no resistance at the start of the movement, because the moment-arm of the weight is zero in that position—but after the first 90 degrees of movement, the moment-arm has reached its maximum point, and the resistance will feel (and will be) as high as it becomes during that exercise—then, later, as the movement is completed, the moment-arm returns to zero, and again there is no effective resistance.

In that sense, barbells do provide variation of resistance—but such variation is random and does far more to downgrade the exercises than to improve them.

Because of such random variation, you encounter such things as so-called "sticking points"—places where the weight seems far heavier than it does in other places; and you also encounter places where there is no effective resistance at all.

Human muscles are stronger in some positions than they are in other positions—in general, muscles are strongest in their positions of full contraction; and because of the way in which they function, the position of full contraction is the only position in which it is possible to involve all of the fibers of any muscle. Yet, in almost all conventional exercises, there is literally **no** resistance in the position of full contraction—in the only position where it is even possible to involve **all** of a muscle, there is no resistance available to require the involvement of the then available fibers; as an unavoidable result in conventional exercises, muscles are worked only in their weakest positions—and are worked not at all in their strongest positions.

There are a few relatively unimportant exceptions to that general rule—but none of very great significance; these are:

1. thigh extensions
2. leg curls
3. wrist curls with the forearms on a declined surface, so that the wrists are below the elbows
4. shoulder shrugs
5. stiff-legged deadlifts (a very, very good conventional exercise, but one which most bodybuilders avoid entirely)
6. side raises with dumbbells
7. front raises with any sort of resistance
8. one-legged calf raises
9. sit-ups on a decline board, and leg-raises on an incline board

10. side bends with one dumbbell, and a few others

With the Nautilus machines, the required variations in resistance are properly provided; the resistance changes throughout the movements—in general, resistance is lowest at the start of an exercise, increases as the movement progresses, and decreases slightly near the end of an exercise. The actual rate of increase varies—depending on a number of factors. But in all cases, the resistance is exactly what it should be in all positions throughout the movements; when a set of an exercise is performed on such a machine, and when the set is carried to a point of momentary failure, then almost literally 100% of the individual muscle fibers contained in the muscles being worked are involved in the exercise—as opposed to less than 18% of the total number of available muscle fibers which are involved in most forms of conventional exercise, and as few as two or three percent of the total number of fibers in some conventional exercises.

4. Balanced resistance occurs in only one position in most conventional exercises; for example, in a barbell curl the resistance is balanced (exactly right) only in the so-called "sticking point" that is encountered about halfway through the movement—if the resistance is higher than the amount that can be handled at the sticking-point, then it is impossible to pass that point in the performance of a repetition using good form, but once the sticking-point has been passed, then the resistance is too low, and before reaching the sticking-point, the resistance is also too low. Thus, in fact, the resistance is "right"—can only be right—at one point throughout the movement.

The Nautilus machines provide perfectly balanced resistance—it is never too high and never too low; there are no sticking-points and no points of little or no resistance—when you might fail in such an exercise, you may fail at any point, instead of always failing at or before the sticking-point, as usually happens in conventional exercises. To a new trainee, however, the "resistance curve" of such a machine might not—probably would not—feel perfectly smooth; while there would be no real sticking-points, it is probable that the resistance would feel heavier towards the end of a repetition than it did at the start—but this is to be expected, because the "resistance curve" is balanced to exactly match the "strength curve" of an individual with balanced development, perfectly proportionate development, and since a man that has been training with conventional equipment has been training only part of his muscular structures (and the weakest part, at that) it is only natural that he would not be as strong as he should be in all area.

Eventually, however, after the machine has been used properly for a reasonable period of time, the movements will start to feel perfectly smooth—the resistance will feel exactly the same in all positions. While in fact, the resistance will be constantly changing—in many cases more than doubling as the movement progresses from a starting position of full extension to a finishing position of full contraction.

5. "Total" exercise cannot be provided by conventional exercise equipment for reasons which should now (following the above explanation) be obvious; conventional exercises involve only a small part of the total number of available muscle fibers—Nautilus machines involve almost all of the available fibers.

6. Rotary resistance is not provided by conventional exercise equipment—since such equipment offers resistance that is reciprocal in nature, moving back and forth, usually up and down but in almost all cases confined to a single direction of movement. But body-parts rotate and it is obvious that a reciprocal form of resistance cannot provide constant resistance against a rotary form of movement.

Nautilus equipment provides the required rotary form of resistance—and again, this requirement should now be clearly understood from the above description.

7. “Directness of resistance” is not provided by conventional forms of exercise; in this sense, the term “direct” refers to the point of application of the resistance—in most conventional exercises, the resistance is imposed against several muscular structures simultaneously, which would be a decided advantage if all of these involved muscles were of equal strength. But in many cases, it happens that some relatively small and weak muscles become involved in the exercises as “weak links”—and it is then literally impossible to work the larger, stronger muscles as heavily as they must be worked for the production of best-possible results.

Several such examples have been mentioned in preceding chapters, so I will limit my examples to only one; in conventional exercises intended for the development of the latissimus muscles, the weak link is provided by the arms—a point-of-failure is reached when the arms are exhausted, long before much of anything in the way of growth stimulation has been provided for the latissimus muscles.

Nautilus equipment overcomes this obvious shortcoming of conventional exercises by directing the resistance against the “prime” body part—rather than attempting to filter the resistance through a weaker, related body-part structure. For example, the latissimus muscles are attached to—and move—the upper arms; what happens to the hands and forearms is of no importance—the resistance is provided against the upper arms, at the elbows, as it must be in order to directly oppose movements powered by the latissimus muscles.

When a point of failure is reached in such exercises, it will be because the latissimus muscles are exhausted—not because the arms were too weak to continue.

The above points should serve as a basic primer of the features incorporated into the new Nautilus training equipment; at a later date, detailed brochures of several types of such equipment will be mailed to each purchaser of this bulletin—these brochures will contain pictures, drawings, charts, diagrams and other types of illustrations that will clearly explain the basic principles involved.

Properly used, such equipment is valuable primarily because it enormously reduces previous requirements in the way of training time, both overall training time and weekly training time; and to an as yet unknown degree, it makes greater degrees of final results possible.

Chapter 41: The Next Step

Using existing types of Nautilus equipment, the most productive routine that we have encountered up to this point requires approximately four minutes of training time to work most of the muscular structures of the upper torso; starting from scratch with a "cold" subject, four exercises are performed in rapid succession:

1. a set of 15 to 20 repetitions on a Pullover-type Torso Machine

2. a set of 12 to 15 repetitions on a Behind-Neck type Torso Machine

3. a set of 10 repetitions on a Torso/Arm Machine, pulling the bar to a behind-neck position, and

4. a set of 10 repetitions on the same machine but using a reverse grip, this time pulling the bar to the chest

The indicated number of repetitions are merely a "guide figure," in practice, a weight should be selected that will permit approximately that number of full repetitions; but then the subject should perform as many repetitions as possible—counting only the full repetitions but continuing with partial movements until it is literally impossible to move the resistance even slightly in any position. Then, when the above indicated number of full repetitions become possible, the resistance should be increased.

The first set, on the pullover-type machine, heavily works the major muscular structures of the upper back and chest over a range of movement of approximately 240 degrees—but the arms are not worked at all, or at least not to a measurable degree; the second set, on the behind-neck type machine, works most of the same muscular structures—but from another angle, in another direction, this time over a range of movement of about 160 degrees. At the end of the second set, the muscles of the upper torso have been worked very hard—far harder than it is possible to work them in any other manner—but the arms are still fresh and strong; thus, for a very brief period, the arms are actually stronger than the torso muscles—a situation has been created (a fleetingly temporary condition that exists for a matter of only a very few seconds) that is the exact reverse of the normal situation.

Normally, the arms are weaker than the torso muscles—and you fail in torso exercises when the arms become exhausted; but now you have reversed that situation—and while it exists, while the arms are actually stronger than the torso muscles, you take advantage of this condition and put it to very good use.

The third set—on the torso/arm machine—is performed instantly after the completion of the second set; in this machine you **are** using the arms—using their strength to enable you to work the torso muscles even harder than they have already been worked by the preceding two sets.

In the fourth set—performed on the same machine but using a different movement—you are again taking advantage of the unbalanced strength relationship; by the end of this last set, the latissimus group of muscles, the upper pectorals, the abdominals, the trapezoids, and several smaller muscular structures will have been worked almost literally "into the ground"—and the bending muscles of the arms will have been worked quite heavily as well. Within a period of about four minutes, you will produce a condition

that is literally impossible to produce in any other fashion—regardless of the number of exercises practiced or the number of sets performed, or the amount of time devoted to any other type of training; the degree of "pump" produced throughout the upper torso must literally be experienced to be believed—and regardless of your condition or previous training experience, the first such cycle will leave you in a state of near-shock, and the resulting degree of muscular soreness will be almost crippling.

Performing the same four-exercise cycle at a slower pace—or with rest periods between the different exercises—will **not** produce the same degree of results; but such a pace—and intensity—of work should not be undertaken right from the start of training on the new equipment, a careful break-in period of about a week should precede any really hard work on this equipment. During that first week of break-in training, five consecutive workouts should be performed—at a much slower pace than that indicated above; with only one such cycle in each workout.

Later, two such cycles should be performed in each of three weekly workouts—a total weekly training time for that section of the body of only about twenty-four minutes (two cycles of four minutes each times three weekly workouts = :24); and when performed in the proper manner described above, such brief training will produce far more results than any amount of any other type of training for the same muscular structures.

Additional training over-and-above the amount indicated above will almost always **reduce** the production of results; and in many cases only one such cycle is all that is required in each of three weekly workouts—or two such cycles in each of two weekly workouts.

Other existing types of Nautilus equipment will produce very similar degrees of results in other areas of the body—in a very brief period of training time; the arms can be worked far better than is otherwise possible, in a period of about twelve minutes, producing a degree of pump that usually exceeds a full inch in the case of a muscular individual—the legs can be worked fully (and for the first time, "properly") in an even briefer period.

The machines that are capable of producing the above described results are available now; there is literally no reasonable basis upon which they can be compared to any previously-existing type of training equipment—they are **not** an improvement in training equipment, they are something new, completely different. Or, at least, they can be—if used properly; but just as owning a set of fine brushes does not make you an artist, it should be clearly understood that these machines merely "make such results possible", they do not remove stupidity, ignorance, or lack of understanding—and they are subject to improper use, like any tool.

The primary value of the machines is solidly based on the simple fact that they "make much **harder** training possible"; and if such harder training is practiced on a brief, irregular basis, then best possible results in any individual case literally **must** be produced—but if the machines are overused, it is just as certain that losses will be produced instead. And if the harder training that these machines provide is not used, then results will not be what they could have been—what they should have been, and what they **would** have been if the machines had been used properly.

And having gone this far, where do we go from here—what is the next step?

The next step is already well underway; having produce full-range, double-direct, omni-directional, rotary form, automatically variable, balanced resistance, we are now working with the first few models of even more advanced types of machines—the "compound" series of machines, machines that work all of the functions of muscular structures, involving literally 100% of the available muscle fibers.

I will not attempt to explain the functions of these machines—but I will say that they will be even better than our present machines; required training time will be reduced even more—final results will be even better—elapsed (overall) training time will be reduced again. Such machines will **not** replace our present machines—just as the currently available machines have not replaced barbells; and in any case, all of the new series of compound machines will not be available for at least several years—but they are coming.

"The primary value of the machines is solidly based on the simple fact that they make much **harder** training possible"

Chapter 42: Deland High School Training Programs

Under the direction of the author and coach Bill Bradford, the Deland, Florida, Public High School is offering special weight training classes as part of their Adult Educational Program; facilities are located in a separate building on school property and are available on a formal enrollment basis at a fee of $6.00 per fiscal year—payable to the Deland, Florida, Public High School.

Equipment includes a number of Olympic barbell sets, a Universal machine, almost all types of conventional training devices, and Nautilus machines of several types.

Normal training hours are from six to nine in the evening, weekdays except Fridays; however, in fact, the facilities are available for training at almost any hour—day or night, every day of the week—so long as such use does not conflict with regularly scheduled weight training classes conducted during normal school hours, or athletic training programs conducted immediately after school hours.

The author will personally extend any reasonable amount of cooperation to sincerely interested trainees; but the facilities are **not** available for self-directed training—and we will expect a reasonable attitude and conduct from all trainees.

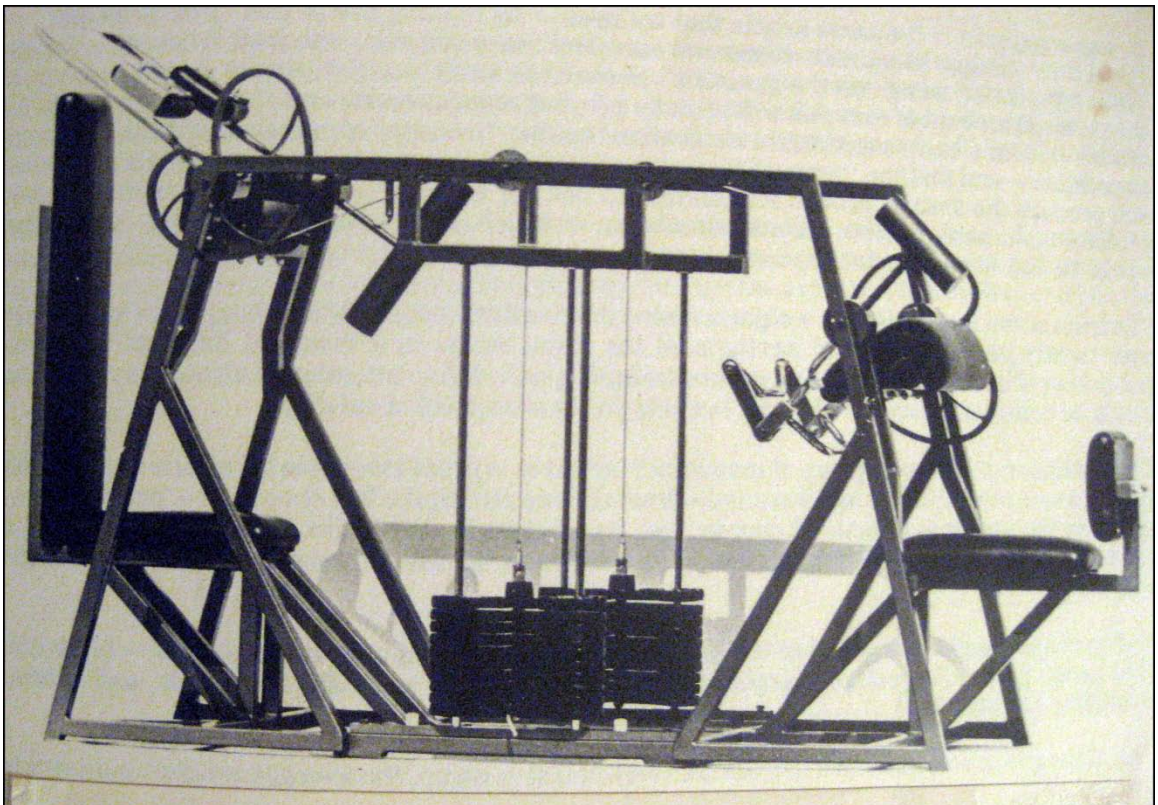
Quite a number of people from all over the country have written the author for more information regarding these training programs; but in fact, little more can be said—we have the best-equipped training facility in the world, and it is available to anyone, but we cannot (and will not) promise anything more.

Deland is a rather small, "off the beaten path," University town located approximately 40 miles from Orlando and 20 miles from Daytona Beach; in general, living expenses are lower here than in most parts of the country—Deland is **not** a tourist town—and some work is available in the general area, but high wage-scales are not generally available.

Trainees who must work to support themselves while training in DeLand must be willing to accept whatever type of work they may be able to find, and the author cannot extend much if any help in the direction of finding employment.

Interested trainees would be well advised to phone the author[1] before visiting DeLand—in order that particular questions that may be of importance can be answered in advance.

[1] Arthur Jones' phone number at the time Bulletin No. 1 was published originally appeared here but has been removed from this edition out of courtesy to the current owner.



An early model Nautilus Arm Machine.

Chapter 43: Training With Conventional Equipment

After reading the preceding few chapters concerning the new types of equipment, some impressionable readers may be left thinking, "…since I don't have the new equipment, why bother to train at all."

But if such an impression has been gained, then it is in grave error; properly used, barbells are extremely productive tools—and to at least some degree, they should be used even by people who do have the use of the new types of equipment.

Men like Schwarzenegger, Coe, Pearl, Columbu—and many others—are products of barbell training; all of the above named men have, or soon will have, used Nautilus equipment—but it was not responsible for their development, all of them were well-known long before they ever heard of the new types of equipment.

Even greater degrees of development will probably be produced by some few individuals in the future—and it is very likely that most such men will use Nautilus equipment; but that will still not reduce the well-proven value of barbell training—and barbells will be in even more common use a hundred years from now than they are at the present.

Twenty-five years ago, I had the distinct impression that the "exact program" was of greatest importance—and such considerations are, of very real importance; but I have long since realized that "how" you train is of even more importance. Properly performed, even a very few basic barbell exercises will produce good results—improperly performed, and no amount of exercises or sets will produce equal results.

Using only a barbell, one light pair of dumbbells, a flat bench, a chinning bar, parallel bars, a squat rack and one fairly-simple pulley device, an enormous amount of results can be produced in a fairly short time by the proper practice of the following training program...

1.	2 sets of 10 repetitions	full squats	:06 (minutes)
2.	3 sets of 20 "	one-legged calf raises	:06
3.	2 sets of 10 "	barbell standing presses	:06
4.	2 sets of 10 "	behind-neck chins	:06
5.	2 sets of 10 "	bench presses	:06
6.	2 sets of 10 "	regular-grip chins	:06
7.	2 sets of 10 "	parallel dips	:06
8.	2 sets of 10 "	barbell curls	:08
9.	2 sets of 12 "	pulley triceps-curls	:06
10.	2 sets of 15 "	wrist curls	:02
11.	1 set of 10 "	regular-grip chins	:03
12.	1 set of 10 "	parallel dips	:03

13.	2 sets of 15 "	stiff-legged deadlifts	:06
14.	2 sets of 10 "	dumbbell side raises	:06

The above program—consisting of a total of 27 sets, to be performed in one hour and sixteen minutes, three times weekly—will build great overall strength and muscular mass in almost all cases; and in individual cases where the results produced are below expectations, it is probable that the program should be reduced, rather than increased.

I used the above outlined training program more than twenty years ago—and produced very good results with it—but in light of knowledge gained in the meantime, I would now alter it in several ways; instead of standing presses with a barbell, I would use a slightly different exercise with heavy dumbbells, strict presses with the elbows held back in line with the shoulders and with a parallel grip (with palms of the hands facing each other)—behind-neck chins would be performed with a fairly narrow grip and I would use a bar that permitted a parallel grip in this case also—a set of dumbbell supine lateral raises with nearly-straight arms would be added immediately before each set of bench presses—the barbell curls and pulley triceps curls would be performed alternately—and I would substitute a set of behind-neck presses for the second set of dumbbell side raises.

Performed in the proper manner, the above routine is certainly **not** an easy routine—on the contrary, it is an almost unbelievably hard routine; most trainees are not willing to work as hard as this routine requires for the production of best-possible results—and many trainees are simply not aware that it is even possible to work that hard—but if performed at a normal pace, or in the usual manner, then only a fraction of possible results will be produced.

If a wider selection of training equipment is available, then the previously-described routine involving three leg exercises—leg-presses, thigh-extensions, and squats—could be substituted for the squats in the routine outlined above; and, depending upon the exact equipment available, other changes could be made to improve the workouts—but since the possibilities are almost infinite, I will not attempt to outline all such possible changes.

If the pre-exhaustion principle is clearly understood, then any reasonably-experienced trainee should be able to design his own workouts in order to incorporate this principle; and beginning trainees should limit themselves to much shorter, less complex routines.

An underweight individual desiring to increase his overall size and strength would be well advised to limit his training activities to a program somewhat along the lines of the following routine.

1.	1 set of 15 repetitions	stiff-legged deadlifts	:04 (minutes)
2.	2 sets of 10 "	full squats	:08
3.	2 sets of 10 "	barbell standing presses	:08
4.	2 sets of 10 "	regular-grip chins	:08
5.	2 sets of 15 "	parallel dips	:06
6.	2 sets of 10 "	barbell curls	:08
7.	2 sets of 15 "	wrist curls	:04
8.	1 set of 15 "	stiff-legged deadlifts	:04

Most beginning trainees are far too anxious to make rapid gains in bodyweight—and in most cases, this results in the addition of fatty tissue; an underweight but mature individual can usually gain at least an average of a pound a week for a period of six months by following a very brief (but hard) training program three times weekly—some subjects will respond much faster, but caution is required if addition of fatty tissue is to be avoided, as it almost always should be.

“Properly performed, even a very few basic barbell exercises will produce good results—improperly performed, and no amount of exercises or sets will produce equal results.”

Chapter 44: Recent Developments

For a period of more than twenty years I used "resulting muscular soreness" as one means of determining the effects of exercises—or, at least, so I thought I was doing; now I am not so sure—in fact, not at all sure.

Most of our new machines produce **extreme** degrees of muscular soreness in previously untrained individuals—and nearly as much in experienced trainees that have not used this equipment before; but one of our recently-developed machines produces absolutely no soreness at all, literally none—while producing all of the other results that are normally associated with severe degrees of muscular soreness.

We simply do not understand "why" no soreness is produced—and this surprising development has led us into a re-examination of the entire subject of muscular soreness and the cause/effect relationships involved. If additional information on this subject becomes available, it will be detailed in supplements to this bulletin.

During the past few months, we have become even more aware of the importance of the time factor in training; it now appears that exercises performed "in cycle" should be spaced as closely as possible—and that best-possible results would be produce only if a literally zero rest period was permitted between sets of different exercises. The initial recovery period of muscular structures is very short; having been worked to a point of absolute failure, most muscular structures are capable of two or three more repetitions after a rest of only three seconds.

Thus, if you are trying to totally exhaust a muscle by performing isolation-type exercises that are immediately followed by compound exercises involving the same muscle, it is obvious that even a few seconds of rest between the different exercises will permit some degree of recovery—which is not desirable; a set of one exercise should **immediately** follow a preceding set—with, if at all possible, less than one second of delay between the last repetition of the first set and the first repetition of the second set. Resting as much as five seconds between sets will reduce the production of results by as much as fifty percent.

In practice, this means that the trainee must prepare all of the required equipment in advance, and even that the related pieces of equipment should be located as close together as possible; if the trainee must change weights between sets—or even walk across the gym to another piece of equipment—then a large part of possible results will not be produced.

Quite a number of people have written requesting the plans for our new types of equipment—and for awhile, it was my intention to publish the plans for all of our machines; some people—given the exact plans—could duplicate our machines, but I honestly do not believe they could do so for a cost even approaching the selling price of the machines, and I am certain that many people would make serious errors in construction, mistakes that would reduce the productivity of the machines greatly. And since the machines—regardless of how well, or how poorly they were constructed—would be considered Nautilus products by most people, I decided not to publish the plans.

My simple statement to this effect will not influence some people, but it should be clearly understood that several of the features of the machines are very critical insofar as construction is concerned—a

slight change can alter the entire geometry of the machines, and greatly reduce their value. So copy them for your own use if you will—but don't be surprised if it turns out to be a bigger job than you expected, or if it happens that the result isn't quite what you desired.

In future issues of Iron Man Magazine, I will publish exact plans for the simple modifications of several types of conventional training equipment—changes that will greatly improve the value of many types of commonly-used equipment.

NAUTILUS

TRAINING PRINCIPLES

BULLETIN NO. 2

Chapter 1: Basic Considerations

The human body is a unit—and must be treated as such; you do not feed your body in sections, and you sleep the entire body at the same time—yet most current weight trainees are firmly convinced that a so-called "split routine" is an absolute requirement for producing the best rate of progress. While the weight of all available evidence clearly supports the contention that more than three weekly workouts will result in a condition of overtraining—in all cases.

On May 16, 1971, Casey Viator won the Junior Mister America contest, and four weeks later, on June 12, 1971, he won the Mister America contest in the most spectacular fashion in the history of such contests—in addition to the Mister America title, he won the Most muscular Man in America title and the subdivisions for Best Arms, Best Back, Best Chest and Best Legs. And—at 19 years old—he is the youngest Mister America winner up to this point in time. More than thirty of the leading bodybuilders in the country competed against Casey in that contest—and I would be willing to bet that almost all of them trained at least twenty-four times during the four weeks immediately prior to the contest; during the same four weeks, Casey trained a total of **six times**—he didn't train at all for two weeks after the Junior Mister America contest, and then he trained only three times weekly during the last two weeks before the Mister America contest. Three weekly "total body" workouts—for the legs, the back, the chest, the shoulders, the upper arms, and the forearms. Workouts requiring less than one hour and twenty minutes each—a total of less than four hours of weekly training.

Dr. Elliott Plese of Colorado State University was in DeLand, Florida during the last week of Casey's training for the Mister America contest and can certify to the frequency, duration and intensity of the workouts. Ellington Darden of the Florida State University was present during Casey's final workout on Thursday, June 10, and can also certify to the facts; during that last workout, Casey's primary leg routine consisted of only three exercises performed within a period of approximately three minutes—one set of leg presses (20 repetitions with 750 pounds), one set of thigh extensions (20 repetitions with 225 pounds), and one set of full squats (13 repetitions with 502 pounds). Each set of every exercise was carried to the point of absolute failure—and there was no rest at all between sets.

In addition to the above-outlined routine, Casey performed two sets of thigh-curls and three sets of calf-raises—thus the entire leg portion of his workout required approximately nine minutes.

And for the benefit of those people who might be led to believe that Casey is an unusually responsive subject (which, of course, he is), I will mention that all of our trainees are following an almost exactly similar program; the bodybuilders are using the leg program outlined above, the power-lifters, Olympic lifters, and football players are using the same routine during two of their three weekly workouts and then performing three sets of heavy squats during the third weekly workout (using the 10-8-6 system).

Very similar—that is, **very brief, but very hard**—routines are being used by all of our trainees for all body parts; the entire arm routine (for both upper-arms and forearms) requires exactly seven minutes and twenty seconds—three times weekly, a total of twenty-two minutes of weekly training for the arms. Additional training is not only not required but would actually reduce the production of results; and in many cases, best results are being produced with only two weekly workouts—or with even shorter routines involving fewer exercises and/or a lower number of sets.

Most of our trainees never perform more than two sets of any one exercise—and none of our trainees ever perform more than three sets of an exercise—and some of our trainees use only one set of each exercise.

Such brief and infrequent training is an absolute requirement for the production of best-possible results from exercise—yet almost all currently active trainees devote at least five times as much weekly training time to their workouts, while producing little or nothing in the way of results in return for their efforts.

If every individual weight-trainee in the country suddenly cut his training in half—merely reduced his weekly workouts by 50 per cent, while making no other change in his training—it is my belief that overall results would be at least doubled.

Overtraining—overtraining insofar as "amount of training" is concerned—is so common that such a 50 per cent reduction in training on the part of **all** trainees would result in an immediate improvement in the rates of progress being produced by **most** trainees; an improvement that would probably double average overall results. And since such doubled results would be produced by only half as much training, the rate-of-progress would be quadrupled—a four to one improvement.

Obviously—if everybody cut their training by half—some trainees would suffer a reduction in their rates of progress; since a few people are now training properly, these few would suffer from a reduction in their training time. But for every individual that is presently training right, there are probably a hundred that are training wrong—usually overtraining; thus, for each trainee that lost from such a reduction in training time, a hundred would gain—and on the average, the overall results would be strongly positive.

If—in addition to the overall average reduction in training time suggested in the above example—everybody simultaneously started training properly insofar as "intensity of effort" is concerned, then at least another doubling of average results would be produced; so that the average rate of progress would be increased from its present level by a ratio of approximately eight to one.

If nothing else of any value is gleaned from this bulletin—but if the above point is clearly understood and put into practical application—then a long first step will have been taken in the direction of sensible training.

Barbell exercises are more productive than free-hand exercises for only one reason—because barbell exercises are **harder** than non-weighted exercises; but as you increase the "intensity of effort: of an exercise, it is necessary to reduce the "amount" of exercise—Japanese wrestlers do as many as 3000 repetitions of non-weighted squats almost daily, but try doing that many squats with a heavy barbell on your back and see what happens.

I will not even suggest that we have tried literally "everything"—nor that we fully understand all of the factors involved—but we have tried a lot of things, under carefully controlled conditions and with hundreds of trainees; and the evidence always points back to the same basic conclusions—more than three weekly workouts, or more than two sets of any one exercise in the same workout, or more than a total of four hours of weekly training will almost always result in overtraining, and a reduction in the production of results.

But in the face of widespread belief that such a brief training is of little or no value for anybody except a beginner, I have little confidence that most experienced trainees will ever be able to bring themselves to an acceptance of the truth.

The above examples on the subject of improvements that are possible by a reduction of the amount of training and an increase in the intensity of training are based on barbell exercises—such rates of improvement can easily be produced by almost any trainee, without the need for any new types of equipment; if Nautilus equipment is available then even greater degrees of improvement become possible. Most of our trainees have shown increases in their rates of progress of at least 3000 per cent—and a few outstanding trainees have improved their previous rates of progress by as much as 14,000 percent. In a few cases, the improvement has been literally infinite.

After ten years of steady training, and after having produced a physique that placed him very near the top in national competition, one subject spent only nine days training in DeLand, Florida—and during these nine days he produced more results than he did during the immediately preceding three years of training with conventional equipment. For a period of two years of steady training, his results had been exactly zero—but then, in nine days, he gained nearly seven pounds of body weight, improved his existing degree of muscularity, added 13/16 of an inch to his "cold" upper-arm measurement and 3/4 of an inch to his calves, and increased his curling strength by 50 per cent.

Since nine days will go into two years approximately eighty-one times, and since zero will go into seven an infinite number of times, it obviously follows that this trainee improved his rate of progress on a scale beyond calculation. But even that doesn't tell the whole story; during the two years of steady training that produced no results, he was training approximately fifteen hours a week—but later, during the period when he was producing such good results, he was training only about four hours a week.

In spite of his previously-established misconceptions, this man was willing to listen—and to at least try the training methods that we suggested; and his results speak for themselves. Unfortunately, some other long-experienced trainees won't listen; one famous bodybuilder on the west coast complained that he wasn't getting spectacular results from the use of a Nautilus Pullover-type Torso Machine that he had been using for two or three months—so I asked him **how** he was using it.
"Nine sets a day," he said, "every day; just like you told me."

But in fact, I told him, "...not more than **nine sets a week**; and if your results aren't what you expect, then try **six sets** a week."

I didn't have to ask him how he was doing the sets—that was obvious, he was doing them **wrong**; nine **properly performed** sets on a Pullover-type machine would kill an adult gorilla. This man was trying to use one of our new machines as if it was a barbell—or even worse than that, as he thinks a barbell should be used; and since he has failed to learn the proper method of using a barbell during his twenty-odd years of experience, I suppose it was expecting a bit too much to even hope that he was capable of understanding the new machines.

But if any lingering traces of doubt remained regarding his inability to understand the machines, he quickly put them to rest; he altered one of the machines in such a manner that its function was utterly destroyed—and then tried to justify the changes on the grounds of improving the convenience and safety of the machine. Which action would be equivalent to installing square wheels on your automobile—and then complaining about the poor performance.

When such an individual has produced better-than-average results from his training—as this man has—then it is only natural for many people to consider him an expert; but it should be clearly understood that final results are no proof of good methods—particularly when such final results are viewed without consideration for the amount of effort that was required to produce them.

So—in all fairness—several factors of actually very great importance must be considered before it is even possible to view final results in a rational manner; and while the individual mentioned above who altered one of our machines has certainly produced good final results, it does not follow that his training methods were good—nor that his rate of progress was even satisfactory.

A recent quotation seems to cover the situation fully, "...there are two common mistakes; some people think that intelligence is a substitute for experience—and some people think that experience is a substitute for intelligence."

People are individuals, and possible variations in the individual response to training are literally infinite—so a program that is exactly right for one man will seldom if ever be perfect for another man; but while the total number of possible variations is certainly great, the "range of possible variations" is quite small—and the limits of that range are clearly known. Because of the great number of possible variations in response to training, it is impossible to outline a program that will be "right" for everybody; but if the primary points to be covered in later chapters are clearly understood, then almost any reasonably intelligent trainee will have the knowledge required for outlining a program to suit his particular purposes.

In short, this bulletin is intended to point intelligent trainees in the direction of logical training—nothing more is even possible.

Chapter 2: Commercial Bias

Prejudice such as that encountered among involved people is a strange factor indeed; many years ago I noted that, "…animals seem to survive in inverse ration to the amount of professional conservation attention that they are afforded." And it has long been obvious that professional pilots are actually biased in favor of dangerous aircraft. It is not the purpose of this bulletin to delve into the psychological factors responsible for such inverted thinking; but I do think that this factor—as it is encountered in the field of physical training—must be carefully considered.

Far from advancing, the field of body building has been steadily marching backwards for the last twenty years or more; which statement will be considered outright heresy by most currently active bodybuilders. A biased selection and a distorted presentation of statistics has been used to "prove" points that are actually the opposite of truth—and there has been little if anything accidental about the final results produced by the flood of propaganda so apparent inmost publications in this field. In effect, the very people who have been claiming that they are trying to elevate the field have almost destroyed it.

An old saying put it very well, "...figures don't lie, but liars figure." Commercial interests in the field of body building constantly point out a few outstanding examples of muscular development as proof of their claims that great advancements have been made within the last few years—and it is certainly true that there some outstanding individuals on the scene at the moment, men like Sergio Oliva, Arnold Schwarzenneger and Casey Viator; but it is equally true that such men are almost literally freaks—the average man could never hope to duplicate their physical development, regardless of how he trained. Thus such individuals represent nothing apart from expectable deviations from the average.

Out of a group of a hundred individuals selected at random, the average body weight might be 160 pounds—and one or two subjects might weigh as much as 190 pounds. But if the sample was increased to a thousand individuals, then you could reasonably expect to find at least one subject with a body weight of 200 pounds—while the average for the group remained as before. And out of a group of a million subjects, you could reasonably expect at least one individual with a body weight of 250 pounds or more—but again, the average would remain 160 pounds.

Thus proof of improvements in method must come from an increase in the average—and in the field of body building, the average production of results has steadily declined during the last twenty years; the average results being produced today are **not** better than they were twenty years ago—instead, they are worse. And exactly the same thing is true in the fields of Olympic lifting and power lifting—in spite of vast propaganda to the contrary; certainly the records have increased—but that is only to be expected when dealing with a far larger number of subjects. But even that is misleading—because the performances really haven't increased as much as most people think; in the case of the Olympic press, a great deal of the so-called "progress" has been produced by relaxation of the rules, to the point that the press has now degenerated into an outright jerk with little or nothing in common with the press as it was practiced twenty years ago—and at least one man, Douglas Hepburn, was capable of bench pressing near-record poundage's over fifteen years ago, and at a body weight far below that of the present record holders. Thirty years ago, Bob Peoples deadlifted well over 700 pounds at a body weight below 180 pounds—today, men weighing twice as much have finally been able to add approximately 100 pounds to his record. Some of Paul Anderson's lifts—performed over fifteen years ago—will probably never be duplicated.

The really outstanding men of today are exceptions—as such men always were, and as they always will be; there are larger numbers of such outstanding individuals in view at the moment simply and only because a much larger number of men are now training with weights. But what about the average trainees?

The simple truth of the matter is that the average trainee of today could not hope to compete on equal terms with the average trainee of twenty years ago; and it is equally true that most of this decline in the average production of results is directly due to commercial bias in the field of weight training.

I cannot begin to attack such commercial bias in a bulletin of reasonable length—but at the same time, I cannot just ignore it; so I will refer to specific examples of such bias in the following chapters—but I will not even attempt to go into the length of explanations required to disprove all such myths.

Chapter 3: Personal Involvement

Thirty-odd years ago, I was very interested in physical training—but knew almost nothing about it; now I find myself in the position of still not knowing much about the subject—but I do, at least, realize that the surface has only been scratched, and that most of the recent so-called progress has actually been retrogression. And while such an awareness can only be fairly called "negative knowledge," it is knowledge of a sort.

Coming from a family of medical doctors, my personal opinion of doctors was understandably influenced by such a background—and for many years I defended doctors against anything that I took to be unfair or biased accusations; until I finally learned that all doctors were not quite like those I had known—it came as quite a shock to me, for example, to learn that all doctors don't work eighteen to twenty hours a day, seven days a week. Much in the same vein, I used to defend bodybuilders against statements that I considered biased—because, up to a certain point in time at least,, the bodybuilders that I knew were reasonable people, and my opinion of bodybuilders as a group was naturally influenced by such personal experiences; but eventually I was in for another shock—when it finally became perfectly clear that many of the charges aimed at bodybuilders were all too true.

Since then, I have frequently remarked that it is a shame that body building is wasted on bodybuilders; there are exceptions, of course, but it seems that one encounters such exceptions with constantly increasing infrequency—and I have finally reached a point where I look upon all bodybuilders with great suspicion, until and unless they have proven themselves on an individual basis. I no longer expect bodybuilders to be reasonable people—I now expect the opposite, and I am seldom surprised anymore.

Thus I am now obviously biased against bodybuilders—but I am at least aware of this bias; and I have not permitted my opinions of individuals to distort my viewpoints on the subject of body building itself. A simple but full listing of the insanity's being currently practiced by thousands of bodybuilders would run to a length of several hundred pages—and since it is not my purpose to detail such outrages, I will devote very little attention to them; but again, I simply cannot ignore them—so a few of them will be mentioned, although I will not attempt to detail such practices.

While it is perfectly true that my personal opinions are of no interest to others, it is also true that these opinions influence my judgment to at least some degree—and that these opinions, and my reasons for holding them, do become matters of importance to others in a few instances; secondly, some of my firmly held opinions simply cannot be supported—in some cases I "know" the facts, but I cannot explain how I know them. In such cases I will clearly indicate that my statements are merely opinions—but will attempt to explain them in instances where explanations are possible.

If the above mention of insupportable opinions seems too vague, I will point to the following example as clear proof of the fact that all of us commonly make use of such opinions—as we should; how, for example, would you describe a smile to a man born blind? Yet you recognize a smile, and an almost infinite variety of subtle variations in smiles; a friendly smile, a malicious smile, a doubting smile, a sly smile, and many other smiles with distinct meanings—all of these you recognize at once, but do you know how you recognize them? And of more direct importance, should you ignore such knowledge—simply because you can't explain it? I think not; but in an effort to be as objective as possible, my opinions—supportable or otherwise—will be labeled as such.

As recently as two years ago—because of my personal bias against bodybuilders, and because I did not then wish to connect my name with a subject as controversial as body building—I offered the results of my work up to that point to a friend of mine in California, as a free gift without strings. "Publish it," I told him, "under your own name; do with it what you will and take full credit for it."

At that time, he wasn't interested; probably because he considered anything I might have done in this field of no possible value—but, for whatever reason, he declined. Now—two years later—this same individual is apparently doing everything he can in a effort to discredit my work; but not because he still considers it to be without value—quite the contrary, he is now fully aware of at least the commercial value, and together with a number of associates he is momentarily engaged in efforts to pirate something that he was once offered as a free gift.

None of which should have been surprising, I suppose—but all of which merely added to my bias against bodybuilders as a class; nor was my opinion of this same individual improved when he unhesitatingly connected his name with a current fraud—simply because it offered a commercial opportunity.

If my writing is to be honest, at least some of this personal bias must come through—and under the circumstances, I think it should; if some people find it offensive, then so be it—but if even a few sincerely interested young trainees are prevented from becoming involved in the outrages so common in the field of body building today, then my purpose will have been served.

The benefits that can be produced from logically outlined and practiced weight training are simply impossible utilizing any other existing method of physical training; this being true—and it is true—the very real value of weight training is firmly established. But it does not follow that such a potentially productive method of physical training is being used in anything even approaching a logical manner—and certainly not on a wide scale. Twenty years ago, most of the then recognized "experts" were mistaken in many of their conclusions—but by and large, they were at least sincere; today, the situation is far worse—little or nothing in the way of actual progress has been made during the last twenty years, and in the meantime involved commercial interests have been successful in their attempts to brainwash most currently-active bodybuilders into an unhesitating acceptance of outright frauds.

As I recently remarked to Mr. Peary Rader, the publisher of Iron Man Magazine, "...I think it is about time that somebody stood up to be counted." The following is an attempt in that direction.

Chapter 4: The Name of The Game

"Progressive Weight Training"—or so it's called; but in fact, there is absolutely nothing progressive about the training of most bodybuilders—and without unceasing efforts in the direction of progress, little or nothing in the way of worthwhile results will ever be produced by any amount of training. Once having learned to spell your own name, you cannot then improve your spelling—nor your vocabulary—by writing your name over and over again; your writing, perhaps, in effect, your form or style, but not your spelling.

And much the same thing is true when it comes to attempting to improve your existing physical ability; you cannot increase your strength by mere repetition of things that are already easy—and for much in the way of muscular growth stimulation, you must constantly attempt the momentarily impossible. Below a certain intensity of effort, no amount of exercise will produce growth simulation—and for maximum-possible growth stimulation, an intensity of effort at least approaching your momentary limit is an absolute requirement. Yet most weight trainees—bodybuilders, power lifters, and Olympic lifters alike—seldom continue an exercise to a point anywhere near the required intensity of effort; while usually attempting to justify their easier styles of training on the grounds that they compensate by performing more exercises or more sets of each exercise.

But in fact, more exercise will never produce the results that are possible from harder exercise—regardless of the amount of additional exercise that is involved; and if much in the way of additional exercise is employed, then growth will be impossible even if growth stimulation is being produced. In practice, most trainees quickly fall into a rut of training wherein their workouts almost totally deplete their recovery ability—and then it takes them years to produce the same degree of results that could have been produced in an equal number of months.

"…more exercise will never produce the results that are possible from harder exercise…"

Chapter 5: Diet

Diet—by far the most controversial subject in the field of physical training today; and for a very simple reason—because the fairly recent attention given to this factor has resulted in a literal bonanza of profits for commercially involved interests.

Twenty years ago, the subject of diet was seldom mentioned in weight training publications—and when it was, no great emphasis was placed upon it; but at approximately that point in time, the supposed benefit to be derived from massive amounts of protein was "discovered"—and the floodgates were opened. Since then, the propaganda devoted to the factor of diet has reached such proportions that it now dominates the entire field of physical training.

Years ago—once having been persuaded to purchase a barbell—most trainees were effectively removed from the category of potential customers; and thus the market was strictly limited—and no great profits were to be made by anybody. But a box of protein food supplement doesn't last almost literally forever—as a barbell does; and secondly, it is far more difficult to judge the quality of a box of powdered food—if a barbell fails to live up to advertised claims, the shortcoming is obvious, but who can really judge the value of a food supplement?

Since many bodybuilders are perfectly willing to endorse any sort of product—for money—it hasn't been difficult for most advertisers to produce all sorts of glowing reports of outstanding results produced by people supposedly using their products; but it might be of interest to note that most such advertisements use the same few people over and over again and it should be of interest to note that such "case histories" are always reported after the fact. That is to say, the people supposedly using these products are always outstanding examples of muscular size—and the supposed fact that they are using a certain product is never mentioned until after the individuals involved become well-known figures on the body building scene.

A few weeks prior to the recent Mr. America Contest, a California manufacturer (or "distributor," since I am sure he doesn't make his own products) of food supplements sent Casey Viator a contract offering him $1,000.00 (retail price) worth of these products—in return for which (and this was clearly stated in the contract), he wanted the unrestricted right to use Casey's pictures and endorsements for publicizing his products. If this offer had been accepted—which it **was not**—then the bodybuilders of the world would soon have been subjected to a barrage of advertising giving the above mentioned products full credit for Casey's success; while, in fact, Casey has never used any of these products.

While it is certainly not my intention to imply that diet is of no importance, I do want it clearly understood that the "amount" of food is of far more importance than the actual makeup of the diet—so long as any reasonable attempt is made in the direction of providing a balanced diet: which points should be obvious to anybody merely from a careful reading of the advertisements for food supplements—in an advertisement for protein supplements, great stress will be placed on avoiding carbohydrates, but in an advertisement for "fast weight-gaining" supplements, equal stress will be placed on consuming a heavy load of carbohydrates.

The truth of the matter is, of course, that you require both—but the barrage of conflicting advertising has now reached such a level that most bodybuilders are hopelessly confused, and many of them end up

trying to restrict their diets to pure protein; under the totally mistaken impression that such a diet is a requirement for producing good results.

The fact of the matter is that the subject of diet is probably the most completely understood factor involved in physical training—but not by bodybuilders, who have been brainwashed into spending hundreds of millions of dollars on products of little or no value.

Many people have strongly urged me to stay clear off of the subject of diet in my writings—since they are fully aware that my simple statement of the facts will surely bring forth a barrage of slings and arrows from outraged commercial interests. In efforts to defend their own positions, it is almost certain that some people who have simply ignored my work up to this point will now feel it necessary to attack me in any way they can.

But in that regard, at least, I am in a unique situation—since I really have no positions to defend; I originally became involved in this field simply from personal interest, and my continuing interest hinges strictly on a desire to improve the methods available for producing certain results from exercise—and I sincerely don't care what the final method turns out to be.

If the methods that we are now advocating do prove to be the "final answer", well and good—but if not, then I will be just as satisfied; and while I am fully aware that many people will not believe that statement, I am just as aware that many other people—the people who really matter to me—do realize that it is a simple statement of the truth.

In my primary business—motion picture production—the amount of time I have devoted to research into physical training would have produced income far in excess of anything that I can even hope to equal in the field of weight training; but until quite recently, my interest was strictly in the nature of a hobby—if, as it happened to be, a very expensive hobby.

During the last year alone—while turning down several offers of film work—I have devoted a total of at least two-thousand hours to directing the training of hundreds of people from all over the country; most of these trainees being young men who came to DeLand because of articles that I have written on the subject of our special weight training classes—and few if any of whom are potential customers for my machines. Nor is this merely an attempt to obtain additional research material—at this stage, we already have far more such information than we actually need; we know what the machines will do, and I have not even bothered to record the training progress of any of our trainees during the last six months—instead, most of my attention has been directed towards attempts to help sincerely interested trainees.

But even that statement is subject to misunderstanding—so I will clarify it; at the moment, research involving the use of Nautilus machines is being conducted in several universities and research foundations—but this work is under neither my direction nor my control. And when the results of this research are available, all of it will be published in an unedited form—in Iron Man Magazine and elsewhere.

In short, my position is such that I literally cannot be hurt by attacks from the commercial interests who will undoubtedly be outraged by my clear statement of the facts—but they will try, of that I am sure.

And for the benefit of those people who may wonder why I thus expose myself to such attacks—when I obviously have nothing to gain by speaking out, when perhaps it might appear that I would be well-advised to remain silent on the subject of diet—I will add the following; my clear statements on this subject will also outrage some people who are **not** commercially involved, and will be taken by many

bodybuilders as clear proof of my ignorance—and, they will rather naturally assume, if I am so ignorant on the subject of diet then I probably don't know much about anything else either. So speaking out will actually prevent me from reaching the minds of many bodybuilders—but I am aware of that unavoidable price in advance, and willing to pay it.

Because—totally apart from the bodybuilders who have been brainwashed into believing all of the garbage that has been published on the subject of diet—there are at least a few bodybuilders left in this country that are aware of the truth, intelligent bodybuilders, actually-educated bodybuilders; and if I failed to speak out in defense of the truth, they would rightly regard such a failure as a shirking of duty.

So—at least and at last—it has been said; the results should be amusing, if nothing else.

“…the "amount" of food is of far more importance than the actual makeup of the diet—so long as any reasonable attempt is made in the direction of providing a balanced diet…”

Chapter 6: A Few Simple Facts

The truth of the matter is that almost every single point of required information on the subject of weight training is contained in the preceding five brief chapters; now I must make at least some attempt to justify those points—and take a stab in the direction of trying to explain such things as the required "form" (or style of performance) of the most important exercises.

The average trainee would be well advised to keep it clearly in mind that it really doesn't matter "why" certain exercises work—so long as it is understood that they do work, and so long as the proper form is understood; unfortunately for their own interests, most experienced trainees are unwilling to accept simple statements of fact—and if they cannot at least convince themselves that they do understand the reasons that exercises produce certain results (or fail to produce them), the tendency is to reject these exercises in favor of others that they feel they do understand. Which attitude is understandable—perhaps even unavoidably natural—but nevertheless unfortunate.

Unfortunate because such an attitude prevents many people from making good use of things that simply can't be satisfactorily explained. I am reasonably certain that such thinking limits all of us to a greater or lesser degrees, and I certainly do not wish to imply that my own thinking is not so limited—on the contrary, I am quite sure that it is; however, in my own case, I have at least been well aware of this factor for many years, and have tried to be on guard against its possible adverse effects. Twenty years ago, I was handling poisonous snakes in large numbers—literally by the tens-of-thousands—and I eventually developed a style of handling them which appeared (to other people) to border on outright insanity; this method was based on a clear awareness (on my part) that I could literally "read a snake's mind." In effect, I knew what a snake was going to do—well in advance of the action; but while I was absolutely certain of the accuracy of this knowledge, I had no slightest idea of "how" I knew it. I could not even explain this ability to myself, let alone to the satisfaction of somebody else.

Now—twenty years and approximately half a million snakes later—I do understand this ability, and I can clearly; explain it to almost anybody; I say "almost" anybody with good cause—because some people are so afraid of snakes that they are literally incapable of rational thought on the subject of snakes. And it is of no small concern to any would-be weight trainee to be aware of the fact that many bodybuilders have a very similar attitude on the subject of exercise and/or diet; having been brainwashed for years, such people are no longer capable of rational thought in this field.

Getting back to the mention of snakes for a moment—because the example is the only one I can think of to parallel a very similar situation in the field of exercise; for a period of at least several years, I was making good practical use of observations of fact—but these observations were entirely on the subconscious level. Snakes clearly "telegraph their punches"—in a manner that is unavoidably obvious, once it has been called to your attention; a rattlesnake does so with its tongue, a chicken snake with its upper lip, a boa constrictor with its neck—and once you know what to look for, almost anybody can handle any of these types of snakes with literally no danger of being bitten. Handle them with their bare hands, I mean.

I can easily demonstrate the validity of these observations to anybody that isn't simply terrified of snakes—but I made good practical use of this knowledge long before I was even aware that I possessed it; I simply "knew" that a particular snake would not bite me—and if the snake changed its intentions, I

was instantly aware of the fact, far enough in advance of any action on the snake's part to avoid being bitten.

In a similar vein, but in the field of weight training, I have long been aware of certain things without clearly understanding "how" I was aware of them—I knew that most barbell exercises weren't quite "right" when I first started using barbells, but it took me over twenty years to explain these shortcomings even to my own satisfaction; and some of the things that were obvious to me as much as thirty years ago have become clear to me only during the last year or two.

It is my firmly-held personal opinion that most bodybuilders keep changing their training schedules primarily because of similar feelings of doubt—apparently they "sense that something is wrong" but can't quite put their finger on the problem; so they keep altering their schedules in an attempt to find exercises, or an order of exercises, that "feels right to them."

Eventually; I realized that most of these problems arise from the simple fact that the situation has been approached from the wrong direction—from a direction exactly opposite to that which is really required; many people—including myself—devoted years to attempts to accommodate the available tools. Rather than trying to devise exercises that were suitable for the muscles involved, practically all of the attention was devoted to attempts to "satisfy" a barbell.

Now—and make no slightest mistake about this point; a barbell is an extremely productive tool for the purpose of building strength and muscular size—a far more productive tool than even most bodybuilders realize. But its advantages must be clearly understood—and its shortcomings must be allowed for.

The barbell is almost literally "the perfect tool" for many purposes—but it is useless for some other purposes; some barbell exercises are extremely productive—some others are an outright waste of time and effort. Several dozen people have been after me for a period of at least two years in concentrated efforts to get me to design and build a Calf Machine—but I have simply refused to do so; because no such machine is required—a block of wood to stand on, a heavy dumbbell, and something to hold on to and you are in business, so why do you need a complicated calf machine that cannot do the job any better?

My only real concern is attempting to improve the production of results from weight training—and in that direction, if new tools are required, then I am prepared to design and build anything that may be an actual requirement, or even a tool that will merely improve the degree of possible results or make worthwhile contributions to better rates-of-progress; but I am not prepared to waste my time in efforts to design or build machines that are not required. At the moment, there is a pile of junked research machines stacked up behind my prototype shop that is literally s big as a house, but every single one of those machines was an effort in the direction of providing an actually-required tool; none of our machines duplicate—or even imitate—barbell exercises. Instead they provide exercise movements that are literally impossible with a barbell—they make it possible for you to actually do what you have been trying to do with a barbell.

But in many cases you actually can do what you are trying to do with a barbell—and in such cases, no other tool is required; and many other cases, you can come so close to doing what you are trying to do that no other tool is justified—in effect, any degree of improvement provided by an improved tool would not be justified on the grounds of expense (or other considerations).

For the average trainee, actually-proper use of a barbell is **not** complicated; in fact, if anything, it may actually be far too simple. In later chapters I will at least attempt explanations of the following and many

other related points, but if the points listed below are clearly understood and practiced then any trainee will be moving in the direction of producing best-possible results.

1. Limit your weekly workouts to three training sessions for the entire body—including the legs.

2. Limit the length of your workouts to a total of not more than two hours each—a weekly total training time of six hours; and in almost all cases, even better results will be produced by a total weekly training time of less than four hours—or even as little as two hours.

3. Seldom perform more than two sets of any one exercise—and **never** perform more than three sets of any one exercise.

4. Make unceasing efforts to progress—always attempt to produce at least some sign of progress in every set of every exercise.

5. Pay particular attention to the "form" of your exercises—do not permit the style of performance to degenerate into a mere "going through the motions."

6. In general, select the "hardest" exercises—and perform them in the hardest manner possible; if a particular style of performance makes an exercise easier, then it almost always makes it less productive.

7. **Never** terminate a particular set simply because you have completed a certain number of repetitions; a set is properly finished only when additional movement is utterly impossible—curl until you can't even begin to bend your arms, squat until you can't start up from the low position, press until you cannot move the bar away from your shoulders or your chest.

8. If you can perform your "guide number" of repetitions—or **more**—then that is your signal to increase the resistance in that particular exercise at the time of your next workout.

9. Judge your progress by measurable strength increases; when you can perform the same number of repetitions with twice as much resistance, then your muscles will be at least twice as big as they were at the start—and probably more than twice as big.

10. An advanced trainee does **not** need "more" exercise than a beginner; he simply needs "harder" exercise, in direct proportion to the differential in strength. An advanced man may be able to "stand" more exercise—but it is not a requirement, and will almost always quickly lead to a situation where additional progress comes to a halt, or slows to a snail's pace.

11. An intelligently selected, reasonably balanced diet is all that is required—and you **must** have both carbohydrates and fats; the amount of food is of more importance than any other factor of diet—if the diet is well rounded. If you are adding fat, then you are eating too much—too many calories; if you are losing weight, then you are not eating enough. It is really just that simple. Any number of freely available government publications contain all of the required information on the subject of diet. And while you may or may not agree with the government's policy on Vietnam, you should at least realize that the government has no axes to grind on the subject of diet; if and when the government starts selling health foods, then look out—but in the meantime, you can take their word on this subject at least.

12. Do not make any attempt to compare yourself with any other individual—unless you happen to have an identical twin, and there are some physical differences even then; far too many factors are involved to make it possible to compare individuals on a rational basis.

13. Building maximum-possible degrees of strength in all of the major muscular structures of the body will also unavoidably produce maximum-possible degrees of muscular size; so work to increase your strength—and control your degree of existing muscularity by regulating the amount of your diet.

14. "Spot reductions" of fatty tissue is an outright myth—a physical impossibility. Build the muscles of your abdominal area by training them in exactly; the same way your exercise your other muscles, two or three sets of from six to twenty repetitions, repeated three times weekly; get rid of any fat in that area by simply reducing your intake of food—or by increasing the "amount" of overall exercises.

But **not** by increasing the amount of abdominal exercise. In effect—and **in fact**—you can reduce fatty tissue in the area of your waist by working your legs (or your arms, or your shoulders, or any other muscle group in your body), it is **not** necessary to work the midsection in order to reduce fat in the midsection; and **absolutely nothing** in the way of an artificial aid will do anything in the way of helping the situation—all that matters is overall consumption of calories, energy; output - foot input.

15. Do **not** make the mistake of trying to add muscular size by "bulking up"—adding fatty tissue; such fatty tissue is not muscle and cannot become muscle—and newly-added fat cells, once added, can be completely removed only by surgery. You can reduce the size of fat cells, but you cannot entirely remove the cell itself—and unlike muscle fibers, fat cells **can be increased in number**.

16. Avoid so-called "growth drugs" like the plague.

17. Have confidence in your training; if you are too sick to make muscular gains you should be in the hospital—**any** healthy individual can do so.

The rest is explanation—or justification; or explanation of required form.

Chapter 7: Self-Evident Truth

Pointing to a short statement in my Bulletin No. 1, Ellington Darden, of the Florida State University asked me, "…what is the source of that quote?"

I looked at him a moment, said nothing, and tapped myself on the chest.

"How can you justify it?" he asked me.

"Self-evident truth—common sense; call it what you like—nothing else is even possible," I told him.

All of us make common use of knowledge gleaned from self-evident truth—as we must in many instances, since a large number of obvious facts are supportable in no other way; but as any good judge clearly understands, circumstantial evidence is frequently the best kind—since it does not depend upon the opinions of witnesses, and can be supported on the basis of pure logic.

But we must, of course, be extremely careful to distinguish actual self-evident truth from apparent self-evident truth; "…oh, everybody knows that," is a common expression—but usually an invalid attempt to support an untrue (even if common) belief.

"They say," is another such common remark—and I frequently ask people who **they** are.

So there are two sides to the coin; on the one hand, all of us frequently make good use of knowledge that we can't always support—but on the other hand, most of us fall prey to common belief that is not valid and certainly can't be supported.

The quotation which Ellington Darden asked me about, and which I supported only as self-evident truth, was this; "…for the production of best-possible results, maximum possible growth stimulation must be induced—but this must be done without disturbing the existing recovery ability any more than necessary." (or words to that effect)

So let us look at that statement carefully, logically; in the first place, it should be obvious that there will be no growth without growth-stimulation, and that maximum-possible stimulation is required for maximum-possible growth—and secondly, it should be equally obvious that the muscular structures cannot grow if there is no recovery ability available to make such growth possible, and that a greater store of existing recovery ability will at least make a faster rate of growth possible, if perhaps not produce such growth in the lack of the required growth stimulation. Logically, then, both factors are required for growth—and there must be a reasonable balance between these factors; the body **will not** grow without growth-stimulation, and **can not** grow without recovery ability. No amount of growth-stimulation will produce growth if the body cannot supply the requirements for such growth—and the body cannot supply the requirements for growth if they are unavailable; unavailable, perhaps, because they are constantly being used up as fast as they are being produced in never ceasing attempts to compensate for too much exercise.

There it is logically; now let us look at it from a purely practical standpoint. Let us assume, for example, that you have the ability to run a distance of one mile before becoming totally exhausted. Without

proper exercise—in this case, running or something very similar—you will never increase your running ability; year by year your ability will decline.

But if you do make a regular practice of running, then one of three things will undoubtedly happen; if you run only a little, you will maintain your existing ability far longer than you otherwise would have done without such exercise—if you run a bit more, then you will gradually increase your running ability—but if you run too much, your running ability will actually decline.

If you constantly increase the length of your runs, always trying to run as far as possible, you will increase your ability—up to a point; but eventually the amount of running will become so great that you will start exceeding your recovery ability, you will not be able to totally recover between exercise periods—and then losses in ability will occur. Nothing else is even possible—it is obvious self-evident truth.

This same self-evident truth can be applied to any form of exercise; but it should be clearly understood that the factor of importance is the "amount" of exercise involved—the body can withstand any possible "intensity" of exercise, so long as the amount of such exercise does not exceed the limits of the recovery ability. In fact, it is the intensity of exercise—and apparently **only** the intensity of exercise—that regulates growth stimulation; thus intense exercise is an actual requirement for inducing growth—but it is also true that the amount of exercise must be decreased as the intensity of exercise is increased.

When the actually involved factors are thus viewed logically, the rule becomes obvious—obvious self-evident truth; in this instance, we need to stimulate as much growth as we can, and we need to leave the system in such shape that it can respond to this stimulation.

Previously untrained subjects—particularly men in their mid-twenties to their late thirties who are healthy but underweight—frequently experience rates of growth that are almost fantastic, when they first start progressive weight training; because, at the start, "any exercise" is "intense exercise"—to them, as individuals—and thus growth is stimulated. And because their systems have not been exhausted by too much exercise—and thus their recovery ability is able to respond properly and provide the requirements for the growth that is being stimulated.

In fact, there is no slightest reason why such a fast rate of growth could not be maintained right up to the point of individual potential—whatever that might be in a particular case; but in practice, most such trainees usually fall into a rut of training too much—while not training hard enough. Exactly contrary to the generally-practiced rule, advanced trainees should actually train less than they did earlier—but much harder.

But just try telling that to a bodybuilder with ten years of experience—a man who has been doing as many as sixty sets of curl in each workout, when he would have been well-advised to do only two sets in each workout.

Or just try to convince a man who spent ten years building his 18-inch arms that he could have done so in less than two years if he had trained much less during each workout, and if he had trained less frequently.

The signs are all there, in plain sight for anybody to see—but most bodybuilders choose not to look; few if any of them, for example, ever wonder why they always experience such fast response after a prolonged layoff from training; but then quickly fall back into a rut where their progress is almost nonexistent. Yet the answer, of course is again self-evident truth; during a layoff from training, their system is able to rebuild the recovery ability to a point where some reserve exists—and thus, when

training is started again and growth is stimulated, the system is capable of meeting the requirements for such growth. But when this reserve is exhausted—as it quickly will be in most such cases—the system is no longer able to meet the requirements for growth; so no growth results, regardless of how much growth-stimulation is being provided.

Back on the treadmill—running and running, and never having enough common sense to notice that they are getting nowhere. And as a result of such non-thinking, the whole field of body building has been marching backwards for the last twenty years—at an ever-increasing pace, until now it has almost reached the point of a rout.

“…the body can withstand any possible "intensity" of exercise, so long as the amount of such exercise does not exceed the limits of the recovery ability.”

Chapter 8: Strength and Muscular Endurance Factors

In the body building and competitive weight lifting fields, the ability to perform one maximum-possible repetition is generally considered the only meaningful test of strength; but in fact, a far more accurate measurement of strength can be based on performances of a given number of repetitions, almost any reasonable number of repetitions—except one repetition.

While most weight trainees consider performances of several consecutive repetitions tests of endurance, there is actually no apparent difference between strength and endurance—accurate measurement of either one of these factors clearly indicates the existing level of the other; at least so long as actual "muscular endurance" itself is being considered—however, if the number of repetitions is too high, then other factors are involved to an extent that meaningful test-results are no longer possible.

The significance of this relationship between strength and endurance should be obvious—but in fact, and in practice, it has been misunderstood, totally overlooked, or ignored.

It is not my intention to become bogged down in attempts to justify this relationship—all of the evidence supports it, and nothing counter indicates it; but it is at least necessary to accept the existence of the relationship—and having done so, then any reasonably intelligent trainee should be immediately aware of the implications. In short—by properly training for strength increases, improvements in endurance are produced in direct proportion, and vice versa; for competitive lifters, an awareness of that simple fact is enough—but for bodybuilders, the implications are even greater. Because there is also a direct relationship between strength (and/or endurance) and muscular size; in effect, producing maximum-possible degrees of strength will simultaneously and unavoidably produce maximum-possible degrees of muscular mass—and again in proportion. If we consider only the actual "input" of strength—the power being generated by the muscle—then increases in muscular mass will be out of proportion to such measurable strength gains. But the "results" will be the same in either case—in order to build maximum-possible muscular mass, you must build maximum-possible strength.

Great confusion on these points exists for several reasons—but primarily because attempts have been made to compare the performance abilities of different individuals: which cannot be done in a meaningful manner. But if such comparisons are restricted to individuals—if a man is compared to himself at another point in time—then the validity of the above points is clearly supported by any sort of presently-available test procedure based on sound principles. However, such tests must be conducted within a reasonable time period—the normal degeneration of age will produce apparent exceptions if the tests are made several years apart; and when such tests involve immature subjects, then careful attention must be given to the maturity factor—and in such cases, reasonable accuracy of measurement depends upon average figures resulting from a rather large number of exactly-similar tests. While the performances of mature subjects will normally remain remarkably consistent, immature subjects will usually show great variation on a day-to-day basis.

Reduced to practical considerations, this means that a bodybuilder must work for maximum-possible strength—and that a competitive lifter must work for maximum-possible muscular mass, at least in those muscular structures that are involved in lifting; and in either case, the "type" of training is exactly-similar—in both cases, the training should be of maximum-possible intensity, but brief and infrequent.

Being clearly aware of this relationship between strength and "actual muscular size" (as opposed to supposed muscular size, or bulk which may have a high percentage of fatty tissue), we have long directed our efforts to attempts to increase strength; Casey Viator is a good example of a trainee with far-better-than-average potential who has trained in this manner—and as a result, he is almost unique. In the past, it was assumed that great size presupposed at least some visible fatty tissue; people spoke of "bulking up", and then "training down"—and this practice is still widespread today. But it is always a mistake; adding fatty tissue has absolutely nothing to do with increasing actual muscular mass—and once added, much of such fatty tissue can never be entirely removed.

Casey has built his almost unbelievable muscular size by building his strength—and as a result, he remains in hard muscular condition at any size; he is not—as some people suppose—"very defined in spite of his size," rather he is literally "very defined **because of his size**."

Regardless of apparent muscular definition, some degree of fatty tissue will always remain—as it must in a living organism; but there does not appear to be any definite requirement for any certain percentage of such fatty tissue—thus a very large muscular individual might remain perfectly healthy with exactly the same "amount" of fatty tissue found in a much smaller individual. And since the actual percentile of fatty tissue would be lower in the case of the larger individual, he would obviously appear more muscular—literally **because of his size**.

Demonstrations of strength depend on many factors—many of them in no way related to actual strength; for this reason, many bodybuilders—probably most bodybuilders, today—cannot demonstrate strength in proportion to their appearance of strength. And thus they have come to believe that "strength training" is of no importance to a bodybuilder; while in fact it is really the only type of training that is even capable of giving them the results they are seeking.

Secondly, many bodybuilders—and probably all successful bodybuilders—actually practice strength training without being aware that they are doing so. Failing to realize that the actual number of repetitions is of no real importance—so long as the set is carried to a point of proper intensity-of-effort, and so long as the number of repetitions is at least reasonable—many bodybuilders are actually training properly without realizing it; training properly for strength, that is. Which, of course, means properly in every sense of the word in this instance.

Chapter 9: Barbells—Pro and Con

By comparison to any previously-existing tool intended for the same purpose, the barbell is almost a miracle machine—with proper use, a barbell is capable of producing degrees of muscular size that are almost unbelievable; so the barbell is certainly a good tool—but it still leaves a great deal to be desired.

The physical—and physiological—factors responsible for the shortcomings of the barbell are actually quite simple, but largely misunderstood. Because the "direction of resistance" provided by barbells is unidirectional (one-directional), it is obviously impossible to provide "rotary resistance" with barbells; and, because the involved body parts moved by human muscles function in a rotary fashion, it is thus impossible to provide resistance against such movement throughout the entire possible range of movement involved in most exercises.

Also, because of the way in which muscular contraction occurs, it thus becomes impossible to provide any resistance at all in the position of full contraction in most barbell exercises—and since all of a particular muscular mass can become involved in any form of exercise only in a position of full contraction, it is thus impossible (with barbells) to exercise muscles in their strongest positions.

To an individual with even a reasonable knowledge of basic physics (as it applies to barbell exercises) and a knowledge of human muscular function, the above two paragraphs should make the situation very clear; but, unfortunately, those qualifications eliminate almost all weight trainees—the very people who most need to understand these simple facts generally lacks the educational background for anything even approaching an actual understanding. And, equally unfortunately, most of them "think they understand," when in fact they don't.

The very existence of a so-called "sticking point"—a point during the exercise movement where the resistance feels heavier than it does at other points—should make it obvious that the muscles are being worked harder in some in some positions than they are in other positions. Likewise, if you are aware that you can "lock out" under a barbell in some positions—and thus support the weight without any significant muscular action—then you should also be aware that the muscles are not being worked in those positions.

All experienced bodybuilders are aware of both sticking-points and their ability to lock-out under the weight in some positions, but few have any idea of the significance of such things; both of these factors (sticking points and lock-out ability) are direct results of the fact that you are trying to provide constant resistance against a rotary form of movement by using a reciprocal form of resistance—an obvious impossibility.

You cannot proceed around a curve in the road by continuing to move in a straight line—and rotary resistance must be provided against rotary movement if you are trying to exercise muscles in all positions.

Using Nautilus exercise machines—which do provide rotary forms of resistance—we can produce a degree of muscular "pump" that is several times as great as the maximum degree of pump that can be produced by any amount of barbell exercise: and this is clear proof of the fact that a far higher percentage of the actual number of fibers contained in the muscles being exercised are involved in the work. Such pumping is a result of the fact that working muscles require more circulation; if only part of a

muscle is working, then a small degree of pump will be produced—but if the entire muscle is working, then a simply enormous degree of pumping is produced from a very small "amount" of exercise.

In several cases—with extremely muscular individuals—we have been able to produce a degree of pumping that resulted in a temporary doubling of the mass of the upper arms; after less than eight minutes of such exercise, the arms of these subjects were swollen to literally grotesque proportions.
With a less muscular individual, a very similar degree of pumping will be produced but will not be so obvious—because a large part of the mass of the arms will be fatty tissue (which, of course, does not pump as a result of exercise), and the actually muscular mass of the arms may represent as little as fifty per cent of the total mass of the same limbs.

In a similar vein, we have long noted that there is very little difference in the measurement of a "fat" arm hanging in a straight and relaxed position and the measurement of the same arm in a bent and flexed position; a recent visitor had a relaxed upper-arm measurement of 18 1/8 inches and a flexed measurement of 18 1/4 inches—a difference of only 1/8 of an inch. When he asked me why there was such a small difference, I told him, "…because you can't flex fat."

But, back to the subject at hand—the value of barbells, and the problems with barbells; when the basic physics involved in the situation is clearly understood, it becomes obvious that barbell exercises tend to provide resistance for muscles only in their weakest positions (or nearly-weakest positions), and that little or no resistance is provided in the strongest positions of the muscles involved. Just "why" a muscle responds (by growing) when it is exposed to a work-load of great intensity is really of no importance—so long as we are aware that this response is thus created; but it should be obvious that growth-stimulation cannot be induced if there is literally no imposed resistance—and in most barbell exercises, that is exactly the situation that is encountered in the fully contracted positions of muscles.

In later chapters devoted to the correct style of performance of barbell exercises, I will go into exact details of the physics involved; but for the moment, I will restrict my comments to general observations on the subject.

In spite of the lack of rotary resistance in barbell exercises, we do encounter a certain amount of "variation of resistance" in such movements—which is a mixed blessing; in some cases the variation of resistance encountered in barbell exercises is a decided advantage—and in some instances it is disadvantageous. Sometimes both advantages and disadvantages are encountered in the same exercise; for example, in the barbell curl (or in any form of conventional curling) the effective resistance or actual "torque" increases as the movement progresses from the starting position up to the sticking-point—but having passed the sticking-point, the torque rapidly decreases to the point of zero. This effective variation of available resistance is a decided advantage during the first part of the movement because the resistance is thus increasing at the same time that the available strength for producing the movement is increasing—but after passing the sticking point, the resulting decrease in resistance is a decided disadvantage.

In a few conventional exercises, because of the restricted ranges of movement or because of other factors, it is possible to perform the movements in such a way that the available variations in effective resistance are entirely positive in nature—even if perhaps not perfect; in such cases, a barbell is the tool of obvious choice—for several reasons, because of cost, ready availability, and convenience. The best of such exercises are wrist curls, calf raises, stiff-legged deadlifts, shoulder shrugs, side raises, sit-ups, and leg raises. All of these should be performed in such a manner that the resistance increases throughout the movement—which style will not result in the exactly "right" rate of resistance increase, but will at least be a great improvement over the normal style of performance.

As should be obvious by this point, a general practice should be to avoid barbell exercises which involve definite sticking points and/or points where it is possible to lock-out under the weight—and seek barbell exercises that are not so restricted; but there are exceptions to that general rule—the squat, the press and the curl are such exceptions, and these movements are productive in spite of the limiting factors encountered, if not nearly as effective as they would be without such limitations.

But as the intelligent reader might expect by this point, the fact of the matter is that most bodybuilders avoid the hardest—and thus the most productive—styles of performing these good basic barbell exercises; paradoxically, these movements are avoided for the same reason that they are productive—because they are a very "hard" group of exercises if properly performed.

“By comparison to any previously-existing tool intended for the same purpose, the barbell is almost a miracle machine.”

Chapter 10: Time Factors In Exercise

Reasonable determinations of rates of progress must be based on two separate time factors, "total training time" and "elapsed training time." Total training time is determined by the total number of hours devoted to training during a certain period of time—elapsed training time is the time period involved, days, weeks, months, or years.

Other related time factors are "actual training time," the time actually devoted to working against resistance—or, in effect, total training time minus resting time that occurs during the workouts; the "pace of training," which is determined by the delay between sets and the speed of movement; and, of course, the "speed of movement" itself.

Final results that appear quite good when measured against only one of the above factors may in fact be quite poor—but most bodybuilders seem to be concerned only with elapsed training time, and are apparently willing to devote almost any amount of total training time to their workouts if they feel that such marathon workouts will reduce the elapsed training time; but in fact, quite the opposite is true—and such long and frequent workouts actually (and enormously) retard progress as measured on any scale.

So—back on the treadmill; running faster and faster and getting nowhere. But even when it is possible to make an individual aware of the real facts, it still remains almost impossible to make all of the involved time factors clear in relation to each other; if, for example, you are finally able to make a particular trainee aware of the requirement for an almost zero time delay (or resting period) between sets of different exercises performed "in cycle" in keeping with the "pre-exhaustion" principle of training, this information is then usually misinterpreted to mean that the exercises themselves should be rushed through—which is of course not at all desirable.

Instead, each set of every exercise should be performed properly—with absolutely no consideration for how much time is involved; and only after one set has been correctly completed, should the "rush factor" be involved—in effect, do each set right, but then move immediately to the next set in the cycle.

Our primary interests have been aimed in the direction of producing maximum-possible progress from each week of training—and within reason, we have been willing to adjust the other time factors to almost any extent in order to improve weekly rates of progress; in effect, we did not care how much total training time was involved—we, like most bodybuilders, were willing to extend the total training time if such an extension would reduce the elapsed training time.

But eventually—even if somewhat to our surprise—it became obvious that it was necessary to reduce total training time in order to reduce elapsed training time; which result, on the face of it, at first seems ridiculous—after all, in how many other situations can you produce faster results by devoting less time to the job? In this instance, faster results meaning "better results"—in every sense of the word better.

But in situations with interrelated physiological and psychological factors, rather strange results are frequently forthcoming—unavoidably plain, if not always clearly understood; for example, during the course of several years devoted to capturing large animals in Africa, we learned that the method of capture which appears to be the least damaging to the animals is actually the most damaging—while

another method of capture that we at first avoided because it seemed to be obviously detrimental to the animals, in the end proved to be the best method.

Capturing animals by running them down in broad daylight with a vehicle would appear to be a very dangerous method of capture—since it obviously involves very strenuous and sometimes long-extended efforts on the part of the animals; while capturing the same animals at night, using the element of surprise, would seem to be the easiest method—and the least damaging to the animals, since such captures can normally be made with no chasing at all. But in fact, quite the opposite is true in both cases.

I have never been able to determine just why the results turn out as they do, but the results themselves are obvious—an animal captured at night with no chasing stands a very good chance of dropping dead shortly afterwards, apparently from shock—while an animal that might appear to have been chased almost literally to death in broad daylight will seldom suffer any bad effects and will usually do quite well in captivity afterwards. There is, of course, a limit to just how much chasing an animal can stand—but within reason, such chasing actually seems to reduce the chance of shock from the capture.

In a similar vein, an animal that is shot by surprise will frequently drop dead from a wound that would not have bothered him much if he had been warned of danger in advance of the shot. While an animal that is aware of danger prior to the shot will sometimes continue frantic efforts with a wound that would seem t make any movement impossible—there are many accurate reports of large animals killing hunters after having their hearts destroyed by heavy bullets.

In such instances, the actually involved factors are far from being clearly understood—while the results are obvious; and in exercise of human muscular structures—particularly when such exercises are compound movements involving several large muscles—somewhat similar results are observed.

In effect, it is obvious that a certain amount of time is required for a muscle to prepare itself for intense exertion—without which preparation, damage may result; secondly, it is also obvious that a muscle so prepared is then capable of working at greater intensity. Most weight trainees are at least aware that such time factors are involved in strenuous exercise—but very few trainees actually understand the implications; for example, the great number of theories regarding the requirement for "warming up" indicates a total lack of widespread agreement on this subject.

Again, it is not necessary to understand the cause-effect relationships involved—so long as the implications are clear. But when an understanding is possible, it is then sometimes also possible to make practical use of the knowledge in apparently unrelated applications; for example, on the practical level it has long been obvious that a resting muscle recovers more quickly if it is exposed to a workload of low intensity during the resting period between heavy exertions—I say that this has been obvious on the practical level because people have made use of this knowledge in practical ways while really not understanding the cause-effect relationship, and frequently without even knowing that they were making use of this knowledge. Horses are walked after a fast run, and this is practical utilization of the factor under discussion—but few people have ever wondered why this is done.

In body building, so-called "super sets" have been in wide use for a number of years—yet nobody seems to have noticed the actual cause-effect relationship responsible for the good results produced from such a style of training; and being unaware of the real factors involved, other practical applications of the same factors have thus been overlooked by almost all bodybuilders—while a few bodybuilders have made more or less accidentally-proper use of these factors.

Heavy work performed by a muscle results in much-lighter work by the opposing muscular structure—in effect, working the triceps results in a much lower order of work by the biceps, and vice versa. So doing a heavy set of curls for the biceps between two heavy sets of a triceps exercise will actually result in faster and more complete recovery by the triceps than would have been experienced if total rest had been employed instead of the work for the opposing muscles.

You might, for example, perform a set of triceps extensions to the point of failure with 100 pounds—and during the first set you might reach a point of failure after ten repetitions; then, following a rest period without exercise of any kind, you might be able to perform only eight repetitions during the second set of triceps work with the same resistance. But if, instead of resting between sets for the triceps, you had performed a heavy set of curls for the biceps between the two triceps sets, you might then have been able to get nine or ten repetitions during the second set for the triceps; because the heavy biceps work would have provided a much lower order of triceps work during the period when the triceps muscles were recovering between heavy sets—and this reduced workload for the triceps would have hastened and improved the recovery of the triceps.

A similar result can be produced without using super sets—but with an unavoidable disadvantage; instead of doing biceps work between two sets of triceps work, you could perform a very light set of triceps work between heavy sets for the triceps—but in that case you would be increasing the amount of exercise involved. Whereas, by using super sets, no additional exercise is being added to the workouts.

From the above, it should be obvious that working the biceps one day and the triceps on another day is a very poor style of training—yet such a style of training is very common among bodybuilders.

In a body building magazine dated September, 1958, apparently-first announcement of the so-called "Inter-set Relaxation Principle" was made; a long article under the byline of the publisher of the magazine made extravagant claims regarding the supposed value of this "discovery—and urged readers to later remember where they first read about the new training style advocated. Or the new "resting style," since the article dealt with the time periods between sets of an exercise.

This article urges "more than total rest" between sets—instead of merely resting in the usual manner, the reader was advised to relax "totally," whatever that means; and the statement was made that this new principle was the "ultimate" step toward achieving the perfect human body.

In the same article, the author also claimed credit for other supposedly revolutionary training principles—and listed among others the "Flushing Method" the "Muscle Cramping Method," and "The Mental Contraction Method," all of which, from their very names, were obviously intended to produce results almost exactly opposite from the results being sought by users of the Inter-set Relaxation Principle. So the readers are simultaneously being urged to do everything possible to prevent muscle-recovery and to hasten and improve muscle-recovery.

And as should be obvious if the previously mentioned result produced by a lower order of work between heavy sets of exercise is clearly understood, total relaxation immediately following heavy work—or between heavy sets of exercise—is certainly **not** the way to hasten or improve muscle-recovery.

It was suggested in the same article that trainees—by making use of this "new principle"—could thus manage to squeeze even more exercises, or more sets, into their workouts; the obvious implication being that the "amount" of exercise is the most-important factor—when in fact, a large amount of exercise will literally prevent muscular size and strength increases. All of the evidence clearly supports the contention that the "intensity of exercise" should be as high as possible—and that the "amount of exercise" should

be limited to the absolute minimum that will produce the desired growth stimulation. If one set of one repetition of one exercise would produce maximum-possible growth stimulation—which, unfortunately, it will not—then that would be the ideal amount of exercise.

The truth of the matter is that weight training publications ran out of anything significant to say over twenty years ago—and having said the same things in a thousand different ways, the publishers of such periodicals are understandably quick to give attention to almost anything that might be considered new or original; but originality is no proof of validity.

The publisher of one such group of magazines has gone to great lengths in his efforts to prove that the "science of body building" has made great strides during the last few years—primarily as a result of his personal efforts, of course; but the obvious fact remains that this same period of time has actually produced a decline in the average degree of results produced by weight trainees.

The average weight of a group of 100 men selected at random might be 160 pounds—but within that group you could probably expect to find one individual weighing 190 pounds, and another weighing 130 pounds.

And if the group was extended to 1,000 men selected at random, the average weight would still be 160 pounds—but now you would have ten individuals weighing 190 pounds (instead of only one) and one individual weighing 210 pounds. Likewise, there would be more below-average individuals, and probably at least one individual that was far below average.

And if the group was extended to 10,000 men selected at random, the average would remain the same 160 pounds—with a hundred men weighing 190 pounds, ten men weighing 210 pounds, and one man weighing 230 pounds.

And so on—as the sample increases in size, the "peaks" and the "valleys" will move farther away from the average, but the average will remain the same.

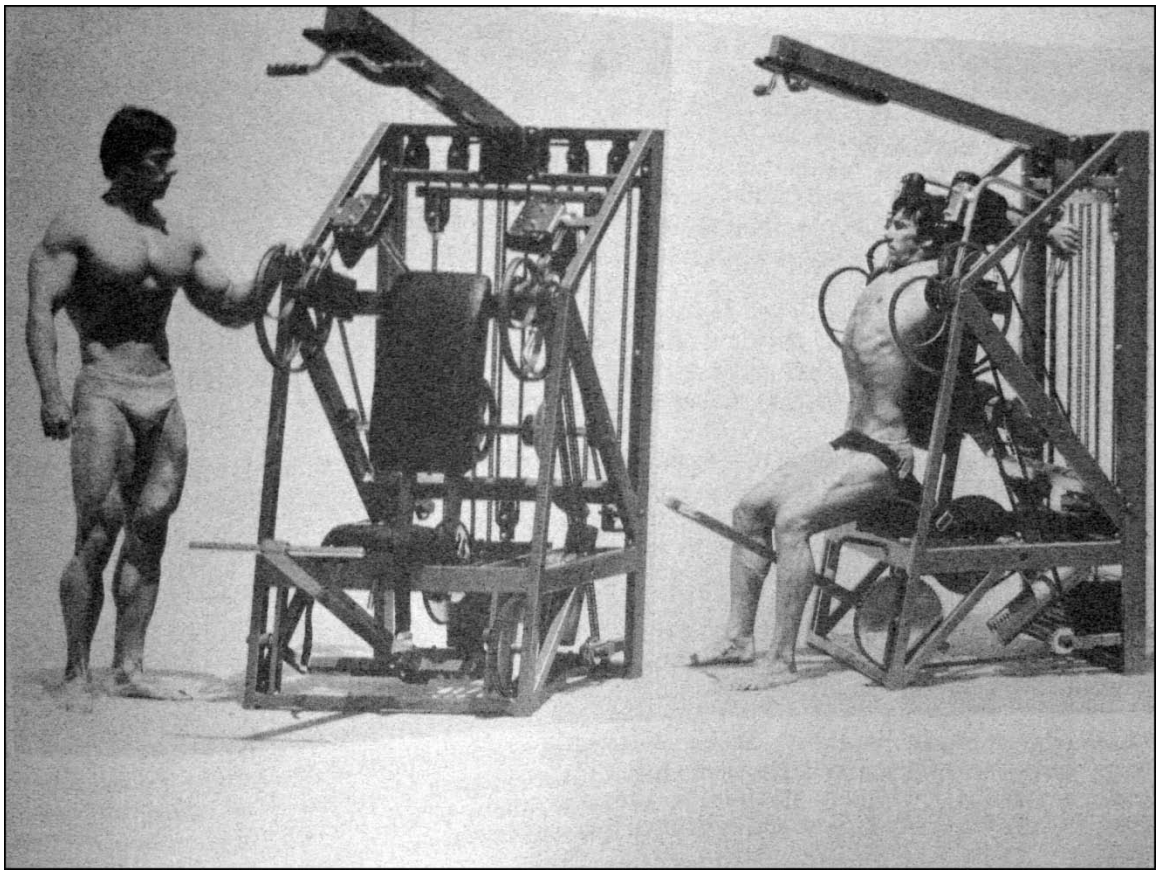
The last twenty years have resulted in an enormous increase in the number of individuals involved in weight training activities—so it is only to be expected that the actual size of a few outstanding individuals would be greater now than it was twenty years ago; but this is certainly no proof that the overall results produced by weight training are better now than they were previously.

Such proof of an improvement in method, or tools, or the systems of employing the available tools must come from—**can only come from**—a rise in the average production of results; and this has certainly not occurred in weight training circles—on the contrary, there has been a distinct decline in the average production of results during the last twenty years.

Most of the decline, I feel, has been a direct result of commercially biased advertising—trainees have been led to believe that they can "buy success," that they can eat their way to great muscular size, or find strength in a bottle. Weight trainees, being only human, have been quick to believe what they wanted to believe, to listen to what they wanted to hear—if there really was such an "easy" road to the top, they were more than willing to follow it.

Most people will take the apparently "easy" way out in any situation, and for that very reason truly outstanding individuals are rare in any field; this apparently basic "law" of human behavior has certainly not been set aside in favor of bodybuilders—who by and large, if anything, seem to be even quicker than average to grasp at straws in search of "easy" solutions to their problems.

At least a practical knowledge of the relative time factors will probably result if careful attention is given to later chapters dealing with the correct style of performance of exercises; but I repeat, do not fall into the common habit of rushing through the exercises themselves—when the "rush factor" is involved, it is applicable **only** between sets.



“All of the evidence clearly supports the contention that the "intensity of exercise" should be as high as possible—and that the "amount of exercise" should be limited to the absolute minimum that will produce the desired growth stimulation.”

Chapter 11: The Psychology of Bodybuilders

By this point, intelligent readers will be well aware of—and perhaps irritated by—my previous comments alluding to the psychology of bodybuilders; so I feel that a clear statement on the subject is in order. In this direction, a few case histories from my personal files may help to establish some sort of a meaningful pattern.

Subject "A"

A man of about thirty when I first met him, the winner of many physique contests—but a seething mass of emotions under an apparently calm exterior. Atypical in that he was willing to work and was reasonably successful in his own business.

I had been out of direct contact with the body building field for a number of years when I first met this subject, and I was then unaware of the use of drugs by bodybuilders—but he openly admitted that he was using at least one type of drug, and told me that he was as yet undecided about the effects, if any. Ten years later he heatedly denied ever having used drugs of any kind during several conversations on the subject and roundly condemned other leading bodybuilders for being "drug freaks;" but in another conversation—apparently having forgotten his previous denials—he admitted that he had used drugs, "once."

During my first contact with this individual I broached the subject of weight training but immediately realized that doing so was a mistake, his totally closed-minded attitude was far too obvious to overlook; so, since our relationship was not based upon physical training activities, and since I liked him as an individual, I never opened the subject with him again for a period of about ten years.

In the meantime, information that I considered of great significance had gradually come to my attention as a result of my continuing interest in the field of weight training—and eventually, I felt that I should at least attempt to communicate some of these new developments to the individual under discussion. Which attempt was made—with, up to the moment, entirely negative results; at first he pretended interest while obviously not understanding even the basic principles involved—later he apparently started to suspect that there might at least be some financial opportunity, and he then promised full cooperation, but somehow always managed an excuse for failing to live up to any of his promises—still later, by which time the financial opportunity was obvious, he attempted, in his own words, "to jump on the bandwagon," but he still failed to live up to any of his promises—finally, in cooperation with a number of associates, he started making outright attempts to belittle the significance of the new developments, while at the same time attempting to produce and market exercise machines based on the new principles, which principles he plainly did not understand.

When reports of his actions—which contrasted sharply with his statements—first reached me, I called him and asked for an explanation; and he denied all of the reports that had been brought to my attention. Repeatedly. Finally, in an effort to get the facts, I sent a friend around for the purpose of making an investigation, and then I telephoned and demanded an explanation.

During the course of a one-hour telephone conversation, his emotions ran the gamut from calm denials of obvious fact to outraged and irrational accusations; but he still attempted to deny undeniable facts.

None of which above-listed reactions are limited to bodybuilders, of course—but all of which (apart from this individual's attitude towards gainful employment) seem to be typical of at least a very high percentage of advanced bodybuilders. Eighty percent? Ninety percent? Ninety-five percent? I don't know, exactly—but a very, very high percentage.

Subject "B"

A man of thirty-five, married to—or at least living with—a woman with a rather large number of children. While claiming a somewhat better than average educational background that qualified him for high school-level teaching positions, he sought low-paying employment in Florida in order, he said, to be able to devote most of his time and attention to body building training. In spite of his education, this subject avidly read all of the body building periodicals and admittedly believed everything he read.

Loud and pushy in situations where he felt confident, he was extremely hesitant and obviously unsure of himself in unfamiliar situations. Quick to jump to mistaken conclusions based on misunderstood hearsay, he was just as quick to change side. Totally without regard for the rights or feelings of other people, he expected great consideration from everybody.

In the end he made the mistake of offering drugs to one of my children.

Subject "C"

Approximately thirty, the picture of a man—or, at least, his picture of a man; sporty automobile, flashy clothes, unused sporting equipment of a wide variety, a wig. In short, a great assortment of possessions and attitudes, none of which were unusual or significant in themselves—but all of which, taken together, spelled "self doubt".

In common with the previously-mentioned subjects—and with a very high percentage of advanced bodybuilders—everything in his life was strictly secondary to his body building aspirations.

Subject "D"

In his late twenties, the owner of a business in a field related to the primary subject of this bulletin—which in itself is apparently part of an emerging pattern, since most advanced bodybuilders seem to eventually become involved commercially in the field. A cause—or an effect? Are such people unable to conform to normal society? Are they rejected by society and thus forced to seek the company of their peers?

While almost all advanced bodybuilders are jealous of contemporaries, and critical in the extreme, they nevertheless go to great lengths to seek approval from their imagined competition. Competition for what? Just what are the prizes, where is the hoped-for reward—the approval of an extremely closed society of individuals like themselves, who are apparently constitutionally incapable of bestowing actual approval on anybody? But this subject was atypical in that he could not—or would not—conform to the accepted rules of even his own chosen society, and was thus openly rejected even by his own. Perhaps a result of the fact that—unlike most advanced bodybuilders—he had been made independent by inherited wealth?

Subject "E"

In his early twenties, an extreme example of a self-created freak—at least capable of apparently relaxed charm, an uncommon trait among bodybuilders in general: perhaps the result of having reached what he probably considers an unchallengeable pinnacle in his own limited world? Or is he really as confident as he appears on the surface? And if so, why must he make such efforts to constantly reprove himself?

This subject displays a trait that is currently very commonly encountered in body building circles—deceit; having lied about their measurements, their body weight, their strength, their training routines, and many other things almost as a matter of course, many advanced bodybuilders finally drift into a habit of habitually lying about almost everything.

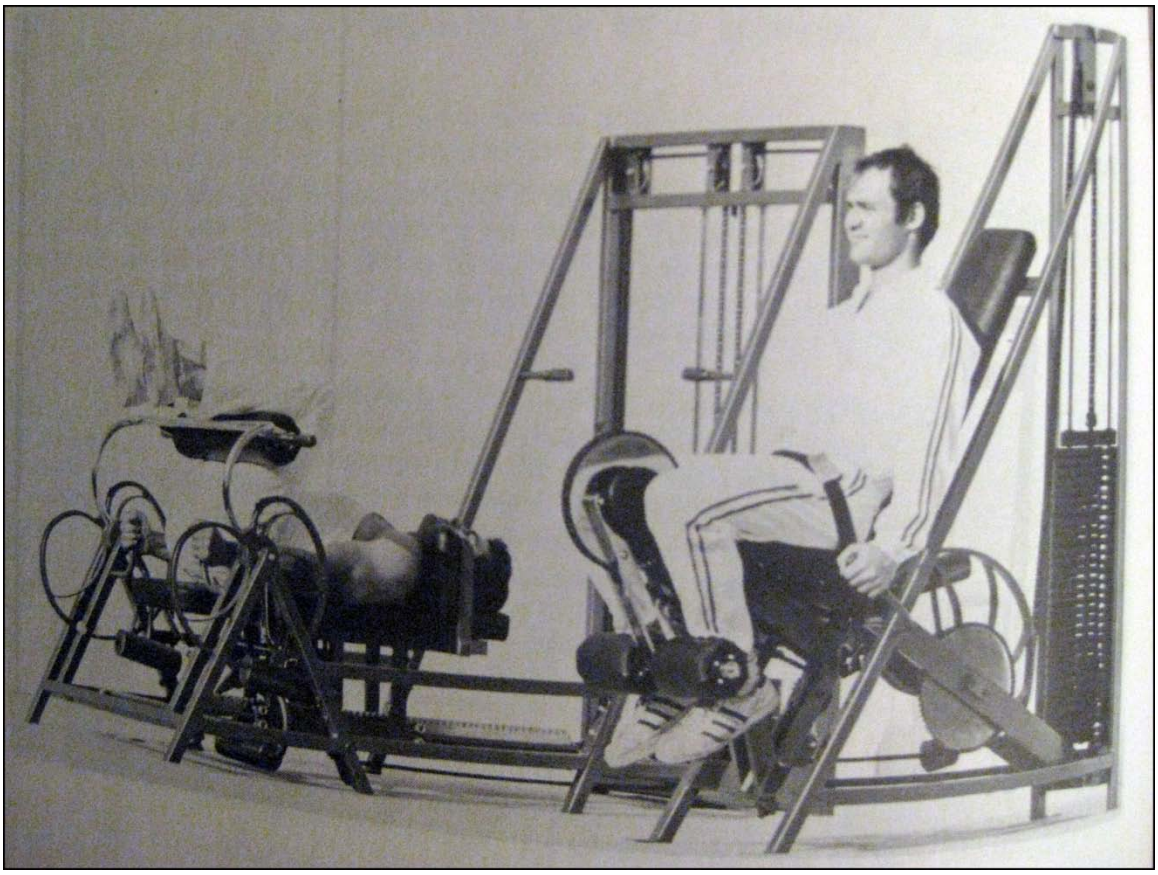
Subjects "F", "G", "H", etc.

Having a lot in common with the general pattern of character traits displayed by the subjects mentioned above, they typical advanced bodybuilder of the moment is certainly not the "Ideal Man" described by weight training publications.

The only question of real importance seems to be, "…are such traits a cause, or an effect."

But the fact of these common traits is beyond question; and under the circumstances, it is only common sense to question the whole subject. There are exceptions, of course, but on the whole the character traits outlined above are extremely common—far more common than might be expected, far too common.

I can offer no solution to the problem—but I have personally learned to approach bodybuilders with great suspicion, expecting the worst.



Chapter 12: The “Mister Nautilus” Contest

Primarily because of the psychological traits mentioned in the previous chapter—and as a result of commercial bias—the field of body building has finally reached a point where it is almost impossible to obtain information on the subject of actual practices, as opposed to claimed practices. If the field was without value, then present trends could be permitted to continue with no loss—but in fact, the very real value of intelligently-practiced weight training is such that it deserves rational consideration, and efforts, directed towards salvaging the situation.

It is my personal opinion that weight training should be a part of the physical education of every student in the country, starting about the freshman year in high school and continuing throughout the remainder of the educational experience—and I also think that something on that order might have resulted already, if it were not for the fact that the entire field has fallen into generally bad repute. If the situation is to be saved—if it can be saved—then present trends must be reversed.

In efforts directed towards that purpose, we will sponsor the "Mr. Nautilus" physique contest—a physique contest with a difference, with many differences, important differences. Up to this point, the promoters of such contests have seldom—and never, recently—offered more than $1,000.00 in the way of a cash prize to the overall winner; we will offer the first place winner a cash prize of $25,000.00—with a total of $50,000.00 in cash prizes.

In the past, little or nothing in the way of significant publicity has been given to such contests—while the winners of the annual Miss America contests receive at least some national publicity, the winners of major physique contests generally remain unknown outside the narrow field of weight training; so widespread publicity will be afforded this contest—among other things, a film will be made for television on the subject of physical training in general, with the contest being the highlight of the film.

The prizes and the publicity should attract both a wide field of entrants and widespread attention—but in this case, we are seeking far more than publicity; while the contest itself will be strictly a physique contest and will be judged accordingly, one of the requirements for entry will be that the entrants must present themselves a week in advance of the contest, and must submit to a wide variety of physical tests, any reasonable tests. We are primarily seeking facts—significant test results. According to present plans, Dr. Elliott Plese of Colorado State University will be in charge of the testing procedures—and the actual tests will be conducted by a group of physiologists from a number of universities and research foundations. The exact nature of the tests will not be made known in advance—but all results will be published within a reasonable time after the contest, and the information obtained will be made available to any interested parties.

Of possible concern to entrants; it should be clearly understood that the test results will not be made known to the judges in advance of the contest—and the judging will not be influenced by the results. But after the contest, all matters of general information will be published; accurate measurements, body weights, actual strength performances, etc. Of particular importance; a number of tests to determine drug usage—and the results of such usage—will be conducted, and the results of these tests will be published.

It should be clearly understood that there is absolutely no intention or desire to "hurt anybody"—on the contrary, it is our sincere desire to help everybody we can; but this can only be accomplished in the full

light of the truth. At the moment, millions of young weight trainees are attempting to build impossible degrees of muscular size, trying to duplicate impossible strength feats—and generally training in a fashion that literally prevents much in the way of worthwhile results; and who knows the actual extent of the damage being done by the use of drugs.

As additional plans for this contest are made, the details will be published in Iron Man Magazine and probably elsewhere; the date of the contest will be approximately November or December, 1972. The probable location will be Los Angeles, California.

While half of the total cash prizes of $50,000.00 will go to the overall winner, the other half will be divided into smaller, but significant, cash awards for a number of "place winners" and the winners of several subdivisions, best arms best back, etc. Additionally, all entrants will be provided with housing during the week of testing immediately prior to the contest.

For the first time in the history of physical training, this contest will provide sincerely interested, qualified, and hopefully unbiased experts the opportunity to study a large group of outstanding muscular specimen in depth; but if bias does exist—as it always does to at least some degree—then it should be balanced out by the large number of people who will be involved in the testing.

One point that still affords some concern is the selection of judges, and we are anxious to receive all possible suggestions in this regard; it is of course of extreme importance to have a panel of judges that are qualified and unbiased.

Additionally, we are interested in communications from the physiology departments of institutions that might like to take part in the testing procedures; but the final selection of such participants will be at the discretion of Dr. Plese.

Chapter 13: The Real Value of Weight Training

Are the benefits of weight training worth the price? If the price is that paid by many—perhaps most—currently-active trainees, then the answer can only be negative; for a physically-normal individual, the possible benefits of weight training are simply not worth the price of fanaticism—if a man must become a slave to his training, then it simply isn't justified on any rational basis.

For a physically-subnormal individual, the situation may be entirely different—sometimes almost any amount of training is not only justified but is an actual requirement for anything approaching a normal existence. But in normal situations—in most situations—the value of the possible results must be carefully compared to the price. And if the price really is that which it is assumed to be by most advanced bodybuilders, then the possible results are grossly overpriced. Fortunately, the opinions of advanced bodybuilders can seldom be considered gospel—personally, I have finally reached a point where I am highly suspicious of anything that such people believe; the very fact that something is being supported by advanced bodybuilders is enough, to me, to raise strong doubts on the subject—after thirty years of interest and no small amount of involvement in the field, I have yet to meet a bodybuilder that understood the basic physics involved in barbell training. Somewhat like lemmings—and with very similar final results—they all seem to be rushing blindly in the same direction, simply because everybody else is doing the same thing.

In my carefully considered opinion, most currently-active advanced bodybuilders will never accept an actually-rational method or style of training—primarily, I think, because many of them are too stupid to understand the real factors involved, and too biased to accept them even if they can understand them; which is a far more pitiful commentary on the state of affairs than it might appear to be at first glance—because the actually-important factors that must be understood for the most practical utilization of weight training (for any purpose) are really very simple, perhaps too simple.

Sour grapes hopefully intended to explain a lack of acceptance of my ideas or my machines? Some people will think so—but opinions don't change facts; and as a matter of fact, we have been simply swamped by orders for our machines since long before they even went into production on a commercial basis—and with very few exceptions, the people who bought the machines from us at first on a sight-unseen basis have promptly ordered more machines. So, since we have literally had more business than we could handle up to this point, and since the flow of orders is constantly increasing, it would seem that both my ideas and my machines have achieved at least a reasonable amount of acceptance—in many cases, even if somewhat to my surprise, from advanced bodybuilders.

The simple fact of the matter is that rationally-practiced progressive weight training is capable of producing results in the way of increases in strength and muscular size that cannot be duplicated by any amount of any other type of presently-existing training; strength for any purpose—for a normal life, for sports, for improved health and/or appearance.

And it is equally true that any possible degree of strength or muscular size can be produced by less than four hours of weekly training—very quickly produced; and for individuals with more reasonable goals, and hour and a half of weekly training will produce results within a period of a few months that must be personally experienced to be appreciated.

Weight training certainly is not the answer to all health problems—but it just as certainly is the answer to a long list of physical problems, many of which can be solved in no other practical manner; and where strength is a factor, it is the only rational choice.

Most people have no desire to be either as big or as strong as Casey Viator—but regardless of your personal goals, it is only common sense to use the most productive method available; and the system of employing the best method is of great importance as well—but the most likely-looking source of information on that score is in fact the poorest possible source of any meaningful information. The simple truth is that advanced bodybuilders in general have no slightest idea what they are doing—or even why they are doing it.

So far without single exception, the advanced bodybuilders that I have trained or closely associated with seem to be unable to progress beyond a certain point if left up to their own devices—and actually good results are to be produced, they must be constantly supervised in their training; if not, they quickly start backsliding. Under the circumstances, I can reach only one logical conclusion; regardless of their statements, the either do not understand or will not accept the validity of the actually important points—and when permitted to supervise their own training, they quickly fall back into habits of overtraining insofar as amount of training is concerned, and under-training in intensity of effort.

For the average person, however, no such drive or self-discipline is required; good results can be produced from a very small amount of the proper type of training.

Chapter 14: The Drug Scene in Bodybuilding

A few years ago, bodybuilders on the west coast were beating-up hippies—today, many thousands of bodybuilders have adopted the hippie style of life, drugs and all. Steroids—the so-called "growth drugs"—have become an almost universal fact of life in the weight training world; and stupid as such utilization of these dangerous drugs may be, it is at least understandable. But drugs are no longer restricted to the steroid category—at a recent lifting meet, one of the heavyweight lifters was so stoned he literally didn't know where he was or what he was doing.

There is no rational excuse for the use of any kind of drugs by healthy individuals—but since it is apparently not in the realm of possibility for me to say anything that might influence people already involved in such practices, I will limit my remarks to a simple statement of the facts as they exist.

Large numbers of young men are attracted to the field of weight training every year—and under the circumstances, it is inevitable that many of them will be influenced by common attitudes and habits that will literally destroy no small numbers of them; in the present state of affairs, the parents of young men attracted to weight training would be well advised to do everything possible to channel this interest into another direction—and if that is not possible, then extreme care should be used in selecting a training environment. If possible, training should be restricted to the home; and for the benefit of those readers who may assume that this is an attempt on my part to sell more equipment, I will add that absolutely nothing in the way of special equipment is required. Very good results can be quickly produced by the use of a barbell, a chinning bar, a pair of parallel bars, and a squat rack—none of which items are manufactured or sold by myself.

The above is not meant to imply that there are literally no decent commercial training environments—there are many; but they do not exist in proportion to the need.

To the young trainee still in doubt on the subject of drugs, I can only say that the use of drugs **will not** help your progress—regardless of what you may hear or read to the contrary; during the last few months alone, we have observed several cases of very serious effects from the use of drugs by bodybuilders—and no slightest sign of any worthwhile results from their use.

“There is no rational excuse for the use of any kind of drugs by healthy individuals…”

Chapter 15: Weight Training for Women

"Spot reduction" is a myth—for men or for women—a physiological impossibility; the overall amount of fat is just that, an "overall" condition—the result of too much food and/or too little exercise. But in certain sections of the body of women or men, a very noticeable degree of "apparent spot reduction" can be produced—sometimes in as short a period as a day or so, or even a matter of hours.

When a fat appearance is a result of poor muscle-tone, as it frequently is—particularly in young women, but not uncommonly in men—then literally spectacular "apparent results" can be produced if direct exercise is applied to that area of the body; with little or no change in the body weight, and no measurable reduction in the actual fat content of the body—and with no change in the diet. And without increasing the size of the involved muscles to any noticeable degree—and with no increase in the size of other muscular structures in the body.

Since this condition is most commonly developed in the upper-thighs and in the buttocks, and since conventional exercises for these muscles involve working the much larger muscles of the frontal thighs as well as the muscles you are actually trying to reach—exercises such as squats and leg presses—and since most women are not anxious to increase the overall size of their thighs (even if they are willing to use such hard exercises, and few are), it is obviously necessary to provide some form of direct exercise for the buttocks and upper-thigh muscles that work in connection with each other; with conventional exercise equipment, the closest approach is with a "thigh curl" machine—an exercise machine that applies direct exercise for the primary function of the thigh biceps, the muscles that bend the lower-legs back against the rear of the thighs.

Such exercise will produce some results in the area—and will do so without involving the much larger frontal-thigh muscles; but there is still a lot lacking in this "closest approach." Primarily because you really need to involve the secondary function of the thigh biceps—moving the thigh back into line with the torso—and because you also need to directly involve the buttocks muscles, which have a very similar function. For these specific purposes, we have recently developed a new machine that works the muscles of this area directly; the Nautilus Buttocks ("Glute Curl") Machine.

Of little or no use to the average man, who should be willing and able to work this area of his body heavily in a normal manner while performing heavy exercises for the legs, such machines will undoubtedly find widespread acceptance by women—for several reasons; primarily because these machines can and will produce the desired results very quickly, but also because they will do so without requiring much-heavier types of exercise involving the major muscles of the thighs, and because no skill or practice is required on the part of the user.

However, I have mentioned the above described machine for a very good reason—because it is one of a very few "exceptional" exercise devices (or exercises), exceptional in that it is primarily limited to the use of women; but by and large, women should practice almost all of the same exercises that are used by men—and they can do so without the "danger" of building huge muscles. Which danger simply does not exist in the case of a normal woman.

The average woman could not build large muscles if her life depended on it—and for health purposes, for reducing purposes, or toning purposes, women should use the same basic exercises that men do. But in an almost opposite manner; instead of trying for maximum-possible "intensity of effort," they should

strive for nothing more than a medium intensity—and instead of trying to reduce the "amount" of exercise to its lowest possible point while still meeting the other requirements, they should practice as much in the way of exercise as it is reasonably possible to do without resulting exhaustion. In short, women should train more than men—but not as hard.

Apart from these general considerations, practically all the rules for training of men apply to with almost equal validity to women.

Chapter 16: Muscular Potential and Heredity

"Potential"—in this sense, the ability to build muscular size and strength—can only be judged in retrospect and then only with a limited degree of certainty; after all who can say "what might have been?"

Nevertheless, the potential muscular size of the average individual is far beyond existing average muscular size; in effect, almost any healthy man can build muscular size and strength to such a degree that most medical doctors would refuse to believe accurate "before" and "after" measurements and photographs. And at least a fair percentage of apparently average men can build literally huge muscular size.

In earlier chapters I have mentioned the relationship between muscular size and strength, and have noted that producing maximum-possible degrees of strength will also produce maximum-possible muscular size; but since this is a point of very great importance—and a point that is generally misunderstood by almost everybody in the weight training world—I will go into a bit more detail in an effort to make this relationship perfectly clear.

Most weight trainees are convinced that muscular size has little or no relationship to strength—and at first glance it might appear that there is quite a lot of evidence to support that belief; for example:

1. some men with 14 inch arms can curl or press more than other men with 16 inch arms

2. almost all champion weight-lifters lack the muscular size of advanced bodybuilders, yet they are much stronger in spite of their smaller muscular mass

3. many of the men with really outstanding degrees of muscular size are actually not very strong, certainly not as strong as they look.

Most of the above points can be answered in one short sentence, "…there is no valid basis for comparing the strength of one individual to that of another individual."

Let us examine the points one at a time; first, assuming an equal length of the muscular structures, a 16 inch arm contains approximately twice as much muscular mass as a 14 inch arm—and if everything else is equal, then the larger arm will be capable of producing approximately twice as much power as the smaller one. But it does not follow that the larger arm will be able to "demonstrate" twice as much power—or lift twice as much weight; if the 14 inch arm is favored (it would be a favor in this case) with very short forearms—and the 16 inch arm is burdened with very long forearms—then the weight is being moved a greater distance in a curl by the larger arm, and more power (and thus more muscular size) will be required to move it the greater distance.

And the length of the forearms is not the only such "leverage factor"—additionally, such things as attachment-points and angles-of-insertion are involved; factors which have the effect of increasing or decreasing "measurable strength."

And even if you are comparing a man's 14 inch arm to the same man's arm at a later date—after it has increased to 16 inches—the leverage factors will still not be exactly the same; as the size of an arm

increases, the angles-of-insertion change—always unfavorable. This happens because a muscle can add significant size only by becoming thicker—and because muscles produce power in a basically reciprocal fashion, exerting a pull in approximately straight lines; obviously then, as part of the mass of a muscle moves "out" due to an increase in the thickness of the muscle, the displaced portion of the muscle will no longer be pulling in the previous direction-of-pull—and as the direction-of-pull changes, the efficiency ratio is reduced, particularly in the strongest ranges of movement.

An increase in measurable strength will be produced in some cases—in some positions; but in general, displacement of the angle-of-pull resulting from an increase in muscular mass will produce a decrease in efficiency.

In effect, if a man increased his arm from 14 inches to 16 inches, then his curling ability would not increase in exact proportion to his gain in muscular size; even though the muscles were twice as large as they were previously, and could produce twice as much power, the curling strength would not be doubled as well—because some of the increased power would be wasted as a result of changed angles-of-pull.

Two, champion weight lifters may well be champions primarily because they have far better than average leverage factors helping them—and if so, they may not need much in the way of actual muscular bulk to lift heavy weights; and, of course, weight lifting is an art requiring far more than strength—form, style, and other factors are equally important.

Also, the muscular mass itself may be very efficient in such individuals—since such efficiency is an individual thing.

Three, a bodybuilder with literally huge muscular size may also be primarily a result of his leverage factors—bad leverage factors; in such a case, an actually great mass of muscle would be required to lift only an average amount of weight.

Once this is understood, then the implications become obvious—a bodybuilder seeking to increase his muscular size should strive to increase strength, knowing that increases in strength will produce at least proportionate increases in muscular size; and weigh-lifters should strive to increase the size of the muscular structures involved in their sport, realizing that their strength will be increased as a result, if perhaps not in exact proportion. Such things as the length of bones, attachment points, etc. are determined by heredity; and by and large they cannot be altered—at least not to your advantage (my left triceps worked much better before it was ripped loose from the original attachment point).

It is at least possible that such individual differences have resulted in the gradual "drifting apart" of weight-lifters and bodybuilders—since it is only natural for a man with huge muscular size to resent the fact that a much smaller man can outperform him in strength demonstrations; and equally natural for the smaller man to look upon the bodybuilder's muscles as "useless."

But in so doing, by drawing apart, both factions have suffered—to at least a large degree because the training styles have gradually become almost two distinct practices; while neither the bodybuilders nor the weight-lifters realized that both should be training in an almost identical fashion—apart from training for style and form.

Some people can rather easily build great muscular size—some others can build great strength—and a few can build remarkable degrees of both; but the style of training should be almost identical in all cases, regardless of individual differences in potential, and no matter what the goals may be.

You cannot change your potential—but is probably greater than you think. And it might be of some interest to a few people to learn that recent evidence indicates that the best age (on the average) for making muscular size-strength gains is thirty-two.

Perhaps it isn't "too late" after all.

“…almost any healthy man can build muscular size and strength to such a degree that most medical doctors would refuse to believe accurate "before" and "after" measurements and photographs…”

Chapter 17: Muscular Function

Human muscular structures—at least the type of muscular structures we are primarily concerned with here, which might be defined as the "visible muscles" by bodybuilders or the "useful muscles" by weight lifters—perform work by contracting, by reducing their length, and thus exerting a pulling force on the body parts to which they are attached. While the body is fully capable of performing a number of "pushing" movements with great force, the actual power for all movements is provided by muscles which "pull."

Since a significant degree of reciprocal movement ("in and out" movement, or "up and down" movement like that of a piston in the cylinder of an engine) is impossible for human body parts, almost all such movements are rotational in nature—but this rotary movement of body parts is powered by reciprocal function of muscular structures.

Unavoidably then, the ratio of efficiency of bodily movements is not constant; at the start of a movement such as a barbell curl, the involved muscles are exerting force almost straight "up," approximately in line with the center-line of the muscles providing the power (primarily the biceps)—but the body part which is moved by this force, the forearms, cannot move "up," they can only move "forward" by rotating around the axis of the elbow. Thus a large part of the force being exerted by the biceps is wasted, since the angle-of-pull is such that the efficiency ratio is very low at that point in the movement; in effect, that is the "weakest" point in the movement—paradoxically, however, it may well appear to be the strongest point in the movement, because (as in a barbell curl) there is literally no resistance at the start of the movement in most conventional exercises.

As the rotational movement of the forearms proceeds during the performance of a curl, the ratio of efficiency rapidly improves—up to a point, the so-called "sticking point" at which point the ratio of efficiency is at its best; but again, appearances are opposite to the facts—because, at that point in the movement, the moment-arm of the resistance is at its highest point and the "effective resistance" or torque is at its highest point, and thus the weight will feel heaviest at that point in the movement and the muscles will seem weakest.

In fact, that point in the movement is **not** the position of maximum strength—but it is the point of best efficiency; the position of maximum muscular strength is reached at the finish of the movement, in the position of full contraction—at that point, and only at that point, it is possible to involve all of a muscular structure in the work. It should be clearly understood that the ratio of efficiency has little or nothing to do with "measurable efficiency"—not, at least, if attempts are made to measure it on the basis of the ability to perform standard strength tests. The ratio of efficiency is based strictly upon a comparison of the amount of power being produced by the muscles and the amount of power reaching the involved body-parts; at the start of a curl, for example, very little of the power from the muscles is useful for any measurable purpose—but at the sticking-point in a curl, a very high percentage of the power is useful. After the movement has passed the sticking point in a curl, then the ratio of efficiency starts to decline again—although, in a curl at least, it will never return to the low point of efficiency that was experienced at the start of the movement.

Thus in a conventional curl, it seems that you are getting weaker as a curl moves from the starting point to the sticking point—when in fact you are getting stronger; and it seems you are getting stronger after you pass the sticking point—when in fact you are getting weaker. Or, at least, the efficiency ratio is

improving when it appears to be declining—and vice versa. But all of these false impressions are due to the fact that the resistance in a conventional curl is reciprocal in nature—and thus not constant throughout the movement.

But even that isn't the full story; because, in addition to the constantly changing efficiency ratio involved, you also have the factor of constantly changing muscular strength. At the start of a curl, the muscles are extended—and in the extended position a muscle can produce only part of its actual power. In order to produce power in proportion to its existing potential, a muscle must be in the position of full contraction. Thus the "input of strength: is constantly rising as a muscle moves from a position of full extension to one of full contraction; in effect, in a curl, the muscles provide constantly increasing amounts of power for the movement as you move from the straight-arm position to the bent-arm position. Although it will not appear that this is happening—for the reasons mentioned above.

When all of the factors are taken together, and when the curling muscles are exposed to rotary-form "direct" resistance so that it becomes possible to judge on the basis of actualities rather than appearances, it is immediately obvious that the usable strength for curling is at its lowest point at the start of the movement, increases to—and past—the sticking point, and then gradually falls off near the end of the movement. Up to the sticking point, all factors are contributing towards an increase in usable strength—the ratio of efficiency is improving and the power input is increasing at the same time; beyond the sticking point, the ratio of efficiency starts to drop off again, but the input of strength from the muscles continues to increase—and the net result is an overall increase in usable strength, up to a point. But beyond a certain point, the drop in efficiency is no longer fully—or more than fully, as is the case in some areas of the movement—compensated for by the increase in input of power from the muscles; and beyond that point, a drop in usable strength must occur.

Such interrelationships are actually quite simple in the case of a movement such as the curl, where movement is confined to rotary movement around one axis (the elbow axis), and where the angle-of-pull factors are easy to visualize and understand; but in some cases the situation is far from being simple or easy to understand—although the factors are known and have been carefully considered and allowed for, it is not an easy task to try to describe them to a person without the required background in physics and physiology.

For example, in a standing press with a barbell the movement is rotational around several axis points—and the angle-of-pull factors are also far more complex; likewise, the changing moment-arm factors in this movement are not as simple as they are in a curl, so it is not so easy to calculate effective resistance, or torque.

Nor is it enough to simply design an exercise—or an exercise machine—that "feels right," that apparently has no sticking points or points of little or no resistance; the very fact that such an exercise did feel right to the average person, or almost **any** person, would in most cases be solid proof that it was "wrong." Muscles cannot develop properly unless they are exposed to proper resistance—which is impossible with conventional exercises; thus actually proper resistance will almost always "feel wrong" at first contact. Our new curling machines "feel" almost perfectly even to me—that is, no point in the movement feels any heavier than any other point, the weight seems to be the same in all positions; while in fact it is constantly changing throughout the movement. Yet to a man with actually much larger arms—a man that has previously trained with conventional equipment—the machine feels decidedly "wrong" when it is first tried; many such individuals have been literally shocked to realize that they could not pass the mid-range of the movement with an actually very light weight—a weight that much smaller men who have used the machine for a while can handle easily in any position.

But the above must not be misconstrued to mean that the machines build "smaller" arms—on the contrary, the machines build larger arms; the potentially largest and strongest part of a muscle is the center of the muscle—the center as determined by its position between the two ends of the muscle—and in conventional exercises this part of the muscle is seldom if ever involved in the work at all. As a result, most people—and this is even more true of men who have trained in a conventional manner than it is of men that have never trained at all—have very little strength or muscular size in the areas that should be largest and strongest; never having trained that part of their muscles—the major part, the potentially largest and strongest part—they have almost no strength or size in those areas. At this point in time, we still don't know just what a fully developed muscular structure will even look like—but it is at least likely that the overall "shape" of fully-developed bodybuilders will be quite different from the shape that is seen today. To some degree, Casey Viator is already an example of "things to come"—standing relaxed, he looks much like many other bodybuilders, but when he flexes his muscles "things happen," things that don't happen when other bodybuilders flex their muscles, he seems to "grow" right before your eyes.

A year ago, a former Mr. America told me very heatedly that Casey could not possibly get any larger without becoming fat—but he did get larger, much larger, and he actually improved his degree of muscularity at the same time, and he did so while maintaining an overall symmetrical appearance; when Bill Pearl won the Mr. America contest it was noted that he did not win any of the "best body parts" awards, and it was mentioned that his failure to win these sub-divisions of the contest was proof of his symmetrical development, that no one body part "stood out" in such a fashion that it appeared outstandingly developed—yet Casey Viator won all of the body-parts awards except best abdominals, and he easily could have won that subdivision as well since his abdominal area is on a par with that of anybody living or dead.

Casey probably failed to win the award for best abdominals simply because that area of the body is never as obvious in a really bulky physique as it is in the case of a much thinner man: the average viewer—even the average judge of a physique contest—is so impressed by the rest of the physique that he simply overlooks the abdominal area, unless it is obviously poorly developed. But if the rest of the body is properly developed, then it is literally impossible for the abdominal area to be really poor; Casey's abdominals are outstanding—yet he has done absolutely no direct work for that area of his body in more than a year—if you train the rest of the body properly, then the abdominal area will take care of itself. The billions of sit-ups and leg-raises that have been performed by millions of trainees have been almost a complete waste of time and effort; if you have fat "anywhere" on the body, then you will have "more fat" in the abdominal area—and if you have "any" fat in the abdominal area, then you will have "some" fat everywhere. You can get rid of all visible fat only by regulating the input of food in relation to the output of energy.

Our efforts have been primarily directed towards attempts to determine the exact functions of muscles—so that exercises could be provided in a logical manner, in a manner suitable to the functions of muscles rather than barbells. Later chapters devoted to particular exercises will help to make the real functions of most of the major muscular structures clear to the average reader; and while you might not care "why" a muscle functions as it does, it should at least be obvious that you must know "how" it functions in order to know how to provide proper exercise.

"…if you train the rest of the body properly, then the abdominal area will take care of itself. The billions of sit-ups and leg-raises that have been performed by millions of trainees have been almost a complete waste of time and effort…"

Chapter 18: Four Steps

The four steps of meaningful progression in the field of physical training have been:

1. calisthenics
2. gymnastics
3. weight training, and
4. Nautilus training

In the field of transportation there have been four similar steps:

1. walking
2. animal-powered transport
3. internally-powered transport, and
4. aerial transport

Each step in the field of transportation provided a marked increase in the speed of transportation at first, and eventually a reduction in the cost of transport; in the field of physical training, the various steps have each provided a marked increase in the degree of possible results, and simultaneously a reduction in the required amount of training (in effect, the "cost").

Both the increases in the production of results and the decreases in the "cost" (the amount of exercise necessary) were provided by the same factor in all cases—each step produced a marked increase in the possible "intensity of effort"; gymnastics are harder than calisthenics—weight training is harder than gymnastics (or, at least, it can be and should be, and will be if it is properly employed)—and Nautilus training is harder than conventional weight training, to a degree that literally must be experienced to be understood.

All of this is so obvious that it seems almost needless to even say it—yet, in fact, it must not be obvious to many current weight trainees, since they train in a fashion that clearly indicates that they are not even aware of the real facts of the matter.

From the very start of the investigations that finally produced the Nautilus methods and systems of training we were clearly aware of "what was needed"—**harder exercise**; the problems have all been concerned with how to provide such harder exercise. I have long been aware that (in physiology, at least), "…the sum of the parts is not always equal to the sum of the parts."

In order to have an elephant, you must have an elephant's head, an elephant's body, four elephant legs, and a number of other parts—but you can have all of the required parts and still not have an elephant. In order to kill an elephant quickly with a .600 Nitro-Express rifle you must hit him in the brain, with a 900 grain bullet delivering an impact force of about 8,000 foot pounds—but you can shoot an elephant ten-thousand times with a .22 rifle delivering a total of both grains of bullet weight and foot-pounds of

impact force many times as great as the totals from the .600 and still not kill him, and certainly not quickly, if at all.

In exercise, we find a similar situation—many light movements do not always equal one heavy movement.

In calisthenics you are primarily working against the resistance provided by only a small part of your own body weight—in gymnastics you are working against the resistance of all, or most, of your body weight—in weight training you are (or should be, where possible) working against resistance far in excess of your body weight—and the only real "break" in this chain of progression from easy exercise to harder exercise to yet-harder exercise comes with the step up to Nautilus training, which provides "harder" exercise in an entirely different manner from that involved in the moves between previous steps; with Nautilus training, you will certainly work against greater resistance, but it isn't simply a matter of increasing the poundage involved—instead it means that you will be using almost literally all of the mass of the muscles you are trying to work, rather than only a small part of the total mass of the muscles.

Until, and unless, you have experienced Nautilus training, you simply don't know what "hard training" really is; but since the average person is too lazy to even do calisthenics, and most people are too lazy to do gymnastics, and even almost all weight trainees are too lazy to use a barbell in an actually "hard" fashion, I do not expect very many people to quickly accept and practice a form of training that makes them all seem like child's play by comparison—but a few people will, and the results they produce will eventually (and sooner than you might think) produce an entirely new breed of strength athletes.

You can slice it as thin as you can, or pile it as high as you like—but you still end up with cheese; if you started with cheese. You can kid yourself any way you like—but you can't change facts; hard exercise—and **only hard exercise**—produces worthwhile results in the way of muscular strength and size increases. If you are not willing to work hard, then forget it—there simply isn't any other way to do it.

Chapter 19: Barbells versus Exercise Machines

Barbells have several advantages over exercise machines—even Nautilus exercise machines; and if the available exercise machines do not provide some sort of advantages that more than compensate for their inherent disadvantages, then you are better off using a barbell. Nautilus machines do provide advantages that far more than compensate for their disadvantages—conventional exercise machines generally do not, and never to any really worthwhile degree.

An "opinion" of the inventor of Nautilus machines? Certainly it is my opinion—but it happens to be supportable fact as well. With only two or three insignificant exceptions (which I will list a bit later in this chapter), almost all conventional exercise machines are actually less productive than barbells—and this is true for obvious reasons; one of the limiting characteristics inherent in all exercise machines (including Nautilus machines) is the factor of "guided resistance"—instead of being free to move in any direction, as it is in almost all barbell exercises, the resistance is confined to a single "track of movement." Another such limitation encountered in most exercise machines (but **not** in Nautilus machines) is "reverse geometry"—the mechanical designs used in most machines actually decrease the efficiency of the exercise movements.

Early attempts in the direction of building conventional exercise machines were usually limited to "redirecting gravity"—changing the "direction of resistance" from "down" to "up," or from "down" to "across." Barbells provide resistance in only one direction—vertically down, as a result of gravity; by the use of pulleys you can "redirect" the resistance, change the direction-of-resistance to any direction desired—but you will still have resistance in only one direction (uni-directional resistance). So at best you still have an exercise almost identical to a barbell exercise—and in most cases, and exercise not quite as good as a barbell exercise—and at the worst, an exercise far less effective than a barbell exercise.

Where and when such simple machines make it possible to work muscles that can not be worked with a barbell, then they are justified; conventional "lat machines" are examples of worthwhile applications of redirected barbell resistance—a leg-press machine is at least a practical example of another such application. But in general, such applications seldom provide any advantages over barbell exercises—and frequently are less effective than barbell exercises.

The state of the art remained at that stage for a number of years, and during that period there were neither any significant improvements nor backward-steps in the nature of available training equipment; but when a major step finally was taken, it was a move in the wrong direction—perhaps primarily because of new and very plush "health studios", the attentions of most equipment manufacturers turned towards improvements in convenience and appearance. But very little, if any, attention was given to function—and in almost all cases, the functions of exercise machines became worse.

Two companies in particular seem to have devoted most of their attentions and efforts towards attempts to design exercise machines that work on leverage principles—because, if cables could be eliminated and replaced by levers, the machines would then not be subject to such frequent breakdowns from cable wear; which would be fine, if the functions of the machines were not harmed in the process—but in fact, most such machines do suffer from greatly reduced function.

Secondly, the same companies were also greatly interested in trying to cram as many different "stations" into the smallest possible space, and wrap the whole thing into one package—eventually the term

"jungle" resulted from this practice; and such machines are certainly just that, jungles, mixed-up multi-exercise monstrosities of little or no actual value by comparison to a barbell. It may be possible to cram fourteen people into a phone booth, too—but if so, then don't plan on any of them using the phone.

In later chapters devoted to exact step-by-step examinations of the supposed purposes and actual functions of many different types of exercise machines and devices, I will point out a large number of the obvious mistakes that were incorporated into the design of most of the current crop of exercise machines; but for the moment, it is enough to state that a barbell is usually better—far better—than an exercise machine which is supposed to duplicate a barbell exercise. If you want barbell exercises, use a barbell—don't try to make an elephant out of a mouse; barbells are very productive tools if they are properly used—and almost all conventional exercise machines are a firm step in the wrong direction.

Chapter 20: Direct Exercise

Most exercises are "direct" in no sense of the word—and many exercises are direct only at one point during a movement that extends over a wide range-of-movement; a squat is not direct at any point during the movement—a curl is direct at only one point during the movement, an infinitely small point, the so-called "sticking point."

In order to be "direct" in the above sense of the term, the resistance provided by an exercise must be directly opposed to the movement, 180 degrees out-of-phase with the movement—if it is direct in this sense, then an inch of movement of the involved body-part produces an inch of movement of the resistance; in effect, any movement of the body-part produces an equal movement of the resistance—and if the resistance is provided by gravity, this means that body-part movement must produce an equal degree of "vertical movement" of the resistance.

The reaction of the average bodybuilder to the above paragraphs will undoubtedly be, "So what?" But if so, then an extremely important factor is being misunderstood or overlooked; the lack of directness of resistance application is one of the major shortcomings encountered in barbell exercises. In the case of a barbell curl, this lack of direct resistance results in a situation where you encounter literally **no resistance** during a fairly large part of the movement—and this occurs in the most important part of the movement, at that.

But the above covers only one of two distinct meanings of the term "direct" as it applies to exercise; to be direct in the other sense, the resistance must be applied against the "prime body-part", against the body-part that is directly moved by the involved muscle. For example; in a curl, the involved muscles are attached to, and directly move, the forearms; thus, in a curl, the resistance must be applied against the forearms. Which, for all practical purposes, is the actual practice in the curl—since the hands are effectively an extension of the forearms.

To be perfectly technical about it, for totally direct resistance in a curl, wrist joints would have to be fused—in order to prevent any possible movement between the hands and forearms; but in practice, because of the limited range of possible movements of the wrists, and because of the positioning of the related arc of this movement, no significant reduction of the effective degree of directness of resistance application is produced by wrist movement. So—for all practical purposes, at least—a curl is a direct exercise in this sense of the word. While the squat is not.

An example of a "perfectly direct" exercise—in both senses of the term—is the movement performed on a thigh-extension machine; in this exercise, the resistance is always directly opposed to the possible direction of movement, and is applied directly against the prime body part. Or at least it is in some machines; and, rather paradoxically, the least-expensive thigh-extension machines are generally the best ones. In the Universal (brand name) thigh extension machine, the resistance is provided by a vertical-rise weight-stack that is driven by a cable—which cable, after passing over redirectional-pulleys, is attached to the movement-bar of the machine; which makes it very convenient—but which also goes a long way in the direction of ruining the function of the machine. Because the resulting geometry is such that the resistance is highest at the start of the movement, and then decreases as the movement progresses. It is undoubtedly possible to design a machine in such a manner that it would be **worse**; but you would be required to think about it first.

In the Universal thigh-extension machine that we have been using for more than a year in experimental weight training programs in Florida, the primary source of resistance is limited to 150 pounds—but since that isn't enough for many of our trainees, we have been adding additional resistance in the form of barbell plates, adding them to a rod incorporated into the machine for that purpose; the somewhat amusing part of the situation is the fact that the "added resistance" is far superior to the primary resistance—since the geometry of resistance in this case is at least not backwards, if perhaps not perfect.

Quite recently, one of our trainees exerted such force against the movement-arm that one of the redirectional-pulley brackets was torn entirely loose from the machine—thus rendering the primary resistance inoperative; so we didn't use the machine for a few days, intending to repair it when we got around to doing so—but then it occurred to me that such a break-down was actually an improvement in the machine, so now we don't intend to ever repair it. Because by using only resistance provided by the secondary resistance source—barbell plates added to a rod on the movement arm—we have a much improved-exercise.

Much less-expensive types of thigh-extension machines, which have only cross-bars for holding barbell plates, are actually far more productive—because the "resistance curve," while certainly not perfect, is at least not backwards.

I do not know if the people who design most machines are simply unaware of the desirable characteristics and actual requirements of exercise—or if they don't care, perhaps being interested only in appearance and convenience; but the results of such incorrect design are the same in either case—the geometry of the machines is not what it should be, and could be, and it thus becomes literally impossible to produce really worthwhile results from the use of such machines, results in proportion to the training-time and effort expended.

Most barbell exercises provide no direct resistance, some barbell exercises provide direct resistance only during a small part of the movement—but a few barbell exercises provide fairly-direct resistance over a wide arc of movement; the barbell wrist-curl—if performed in the proper manner—is almost literally a "perfect" exercise, since it provides full-range directness of resistance and even automatically varying resistance which comes very close to being exactly "right".

To begin with, the resistance in a wrist-curl is applied directly to the prime body-part (the hands)—secondly, the arc of movement is such that the resistance increases throughout the movement, and if the angle of the forearms is proper then the resistance reaches its highest point just as the involved muscles reach their strongest position—thirdly, the geometry of the involved joints and muscular attachments is such that the strength curve increases throughout the movement, steadily (if not quite evenly) increasing as the muscles move from a position of full extension to one of full contraction.

If a trainee can be taught to perform this exercise properly—and if he will then practice it properly—nothing but a barbell is required for producing results that are so close to being maximum-possible results that no slightest difference is of any significance; secondly, while it would at least be "possible" to design and build a machine what would provide better exercise for the involved muscles, the degree of improvement would not be justified.

And an almost exactly parallel situation exists in regard to the calf muscles; which is paradoxical—and amusing—because the forearms and the calves are by far the easiest parts of the body to develop, and because the required exercises have been in existence for many years, and because these exercises can be properly performed with absolutely; nothing in the way of special equipment—and yet, most bodybuilders are firmly convinced that the calves and forearms are the "hardest" body-parts to develop.

I have consistently refused to waste my time and energy designing and building a calf-machine—because no such machine is needed; but we will eventually offer forearm-machines—even though they will almost-exactly duplicate barbell exercises, and in spite of the fact that they will offer absolutely nothing in the way of actual "improvement" by comparison to barbell exercises. These machines apparently are a necessity, because it seems to be almost impossible to teach most trainees the proper style of performance using a barbell; and it seems to be utterly impossible to get trainees to use the proper style even when they do understand it. So a machine that forces the trainee to use the proper style does seem to be a requirement in this instance.

It might be a source of interest to some readers to mention the fact that the entire Nautilus method and system of training was a result of a search for "direct exercises"—at the start, we were looking for a method that would provide direct exercise for the latissimus muscles of the back, since it was obvious that all conventional exercises for those muscles left a great deal to be desired. "Pullups" (or "chins"), pulldowns, behind-the-neck chins, rowing exercises of a wide variety, and all other conventional exercises for the latissimus muscles certainly do provide "some" work for those muscles; but they all have one fault in common—they all involve the muscles of the arms as well as the muscles of the back that you are trying to work.

The latissimus muscles are attached to, and move, the upper arms—thus, for direct exercise, the resistance must be applied against the upper arms; what happens to the forearms, and/or the muscles of the upper arms that move the forearms, is of no slightest importance—or would not be of any importance in a direct exercise for the latissimus muscles.

You hang a man by suspending his weight from his head—thus imposing the resistance on his neck; if you tried hanging him by his hair, the hair might pull out before any results were produced in regard to the neck. A very similar situation exists in conventional exercises for the latissimus muscles; instead of applying the resistance directly against the prime body-parts (the upper arms), such exercises apply resistance against the forearms—thus creating a "weak link" in the form of the proportionate lack-of-strength of the muscles in the upper arms. You fail in such an exercise when your arms reach a point of failure—not when the latissimus muscles become exhausted.

So you are constantly limited in such exercises by the limits of existing strength of the upper arms—which, being smaller and weaker than the latissimus muscles, fail long before the much larger latissimus muscles have been worked hard enough to induce much in the way of growth stimulation.

All of which is obvious, and all of which we were clearly aware of nearly thirty years ago—and vaguely aware of more than thirty years ago; since then, we have gone through many intermediate steps in our attempts to provide direct exercises for the latissimus muscles—and while we make no claim that our present machines are literally "perfect," they are, at least, so close to being perfect that no significant shortcomings remain. Additionally, we are clearly aware of the actual shortcomings that do exist—and also aware that they are the results of unavoidable compromises imposed upon us by unchangeable mechanical limitations and/or physical laws. In effect, our machines are as perfect as they can be—as they ever will be; in function, at least.

But we certainly did not reach the presently-existing state of development in one jump; which is why, I think, that some people do not understand the actual principles involved—or think that "just any" similar-appearing machine will produce similar results—or feel that the machines should be used in a fashion similar to the style of training usually employed with a barbell.

Automobiles would be far safer and more efficient if they didn't have doors and windows—and less-expensive, too; but in practice, you must be able to enter and exit an automobile, so you must have at least one door—and for any sort of practical function, an automobile must provide some view of the outside, so you must have at least one window. In order to use one of our Pullover-type Torso Machines, you must be able to get into it—with your elbows in the proper position; so we had to provide a means of entry (and exit), and in so doing we reduced the efficiency of the machine slightly—but a "not quite perfect" machine that can be used is certainly better than a perfect machine that can't be used.

Some of our earlier machines were actually "better"—or, at least, more efficient (very, very **slightly** more-efficient) but they were literally "three-man machines," it took the help of two other people to get you into (or out of) these machines. So we compromised—as we were forced to; but at least we were clearly aware of what we were doing, and why we were doing it, and also knew what the results would be—and since it is my personal inclination to work for absolute perfection, I have now designed and built more than forty different models of the Pullover-type machine in efforts to get the function as close to being perfect as it can be in practical application.

Which might explain why I was so irritated when a man on the west coast altered one of my machines in a stupid attempt to improve its convenience and safety; which action was fully on a par with a remark a primitive African made to me immediately after I had given him a ride in a helicopter—I asked him if he thought he could fly the helicopter, and he said, "…oh, yes; I saw what you did, you turned that switch (meaning the ignition switch), and then you held onto that stick. I can do that, too." But the African, at least, was innocent in his ignorance—he wasn't arrogant enough to think that he could improve something that he didn't understand. He didn't remove the engine and rotor from the helicopter—replace them with a tree—and then complain it wouldn't fly.

Having spent more than twenty years of his life almost desperately searching for direct and "actually proper" exercise, this man on the west coast not only remained totally unaware of what he was really seeking but promptly ruined it when it was provided.

With a barbell, direct exercise **can not** be provided if rotation occurs around more than one axis—and it will not be provided even in single axis exercises unless the position of the involved body-parts is correct; and even then, usually only at a certain point during the movement.

Chapter 21: The Recovery Factor

When a muscle has been worked to a point of momentary failure by heavy exercise, the situation is just that—the muscle has "failed **momentarily**." But in most cases, within three seconds—or less—the muscle has recovered approximately fifty per cent of the strength which it had lost as a result of the exercise; but it does not follow that it will then be fully recovered in six seconds, or even six minutes—full recovery usually takes **more than** twenty-four hours, frequently as much as forty to sixty hours. But even if the muscle itself does recover entirely, this is no indication that the system—which supplies the muscle—is fully recovered.

In order to produce increases in muscular size and strength, the muscles must be induced to make certain (but largely unknown) demands upon the system as a whole—demands for the materials required for growth; but growth cannot result even then if the system is unable to supply the needed materials—and do **not** misread this to mean that this is simply a matter of assuring that the right food has been eaten. Far from it; the primary limiting factor in this case is the ability of the system to make the required physiological (apparently largely chemical) changes within the allotted period of time—and if another workout occurs before these processes are complete, then little or nothing in the way of growth can occur.

In effect, it takes hard work to induce growth—and time to permit growth.

There will be individual variation, of course—but only within the limits of a certain rather limited scale; and it is also true that the recovery ability of a well-trained individual will be better than it was before he started training—but again, only to a certain degree. And, please note, I said "well-trained", not "**long trained**"; in fact, many long-experienced bodybuilders have very poor recovery ability—having overworked their systems for months or years they have far less recovery ability than the proverbial "90 pound weakling".

Within the human system as a whole there exist a number of regulatory sub-systems, whose functions are obvious—even if almost entirely unknown; some of these are fairly well understood, some are the subject of heated controversy at the moment, and some remain entirely mysterious—the only people who even claim to understand all of these factors are people like the self-proclaimed "nutritional expert" who dropped dead recently on a television show, moments after proclaiming that he would live to be at least a hundred years old "unless killed by a sugar-crazed taxicab driver". He was seventy years old when he died.

While it should be obvious from a reading of previous chapters that I am certainly making little or no attempt to avoid controversial subjects, it should be equally obvious to intelligent readers that an attempt to explore all of the seriously-proposed theories on the subject of the human recovery factor would be far beyond the scope of a bulletin of this nature; but in fact, such an in-depth examination is not even required for our purposes here—if we are at least aware of the existence of these factors, and able to make practical use of this awareness. After all, just how many people know "exactly what happens" when they turn the ignition switch and activate the starter of their automobile?

When anything is in limited supply, then it is simply common-sense practice to make the best-possible utilization of the quantity that is available—and when you are not sure just how much is available, it is equally good practice to use as little as necessary; in the field of exercise, the implication is clear—use

your limited recovery ability as wisely as possible, and as little as possible in line with the actual requirements for producing the results you are after.

It really doesn't matter just "why" intense exertion is required to induce muscular growth, or exactly "how" this is brought about—and it is equally unimportant that we understand the actual reasons responsible for the limitations in our recovery ability; but it is necessary to know that hard work is required, and that recovery ability is limited. A failure to understand—or even be aware of—these factors has led to the presently-existing situation in body building circles, where almost all trainees work far too much and very few trainees work hard enough. Rather than constantly trying to increase the length of workouts, **all** trainees would be well advised to attempt to reduce their training to an absolute minimum. It is my personal belief at this point in time that we will eventually—and rather soon—replace the requirement for training to about one and one-half hours weekly; and I mean the requirement for an advanced bodybuilder who is training for world-class physique competition—and I also mean that any more training would actually reduce the production of results.

Part of this requirement for sharply-reduced weekly training time will not be produced by the use of "cycle training"—but it should be clearly understood that we are **not** using cycle training merely in an attempt to save training time; we are using it because it is an absolute requirement for producing best-possible degrees of results—and it is a requirement because of the extremely short initial recovery time-factors encountered in muscular activity. In order to work a particular muscle as hard as it must be worked to induce maximum growth stimulation—while staying within the limits imposed by the overall recovery ability of the system—you must use cycle training. And when this is done properly, then only one or two such very brief cycles are all that are required—or even desirable; doing more cycles may or may not induce more growth stimulation—but even if so, it would exhaust the recovery ability of the system to a point where growth would be impossible in many cases and very slow in all cases.

At the moment, we are producing extremely good results from the following training schedule for the arms …

1. One set of 10 repetitions, standing curl with barbell
2. One set of 12 repetitions, Nautilus Triceps Machine
3. One set of 12 repetitions, Nautilus Curling Machine
4. One set of 15 repetitions, wrist-curls with a barbell
5. One set of 15 repetitions, reverse barbell wrist-curls

That completes one cycle, and up to this point in the schedule there is no requirement for the "rush factor"—performed at the proper pace and with a brief pause between sets, the above five exercises should require about four minutes to perform; although little or no harm would result if as much as ten minutes was used.

6. One set of 12 repetitions, Nautilus Triceps Machine
7. **Rush**—One set of parallel dips, maximum-possible repetitions
8. One set of 12 repetitions Nautilus Curling Machine
9. **Rush**—One set of "front pulldowns" on a Nautilus Torso-Arm Machine, using a close grip, approximately 10 repetitions

10. One set of 15 repetitions, wrist-curls with a barbell
11. One set of 15 repetitions, reverse barbell wrist-curls

The "rush factor" occurs only twice during the schedule—between the 6th and 7th sets, and between the 8th and 9th sets—at those points in the workout you must move from the end of one set to the start of the next-following set as quickly as possible, and certainly in less than three seconds.

Properly performed, this schedule requires a total of seven minutes and twenty seconds—or exactly twenty-two minutes weekly, since our trainees use it three times weekly; but it would make little or no real difference in most cases if a trainee used as much as sixteen minutes for each arm workout, a total of forty-eight minutes weekly—however, it certainly would make a big difference if he rested at those points where the rush factor is called for.

And please note, the above schedule is not intended only for beginners—it is the exact schedule being used at this time by our largest and strongest trainees, some of the strongest men in the world. At times we do a bit more—but at other times we do quite a bit less; and when any doubt exists, we always do **less**. And we **never** do **much more**.

Training schedules for other muscular structures of the body are—for the most part—even briefer, and usually involve the rush factor between all sets within the cycles being used. The rush factor—movement from the end of one set to the start of the next set with almost zero delay—makes it possible to work a muscle far beyond its normal point of failure; in the above arm routine, for example, it works as follows—the 6th set, the second set on the triceps machine, works the triceps to a point of normal failure, thus "pre-exhausting" the triceps muscles for the work to follow immediately, and then the parallel dips force the triceps to become involved in work that is actually beyond the normal point of failure.

And while it might appear that a similar result could be produced in another obvious way—by gradually reducing the resistance on the triceps machine, so that the triceps could continue to work until simply unable to continue even with no resistance—in practice this does not produce results on the same order; for at least two reasons—because the repetitions thus become far too high, and because the change of exercises provides needed variety of work. In this case, moving from the triceps machine—which provides full-range work for the primary function of the triceps muscles—to the parallel dips—which provide work in the position of contraction for the secondary function of the triceps, as well as the position of contraction for the primary function—makes it possible to work much more of the actual mass of the triceps muscles, while still not moving outside the limits of the recovery ability.

A very similar principle is involved in the work for the biceps, when you move immediately from the second set on the curling machine to a set of front pulldowns.

No amount of exercises performed in another fashion will produce equal results—and increasing the amount of exercise almost always reduces the production of results, even when similar principles are employed; or, in fact, especially when similar principles are employed, because this actually is **hard** exercise—you not only don't need much of such exercise, you literally can't stand much of it.

“Rather than constantly trying to increase the length of workouts, ALL trainees would be well advised to attempt to reduce their training to an absolute minimum.”

Chapter 22: Individuality

The hereditary differences between individuals are such that some men who have never trained will be actually stronger and more muscular than some men who have trained properly for years—but it does not follow that neither type should train; without training, the individual with very poor potential will literally remain a weakling, while with proper training he can usually reach a point of strength and muscular size at least above average—without training, an individual with very good potential may well be far above average in strength and muscular size, but with proper training he can probably become almost a superman.

But while it is perfectly true that the potential for growth varies enormously, it is not true that such differences require different methods or systems of training—the best methods and the best style of training will produce best-possible results in **all** cases, regardless of what individual potential may be in a particular case.

The fact that an individual has finally managed to produce "apparently good" final results proves absolutely nothing—since it is never then possible to determine just what that same individual might have done if he had trained properly; since almost anything is at least possible, it may well be true—and probably is true, that at least "some" bodybuilders, somewhere, are training properly, or at least in a fashion that is in some ways close to being proper; but if so, then they have so far managed to evade my attention—since I have yet to meet such an individual, not even one such individual.

Nor have I yet encountered an individual that seems capable of directing his own training properly—even after he clearly understands what is required, and fully realizes that the involved factors actually are required; left up to their own devices, even such apparently aware individuals almost always permit their training schedules to degenerate into something more closely approaching what they would like a proper training program to be—and then usually make all sorts of attempts to rationalize their actually irrational actions.

In practice, some individuals suffer badly from such traits—and other individuals suffer worse—but all seem to suffer to some degree; for that reason, we tried to make our machines and exercise systems as foolproof as possible—which, quite literally, means "proof against fools." Which, apparently, all of us are to at least some degree—and some of us to an actually great degree.

A .600 Nitro-Express will kill no elephants if it is left standing in the gun-closet—and it will kill no elephants if you merely shoot them in the tail (the actual "tail," not the backside); you must muse it properly for proper results—and the same thing is true in regard to any tool. Properly placed, one bullet from a .600 will literally knock a charging elephant to his knees—like sticking a pin into an inflated balloon, one second it is there, and a split second later it isn't; properly performed heavy exercise will produce a very similar type of result—and no amount of improperly performed exercise, no matter how heavy it may be, will produce an equal result.

But just as a .600 rifle has an understandable tendency to kick the user a bit, heavy exercise performed properly is not an entirely pleasant feeling; and in unwise attempts to produce the same sort of results in a more comfortable fashion, quite a few people have been stomped to death by elephants that they tried to kill with light rifles—and millions of weight trainees have been almost literally beating their own brains out for years in attempts to produce good results from actually-light training, even when they had

access to the tools for heavy training they almost always used the tools incorrectly in attempts to make the exercises more comfortable.

Within the next two years—and perhaps sooner—we fully expect to have both the tools and the required knowledge for the proper use of these tools that will make it possible for anybody, regardless of their individual potential, to produce the best-possible results for themselves, as individuals, from a training program that will be almost completely standardized for **everybody** and very brief for **anybody**; then all we will have to figure out is a means to induce proper utilization of the tools and system—and that may well, probably will, prove to be the biggest problem of all.

If for no other reason—and for no logical reason in any case—than people like to consider themselves individuals; but shooting yourself through the head with a .600 will produce certain results no matter how "individual" you are.

Twenty years ago, I finally learned that an actually-proper workout with barbells had to be brief in the extreme—so brief that I was always tempted to increase the number of exercises or sets, since the workouts never appeared to contain "enough"; but when I did increase anything in the workouts, the production of results was always reduced, **always**.

Twenty years later, with a total of at least a million active weight trainees in the country, it is doubtful if as many as a thousand (or literally one out of a thousand) trainees have any slightest idea of what a proper style of training consists of; in the meantime, almost all trainees have moved firmly in the exactly-wrong direction—constantly increasing the amount of their training, and decreasing the intensity of their training, which is **wrong** for **anybody**, regardless of his potential.

During that same "meantime," several parties have made themselves far richer—and millions of other people far poorer—by preaching outright nonsense; well knowing that most people are more than willing to lend an attentive ear to "what they want to hear", in this case that good results can be obtained by the use of some "easy" factor.

Chapter 23: It Won’t Happen Here

A number of years ago, the situation at Muscle Beach in California finally degenerated to the point that the city was forced to close the whole thing down—at the moment, an even more famous mecca for weight trainees is apparently undergoing a similar degeneration, is rapidly becoming a haven "of and for" drug freaks; but it won't happen here—and I think that some people, at least, know it won't happen, now. "That which is necessary" will be done to stop it from happening—**whatever** that may prove to be.

We have—in the past, we have had—and in the future, we expect to have large numbers of sincerely interested trainees from all over the country, and we welcome them, and will do everything reasonably possible to help them; but we have also had—if briefly—a few outright kooks, who were neither welcomed nor helped very much. Such people would be well advised to stay away.

If you are using drugs—of any kind—don't bother to come to DeLand, Florida, hoping to train; and please don't be foolish enough to think you can fool us on the subject—even though you might, briefly.

But if you are sincerely interested in weight training—for any worthwhile purpose—then you perhaps should consider at least a brief visit to DeLand; primarily for the purpose of learning just what proper training consists of, so that you can then apply the proper style of training with any available tools, anywhere.

We are not seeking "guinea pigs" for research purposes—at this point we already have so much research data that it will take years to reduce it all to a concise printed form; we know what is required in the way of equipment—and we know how to use this equipment in at least very practical, if perhaps not perfect, ways. We are also clearly aware that most trainees will not soon have—perhaps may never have—the use of Nautilus equipment, but the important thing that can be gained by any trainee is a knowledge of the proper style of training, and this seems to be something that cannot be clearly reduced to the written word, something that must be seen and experienced to be understood.

Even one or two weeks in DeLand will usually provide at least a working knowledge of the involved principles—if the individual trainee is intelligent enough to understand, and unbiased enough to abandon previously-formed misconceptions formed as a result of prior experience and reading, and willing to practice a style of training that certainly is **not** easy but just as certainly is very productive.

But I want it clearly understood that we are looking for, and willing to help, only members of a "new breed" of weight trainees—and not at all interested in average members of the "old breed". How big you are, what your potential may be (good or bad), or your financial or social position—none of these matter to us in the least, so long as your attitude is reasonable and your actions are acceptable by our standards; but keep it clearly in mind that they are "our standards"—and since we are offering cooperation and help on a free basis, we can certainly continue to dictate standards, and we will.

As of the moment, Sergio Oliva plans to spend approximately two months training in DeLand in preparation for the Mr. Universe contest in London in September, 1971—and Sergio uses the so-called "growth drugs", and he will continue to use them during his period of training here, because he is now at least temporarily "hooked" on them, if he stopped using them now he would undoubtedly lose muscular size for at least six months, until such time that his body was able to return to a normal chemical balance; but Sergio is an exceptional case—we don't approve of his use of such drugs but we will at least permit it

under the circumstances. However, there will be no other such exceptions; so if you have been using these drugs, I would advise you to cease their use at least six months before even seriously considering coming to DeLand to train—and if you are using any other types of drugs, then don't bother coming at all.

The parents of any young trainees should be well aware that we will do everything possible to maintain a good training environment—and that we will not permit trainees to use our facilities if their actions or statements are such that we feel they may be a bad influence on other trainees, in any way; but it should also be obvious that we can neither be responsible for, nor police the actions of, anybody when they are not on our property—so if your son is interested in coming to DeLand, but if you are aware that he is "out of control", then don't send him here hoping for a miracle, as some parents have rather obviously done.

While the overall environment in this part of Florida has not yet reached the point of outrage so plain in many other places, it is still easily possible for anybody to find just as much trouble as they may be seeking—and sometimes they find types of trouble that they aren't seeking, and that they can't handle.

We try to fit our actions to the situation, we "don't shoot sick children and we don't pet mad dogs", but we can do rather nicely without either—although we have had a few of both.

If the above is too strong, if it serves only the purpose—not my intended purpose—of keeping away reasonable people in some cases, then sobeit; but it seems to be an actual requirement to speak very plainly to unreasonable people—and we will do whatever becomes necessary to discourage them, even if it finally results in keeping everybody away. This whole thing started out as a hobby with me, and I devoted thousands of hours and hundreds of thousands of dollars to it long before I had any slightest intention of turning it into anything more than a hobby—and I will turn it back into a very private hobby if it becomes necessary to do so in order to prevent the formation of another Muscle Beach.

There are certainly more than enough football players available for my purposes and my private interest, and I have no intention of letting bodybuilders—or anybody else—misuse or distort something of real value to large numbers of people, something that could and should be of value to almost literally everybody. Since becoming openly involved with bodybuilders approximately two years ago, my impression of the whole field of body building has steadily become worse—and it was pretty bad at the start.

While it is neither my desire nor my intention to attempt to force my opinions—or my standards of conduct—onto anybody, it is clearly my right to pick my associates, and I will; and if people feel that they can benefit from an association with me, then it is up to them to conform to my standards.

And while it isn't quite true, as I told an associate on the telephone recently, that I "live on an island in a lake full of crocodiles," I probably would if I could; but it is literally true that I was the first man in the world (at least in modern times) to capture an adult crocodile alive, and that I did so at a time when it was considered impossible—and it is also true that I had dozens of adult, formerly man-eating crocodiles eating out of my hand within a matter of weeks after I captured them, and by that point they were being very careful about the hand, too.

The paradox of technocracy seems to be that survival presupposes the ability to attract crowds—which crowds make survival unacceptable.

Chapter 24: A Natural Mistake

The movie magazines are devoted primarily to the doings of the "stars"—the average actor is seldom mentioned; but for each star, there are hundreds of actors of average ability—and who can say how many actors with very great, but unrecognized (or unpublished) ability?

And having become recognized as a star—frequently through no fault of their own—many actors become "instant experts" on practically everything, acting, directing, writing, even political science. In the field of weight training—and this is particularly apparent in body building—many of the stars are literally freaks, hereditary freaks; and having received a lot of publicity, and credit for something that was thrust upon them by heredity, they frequently become instant experts.

It is a mistake—although a natural mistake—to listen to such people, who seldom if ever really understand the actual cause-effect relationships responsible for their development; and who would probably be the last to admit it if they did. It is probable that something on the order of ninety per cent of the total number of words published on the subject of weight training during the last twenty years were devoted to the actions and opinions of less than a thousand individuals; in effect, less than one per cent of the weight training public has received about ninety per cent of the publicity.

Which is unfortunate, doubly unfortunate—because almost none of the published "information" is even true, and because very little of it has any significance for the average trainee even when it is true; very few of the published training routines of well-known bodybuilders are in any way related to their actual training routines—and when they are, it certainly doesn't follow that it was an actually good routine, regardless of the degree of results that its advocate may have produced, eventually.

Most well-known bodybuilders have followed so many different routines by the time they finally do attain a point of recognition that they really have no slightest idea regarding "which routing produced which result"—but they almost invariably think they do; which is, I suppose, another natural mistake—but a mistake, nevertheless.

Paraphrasing one of Mark Twain's famous remarks, "…it might appear that God made idiots for practice—and then made bodybuilders." And if we are supposed to look upon the published remarks of many leading bodybuilders as sincere statements of their actual beliefs, then I think that would be giving them the benefit of an unjustified doubt. Hundreds of articles have been published on the subject of "muscle shaping" exercises and/or training routines—but the fact of the matter is, of course, that the shape of a muscle is entirely determined by heredity and by its existing degree of development, in relation to the overall fatty-tissue to muscle-tissue ratio.

"Train this way for bulk"—"train that way for definition"—"train like this for strength"—"train like that for size", and so on; hogwash, pure hogwash—the people who write such trash have no slightest idea of the real facts—and any results they may have produced were produced almost literally in spite of their efforts.

If a muscle gets bigger, it must change its shape—because little or nothing in the way of an increase in the length of a muscle is even possible, for obvious reasons; so in growing, a muscle changes its aspect ratio, the relationship of length to width (and/or thickness), and thus its shape—and since any significant

increase in actual muscular bulk presupposes an increase in strength, and vice versa, it obviously follows that increasing the existing level of strength will change the shape of a muscle.

But it does not follow that the change in shape will be apparent; because, if the muscular tissue is covered with a thick layer of fatty tissue then an actually significant change in muscular size and shape may not result in a noticeable degree of change in external appearances.

I could quote literally hundreds of equally foolish beliefs that are held to be established fact by almost all bodybuilders—and in other chapters I have listed at least a dozen such false beliefs—but my real point is that "believing doesn't make it so."

But the recent upsurge of the "**now** culture"—which encourages people to demand, and even expect, instant results—has led to a widespread refusal to even consider the facts; and being quick to recognize the trend, the commercial interests in the field of body building have been equally quick to take advantage of it—to their own enormous profit.

So bodybuilders—and publishers in the body building field—say anything that just might attract attention; having run out of anything of any real value to say at least twenty years ago, and feeling that they must publish "something", they end up publishing almost literally "anything"—most of it pure hogwash, to put it very mildly. And don't make the mistake of holding your breath until the situation improves—it probably never will, and certainly not soon.

But there is an answer, a very simple one—just ignore anything you read in almost all body building publications; better yet, read them very selectively—if at all. In my obviously biased opinion, the only one worth reading is Iron Man—and don't believe everything you read there; Peary Rader (the publisher of Iron Man) is an honest man, to my personal knowledge—but like all of us, he makes mistakes. In my opinion, most of his mistakes have come about as an unavoidable result of leaning over backwards in his attempts to be fair; frequently in relationships with people who obviously feel that anything to their own advantage is "fair".

A former friend of mine on the west coast (at a time when I was still foolish enough to listen to his advice—if perhaps not stupid enough to follow it) told me, upon reading a prior-to-publication draft of one of my articles, "…my God, Arthur, you've insulted everybody but Jesus Christ and Ghandi."

So I told him, "Don't worry about it; I'll get around to them in the next article."

From almost all directions I have been getting similar advice, "Don't rock the boat," or "play along, don't mess up a good thing."

A "good thing" for who? Certainly not for the poor kids that read—and sometimes apparently even believe—all the garbage that has been published during the last few years; there was a time, not too many years ago, when most bodybuilders read the magazines strictly for laughs—they knew it wasn't true, and it gave them a source of amusement. But now, quite a few bodybuilders obviously take everything they read in the muscle magazines at face value—primarily, I think, because they want to; because the publishers of such magazines have learned just what their readers want to hear and are very careful not to give them anything else.

One publisher of such a magazine told me to my fact that, "…my readers are too dumb to understand anything of real value; your articles would be clear over their heads—and they don't want the facts anyway."

Mabel Rader (Peary Rader's wife) told me in good faith, "…Arthur, I don't approve of you calling our readers fools in your articles."

So I said, "Mabel, I didn't call **all** of your readers fools—just some of them; but in any case, I didn't make **any** of your readers fools, God did that—I just pointed it out. But should I lie to them? Should I encourage them in outright foolishness? Or tell them the truth?"

"Well," she said, "you're still calling them fools."

And I said, "Mabel, some of your readers are fools, and calling them fools won't change them, or help them, it will only serve to infuriate them; but a lot of your readers aren't fools, they're intelligent people—but you can't have it both ways, you have to take a stand, support the truth and let the chips fall where they may. If that outrages a few fools—and it will, I promise you—then so be it; but in the end you will get across to intelligent people—and nobody can ever get across to a fool, so why bother trying?"

And of course, a lot of the people who have been misled aren't fools—and in the almost total lack of a place to go for reliable information, it isn't surprising that a lot of them have been misled; simply another natural mistake—but still a mistake.

During the last year or so I have been almost shocked by the ignorance of a very high percentage of the bodybuilders I have met—and don't be disturbed by the term "ignorance," it simply implies a lack of knowledge, and we are all ignorant on at least some subjects, and most of us on nearly all subjects; things that I always assumed "everybody knew," seem, in fact, to be totally new to most current bodybuilders—things that almost all bodybuilders did know, and understand, at one time, basic things, simple things, obvious things.

So, in following chapters, I will do my best to at least bring these things back into the light—point by point, simply and clearly; a few readers will unavoidably feel that such attention to basic points is unjustified, a waste of their reading time, but I would remind them of the classic example of a clear explanation, "how to make a rabbit stew; first, you catch a rabbit…"

“"Train this way for bulk"—"train that way for definition"—"train like this for strength"—"train like that for size", and so on; hogwash, pure hogwash—the people who write such trash have no slightest idea of the real facts—and any results they may have produced were produced almost literally in spite of their efforts.”

Chapter 25: The First Step Towards Understanding

You cannot change your heredity, and thus limitations will always exist—but if you actually understand the interrelationships of cause and effect, then you certainly can go a long way in the direction of regulating the course of events; to a degree far beyond that generally yet recognized by medical science. But in order to do so, you must not repeat the errors of most medical doctors—who fail to recognize the value of exercise; instead of permitting an awareness of one such obvious blind-spot in current medical belief to mislead you into a rejection of medical science as a whole, you must attempt to use this field of knowledge in a practical manner—thus giving yourself the benefit of knowledge gained by literally millions of workers over a period of thousands of years, people who may by and large still be ignorant of the value of exercise, but people who can add to your own knowledge in many useful ways. Many doctors—perhaps most doctors—may be biased on the subject of exercise; but that is no excuse for bias on your part, particularly when such bias leads—as it frequently does in the field of body building—to an attempt to deny well-established facts on the subject of physiology.

Nor is it necessary to obtain a medical degree in order to understand and make practical use of the involved factors; but you must at least be aware of these factors, and know how to apply the involved principles. Starting with this chapter, and continuing through the next few chapters, I will attempt—in as simple a manner as possible—to outline the points of knowledge required for producing good results from exercise.

To begin with, it should be clearly understood that a certain degree of muscular size-strength will be produced "automatically"—that is, with nothing in the way of formal exercise, simply as a normal part of human growth. The average person growing up in today's society does little or nothing in the way of exercise that contributes towards normal growth—or if so, then purely in an instinctive way, in the form of the usual physical play of children; in effect, most people would be much as they are with or without formal exercise—the small amount of exercise they may have been exposed to had no significant effect upon their growth.

But it does not follow that such people cannot gain from exercise—they certainly can; all I am trying to make clear is that the activities that most people look upon as "exercise" are really of very little importance.

Thus "average muscular size-strength" is really "normal muscular size-strength"—the normal result of simply being alive, not being sick, not being particularly underweight or overweight, and being within a certain age group. Apart from accident or illness, the body will maintain such average size-strength with almost nothing in the way of exercise; and if size-strength is lost (reduced) because of illness, then the body will usually return to normal levels within a very short period of time after a recovery from the illness—and will regain the normal levels of size-strength with little or nothing in the way of exercise.

But is has been obvious for centuries that exercise is capable of producing levels of size-strength that are far beyond normal levels; "why this happens" is really of no importance, so long as we are aware that it does happen '' and if we know how to make it happen.

Somewhere within the overall system, there is obviously some sort of a regulatory and sensory mechanism that serves the purpose of regulating muscular growth; up to a point—up to the point of normal adult muscular size-strength—this regulation is apparently automatic in healthy individuals. And

having reached that point, there is an equally automatic "cut-off"; once having produced the required size-strength for normal living, the sensory part of the mechanism informs the growth-stimulating part of the mechanism that the goal has been reached and growth ceases.

Again, while there are any number of theories about exactly "why" this happens, or "how" it happens, it is necessary only to understand that it does happen. However, a common sense examination of a few simple cause-effect relationships will make the situation clear for all practical purposes.

It seems that a normal level of size-strength calls for the ability to rather easily perform routine activities—and a certain percentile of reserve ability, an obvious hedge against emergency need.

Then—so long as activity remains fairly normal—the size-strength will remain relatively unchanged, and the percentile of reserve ability will also remain unchanged.

But if the level (or intensity) of activity is increased above normal—thus placing demands upon the existing reserves—then the sensory part of the regulatory mechanism takes note of what is happening and triggers the system as a whole into another growth cycle; apparently; the body attempts to maintain a certain reserve of ability at all times—and will increase overall ability rather than permit the continuation of activity that continually requires the utilization of reserve ability.

In effect, suppose that you were able to curl 100 pounds as a routine matter—and did so as part of your normal activity; once having gained the ability (the size-strength) required to curl 100 pounds fairly easily—and a reserve of ability that would make it possible for you to curl perhaps 150 pounds "if you really had to"—then growth would cease. Having accepted that level of ability as "normal", for you as an individual, the body would maintain it—so long as you continued routine activity at that level.

But if you then started routinely curling 125 pounds, you would be working inside your reserve of ability—and another growth cycle would be triggered; apparently in an effort to keep "reserve ability" above the level of "normally-used ability."

Such "growth-stimulation" **causes** growth—if growth is possible; but it does not produce growth—it merely points out that growth is desirable, that existing levels of ability are not adequate for the requirements of normal activity.

If actual growth is to be produced in response to this growth-stimulation, then other factors are involved; the system as a whole must be able to provide the chemical requirements for growth—and under normal circumstances it will provide the requirements, and growth will occur, again to a point where the sensory mechanism triggers another cut-off signal, which will occur when an apparently adequate reserve has been reestablished.

But if the system cannot provide the requirements for growth, then no amount of growth-stimulation will result in actual growth.

That much, at least, has been clear to almost everybody for about fifty years; but there is still a great deal of confusion on the subjects of "just what stimulates growth" and "what is needed to provide the requirements for growth".

But with or without a clear understanding, we have at least established the first two important points…

1. Above-normal levels of activity trigger growth stimulation.

2. Having been stimulated, growth will occur if the requirements are provided.

We will return to the above points later, in more detail—but first I want to establish a number of other related points.

A certain amount (or percentile) of fatty tissue is equally as normal as average levels of muscular size-strength—since it serves a number of useful functions, providing fuel reserves, insulation, padding, and other requirements; but unlike muscular tissue, fatty tissue is not increased by higher than normal levels of activity—on the contrary, if compensation in the form of larger intake of food is not provided, increased activity will result in decrease in the amount of fatty tissue, since the body will then be forced to use at least part of the fatty tissue as a source of fuel to provide the energy required for the extra activity.

Secondly, while the muscular fibers are not increased in number by growth—only the size of the fibers changes—the number of fat cells can be increased; and once formed, new fat cells can only be removed by surgery—while an increase in activity without a compensating increase in the intake of food will reduce the size of individual fat cells, it will not reduce the number of cells.

The disposition of fat—the actual location of fat on the body—is not uniform; but it is not deposited in a random fashion—on the contrary, the locations of fatty deposits (and the reasons for such location) are matters of no small concern, especially for bodybuilders.

Living organisms produce heat in proportion to their mass—and radiate heat in proportion to their surface area; and (all other considerations aside) the ratio between mass and surface area primarily determine the environmental requirements for particular types of warm-blooded animals. A whale could not survive on land—because its mass would generate more heat than its surface area could dissipate by radiation; at least in a warm or temperate climate, although it might do well in the Arctic.

The mass of an African elephant is such that it actually exceeds the maximum-possible size for a warm-blooded animal living on land—and, unlike the whale, it cannot get rid of excess heat by living in cold water; but in the case of the elephant, compensation has been provided in the form of its enormous ears—which are nothing more or less than radiators, which serve to greatly increase the surface area available for cooling purposes. Additionally, elephants carry a large reserve of water in their stomachs—and on hot days they use this water to aid the cooling process; by reaching down their throats with their trunks, withdrawing water by suction, and then spraying it behind their ears—where it provides additional cooling by evaporation.

Fat deposits on the surface of humans primarily serve the purpose of providing reserves of fuel—but they unavoidably serve as insulation as well, keeping the body warm on cold days and causing an uncomfortable (and sometimes dangerous) rise in heat on hot days; if the total fat deposits were evenly distributed over the entire surface of the body the result would be an enormous increase in the effectiveness of the insulation—and in races of people that developed in cold areas, there is a tendency for such overall distribution of fat deposits.

In some other races of people, races that developed in warm areas, even more obvious evidence of a tendency in the opposite direction can be seen; some of the African tribes are capable of becoming grossly fat in the region of the buttocks while remaining quite muscular in appearance in other sections. The fat is stored in one area in order to provide better overall cooling—instead of serving as a thinner layer of insulation over the entire surface of the body, it is concentrated in one fairly small area.

To at least some degree, this tendency to store a disproportionate percentile of surface fat in the midsection is common in most races of people; and there is absolutely nothing you can do about it, short of getting rid of all visible signs of fat.

It should be clearly understood that **any** fat in the midsection means **some** fat everywhere; and you cannot remove or reduce fat in the midsection by doing exercises for that part of the body—the removal of visible signs of fat can be brought about in only one way (apart from surgery), by reducing the amount of food and/or by increasing the amount of overall exercise until a negative calorie balance is produced, until you are consuming less calories in the form of food than you are expending as energy.

You **can** build the muscles of the midsection by performing a reasonable amount of intense exercise for the directly involved muscles, but no amount of exercise for these same muscles will help to reduce fat in that area of the body so long as a positive calorie balance exists—a much better approach to the problem is to reduce the food intake as much as possible while performing a reasonable amount of exercise for all of the muscles of the body.

It should also be noted that an increase in the amount of activity does **not** have any significant effect upon the body's requirement for protein; protein requirements are primarily determined by existing body weight. And if you are under the common but badly mistaken impression that "extra protein can't hurt you," then guess again; you can get as fat as a pig on a diet of almost pure protein—and quickly, too.

So now we have established the next two important points…

3. Fat deposits are an overall situation, with naturally heavier concentrations in some parts of the body.

4. The addition of fat is a result of a positive calorie balance; reduction of fat is produced by a negative calorie balance.

Since bodybuilders are usually interested in increasing their body weight—without increasing, or while actually reducing, the total amount of body fat—it should be obvious that the only possible way to do so is by increasing the mass of the major muscular structures, while keeping the calorie balance as close to a point of perfect balance as they can; but in practice, most bodybuilders attempt to increase their muscular mass by so-called "bulking up", by adding overall weight and size even at the expense of adding fatty tissue—this usually being done by eating as much as possible while reducing the amount of exercise, and by concentrating on heavy exercise for the largest muscular structures.

Two of the three steps in a normally-practiced "bulking-up" routine are reasonably correct—but the third is always a mistake; reducing the "amount" of exercise is almost always a move in the proper direction, because almost all bodybuilders perform far too much exercise—and performing heavier exercises is also desirable, because it is the "intensity" of exercise that determines growth stimulation—but increasing the amount of food is a mistake, because the extra calories will merely be stored in the form of additional fatty tissue.

A simple test that clearly indicates the correctness of a particular diet is the "pinch test"—pinch up a layer of skin and the fat directly beneath it and compare it to the thickness at an earlier date; if the thickness is increasing, you are getting fatter, and vice versa.

Determine your calorie requirements and daily requirements of vital food elements and establish a reasonably normal diet in keeping with your goals; if you are trying to gain muscular weight, then

increase the amount of protein slightly—something on the order of twenty per cent over normal—but be sure to reduce some other portion of the diet by an equal number of calories. Then concentrate on getting strong; as muscular strength increases, muscular size will increase at least in proportion—nothing else is even possible.

"You **can** build the muscles of the midsection by performing a reasonable amount of intense exercise for the directly involved muscles, but no amount of exercise for these same muscles will help to reduce fat in that area of the body so long as a positive calorie balance exists—a much better approach to the problem is to reduce the food intake as much as possible while performing a reasonable amount of exercise for all of the muscles of the body."

Chapter 26: The Second Step

More than a century ago, by a study of the bones of men who spent their lives at manual labor, it was determined that the intensity of work is a factor of great importance; even the chemical composition of the bones is changed by hard work. How much you work—the actual "amount" of work—is a factor of only secondary importance, and usually in a negative sense. In effect, "hard work" is a desirable factor—and a large "amount of work" is an undesirable factor.

Even men who spend years working at a job that requires constant repetition of fairly light movements seldom if ever develop much if any more than average levels of size-strength; while men who work much less—but harder—usually develop above average muscular mass.

Hundreds of examples could be given to prove the relationship of hard work to muscular mass—and in previous chapters, a number of such examples have been outlined; but in this chapter I want to clearly define "hard" work, to describe it in a reasonably technical sense.

Given enough time, an ant could move the pyramids from Cairo to Capetown—and in the process he would perform an enormous amount of work; while the intensity of work would never be high enough to measure in meaningful terms. In effect, the "power production" would be extremely low. The mass—the actual size—of a muscle clearly indicates its "power potential", its ability to produce power; even a very small muscle is easily capable of performing a large amount of work, but its power will be limited by its size.

One "horsepower" is the ability to lift 550 pounds a vertical distance of one foot within a period of exactly one second; or, if you can lift 550 pounds a distance of six inches within one half of a second, you are still producing one horsepower—and, obviously, an infinite number of other possible combinations of weight, distance of movement and time would also indicate a power potential of one horsepower.

From the above it should be obvious that a muscle can perform almost any amount of work while its power potential remains very low—and that its ability to produce power can be determined only by careful consideration of at least three factors, the resistance, the vertical distance of movement, and the speed of movement. In the preceding chapter we established the need for increased activity as a means of stimulating growth—an increase in activity that forces the involved muscles to work inside their existing levels of reserve ability; but it should now be obvious that increasing the "amount" of activity will not force a muscle to work inside its existing level of reserve ability, since the muscle is already capable of almost any amount of work.

Demands for work inside the existing levels of reserve ability can only be produced by forcing a muscle to produce more power—by lifting more weight the same distance in the same length of time, or by lifting the same amount of weight a greater distance in the same length of time, or by lifting the same weight the same distance in less time. One of the three involved factors—resistance, distance, and speed—must be increased, while keeping the other two factors at least constant.

It should be obvious that "speed of movement" is of the utmost importance; ten slowly-performed repetitions with 100 pounds will **not** product the same result that ten rapidly-performed repetitions with the same weight will produce—while the amount of work would be exactly the same in both cases, the power production could easily vary from almost "none" to a very high level.

In general, speed of movement should always be as great as possible; but in practice, this does not mean that actual movement will be very fast—because, if resistance is as high as it should be, then maximum-possible speed of movement may in fact be quite slow.

In order to be sure that the above points are perfectly clear—and because they are of extreme importance—I will review them in yet another example, as follows; curling a 100 pound barbell at a very slow speed is **not** equal to curling the same barbell at a much higher speed—although the amount of work performed would be exactly the same in both cases, the power production would be higher in the faster curl. If the slow curl required ten seconds, and if the fast curl required only one second—then you would be producing **ten times as much power** in the fast curl as you were in the slow curl with the same amount of weight, and of course the distance of movement would be the same in both cases.

However, in practice, you might **not** be producing all of the power with the actual "curling muscles" in an extremely fast curl; the power production would be ten times as great—if the movement was ten times as fast—but a large part of the power production might come from muscles that you were not trying to work in that particular exercise. If the great speed of movement was partially created by body swing—by so-called cheating methods—then you would be working the muscles of the lower back, the shoulders and perhaps even the muscles of the legs; you **would be** generating the maximum amount of power under the circumstances—but you **would not** be generating all of it with the muscles of the arms. And if the amount of body-swing was great enough, you might actually be generating **none** of the power with the arms—or very little of it.

So it is certainly important to generate as much power as possible—but it is just as important to be sure that you are doing so with the muscles that you are actually trying to exercise.

But for the purpose of stimulating muscle growth, it is **not** necessary to produce maximum-possible power with a fresh, well rested muscle—and because of safety considerations, it is not a good idea to do so. In practice, then, a muscle **must be** worked as hard as possible—but only after it has been partially exhausted by the performance of several repetitions that are well below the momentarily-existing level of ability.

In practical terms—in a curl—this means that you should select an amount of weight that you can curl in perfect form for at least six repetitions; the first repetition should **not** be performed at maximum-possible speed, because at that point in the exercise your strength is at its highest level, and if you actually generate as much power as you are capable of doing at that moment you may damage the connections of the muscles. Instead of moving as fast as possible in the first repetition, you should limit the actual speed of movement to a speed that will result in a steady, smooth movement—"jerking" should be avoided. The second and third repetitions should be performed at a similar speed—and up to that point in the set, you will not be producing as much power as you are capable of doing: but by the time you reach the fourth or fifth repetition, you should be moving as fast as possible—which speed, in fact, will be quite slow. Having exhausted your muscles to some degree by the first three or four repetitions—and having thus reduced your momentary power potential—you should then work at the greatest speed possible; by that point in the set you **will be** producing as much power as possible—but you will have reduced your momentary ability to such a degree that the actual power production will not be very high.

The fourth or fifth repetition—the first repetition in the set that is actually performed as fast as possible—will result in the momentarily maximum-possible production of power, and each following repetition will also produce maximum-possible power; thus, in a set of ten repetition, each of the last six or seven repetitions will involve the production of maximum-possible power—but the actual amount of

power being produced will decline steadily, repetition by repetition. You might produce 100 "units of power" in the fourth repetition, only 90 units in the fifth repetition, 80 units in the sixth repetition, 70 units in the seventh repetition, 60 units in the eighth repetition, and so on—but in each of the last several repetitions, you would be producing as much power as you were capable of doing **at that moment**.

By training in that fashion, each of the last several repetitions will force the curling muscles to work well inside their momentary level of reserve ability—all of the last several repetitions are maximum-possible efforts.

During the first three or four repetitions you are **not** moving as fast as possible, and the actual speed of movement will be about the same in each of these first few repetitions—but starting about the fourth or fifth repetition, speed of movement should be as fast as possible; and from that point until the end of the set, the actual speed of movement will become slower, repetition by repetition—until, at the end of the set, movement is literally impossible at any speed.

One or two such properly performed sets of an exercise—and never more than three such sets—are all that are required in order to produce maximum-possible growth stimulation; fifty, or a hundred, or any other number of improperly performed sets will **not** produce the same result, will **not** stimulate growth to the same degree—because a muscle is capable of almost any "amount" of work regardless of its size, and will respond (by growing) only when demands for more power are placed upon it. In order to produce more power, a muscle must increase its strength—and in order to increase its strength, a muscle must grow larger.

But while the "amount" of work has little or nothing to do with the production of results from exercise in a positive sense, it should not be assumed that the amount of work is of no importance; on the contrary, in a negative sense the amount of work is of very great importance—because the amount of work has a direct bearing upon the recovery ability—the system can repair only so much damage within a given period of time, can restore only so much energy; and if the amount of exercise is such that the entire recovery ability is exhausted, then growth becomes impossible, regardless of the degree of growth-stimulation that may have been induced.

From the above it should now be clear that exercise must be as hard as possible in order to induce growth-stimulation—and as brief as possible in order to disturb the recovery ability to the least practical degree.

Momentarily-exhausted power potential is replaced very quickly—but the resulting drain on the overall recovery ability is not compensated for quickly; restoring most of the power potential is a matter of seconds—but restoring the recovery ability is a matter of days. A muscle can be worked to the point where it is momentarily incapable of producing more than 10 per cent of its normal power potential—and three seconds later it will be restored to a level of about 55 per cent of maximum-power potential; and three minutes later it will probably be capable of performing at a level of very close to 100 percent of its maximum-possible power potential.

But such rapid recovery of power potential makes demands upon the overall recovery ability that cannot be compensated for quickly—in most cases, at least forty-eight hours are required for fully restoring the previously-existing overall recovery ability; and in many cases, full recovery will take as much as seventy-two hours.

So now we have established two more basic points…

5. Maximum-possible power production is required to stimulate maximum-possible muscle-mass increases; the "intensity of effort" should be as high as possible.

6. The actual "amount" of exercise should be as limited as possible in line with other considerations.

Chapter 27: The Third Step

The regulatory mechanism of the system has a strong tendency to maintain the existing situation; which is both perfectly normal and, upon examination, obviously reasonable—an actual requirement for normal living.

Regularly recurring cycles of working, resting, and eating establish a pattern that the system accepts as normal; and once having become accustomed to a particular pattern of living, the system regulates the metabolic processes accordingly. As it must do—since bodily requirements are not instantly provided in response to need; some requirements can be provided rather quickly, some others require a matter of hours, a few require as much as two or three days, or longer.

A certain percentile of reserve ability serves the purpose of providing most of the requirements in quantities sufficient for emergencies of reasonable proportions; but the aftereffects of emergency utilization of this store of reserve ability are clear proof that the actual amount of such reserve is very limited—while a momentary increase in usable strength may be quite high, such a level of performance can be maintained only very briefly, and afterwards the entire system will be "drained" for a period of at least several hours, and to some degree for several days.

Since the normal requirements for living cannot be supplied instantly in response to demand, it is obviously necessary for the system to be able to anticipate needs—to "plan ahead"—and just as obviously, this can only be done by basing expectations for the future upon the demands of the past; with, as mentioned earlier, a certain percentile of reserve for emergency utilization.

Upon recovery from a serious illness, the system will usually return very quickly to a level of ability closely matching that which existed immediately prior to the illness—and it will do so with little or nothing in the way of exercise or special diet, if the internal organs have not been permanently damaged; and if the organs have been permanently damaged, the system may never return to previously-existing levels of ability.

Likewise, if the level of size-strength is increased rapidly by heavy exercise—and if the exercise is terminated immediately after a period of rapid growth—the system will quickly lose all or most of the recent gains and will return to previously-existing levels of size-strength; apparently it takes a certain period of time for the system to accept such increased size-strength as normal—and until it has been accepted as normal, the natural tendency of the system will be to return to levels that it has previously accepted as normal.

In effect, the system attempts to maintain certain levels of ability—and will return to those levels if it is able to do so. Which is not meant to imply that gains in size-strength resulting from exercise will never become permanent and can only be maintained by continued exercise; to at least some degree, increased levels of ability resulting from exercise will become permanent—if the raised levels of size-strength have been maintained long enough for the body to accept them as normal. And the longer such levels are maintained, the higher the degree of permanence; in effect, if you gain twenty pounds of muscular mass within a period of a month, and then quit exercising entirely, you will probably lose almost all of the twenty pounds within a period of three or four months—but if, instead, you made the same gains within the same period of time, and then continued with only enough exercise to maintain the new growth for a period of a year, and then quit exercising entirely, your losses of size-strength

would occur much more slowly; and at least part of the increase would be maintained as part of a new and larger "normal size."

Such gains will apparently never become entirely permanent in the absence of at least enough exercise to maintain them, but the longer such increased size-strength is maintained, the higher the percentage of permanence becomes. In effect, increases in size-strength resulting from exercise are to some degree temporary and to some degree permanent; with the ratio of temporary gains to permanent gains constantly changing with time.

In the past it has frequently been stated that "fast gains produce fast losses"—in effect, that size-strength gained quickly is somehow inferior to size-strength gained more slowly; but in fact, the period of gaining has little or nothing to do with the matter—size-strength is the same no matter how it was obtained, and regardless of how long it took to produce it.

However, it may easily appear that quickly gained size is less permanent; simply because the system requires a period of time to accept such increased size—obviously, if the new size was added over a longer period of time, then the system would have more time to adjust to it, and a greater proportion of it would thus become permanent.

But if identical twins gain twenty pounds of muscular mass, with one twin doing so in a period of a month and then merely continuing enough exercise to maintain the new size, and with the other twin gaining more slowly over a period of a year, and if both twins cease all exercise at the end of the year, then the first twin—the one that gained most rapidly—will actually maintain more of his gains than the other twin will; because his system will have been given eleven full months to accept the entire twenty pounds of new growth—whereas, the second twin's system will have been given no time at all to become accustomed to the entire twenty pounds of growth, perhaps only a month to become accustomed to about eighteen pounds of it, two months to become accustomed to approximately sixteen pounds of it, and so on. In effect, the second twin's "average time of maintained size" will be lower than that of the first twin.

On the other hand, if the first twin—the rapidly growing twin—ceased all exercise at the end of his month of growth, then he might maintain only about two pounds of it five years later; and if the second twin—the slow growing one—also ceased all exercise at the end of his year of growth, then he might maintain five or six pounds of it five years later. Because, in that case, the second twin would have the highest "average time of maintained size".

But apart from such degrees of permanence—which apparently are determined entirely from the time such size has been maintained—there is no slightest difference in size-strength resulting from very fast growth or resulting from very slow growth.

Previously-existing levels of size-strength that have been lost from a total lack of exercise can be quickly regained by resuming exercise—and a level of ability that required a period of a year to build in the first place can usually be rebuilt within a period of two or three months; in this instance, it appears that the time period "out of training" is the primary factor which determines just how long it will take to rebuild previously-existing levels of ability. The longer you have been out of training, the longer it will take to rebuild previously-existing size.

It should also be obvious from the above that the system responds on the basis of expectations for the future—which in turn are based upon actual requirements of the past; and that the system constantly attempts to maintain at least a certain percentile of reserve ability for emergency utilization. And if the

clear implications are understood, it logically follows that a system of training that provides constant progression is an absolute requirement; the system will respond (by growing) only when there is a requirement for growth—only when the experiences of the past indicates that existing levels of ability are not adequate to provide the requirements of the future without utilization of the reserve ability.

If you are regularly performing exercise which forces your system to work inside the levels of existing reserve ability, then the system will increase its levels of normal ability (and, simultaneously, its levels of reserve ability) in an effort to maintain a reserve for emergency utilization; but having increased its ability to the required degree, the system will then bring growth to a halt—unless additional demands are then imposed by even heavier exercise, heavier in terms of requirements for greater power production.

Increasing the "amount" of exercise is not true progression, because (as mentioned in an earlier chapter) a muscle of any size is capable of performing almost any amount of exercise; thus progress must come in the form of greater demands for the ability to produce power—instead of trying to increase your capacity for work, you must attempt to increase your power potential. Instead of constantly trying to increase the amount of work, you must attempt to increase the intensity of work.

A properly performed set of barbell curls should always consist of ten repetitions—do not attempt to increase the number of repetitions; instead, try to increase the amount of weight being used, while maintaining or increasing the speed of movement. If the last six or seven repetitions of a set of ten curls are performed properly, then you will always fail during the last two or three repetitions—and be forced to finish the set of ten repetitions by using a slight amount of "cheat" during the last two or three repetitions; when you can perform eight repetitions in good form without cheating, then increase the weight during the next workout—but after the first three or four repetitions, each repetition should always be a maximum-possible effort, involving the production of as much power as you are capable of producing at the moment.

Such a style of training is truly progressive—and will impose constant demands for continued growth on your system; and if the system is capable of growth—if the recovery ability is not overextended by too much exercise—then growth will occur, at the fastest-possible rate in accordance with considerations of individual potential.

In practice it has been found that two such properly performed sets of each of several basic heavy exercises are usually best for promoting a fast rate of growth—and that three sets of each exercise will usually result in "overtraining" insofar as the amount of exercise is concerned and an actual reduction in the rate of growth.

It has also been found that three weekly workouts will almost always produce the best rate of progress—and in cases where actual progress is quite slow, it is usually best to perform only two weekly workouts.

In spite of the above findings, most current bodybuilders practice at least four sets of each of a wide variety of exercises—and many bodybuilders practice as many as ten sets of each exercise; secondly, there is little or nothing progressive about the training of most bodybuilders, who generally perform a given number of repetitions in each set and terminate each set at a point far below maximum-possible intensity of effort.

As an unavoidable result of such basic misunderstanding—and such a poor style of training—the rate of progress is always far below what it could have been, and what it should have been, and what it would have been with a proper style of training based upon fact instead of misconceptions.

Most of this unfortunate—and extremely widespread—misunderstanding is apparently a result of confusing "amount of exercise" with "intensity of effort," of confusing work with power; made even worse by a common overestimation of the extent of the recovery ability of the system—or a failure to realize that the recovery ability must be disturbed as little as possible if it is expected to provide the requirements for growth.

So now we have established the following additions to our list of basic points…

7. The system has a natural tendency to return to previously established and accepted (accepted as "normal") levels of ability.

8. The longer a particular level of ability is maintained, the greater the degree of permanence.

9. There is no practical difference in increased levels of ability resulting from fast growth and gains produced by a slower rate of growth.

10. Previously established—but lost—levels of ability can be rebuilt far more quickly than they were initially.

11. Training programs must be truly progressive—with constant attempts to increase the power potential.

12. Two sets of each of a few basic, heavy exercises are best for promoting fast gains in strength-size.

Chapter 28: The Fourth Step

Anatomical charts of the human muscular structure unavoidably give a somewhat distorted impression of the major muscles—it is thus a common misconception that the muscles are entirely separate, that each muscle is an entity unto itself; but in fact, the actual interweaving of muscles is such that it is sometimes almost literally impossible to separate and accurately identify them—and secondly, recent work on neurological patterns makes it obvious that many of the previous assumptions regarding the actual contributions of particular muscular structures to specific movements were invalid. Careful tracing of nerve patterns has indicated that nerves frequently pass entirely through one muscle and terminate elsewhere. In the past, it was generally assumed that these nerves served the first muscle, but it is now obvious that in fact they are involved in the functions of the second muscle in such situations.

All of which is really of no practical concern for our purposes here—so long as we are clearly aware of the implications; human muscular structures are capable of an almost infinite number of individual movements if we consider all of the possibilities and combinations, and attempting to provide a separate exercise for each of these possible movements would certainly be impractical at the very least—but if we consider only major movements, then the number of functions are such that "almost all muscles are involved in almost all movements" (at least in gross terms and in a general sense), it becomes obvious that an actually very limited number of exercises can provide the required work for all of the muscular structures.

In general, the value of an exercise can be fairly judged on the basis of the following considerations; an exercise should:

1. be a "full range" movement, providing resistance over the entire possible range of movement from a position of full extension of the prime body-part involved to a position of full contraction of the same body part (extension and contraction, in this instance, being applicable to the major muscular structures involved, rather than to the body-part itself; since many situations exist where contraction of a muscle results in extension of the prime body-part involved—the function of the triceps being one such example)

2. involve as many major muscular structures as possible; in effect, everything else being equal, a compound movement is superior to an isolation movement

3. provide resistance in the position of contraction of the major muscular structures involved; in effect, an exercise that permits "locking out" under the resistance in a position of contraction is inferior to an exercise where resistance remains constant

4. involve as much total muscle mass as possible; in effect, the greater the mass of involved muscles, the greater the value of the exercise.

But if we consider those required characteristics for a "good" exercise, it becomes obvious that at least some of them, in at least some situations, are mutually exclusive; in order to provide one of the requirements, it is frequently necessary to make use of an exercise that provides none of, or at least not all of, the other requirements.

For example; the full squat involves a large mass of muscle, which is an advantage—it is also a compound exercise, involving a number of major muscular structures working together, another advantage—but it is not an actually full-range movement, since there is no resistance during the last part of the movement, as you come fully erect; and since you can "lock out" in the fully erect position, there is obviously no resistance in the position of full contraction of the involved muscles.

Also, in a squat, the point of maximum resistance is encountered shortly after the start of the upwards movement, when the midline of the thighs is parallel to the floor; and in that position, the involved muscles are not in their strongest positions—thus you encounter the most resistance at a point during the movement where the muscles are not as capable of handling it as they would be at a later point during the movement, and the resistance you can handle in a squat is limited by the strength of the muscles in that particular position, not their strongest position. The muscles will be worked to their maximum ability in that one position—but will not encounter enough resistance in other positions.

Similar problems are encountered in almost all conventional exercises—but in spite of these limitations, it is still possible to outline a training routine made up of only a few basic, heavy exercises, a program that will produce very good results; the most common mistake is an attempt to include too many exercises, and the unavoidable result is that the overall recovery ability of the system cannot meet the requirements for both full recovery from the workouts and additional growth at the same time—under such circumstances, growth will be impossible, or very slow at best.

Another valid means of determining the relative values of exercises of a similar nature is to compare the actual distances of movement; everything else being equal, the greater the distance of movement, the greater the value of exercise. For example; a standing press is a much better exercise than a bench press—primarily because the distance of movement is greater in a standing press.

And from the above, it should also be obvious that the style of performance of an exercise that provides the greatest distance of movement is the best style; for that reason, bench presses with a reasonably-narrow grip are more productive than the same movements with a wider grip.

Another method—perhaps the most logical method—of judging the value of exercises involves a comparison of the power production in one exercise to the power production in another exercise; but in this case, we must be very sure that we know exactly; what power really is—and what it is not. The amount of resistance involved is only one of three factors that must be considered—and we must also consider the distance that the resistance is moved (moved vertically), and the time involved, the speed-of-movement.

Most people consider the bench press a "power lift"—assuming that more power is required in a bench press than in a standing press; but in fact, quite the opposite is true—while the amount of resistance may well be greater in the bench press than it is in a standing press, the other two related factors are both reduced in the bench press, the distance-of-movement and the speed-of-movement are both less in a bench press than they are in a standing press. And in almost all cases, more power is actually produced in a maximum-possible standing press than in a maximum-possible bench press.

But again, the style of performance is an important factor—all exercises should be performed in a style that results in maximum-possible power production "by the muscles that you are trying to develop." A jerk-press will produce a faster speed-of-movement and thus more power than a military press; but most of the power is not produced by the muscles that you are usually trying to develop from pressing exercises, the triceps, the deltoids, and the trapezoids. So, for developmental purposes, exercises should

be performed in a style such that most (or all) of the power is being produced by the muscles that you are trying to develop.

Which does **not** mean that cheating methods should never be employed; they should be, in almost every set of every exercise—but only after a point of failure has been reached while performing the movements with good form. Two or three cheating repetitions performed at the end of a set of several repetitions performed in perfect style will force the muscles to work beyond a point of normal failure; but it is extremely important that such permissible cheating should be restricted to the minimum amount required to complete the movements—in effect, cheat to make the last two or three repetitions possible, not to make them easy. Properly performed, the cheated repetitions should be brutally hard.

So now we have the following points to add to our list of basic points …

13. Muscular functions are interrelated to such a degree that it is almost impossible to isolate the function of one particular muscle.

14. The value of exercise should be judged upon a basis of power production.

15. Compound movements are usually superior—for developmental purposes—to isolation movements.

“…human muscular structures are capable of an almost infinite number of individual movements if we consider all of the possibilities and combinations, and attempting to provide a separate exercise for each of these possible movements would certainly be impractical at the very least—but if we consider only major movements, then the number of functions are such that "almost all muscles are involved in almost all movements" (at least in gross terms and in a general sense), it becomes obvious that an actually very limited number of exercises can provide the required work for all of the muscular structures.”

Chapter 29: The Fifth Step

The individual fibers of muscles function in accordance with the well-known—but widely misunderstood—principle of so-called "all or nothing function". In effect, a fiber is working as hard as possible—or not at all. A movement against light resistance does not involve a small amount of work on the part of all of the fibers in the muscles contributing to the movement; instead, only a few fibers are involved at all—the minimum number of fibers that are required to move the imposed resistance—and the remainder of the fibers are not involved at all. But the fibers that are working, are working as hard as possible—as hard as possible **at that moment**.

One individual fiber may be involved in each of several repetitions in a set of an exercise—but it will not contribute an equal amount of power to each of the several movements; it will always be working as hard as possible—or not working at all—but its strength will decline as the exercise progresses.

Thus, in practice, a set might involve a number of fibers in much the following fashion; the first repetition might involve ten fibers, with each fiber contributing ten "units of power" to the movement—the second repetition might involve the same ten fibers, which then contribute only nine units of power each, and one previously uninvolved fiber (an eleventh fiber, a fresh fiber) which contributes ten units of power, bring the total power production in the second repetition up to the same level as that involved in the first repetition—the third repetition might involve the same initially-used ten fibers, with each of them now contributing only 8.1 (eight and one-tenth) units of power, plus the eleventh fiber that was used previously only during the second repetition, and which now contributes nine units of power, plus a twelfth fiber, a fresh fiber that is involved for the first time only during the third repetition and contributes ten units of power.

Thus each of the first three repetitions would result in exactly the same amount of power production—and all of the involved fibers would always be contributing to the limit of their momentary ability; but the fibers would not be contributing equally, and the actual number of involved fibers would change from repetition to repetition.

If the set was ended at that point, then little or nothing in the way of growth stimulation was produced—because none of the fibers were worked very hard, and because there were still unused fibers in reserve.

In order to produce significant growth stimulation, the set must be continued to a point where as many as possible of the available fibers have been involved—and where at least some of the fibers have been worked to a point of total failure, until they simply quit, refusing to function at all.

If the set had been continued beyond the third repetition, then eventually a point would have been reached where the total power production started to decline—where it was no longer possible to move the weight as rapidly as it was moved during each of the first three repetitions; this would happen when the total contributions of all of the fibers that were still functioning added up to a lower amount of power than that which was involved in each of the first three repetitions—and at that point, you could still continue (and should still continue), but you would be forced to continue at a reduced speed, with reduced power.

For best results in the way of growth-stimulation, the set should be continued to a point of failure while still maintaining good form—and then two or three cheated repetitions should be performed, as described in the preceding chapter.

With this style of training, you will involve as high a percentage of the total number of fibers as it is possible to involve in any particular exercise—and you will work some of the fibers to the point of utter failure; both of which results are highly desirable—since they obviously involve working the muscles well inside their momentary levels of reserve ability.

But it should be remembered that the system tries to maintain a level of ability that it has previously accepted as normal, and it will rebel against workloads of this intensity; the sensory portion of the regulatory mechanism is fully capable of recognizing an emergency situation that actually requires the utilization of reserve ability, and it will not easily permit use of the reserve ability in an obviously non-emergency situation—thus you will be exposed to "pressures" of various types, signals hopefully intended to bring the exercise to a halt before it becomes necessary to involve the reserve ability. The exercise will be painful—you may feel slightly nauseated, especially the first time you try working that hard—and there will be strong overall "desire to quit".

Unless you are willing to ignore these signals, and work to the actual point of failure, then long-range progress will be strictly limited to a very slow average rate of growth; but if you are willing to ignore them—and do ignore them, and do work regularly to the actual point of failure—then such "cease and desist" signals will quickly stop bothering you, the pain will no longer occur, the nausea won't return, and you will be able to continue to an actual point of failure without a constant desire to quit.

The system apparently maintains at least two separate sources of reserve ability; which we might define as a "surplus of fibers" reserve and a "chemical" reserve—and while the system will permit work inside the "surplus of fibers" reserve, although it will discourage such an intensity of work in non-emergency situations if it can, it usually will not permit work inside the level of ability possible from the "chemical" reserve's contribution in anything except an emergency.

In an actual emergency, the sensory portion of the regulatory mechanism quickly recognizes the possible need for a level of ability far above normal—and it triggers a chemical response which greatly, but temporarily, increases the existing level of usable strength; but under normal circumstances, it is NOT desirable to work inside the levels of reserve ability provided by this form of chemical "supercharging"—because, among other things, doing so exerts an enormous drain on the overall recovery ability. The possible benefits are far outweighed by the very real disadvantages; some of the possible results are ulcers, heart attacks, extreme nervousness, and premature aging.

But while the "chemical" reserve should be retained for emergency use only, the "surplus of fibers" reserve must be used regularly if a fast rate of growth is desirable—and it can be used safely; the only result from overuse would be eventual exhaustion, which would finally result in a complete halt to training of any kind. But, if properly used, which means "with maximum-possible intensity of effort", very "briefly" and "infrequently", then such a style of training will produce maximum-possible gains in size-strength with no adverse effects.

But since such a style of training never becomes "easy"—although it will cease being painful, and will quit making you sick, after the first few actually hard workouts—it is very easy to gradually slip back into a much easier style of training, frequently without even being aware that you are doing so. For that reason, it is a very good idea to keep a careful watch on your actual rate of progress—and this can only be done in a logical manner by charting your strength increases; but do **not** attempt to chart your strength

increases on the basis of your ability in single-repetition, maximum-possible attempts—instead, use a particular number of repetitions (almost any reasonable number of repetitions, except one repetition) as an indication of your ability. When you can perform ten repetitions with 200 pounds, then you are twice as strong as you were when you could perform ten repetitions with only 100 pounds.

When you can perform ten repetitions with 200 pounds—and previously you could perform only eight repetitions with 200 pounds—then you are "stronger" than you were; but there is no real agreement as to just how much stronger you are. So, for the greatest accuracy in charting strength increases, compare only those sets that result in a particular number of full repetitions performed in good form; if you are using ten repetitions as a basis for comparison, then ignore any sets that result in any other number of repetitions—over a reasonable period of time, there will always be enough sets that do result in ten repetitions to provide regular checks on your progress.

Numerous writers have mentioned the relationship of the size of a muscle to its existing level of strength; but they usually do so in a fashion that leaves a great deal to be desired at the very least, in a fashion that leaves the average reader in a state of total confusion, not knowing just what was meant—some writers will state that there is a direct relationship between the "area of the cross-section of a muscle" and existing strength—other writers put it differently, by comparing the "diameter of the cross-section of a muscle" and existing strength—but regardless of how it is worded, it still means the same thing, the **size** of a muscle indicates the **strength** of a muscle, and vice versa.

Now, for the benefit of those people who might wish to dispute my above statement on technical grounds, I will point out the fact that a muscle changes its **length** very little if at all as a result of growth; so we are **not** dealing with an ever-increasing sphere—instead, for all practical purposes, we are dealing with a cylinder of constant length, and thus, if we double the area of the cross-section we will simultaneously double the mass, and if we increase the diameter of the cross-section of a muscle by a factor of approximately 1.4 (one and four tenths) then we will double the area of the cross-section, and also double the mass, **and also double the power potential** of the muscle—as least insofar as the "input" of power is concerned, although the lowered efficiency resulting from unavoidable changes in the "angle of pull" may not (probably will not) permit a doubling of measurable power, or power "output".

Because of such ambiguous wording—such unclear statements in situations where clear expression is not only possible but highly desirable, even an absolute requirement—most current weight trainees remain totally unaware of the simple fact that the size of a muscle is directly related to its strength; and since most bodybuilders are interested only in "size"—and since they remain unaware that size is impossible without strength, and vice versa—they ignore the only type of training that is capable of giving them the size they are seeking, strength training. And competitive weight-lifters are just as confused—not realizing that increasing their muscular size will also increase their strength, **must** increase their strength.

So now we can add the following points to our ever-growing list of basic points …

16. Individual muscle fibers perform on an "all or nothing" basis; and only the number of fibers that are actually required to move a particular amount of resistance are involved in any movement.

17. A set that is terminated prior to the point of failure will not involve (cannot involve) all of the available fibers; at least not to a significant degree.

18. Every set of every exercise should involve work as far as possible inside the existing level of the "surplus of fibers" reserve ability.

19. Careful attention should be given to the actual rate of progress, in order to prevent a gradual and probably unnoticed reduction in the intensity of effort.

20. Accurate charting of progress can only be based on measurable strength increases.

21. There is a direct relationship between the size of a muscle and the strength of the same muscle.

Chapter 30: The Sixth Step

There is apparently a definite (but unknown) limit to the degree of disproportionate muscular development that the system will permit; thus "any growth" somewhat produces "some growth" everywhere. In Bulletin Number One, I termed this factor "indirect effect." While it is certainly possible to build a rather large degree of disproportionate muscular size—the most commonly-encountered examples being bodybuilders with fairly large arms and proportionately small legs—there is, nevertheless a limit to such possible disproportion.

Heavy exercises for the arms will, while building the muscles of the arms, indirectly stimulate a smaller degree of growth in the entire body, even in the legs; and I am not referring to growth that may be caused by the slight involvement of the leg muscles in exercises intended for the arms—instead, it is the actual growth in the arms that stimulates a lower order of growth throughout all of the other muscular structures of the body. It appears that this indirect effect is primarily determined by two factors—the size of the muscle mass that is growing, and the location of the muscle mass that is growing; the larger the muscle mass that is growing in response to exercise, the greater the degree of indirect effect—and the closer another muscle is located to the muscle that is growing in response to exercise, the greater the degree of indirect effect.

At least part of this result is undoubtedly due to the interrelationships of muscular function mentioned in an earlier chapter, when a muscle is involved in an exercise without you being aware that it is; but such an explanation cannot account for all of the results of indirect effect—when, for example, the muscles of the legs grow as a result of a program of training restricted to chinning movements for the arms and torso muscles, or when the arms grow as a result of a training program limited to squats.

It is my belief that an as yet unidentified chemical response is produced by heavy exercise—a response that does not occur at all when the intensity of effort is below a certain (but unknown) percentile of momentary ability, but that does occur as a result of exercise with an intensity of effort beyond a certain level, a level that obviously changes as growth occurs; all of the available evidence seems to exclude any other possible conclusion—because growth certainly is **not** produced in proportion to the "amount" of exercise. Exercise below a certain percentile of the momentarily-existing level of ability will produce no increases in size-strength, regardless of the amount of exercise; if a subject is in very poor condition—with below average tonus in the major muscular structures—then low-intensity exercise will eventually restore normal tonus, and will result in a slight increase in strength with little or no increase in muscle mass, but such low intensity exercise will never build significant size-strength.

And the actual level of such low-intensity exercise is always a relative matter—thus it is clear that the factor of importance is the percentile of momentary ability, rather than the actual level of performance; in effect, squatting with 100 pounds might be heavy enough work to produce very fast growth in one individual, a very weak individual—but for a man like Paul Anderson, it would be so light that no amount of such exercise would produce any increases in size-strength in his case.

Secondly, it seems that there is a definite "break-over" point—a point below which growth will not be stimulated, and above which growth will be stimulated; and having passed above that break-over point in the required intensity of exercise, the results then seem to increase in a geometrical fashion. In effect (using purely arbitrary figures for the following example), it seems that an intensity of effort below 70 per cent will produce nothing in the way of growth stimulation—while a level of 80 per cent will produce

"ten units of growth stimulation"—and a level of 90 per cent will produce "one hundred units" of growth stimulation—and it apparently follows logically, that a level of 100 percent of possible intensity is required for producing maximum-possible growth stimulation.

It may well be true that a level of intensity "somewhat less than 100 per cent of the momentarily-possible level" is all that is required to produce maximum-possible growth stimulation; but even if that does happen to be the case—and I personally feel otherwise—it is obvious that any such difference in the required intensity of effort and an outright 100 per cent intensity of effort is of no significance, and impossible to determine in any case.

And even if it should be clearly proven that all that was required for maximum-possible growth stimulation was a level of intensity of, for example, 95 per cent of momentary ability—just how would you propose to use such information? How would you know that you actually were working at a level of 95 per cent—instead of 90 per cent, or 85 per cent? How would you measure it?

But you **can measure** 100 per cent—quite easily by simply going to a point of utter failure.

By this point it should be obvious that an intensity of effort anything less than outright 100 per cent effort is probably a mistake, and that much less is a major mistake—with no "probably" about it; and that, in any case, since it is impossible to measure any degree of effort less than 100 per cent, the only way to be sure that you are working hard enough is to go all the way.

But in any case, regardless of the required intensity of effort, it certainly is obvious that heavy work for the larger muscle masses will result in large-scale growth in those muscles—and a lower order of growth in all of the muscles of the body; it is my belief that this occurs as a result of a chemical reaction which results only from heavy exercise—a reaction which "spills over" and affects the entire body to at least some degree.

But even with such a chemical reaction—if it actually does occur, and I have no firm evidence, only circumstantial evidence, in support of it—there still remains a disproportionate effect from exercise, and there still remains a limit to the amount of such allowable disproportion; and the implications should be perfectly clear.

For best results from exercise, all of the major muscular structures should be worked—**all of them**; you certainly can build large arms without working your legs—but you will build them much larger, and much quicker, if you also exercise your legs.

And since there is a limit to the overall recovery ability, and since many of the involved chemical functions are just that, "overall"—it should be clear that daily workouts are a mistake, even when a so-called "split routine" is used, a training program providing three weekly workouts for the upper-body and three weekly workouts for the legs; because the system cannot recover properly from a hard workout in much if any less than forty-eight hours—and if a heavy leg workout occurs between each heavy workout for the upper body, then the system will never be given quite enough time for both full recovery and growth. Certainly not rapid growth.

So now we can add the following to our list of basic points…

22. Faster rates of growth will result if growth is proportionate.

23. Greater overall growth will result if the largest muscular structures of the body are worked heavily.

24. Not more than three weekly workouts should be performed; three "overall" workouts.

25. A slight decrease in the intensity of effort in exercise will result in a disproportionately great reduction in the production of results.

26. It is impossible to measure relative intensity of effort less than maximum-possible (100 percent) effort; thus impossible to be sure of the actual intensity of effort if anything less than 100 percent effort is being employed.

"For best results from exercise, all of the major muscular structures should be worked—**all of them**; you certainly can build large arms without working your legs—but you will build them much larger, and much quicker, if you also exercise your legs."

Chapter 31: The Seventh Step

A workout is one thing—a competitive weight lifting meet is something else, an entirely different thing; or, at least, it should be an entirely different thing—since the best way to build strength has very little in common with the best way to demonstrate strength. Yet many current trainees make the mistake of training as if they were in a contest—perhaps being more interested in attempts to impress their training associates than in trying to build strength, or maybe just unaware of the actual facts.

Olympic lifters and power lifters obviously must practice maximum-possible, single-attempt lifts—both in training and in competition; but there is absolutely no reason—and even less excuse—for bodybuilders to ever attempt heavy "singles". While it should now be clear that maximum-possible muscular size cannot be produced without maximum-possible muscular strength, it does not follow that building maximum-possible strength requires the performance of heavy single-attempt lifts; on the contrary, greater strength and size will result from the performance of sets of at least several repetitions.

Secondly, it is easily possible to build the muscular strength to such a level that it literally becomes dangerous to employ this strength in maximum-possible single-attempt lifts; which might lead some people to ask, "…then what is the value of such strength, if it is dangerous to use?"

But since it is not my purpose to examine the "value" of building great size and strength—but, rather, to discuss the best method for doing so—I will not become involved on that point in great detail; however, I will mention that great strength—even a level of strength that might be unsafe in some applications—obviously provides a reserve that actually improves the safety of any normal activity, since the system is then normally operating at a level well within safe limits, at a level which imposes no strain.

Maximum-possible strength-size absolutely **can** be produced without ever producing maximum-possible power—even though maximum power production is a requirement for maximum growth—stimulation, and there is no paradox involved in this situation; for maximum growth-stimulation, it is only necessary to produce the **momentarily** maximum-possible amount of power—and this can be done (and **should** be done) only after the momentary ability has been reduced by the performance of at least three immediately-preceding repetitions that did **not** involve maximum power production. In effect, by the time you do produce maximum power, your momentary ability will be reduced to the point where the danger of injury is greatly reduced.

This can easily be accomplished in practice by using a weight with which you can perform several consecutive repetitions—and by performing the first three or four such repetitions at a reduced speed, at a speed below maximum-possible speed; remember, power production involves three factors—resistance, distance of vertical movement, and speed-of-movement. And if you reduce the speed you are reducing the production of power in direct ratio—and reducing the danger of injury to an even greater degree; because, it is not the resistance that causes injury, it is your attempt to move (or to restrain the movement of) the resistance that causes injury, and the less power you are using, the less likely you are to produce injury. But, more than that, while a reduction in power production obviously reduces the pull on the connective tissues in direct ratio, such "slower than possible" movements also reduce the acceleration factor—a movement involving maximum-possible speed-of-movement will increase the acceleration factors (the "jerk" factors) far out of proportion to the increase in actual speed; momentum is the tendency shown by a moving mass to continue such movement—but it is also the tendency for a stationary mass to remain stationary—and the forces resulting from an attempt to suddenly accelerate a

stationary mass enormously increase the "jerk" imposed upon whatever is connecting the source of power and the resistance, in this case the connection being the attachments of tendons and ligaments, and to a somewhat lower degree even the muscles themselves.

Thus, in practice, if "four units" of power applied against an immobile resistance imposes "four units" of strain (or "pull") on the connective tissues—eight units of power applied against the same amount of resistance will **not** impose eight units of strain; instead, it will impose **sixteen** units of strain.

And sixteen units of power applied against the same resistance will impose two-hundred and fifty-six (256) units of strain; thus increasing the power application by a ratio of four to one will increase the strain by a ratio of sixty-four to one. So it should be obvious that the danger of injury rises at a much faster rate than the increase in power application.

People do not hurt themselves during a "first repetition" because they were not warmed-up properly—but because they are strongest at that point in the set, and because they make the mistake of moving at maximum speed at a time when this results in more pull from an increase in the power production and much more "jerk" from a resulting geometrical increase in the acceleration factor. And since single-attempt lifts are always "first repetitions," it should be obvious that they are the most dangerous type of movements—far more dangerous than might be apparent at first glance.

But since maximum-possible growth-stimulation can be induced by the production of **momentarily** maximum-possible power, almost all of the potential danger can be avoided; simply by reducing the existing level of ability before actually producing maximum-possible power—and this can easily be accomplished by performing three or four repetitions at a reduced speed-of-movement immediately prior to an actually maximum-possible movement—or it can be accomplished by "pre-exhausting" the muscles by working them in an isolated fashion immediately prior to involving them in a heavier compound movement.

Since the ability of the muscles to increase their strength is apparently far out of proportion to the ability of the connective tissues to increase their resistance to strain, it is almost inevitable that injuries will eventually result if you constantly make a practice of producing maximum-possible power during first repetitions—or while attempting heavy single-attempts; which, in plain English, means that practically all competitive lifters are almost certain to hurt themselves sooner or later—but in cases of competitive lifters, that is a risk that simply cannot be entirely avoided. You cannot hurt elephants without running at least some risk of getting stomped by an elephant—by you should at least be aware of the risk involved.

But it does not follow that even competitive lifters cannot at least reduce the risk to some degree—they can, to a rather great degree; supporting heavy weights in a variety of positions—with little or no attempt to actually move them, and with absolutely no attempt to move them suddenly—will apparently increase the "connective strength" of tendons and ligaments, and will do so without the enormous increase in the risk of injury resulting from the acceleration factors involved in fast movements.

The reader is requested to excuse my repetition in this chapter—but since this factor is of such actually great concern to anybody involved in weight training for any reason, and since this point has been so generally misunderstood for so long by almost everybody involved in weight training, I feel that it simply cannot be overstressed.

Most weight trainees sincerely believe that they are avoiding most of the danger of injury if they terminate a set prior to the point where the movements start to "feel" actually hard—they consider the

last repetition the most dangerous repetition; but in fact, of course, quite the opposite is true—the farther you progress into a set, the safer it gets.

Regardless of the number of repetitions involved in a set, the first repetition is **always** the most dangerous repetition—and the last repetition is **always** the safest repetition; and the harder it seems, the easier it is—and the more dangerous it appears, the safer it is.

The last repetition of a set of ten repetitions, for example, "feels" harder only because you are becoming exhausted by that point in the set—you do not "feel" actual output, instead you "feel" the percentile of momentarily-possible output; if a man can press 200 pounds, then 100 pounds will "feel light" to him during a first repetition, and will "feel" heavier during each following repetition—and by the time he reaches a point where he is barely capable of performing one more repetition, then the 100 pounds will "feel" very heavy. Because—to him, **at that moment**—100 pounds actually will be very heavy, since it will momentarily require 100 per cent of his strength to move it.

Everything is relative insofar as "feelings" are concerned—a puma looks big to a man that has never seen a lion; but the danger of injury is not based on relative factors in that sense—instead, the connective tissues have an actual level of resistance to pull, and since they are not performing work this resistance is not reduced during the performance of a set of several repetitions. If a particular tendon's connective tissues have an existing level of resistance capable of withstanding "one hundred units of pull," then that level of resistance remains constant throughout a set—it will be 100 units during the first repetition and 100 units during the tenth repetition; but the "danger factor" certainly does **not** remain constant—because, during a first repetition you might be momentarily capable of exerting 200 units of pull, and if you do then an injury literally **must** result, but by the time you reach the tenth repetition your momentary ability may be reduced to a maximum of only 10 units of pull, and you couldn't hurt yourself if you tried, you simply are not strong enough to hurt yourself at that point.

But—out of a totally misplaced and absolutely unjustified fear of injury—almost all weight trainees avoid the actually most productive repetitions in all of their sets; they work right up to the point where one or two more repetitions would have done them some good—and then they stop because of fear of injury, thus avoiding the actually "easiest" repetitions, the actually "safest" repetitions, and the only repetitions in the set that would have produced much in the way of growth-stimulation.

Earlier, I said "almost all weight trainees" are guilty; of this mistake; but in fact, I have yet to meet a single weight-trainee who was aware of the actual facts in this situation prior to the moment that I pointed them out to them—and I have yet to meet very many trainees who really understood, or even accepted, the facts even **after** they were carefully explained to them—and during more than thirty years of interest in this field, I never heard mention of these facts until I first pointed them out myself. Yet there is nothing at all "complicated" about the matter—the basic physical laws involved in this situation are so simple that they; should be self-evident truth to any reasonably intelligent fifth-grader.

Until quite recently, I was under the impression that the "old timers" in weight lifting were once aware of the real facts—or that they at least understood them in a practical sense; and I could never quite figure out why such simple things could have been so quickly forgotten. But now I have come to realize that even the trainees of the past really didn't understand what they were doing, or why they were doing it that way—instead, they merely practiced a style of training that was actually very productive without understanding "why" it was productive; they were doing the right things, but they were totally unaware of the real factors involved—they were literally training correctly "by accident".

Thus, later, when the so-called "modern methods" of training were introduced, even the older trainees accepted them—apparently without question, and probably because they "seemed easier."

From all of the evidence, I can only reach the conclusion that nobody ever really made a serious attempt to examine the actual facts of the matter—or if so, that the people who tried to do so were simply unaware of basic physics and simple math. In no other manner can I even begin to explain the fact that most of the sincere beliefs of almost all weight trainees literally attempt to ignore the laws of physics. But I will remind you that an unawareness of the law of gravity—or a refusal to admit the existence of gravity—will not change the facts; and you will hit the sidewalk with exactly the same speed as the next guy if you make the mistake of stepping off a tall building—and with much the same results.

So—since it is obviously required—in the next few chapters I will attempt to cover the actually very simple points of basic physics that are involved in exercise; and because of the very real importance of these physical laws, I hope I can be excused for using an extremely simple method of explanation.

But in the meantime, we should add the following points to our list of basic points …

27. The first repetition is actually the hardest repetition—in spite of appearances to the contrary.

28. The first repetition is by far the most dangerous repetition.

29. Momentarily maximum-possible power should be produced in each set of every exercise—but **not** during the first three or four repetitions.

30. "Stopping short" of the point of failure will not reduce the danger of injury—but it will enormously reduce growth stimulation.

31. Workouts are for the purpose of "building size-strength," not for the purpose of demonstrating strength.

32. Supporting heavy weights—but **not** moving them—will increase the strength of connective tissue; and will do so without much danger of injury.

33. Sudden movements against resistance are the most dangerous types of movements—and the actual amount of the resistance is of little or no importance.

34. "Jerky" movements should be avoided at all costs.

35. You cannot judge the intensity of an exercise by the "feel"—except in relative terms; but you can judge the value of a movement by the "feel"—because relative intensity is the only factor of any real concern insofar as inducing growth-stimulation is concerned.

Chapter 32: The Moment-Arm Factor

If you are sitting off to one side of a table, with your eyes on exactly the same level as the edge of a plate upon the table, and if a bug is walking around the near edge of the plate—then it may appear, from your viewpoint, that the bug is walking in a perfectly straight line; but in fact, the bug will be moving in a circular fashion—if he continues moving long enough in the same direction, he will eventually complete a full circle, having walked entirely around the edge of the plate.

Or, if your eyes were slightly above, or below, the edge of the plate, then it might appear that the bug was walking in a curving fashion—but was following a curve with a larger radius than the actual radius of turn; in effect, the bug would appear to be curving less than he actually was.

In the above examples, I said "may appear" and "might appear" very pointedly; because, if you were aware of the actual facts, then you could ignore "appearances" and see things as they actually were. While no amount of "understanding" will assure good results from weight training, it nevertheless remains perfectly true that actual knowledge is required for producing good results—actual knowledge possessed by "somebody", if perhaps not by the trainee himself; if the trainee doesn't understand, then at least the coach must understand—but somebody has to be aware of the actual facts, and in a position to enforce a style of training in accordance with the facts.

Different people will unavoidably have different viewpoints—the trainee may see the bug as walking in a straight line, the coach may think it is walking in a slightly curving line; in which case nobody is aware of the facts—but both parties will very naturally have strong opinions on the subject, opinions which they will sincerely feel are based on solid observation and undeniable personal experience, and yet they are both wrong.

Additionally, your distance from the situation will influence your viewpoint—literally and figuratively; in the case of the bug on the plate, in order to see the situation properly, you would have to be directly above the center of the plate, looking down—but you would also have to be an infinite distance away, because, from anything less than an infinite distance, your perspective would be distorted. In training situations, your relationship to the overall environment—and your relationships with the people who are a part of that environment—will always distort your perspective to at least some degree.

If you are training in a gym with the current Mr. America, and if you like him personally, you will rather naturally look upon his advice as sound, "...after all, he did win, didn't he?" But in fact, with his potential, perhaps he should have won earlier—maybe his own firmly held beliefs have delayed his progress enormously.

You think otherwise? Well, let me give you a case in point; I have just finished a year devoted to (among other things) the training of Casey Viator, who recently won the Mr. America title in the most spectacular style in history—together with the Mr. America title, he won five of the "subdivisions", most muscular, best arms, best back, best legs, and best chest, so, all in all, he took home six out of a possible seven trophies from that contest; additionally, during the year that he trained under my supervision, he won every other contest that he entered—the Teen-Age Mr. America, the Mr. U.S.A., and the Jr. Mr. America; and on top of that, he is undoubtedly the most massively muscular bodybuilder in history, fully as defined as any major physique contestant has ever been, literally "because of his size" rather than in

spite of it, because his size is muscular size, not fatty tissue, and he is one of the strongest men in the world, and certainly by far the strongest bodybuilder in the world.

Under the circumstances, you would probably expect Casey to be extremely well-informed on the subject of proper training; but is he, in fact? Quite frankly, I simply don't know; all I can do is judge his knowledge on the basis of my experiences with him. And since I like Casey, this becomes difficult to do; because it puts me in an unavoidably biased position.

When Casey first came to Deland, Florida to train under my supervision, he weighed 198 pounds in well-defined, muscular condition; his largest upper-arm measured exactly 18 1/6 inches; and while he was fairly strong for a bodybuilder of his size, he could not have squatted once with 500 pounds if his life had depended on it.

A bit less than a year later, his largest upper-arm measured exactly 19 15-16 inches; he weighed 218 pounds in even more defined condition; and two days before the Mr. America contest that he won, he squatted 13 repetitions with 502 pounds—after "pre-exhausting" his legs with 20 repetitions with 750 pounds in the leg-press and 20 repetitions with 225 pounds in the thigh-extension machine. All three of which exercises, leg-presses, thigh-extensions, and squats, were performed in rapid succession, with no rest between sets.

And while the "actual gains" that Casey made during that time are really not exceptional—his "relative gains" are almost unbelievable; since the larger you become, the harder it becomes to get even larger—the first part of the trip up a mountain may not be too hard, and you may move quite rapidly, but wait until you get near the top and see how fast you are moving. You may reduce your time for the mile from six minutes to five minutes with very little training—but then see how long it takes you to reduce it to four minutes.

Yet, the simple truth of the matter is that Casey probably could have gained at least twice as much as he did during that period of time—and I really expected him to do so; I wanted him to weigh-in at the Mr. America at a bodyweight close to 240 pounds, with a "cold" upper-arm measurement in excess of a legitimate 20 inches—and I think he could have done so, if I had actually trained him during the entire period while he was in Florida.

Casey never failed to cooperate fully when I was training him—if I told him to do something, he did it—If I told him to avoid something, or change something, he did it; I have no slightest complaint regarding his cooperation—but, unfortunately, I simply did not have time to supervise all of his workouts.

Up to November 1st, 1970, I did supervise almost all of his workouts—and he gained in size, in strength, and in muscularity (definition) during that period; when we took a photograph of his back and another photograph of his arm on November 1st, Casey could hardly believe that they were actually pictures of him, and said so.

But from November 1st until April 1st—a period of five full months—I was simply too busy to supervise Casey's training; so during that period he trained with several people for different periods of time—still in the Deland High School gym, still using all of the Nautilus equipment and a large variety of conventional equipment, but without my supervision.

And for a period of five full months, his muscular size, strength, and degree of muscularity steadily declined—and if you think not, then compare the pictures that were taken on November 1st, 1970, and

that were published shortly afterwards in Iron Man, to the picture of Casey that was on the cover of Muscular Development magazine a few months later.

Peary Rader, the publisher of Iron Man Magazine, wanted a good color photo of Casey to use on the cover of his magazine for the issue that appeared just prior to the Mr. America contest—and in an attempt to get a good picture of Casey, we took literally hundreds of color photographs; but none of them were satisfactory—Casey looked "smooth" in all of them, he looked "fat", because he was fat.

So, on the first of April, with the next contest—the Junior Mr. America contest—only six weeks away, I realized that I had to start supervising Casey's workouts again; or take the risk of having him lose the contest. So I did start supervising his workouts again—every repetition of every set of every exercise during each workout.

While he had been supervising his own training, Casey had fallen back into the habit of training almost every day—and always at least five days each week; so the first thing I did was get him back on a schedule of three workouts each week—and the second thing I did was cut out about half of the exercises he had been doing while supervising his own training—and the third thing I did was cut his number of sets to two per exercise in most cases, and one per exercise in some cases; for example, only one set of squats, three times weekly—and the fourth thing I did was to assign a very strong football player the job of training with Casey in order to "push" him—and the fifth thing I did was push them both.

And immediately, Casey started moving in the other direction—we could literally see him grow from workout to workout; his high-repetition sets of leg-presses moved from 400 pounds to 750 pounds within less than a month, his squats (after "pre-exhaustion") moved from less than 400 pounds to over 500 pounds in the same period of time—he got larger, noticeably larger, by the workout—he became more defined, day by day—and within four weeks he was almost back into the shape that he had attained earlier, the peak of condition that he reached the previous November 1st—and within six weeks, by the time of the Junior Mr. America contest, he was in almost unbelievable condition, larger, stronger, and more defined than he had ever been before. When Red LeRille (Mr. America of 1960) saw him—and Red prepared Casey for the Mr. America contest the previous year, eleven months earlier, and thus was very familiar with Casey's physique—he stated that he "…would not have believed that Casey could improve that much in a year if he hadn't seen it personally."

Yet, in fact, it hadn't "actually" been a year—it was more like six weeks; or, if you want to include all of his training that produced gains instead of losses, you could call it twelve weeks—six weeks "up", five months "down", and the six weeks "up" again.

So—did Casey actually learn anything while training here? I don't know; but from all appearances, I can only say that he certainly displayed very few signs of any real learning—and no practical results at all, except negative results.

Now—it may well be true that Casey is an individual who cannot—or will not—push himself; and you must be pushed by somebody to produce the size and strength that he attained while I was supervising his training—if you can't, or won't, push yourself, then somebody else must do the pushing for you.

Ellington Darden was present during Casey's last week of training just before the Mr. America contest, and he remarked "…it would be interesting to know just how much of the results are produced by the machines and how much by Jones' pushing."

Which is certainly an interesting question—and one that I obviously can't answer; but it should also be obvious that you can't push with a rope, you must have a pole—regardless of how much I push, the machines must still be able to do the job, otherwise the results would not be produced. And anybody familiar with my writing should certainly be aware that I have always clearly stated that the machines are merely tools—and that like any tool, they will do nothing by themselves; they must be used, and used properly, and like any tool they are subject to misuse.

Then two or three days before the Mr. America contest, I overheard Casey tell somebody in the gym that, "…I learned long ago that it is impossible for me to overtrain."

All I can say is, "…did he?"

Now—let there be no slightest doubt on one point; Casey trained hard—Casey performed actual workouts—Casey made the gains—and Casey deserves the credit for these gains. But that is not my point; my point is, "…did Casey actually learn anything from the experience?" Under the circumstances, I can only judge from my experiences with him—and using that experience as a guide, I am forced to say that he apparently learned very little.

But I certainly learned something from those same experiences. I was able to demonstrate just what could be done with a subject who has far better than average potential and a willingness to work hard (even if he apparently does require outside pushing; which most of us do at one time or another, in one way or another), and I also learned that I must personally supervise every workout if I am going to be sure of best-possible results.

And using these lessons as a guide, I know what to do next time—and just wait and see what we do for next year's contest; but I can tell you very clearly in advance that you will probably be literally; shocked when you see the results of a year of proper training on the Nautilus machines—again with a subject who has far better than average potential, but this time with my constant supervision of all of his workouts.

And please do not misread any of the above as criticism of Casey—in spite of my generally bad opinion of bodybuilders as a group, I enjoyed supervising Casey's workouts; it is only a shame that I couldn't find the time to supervise all of them while he was here.

And what does the future hold for Casey now? Again, all I can say is that I don't know; he originally intended to stay here and train at least until the time of the Mr. Universe contest in London, in September of 1971, but then he got married, and things changed insofar as his immediate plans were concerned. For the benefit of any readers who may be interested in my personal advice to Casey upon the occasion of our last conversation just before he returned to his home in Louisiana, I will mention that I advised him to go back to school—and to get clear out of the bodybuilding scene; but since my opinion of the current bodybuilding scene has very little in common with Casey's opinion of the current bodybuilding scene, and since Casey is 19 years old, and since I am …well, older than that, and since my ambitions are not the same as Casey's, I really don't know what he intends to do, and I doubt if even he knows at this point. How many people do—at nineteen?

I made him an offer that involved staying here, and working, and going back to school—but he apparently has something else in mind; or maybe he just wants to get out on his own and see the world a bit—which at his age is perfectly normal.

But, wherever he goes, and whatever he does, I wish him the best of luck; in today's world, at nineteen, with an almost unbelievable physique and perhaps too much publicity, he is going to need lots of luck—especially if he stays on the bodybuilding scene.

So—there is one case in point, a recent case, a case based on personal knowledge and experience, involving a young man with perhaps the greatest physique up to this point in time, and certainly the greatest at his age; and is he an expert? Would his advice be sound?

So don't look to the "experts" for advice; instead, try to understand at least the basic facts involved—and when you do, then you can at least base your training on facts, instead of on perhaps well-meant but probably faulty opinion.

In the direction of understanding the first of the required facts—or factors—let us now examine some basic laws of physics; starting with a simple, clear look at something called a "moment-arm."

It is easily possible to move almost any amount of weight an actually great distance, and you can do so while producing almost nothing in the way of power—if the **vertical** distance of movement is not great, and if you do not attempt to induce sudden acceleration; if your car is parked on smooth, flat pavement, you can push it quite easily—if you start the movement very gradually. But just try lifting the same car.

In the first instance, when you are pushing the car on a flat surface, the "moment-arm" is effectively **zero**; in order to move the car, it is only necessary; to overcome the inertia of the unmoving mass (or, in fact, since everything is always moving is several directions, from the rotation of the planet, the rotation of the galaxy, etc., you must "overcome the inertia by changing the direction of movement"—even though, because of your viewpoint, you may; not be aware of the actual movement that existed prior to the movement initiated by your own efforts), and, of course, you must also overcome the friction involved in such a situation—all of which is rather easy to do, if you start the movement slowly and smoothly.

But in the second instance, when you are attempting to lift the car, the situation is entirely different—from a moment-arm of zero, you have moved to a moment-arm of 100 per cent, every inch of movement will be an inch of **vertical** movement; in effect, you have changed the situation from one where you had an almost infinite leverage advantage to a situation where you have no leverage advantage at all.

While the above example is not perfectly valid in technical terms—it is, I think, a worthwhile example of the points I am trying to get across.

Now let us again imagine that the same car was parked on the end of a diving board—and that the diving board, instead of being rigidly attached on the opposite end, was supported by an axle—and, for this example, let us suppose you have a very light car—one weighting 1000 pounds. Let us also suppose that the length of the diving board—from the center of the axle to the center of the car—is exactly 10 feet long.

The "downwards" force exerted by the car would be attempting to rotate the diving board around the axle—and this rotational force would be properly known as "torque." In this example—when the diving board was perfectly horizontal—the amount of torque would be exactly 10,000 "foot-pounds". The distance from the center of the axle to the center of the car would be 10 feet—and that 10 feet would represent the "moment arm"—and the torque (the twisting force applied to the axle) would be determined by multiplying the moment-arm by the weight of the car; 10 times 1000—or 10,000. There

would, of course, also be some torque resulting from the weight of the diving board—but in this example we will ignore it, assuming that the diving board was infinitely rigid and infinitely light in weight.

The 10,000 foot-pounds of torque would be the "maximum-possible" amount of torque in this situation—and you would have the amount of torque **only** when the diving board was perfectly horizontal. If **any** movement occurred—either up or down—then the torque would be reduced; never **increased**—always **reduced**.

If the diving board was rotated 90 degrees—either up or down—and assuming that the car was attached to the diving board so that it could not fall off, then there would be no torque, literally **none**. Because, then, the moment-arm would be zero—and zero multiplied by any amount of weight is still zero.

And just how did we determine the moment-arm? Very simply; when the diving board was horizontal, we drew a **vertical** line through the center of the axle, and another **vertical** line through the center of the car—and then we measured the **horizontal** distance between these two vertical lines, and that distance is the moment-arm.

But when the diving board was rotated 90 degrees, so that the car was hanging straight down (or sitting on top of the vertical diving board), then a vertical line that passed through the center of the axle would also pass through the center of the car—if you drew two vertical lines, one through the center of the axle, and one through the center of the car, then the lines would have zero horizontal distance between them. The moment-arm would be zero.

If you stood under the car, while the diving board was perfectly horizontal, and attempted to rotate the diving board by pushing straight up on the car, then you would have to exert something in excess of 1000 pounds of force to produce movement—exactly 1000 pounds of force would be required to merely support the car, to prevent it from pushing you down; but literally **anything in excess of 1000 pounds** of force would produce movement upwards—and the greater the force, the faster the upwards movement would be.

However, if you wanted to move the diving board (and the car) while the diving board was in a vertical position, then only a very slight amount of force would be required—only enough force to overcome the momentum and the friction involved.

In both cases you would be rotating the diving board and the car around the axle—but in one case it would require a great amount of force, and in the other case it would require only a very small amount of force.

Because—when you were pushing upwards, you were trying to move the diving board and the car **vertically**, but when you were pushing "across", you were trying to move the diving board and the car **horizontally**.

For all practical purposes—in the field of exercise—we can (and should) ignore anything except **vertical** movement of resistance; it makes no slightest difference in which direction we are pulling or pushing, and the "total amount" of movement is of no importance—what matters, and all that matters, is the vertical movement of the resistance.

All human movements involved in exercise are very similar to the example of the diving board and the car—all such movements are **rotational** movements; and as an unavoidable consequence, the moment-arm (and thus the torque, the actual resistance) is constantly changing—in some areas of movement

there is literally no resistance, and in other areas of movement the resistance is 100 per cent of its actual weight. And it makes no slightest difference that the actual weight is not rotating in some instances—because **something** is **always** rotating; if not the weight, then the involved body parts—or perhaps the rotation is shared, part of the actual rotation may be on the part of the weight and part of it on the part of the involved body parts—but it amounts to exactly the same thing in the end. Such rotation is unavoidable—it cannot be eliminated; and it must be understood—and allowed for.

When "compound rotation" (rotation around two or more separate points) is involved—as it is in a press, a squat, and in many other exercise movements—then the situation becomes a bit more difficult to understand; but the factors are the same in all cases—and the results are unavoidably the same. In an effort to avoid unnecessary complexity of explanation, I will simply skip any detailed mention of compound rotation—and will limit my examples to single-rotation situations, such as the curl.

In a standing barbell curl, there is literally no resistance at the start of the movement—because in that position, the moment-arm is zero. Likewise, at the end of a curl, there is no resistance—for exactly the same reason.

Viewed from the side, the performance of a curl goes about as follows; at the start, the forearms are in line with the upper-arms and the center of the barbell is directly below the center of the elbow joint—thus a straight, vertical line drawn through the "axis of rotation" (the elbow) will also pass through the center of the barbell. Thus the moment-arm is zero—and the torque is also zero, regardless of how much the barbell weighs.

The movement can be started with almost literally no power—since, at the start, you are moving the barbell perfectly horizontally, there is absolutely no vertical movement at that point; but as the curl progresses, the "direction-of-movement" rapidly changes from horizontal to vertical—after the first 45 degrees of movement, the direction-of-movement has become equally divided between horizontal movement and vertical movement, and (for the average man) the moment-arm has increased from zero to about 8 1/2 inches, and the torque has increased from zero to approximately 850 "inch pounds" (assuming a barbell of 100 pounds weight).

During the first part of a curl, the effective resistance will increase very rapidly—and during the next 45 degrees of movement it will continue to increase, but at a slower rate of increase. So, at the so-called "sticking point" in a curl, after the first 90 degrees of movement, when the forearms are bent 90 degrees in relation to the upper arms, and when the forearms are parallel with the floor (perfectly horizontal), the moment-arm will be at its highest point—the moment-arm will be about 12 inches, and the torque will be approximately 1,200 inch-pounds, or 100 "foot-pounds". In either case, of course, the torque is calculated by multiplying the moment-arm by the resistance; 12 inches times 100 pounds equals 1,200 inch-pounds—or one foot times 100 pounds equals 100 foot-pounds.

Thus during the first 90 degrees of movement in a curl the resistance is constantly changing—at first it increases very slowly, then it starts increasing more rapidly, and then it slows down again; but it is constantly increasing throughout that first 90 degrees of movement.

After the first 90 degrees of movement, the resistance continues to change—but from that point on to the end of the movement the moment-arm, and thus the torque, decreases; and by the time the curl is finished, the moment-arm has returned to zero—and there is no resistance at all.

So now we should add the following points to our list of basic points…

36. You cannot learn the proper method of training a race horse by asking a race horse.

37. If left up to their own devices, most trainees will not train properly.

38. In order to produce maximum-possible results, "somebody" has to push the trainee, any trainee; some trainees can and will push themselves—most will not, or cannot.

39. The moment-arm of the resistance must be considered in order to determine the actual resistance imposed on the muscles.

40. All exercise movements are rotational in nature.

41. The resistance imposed upon the muscles in all conventional forms of exercise is constantly changing as movement occurs.

42. There is literally no resistance in the finishing position of many conventional exercises.

Chapter 33: Fuel-Air Factors

An engine produces maximum power only when the fuel-air mixture is exactly right—a change in either direction, increasing or decreasing the amount of fuel in relation to the amount of air, will always **decrease** power.

For most practical purposes, your body is an engine—and many of the same basic principles can be applied with equal validity to an engine or to a human muscle and its supporting organs.

In 1955, I bought a new car—and I maintained an exact record of its performance during the time that I owned it, for 68,000 miles; during the entire period of ownership it averaged 15.8 miles to the gallon, overall—highway driving, city driving, and some outright competitive racing. When driven at a reasonable speed, a true 60 miles an hour—which, on that car, when the tires were new, was 64 miles per hour on the speedometer—it gave an average of well over 20 miles to the gallon, and sometimes as much as 22 miles to the gallon.

Ten years later, in 1965, I bought another new car of the same make—and by that point my driving habits were much improved; which should have resulted in even better gas mileage—but, in fact, I was lucky to get as much as 12 miles to the gallon even on the highway, and the average mileage was about 10 miles to the gallon.

The two cars weighted about the same, had basically the same "extras", and should have performed in a very similar fashion—but in fact, the 1955 car was faster, had much better acceleration, and used a lot less fuel.

At first I didn't understand why—but now I do; the later model car was designed to use an "over-rich" fuel-air mixture for cooling purposes—the engine was literally being cooled by the use of excess fuel.

During that period of ten years, the size of the engine had been increased, the compression ration had been increased, the "advertised" horsepower had been increased, fuel consumption had gone up enormously—and the car weighed about the same and performed a lot worse; because the engine had become so big it couldn't be cooled adequately in the normal way—it was creating more heat than the cooling system could handle.

So how did they solve the problem? In a logical way, by reducing the size of the engine to a point where the cooling system could cope with the situation? Of course not—because then they; couldn't advertise the huge size of the engine; size they couldn't use in a logical manner—a lot of which size, and potential power, they couldn't use at all.

In an airplane engine, where you do have adequate cooling (at least in the air), the maximum power setting of a fuel-air mixture will also be the fuel-air mixture that produces the most heat—and the same thing is true of any engine; during takeoff, when the engine is actually operating above safe limits—producing more power than it is really safe to use—you must use an over-rich fuel-air mixture, which will obviously reduce the power production somewhat, but which is compensated for by using more revolutions per minute and higher manifold pressure.

But when cruising power settings are being used, the situation is somewhat different—then you are interested in getting as much power as you can out of each gallon of fuel; and when the fuel-air mixture is regulated to give maximum power, you will also be creating maximum heat.

In practice, most airplanes aren't cruised at such fuel-air settings, because it is more economical to use a mixture that actually gives a bit less power; an airplane is designed to cruise within a certain speed range, and any speed outside that range is highly inefficient—flying slower, or flying faster, in either case the fuel consumption will be increased. Secondly, a slight increase in speed requires a disproportionate increase in power—to increase the speed by 10 per cent you might have to increase the power by; 100 per cent, so it isn't justified.

So in practice, you try to use the fuel-air mixture that will give you the most miles per gallon—even though that mixture won't give you quite as much power, or, at least, that's the way you should do it, the intelligent pilots do it—which means, of course, that it is **not** the way most pilots do it. Instead, most pilots actually reduce the power, and the speed, while **increasing** the fuel consumption.

If you are cruising at an indicated speed of 200 miles per hour, and if your engines are turning at the correct number of revolutions per minute, and if your manifold pressure are proper for the circumstances—then your engines will also be producing maximum heat, and you may be burning a total of 400 gallons of fuel per hour (100 in each of four engines); which means that you are burning two gallons of fuel for each mile of indicated speed.

But you are aware that a rather large scale reduction of power (and thus a large reduction in fuel consumption) will not produce a proportionate reduction in speed—so it is only common sense to use a more economical combination of power and speed factors; so you reduce the power by moving the mixture-control levers in the direction of a "lean" setting, you reduce the amount of fuel being fed to the engines but leave the air input just as it was—and both the power and the heat start to drop off.

And the speed drops as well—but not in proportion to the reduction in fuel consumption; with a proper mixture setting, you may be burning only 300 gallons per hour—but you are still getting 190 miles per hour speed, so you are then getting far better fuel consumption; in effect, by reducing your speed only 5 per cent you reduced your fuel consumption by 25 per cent, an obvious improvement.

But that is the **proper** way to do it—and how do most pilots do it? By moving the mixture levers in the opposite direction, by giving the engines **more** gas instead of less gas—which will have exactly the same effect as far as power and hear are concerned, both of which will be reduced. And as the power drops off, the speed will also drop off. But what about the fuel consumption? Well, instead of dropping off from 400 gallons per hour to only 300 gallons per hour, it will increase from 400 gallons per hour to possibly 500 gallons per hour—instead of getting better, the situation gets worse.

If you ask a pilot that does this "why he does it", you may get almost anything for an answer—anything but a rational answer, that is; but usually they will mumble something about "playing it safe." Whatever that means.

And if, by this point, you are wondering just what all of this has to do with physical training—then wait a bit, it will all come clear in a moment.

As I mentioned a page or so back, your body has much in common with an engine—your body also requires a proper fuel-air mixture, and like an engine it likewise requires a proper chemical mixture in the

fuel itself; if the mixture is changed—in either direction—then the result will be a reduction in power, **never** an increase, **always** a reduction.

Yet, much like pilots that really don't understand the involved factors, most bodybuilders constantly think they are "playing it safe." By giving their body an amount of one element of fuel that is out of proportion to the other required elements. And all they are actually doing, of course, is overloading their systems—providing a mixture that cannot be used properly; wasting fuel and reducing power at the same time—and throwing at least some strain on their organs for no good reason.

An airplane engine cannot convert fuel to air, and if you give it too much fuel in proportion to the amount of air it is getting then it will simply quit running entirely; but the human body can convert certain food elements into other elements if it is required to do so—and it will do so, up to a reasonable point. But there are limits—and if pushed too far, the body may not stop running entirely but will certainly start operating at greatly reduced efficiency.

While it may or may not be true, as many self-appointed "nutritional experts" maintain, that Americans are the **worst fed** people on earth—if so, then bodybuilders are the worst of the lot.

Unfortunately, the human body doesn't come equipped with instruments to tell us just what is happening at the moment—not on a dial, at least; but the body will tell you quite a bit about what is happening if you know how to read the signs—and if you can't, but if you can at least read English, then you can learn what to do from somebody who can read the signs.

Twenty years ago, most bodybuilders had probably never heard of protein—today, most of them try to restrict their diets to almost pure protein; and when that doesn't give them instant results, then they try to force their system to use more of the protein by taking drugs—and most of them end up fast as a pig, wondering what happened. What happened, of course, was that the body did the only thing it could do under the circumstances—not being able to use the protein in the amount supplied, it converted it to fat.

And quite a few of them, as a result of the drugs, end up with greatly-reduced interest in girls, or, even if they maintain their interest, they can't do much about it.

In an airplane, in certain situations where operation is **not normal**, it is permissible—even recommended practice—to vary the fuel-air mixture for reasons other than the one outlined earlier; but in all such situations the efficiency will be reduced, and it should also be noted that all such variations will reduce the power output to a point well below that which might me indicated by fuel consumption, by revolutions per minute, by manifold pressure, or by any other means of calculation.

And the human body is subject to very similar physical laws—and if all of the involved factors and their interrelationships were clearly and exactly understood, then it is at least probably that the physical laws would be found to be identical; and to the degree that they are known, they are identical—with no **single exception** that can be supported on any basis except outright myth.

All of which is so simple, so basic, so obvious, so undeniably true that I am almost embarrassed to write it—but most of which will sound like outright heresy to many bodybuilders, perhaps to most bodybuilders.

You might also take note of the fact that varying the fuel-air mixture from "lean" to "rich" also changes the octane rating of the fuel—literally reduces the power of the fuel; kindly note, **low octane** fuel is **more powerful** than high octane fuel.

You cannot safely use low-octane fuel in a high-compression engine—but not because it isn't powerful enough; on the contrary, it isn't safe because it is **too powerful**. And high-octane fuel, of course, can be safely used in **any** engine—because it isn't powerful enough to be dangerous; and if you raise the octane rating high enough, then the fuel won't even burn.

All of which, of course, is exactly the opposite of what most people believe.

And while I am certainly not suggesting a low-protein diet, and while a diet that is slightly rich in protein may be an advantage during periods of rapid growth—there is a very definite limit to the amount of protein that can be used by the body under any circumstances; an if you exceed that limit, the results will be **worse** rather than better.

In many cases, the diets of bodybuilders are merely foolish—but in no small number of cases, they are actually dangerous.

And now we come to the real point of this chapter—which might not have been clear without the preceding examples; the human muscular system also depends upon a very definite fuel-air mixture for proper performance—or even for life itself.

Without becoming bogged down in lengthy descriptions of all of the factors involved, things like "steady state" function and "oxygen debt" limitations, I will attempt to make the reader aware of the implications of all of the related cause-effect relationships; again it isn't necessary to understand just "why" such situations exist, if we are at least aware of the practical considerations.

To function, muscles require oxygen—in proper ratio to the available fuel; to that degree, muscles and engines are exactly alike—but muscles, unlike an engine, can store oxygen, and can borrow oxygen. In effect, a muscle can and will use oxygen from sources that are not normally called upon; and thus it is able to function longer than might be expected—but there are limits to this ability as well.

For proper results from exercise, these limits must be understood and allowed for; if not, then the usual result is that a point of failure is reached because the muscles simply run out of available oxygen—they will quit functioning, they **must quit** functioning, because the fuel-air mixture becomes unbalanced to the point that the still available fuel cannot be used. And if this is allowed to happen, then you can repeatedly work to a point of actual failure without doing much in the way of stimulating growth; because, if failure results from a simple lack of oxygen rather than from true exhaustion of the reserve ability of the muscles, then you obviously are not working within the momentarily-existing levels of reserve ability.

In very simple terms, this means that you must work fast—and that the amount of work must be limited to a certain maximum number of repetitions; in following chapters I will list several suggested training routines—which are not based upon guesswork, and which must be performed exactly as outlined if the results that they are capable of producing are to be realized in fact.

"Yes, but different people react differently" (or words to that effect), is a statement I have heard from hundreds of bodybuilders; and the idea expressed is certainly true—up to a point. But it is equally true—and of far more importance—that the basic laws of physics are the same for **everybody**.

In practice, we found that the number of repetitions should remain within certain fairly rigid limits—and we understand why these limits are imposed; in previous chapters, I have detailed points that should

make the lower limiting factors clear to anybody, so I will add very little in that regard here—and the above should help to explain at least some of the upper limiting factors.

All that remains, then, is to state those limits in simple terms; in general, the number of repetitions should be not less than six nor more than twenty—and in many exercises, limits of 8 to 12 repetitions should be observed.

If you practice less than six repetitions, it is unlikely that you will actually work far inside the momentarily-existing level of reserve ability—and if you exceed twenty repetitions, you will probably fail from a lack of oxygen, rather than from having reached a point of actual muscular failure, and again you would not be working inside the levels of reserve ability.

We do, on an occasional basis, perform sets of as few as four repetitions—but in general, sets of such a limited number of repetitions are not advisable; they are dangerous if performed in a proper style, and will accomplish little or nothing if not performed properly.

It should also be obvious by this point that doing "more" exercise is **never** the proper solution, and that no amount of extra exercise can compensate for exercises performed improperly; the style of performance of any exercise is perhaps the most important point of all—and this is far from being a simple matter, involving, as it does, such factors as proper resistance selection, speed-of-movement, calculated variation of power production from repetition to repetition, and other factors of equal importance.

"And," you may be asking at this point, "What does the difference between the performance of the 1955 car and the performance of the 1965 car have to do with the matter?"

Quite a lot; that was merely an example of the fact that the ratio of efficiency of the cooling system has a great deal to do with the ability to make practical utilization of potential power—in a car, or in a man. This one factor is responsible for a lot of the obvious differential in the performances of light-weight lifters and heavy-weight lifters; and it is also a factor to be reckoned with in training.

In an earlier chapter I mentioned that an increase in mass will always be out of proportion to the simultaneously occurring increase in surface area—and that heat is produced in proportion to mass, and cooling is provided in proportion to the surface area; which simply means that an increase in size will always result in a decrease in cooling efficiency—as you get larger, you get warmer.

And it should also be remembered that maximum-possible power production simultaneously and unavoidably produces a maximum-possible heat rise; which simply means that actually hard work must raise the temperature of the body. And since the body's efficient operating range is extremely narrow insofar as internal temperature is concerned, this means that a large man will not be able to sustain actually hard work as long as a smaller man can—everything else being equal; and this, I think, is another reason why most advanced bodybuilders fall into a habit of working at a lower intensity of effort and at a slower pace, with more frequent and longer rest periods between sets—which, in turn, reduces their production of results.

So again it should be obvious that you simply cannot escape the basic laws of physics—and that these effects must be understood and allowed for; if not understood by the trainee—and they seldom will be—they must, at least, be understood by the coach, or by the person outlining a program of training. And for the production of an actually worthwhile rate of progress from physical training, a program that is designed with these limiting factors clearly in mind must be followed exactly as it is outlined.

Remember—you can have an elephant's body, an elephant's head, four elephant's feet, and all of the other required parts, but you still won't have an elephant if all of the required parts are not fitted together properly.

Yet, in practice, I find that most bodybuilders start "changing things" almost immediately after they have been given a training program; and then wonder why they don't get the results they expected.

"Well", you may be thinking now, "this still doesn't justify a detailed description of the best fuel-air mixture settings for an airplane."

But perhaps it does; and in any case, that example was carefully chosen for a particular reason—or, actually, for several reasons, since there are several parallels with situations commonly encountered in weight training. Some of which parallels have already been mentioned—the fact that maximum power production unavoidably involves maximum heat production, the fact that an over-rich mixture actually reduces power production, and the fact that many bodybuilders (like most pilots) mistakenly feel that they are "playing it safe" by operating with an over-rich mixture—and some other parallels that might not be clear at this point.

While cruising, the pilot of an airplane should be primarily concerned with operating his engines for maximum economy—in order to extend the range and in order to avoid undue stress on the engines; and many; bodybuilders train as if they were trying to do exactly the same things—apparently for much the same reasons. While, of course, they should be trying to produce the results that the pilot is trying to avoid; they should be trying to impose "stress," and "extending the range" of their workouts is certainly not desirable.

A pilot should understand that increasing his cruising speed by as little as 5 per cent may require increasing his power output (and thus his fuel consumption) by as much as 100 per cent—and that doing so will obviously reduce his range; and a weight-trainee is faced with much the same situation, but with a difference—inducing growth-stimulation requires maximum-possible power production, which will unavoidably "reduce the range", make long workouts literally impossible.

And again, confusing the "amount of exercise" with "intensity of effort", most bodybuilders soon fall into a pattern of training more, but never actually training very hard.

If you train properly, you don't need an actually large "amount" of exercise; more than that, if you train properly, you can't **stand** much exercise.

A distance runner is interested in one thing, a sprinter is interested in something else; the distance runner literally must operate under "steady state" conditions that will permit long range operation—the sprinter must use all available power for one quick burst of speed. The distance runner certainly works more—and the sprinter just as certainly works harder; distance runners seldom have much in the way of muscular mass or strength—while good sprinters frequently do have impressive muscular mass in their legs, and are actually quite strong.

For the purpose of building muscular size-strength, it is important to perform "as much work as possible" within a "strictly limited time period", the period required to reach a point of actual muscular failure, and a period of time that is below the limit imposed by fuel-air factors.

Which adds the following to the list of basic points…

43. Exercises involving maximum power production must be performed at a fast pace, with little or no pause between repetitions.

44. The number of repetitions should be at least 6 and not more than 20 in all sets—and at least 8 and not more than 12 in some exercises.

45. Increasing the "intensity of effort" requires a disproportionate reduction in the "amount" of exercise.

46. A point of failure must be reached as a result of muscular failure.

“If you train properly, you don't need an actually large "amount" of exercise; more than that, if you train properly, you can't **stand** much exercise.”

Chapter 34: A Simple Example

The attention span of people being what it is, most readers will probably be hopelessly confused by this stage; because, even though the preceding points—taken one at a time—are actually quite simple, the number of important points, and the complex interrelationships involved, simply add up to a total of information that cannot be quickly absorbed by most people. And let there be no doubt on this score—it took me more than thirty years to fully realize the implications of the related factors as outlined in preceding chapters.

So I think it might be a good idea, at this point in the proceedings, to clearly and simply outline an actual training program that I might recommend for a beginning trainee—with no attempt to explain "why" the program is outlined as it is.

Let us assume, for this example, that the trainee is between 18 and 25 years of age, is 5 feet and 8 inches tall, and weighs 150 pounds (stripped) and has never engaged in any serious form of physical training—and, of course, is in normal health.

Available training equipment will be a barbell, a chinning bar, a set of parallel bars, and a squat rack—all of which can be purchased and/or built for less than $100.

At the start, I would suggest the following routine as a "break-in" training program—to be practiced daily for a period of 5 days in a row…

1. 1 set of 20 repetitions, full squat
2. 1 set of 20 repetitions, one-leg calf raises (1 set for each leg)
3. 1 set of 10 repetitions, standing presses, with a barbell
4. 1 set of 10 repetitions, regular-grip chins
5. 1 set of 10 repetitions, parallel dips
6. 1 set of 10 repetitions, standing curls, with barbell
7. 1 set of 15 repetitions, stiff-leg deadlifts, with barbell

During the first workout, the selection of weight to be used will necessarily be outright guesswork—but I would suggest the following as a start…

Squats.....100 pounds

Calf raises.....None

Standing presses.....80 pounds

Chins.....None

Parallel dips.....None

Standing curls.....60 pounds

Deadlifts.....100 pounds

If the trainee is unable to perform the indicated number of repetitions, then the selected weight is either too high or is approximately right—depending upon how close to the suggested number of repetitions the trainee can come; if 80 per cent or more (8 out of 10, or 16 out of 20, or 12 out of 15) of the suggested number of repetitions can be performed in good style, then the weight is not too high—but it might be too low.

If the trainee can perform the full number of suggested repetitions—or more—then the weight is too low.

But in any case, it will require about a week of experimentation to determine the proper resistance for each of the exercises; a properly selected resistance will permit 70 per cent to 90 per cent of the suggested number of repetitions.

During each of the first five workouts, the trainee should perform as many repetitions as possible—up to the suggested number; but should not exceed the suggested number of repetitions, even though he may be able to do so. If he can exceed the suggested number of repetitions, then he should increase the resistance during the next workout.

By the end of the first week of training (during the fifth workout) the trainee should know the proper resistance for each exercise.

Some muscular soreness can be expected to result from this first week of training—but by training fairly lightly for five days in a row, most trainees will avoid actually severe muscular soreness. After the first five workouts, a 72 hour rest should be permitted before resuming training on a regular basis; in effect, you might train Monday through Friday during the first week, then skip Saturday and Sunday, and resume training on Monday.

Starting on Monday the second week, the program should be changed to the following routine …

1. 1 set of 20 repetitions, full squat
2. 1 set of 20 repetitions, one-leg calf raises
3. 1 set of 10 repetitions, standing presses
4. 1 set of 10 repetitions, regular-grip chins
5. 1 set of 10 repetitions, standing presses (a second set)
6. 1 set of 10 repetitions, regular-grip chins (a second set)
7. 1 set of 10 repetitions, parallel dips
8. 1 set of 10 repetitions, standing curls
9. 1 set of 10 repetitions, parallel dips (a second set)
10. 1 set of 10 repetitions, standing curls (a second set)
11. 1 set of 15 repetitions, stiff-leg deadlifts

During the second week of training—and thereafter—the trainee should perform as many repetitions as possible in each set of every exercise, except stiff-leg deadlifts; regardless of the actual number of repetitions that can be performed. Do **not** stop simply because the indicated number of repetitions has been reached—continue until a point of failure has been reached.

In the squats, an actual point of failure (for the legs) has been reached when it is impossible to continue without excessive bending of the back; when you find yourself starting to straighten the legs fully while the back is still bent, that is the point to stop. In the deadlifts, continue to a point where the weight starts to feel quite heavy—but not to a point of actual failure.

But in all of the other exercises, continue to the point where another repetition in good form is literally impossible—but do **not** use cheating methods, maintain good form.

The first three or four repetitions in each set of every exercise should be performed at a speed well below the maximum speed that would be possible at that point—but starting with the fourth or fifth repetition, the speed of movement should be as fast as possible without jerking or body swing; the remainder of the repetitions in each set should be performed at maximum-possible speed—but the "actual speed" will be quite slow if the weight is as heavy as it should be, and the speed during the last one or two repetitions in each set will be extremely slow.

The above routine should be followed for at least three weeks—and perhaps as much as six, or even nine weeks; but in any case, it should be followed until such time as the trainee is obviously gaining rapidly in strength.

The program should not be changed until the trainee is capable of performing the proper number of repetitions with the following amounts of resistance…

Squats 15 repetitions with 200 pounds

Calf-raises 15 repetitions with 30 pounds

Standing presses 10 repetitions with 120 pounds

Chins 10 repetitions with 25 pounds

Parallel dips 10 repetitions with 50 pounds

Standing curls 10 repetitions with 100 pounds

Deadlifts 15 repetitions with 200 pounds

Some trainees will reach the above strength levels very quickly—others will take longer; but heavier training should not be undertaken at strength levels much if any below those listed.

When the trainee can perform at the above levels—on the average, although all trainees will obviously not reach exactly similar levels—then the program should be changed; by the time these strength levels have been reached, the trainee should have increased his bodyweight by at least 10 pounds—but **not more than 15 pounds**—and should be more muscular in appearance than he was at the start of training. If weight is gained too rapidly, or out of proportion to strength increases, then this is a clear indication that fatty tissue is being added—which is **not desirable**.

If a "pinch test" of the skin in the area of the waist indicates the addition of fatty tissue—if the skin is getting thicker in that area—then the diet is too high in calories, and should be reduced to a point where regular pinch tests indicate a slow loss of fatty tissue.

Up to the end of the second training program, the time factor is not critical—but excessive rest periods between sets should not be permitted. The entire workout (during the second program) should be completed within not more than forty-five minutes. Three weekly workouts should be used—on Monday, Wednesday, and Friday, or Tuesday, Thursday, and Saturday.

There will be a natural temptation to do "more"—to add sets, or new exercises; but fastest growth will result if the program is performed exactly as outlined.

At no time should the trainee attempt "maximum-possible single-attempt lifts"—don't worry about what you can press once, or how much you can squat with once.

When you are capable of reaching the designated number of repetition in squats, chins, parallel dips, and deadlifts, add 25 pounds to the resistance; increase from 100 pounds to 125 pounds, from 125 pounds to 150 pounds, and so on.

When you can perform the proper number of repetitions in standing presses, curls, and calf-raises, add 5 pounds to the resistance; from 80 pounds increase to 85 pounds—from 85 to 90, and so on.

In the chins and parallel dips, the first addition of weight to your bodyweight should be 25 pounds—a 25 pound barbell plate hung to your waist by a short rope.

In the one-leg calf-raises, the first addition of weight to your bodyweight should be 20 pounds—in the form of a 20 pound dumbbell (or two 10 pound barbell plates tied together with a rope) held in one hand.

With average subjects in anything except an outright "fat" condition at the start of training, no direct training for the abdominal area is required—nor is it desirable; proper performance of the other exercises will assure enough indirect exercise for this area of the body at first—and at no time is much in the way of direct abdominal exercise either required or desirable.

During the first few weeks of training the trainee should concentrate on learning the proper style of performing the exercises—and should constantly attempt to increase his strength; if increases in strength are being produced at a reasonable rate, and if the addition of fatty tissue is kept under control by watching the amount of food intake, then everything else will take care of itself at this point.

In the next chapter, I will outline additional—more advanced—training programs to follow the above training routines; but I cannot suggest too strongly that the more advanced programs should NOT be undertaken at strength levels much if any below those listed earlier.

Chapter 35: Advanced Training

In Bulletin Number 1, the so-called "Total Tonnage" theory was discussed, and I pointed out the outright stupidity of the thinking behind this theory. According to that theory, the "value" of a workout can be determined by adding up the "total tonnage" lifted; for example—ten reps with 100 pounds in the curl would total 1,000 pounds lifted, added to ten reps with 200 pounds in the squat (2,000 pounds) would give a total tonnage of 3,000 pounds in the workout.

Which, of course, is outright hogwash—since it is easily possible to lift an enormous "total tonnage" while doing nothing worthwhile—and just as easy to perform a very productive workout that involves very little "total tonnage". Secondly, according to that theory, ten reps with 100 pounds are exactly equal to two reps with 500 pounds—which is obvious nonsense; the "work performed" would be equal—but the power required and the results produced would certainly **not** be equal.

However—in spite of the totally invalid thinking involved in that theory—there is a lesson to be learned from the basic physics of the that theory, if **all** of the factors are considered. In the total tonnage theory, all of the factors were **not** considered—resulting in invalid conclusions—but in the following example, we will consider all related factors. And since the unavoidable conclusions resulting from such consideration are of particular importance to advanced trainees, I would suggest that every effort be made to understand the following example.

Let us assume, for this example, that you weigh 160 pounds in muscular condition—and that you have a 15 inch upper arm—and that you can curl 100 pounds for 8 reps in perfect form. Let us also assume that you are training three times weekly—and that you are performing four sets of curls in each workout. We will ignore the rest of your workout, since one example of the curl will be enough for explanation purposes, and since considering the entire workout would merely confuse the issue.

During workout No. 1 you perform as follows…

1st set 8 reps with 100 pounds total 800 pounds

2nd set 8 reps with 100 pounds total 800 pounds

3rd set 7 reps with 100 pounds total 700 pounds

4th set 7 reps with 100 pounds total 700 pounds

Grand total 3,000 pounds

And since you moved the weight vertically a distance of 2 feet during each repetition, we will multiply the 3,000 pounds by 2 feet—giving us a "total of work" of 6,000.

A while later, during workout No. 7, you perform as follows…

1st set 9 reps with 110 pounds total 990 pounds

2nd set 9 reps with 110 pounds total 990 pounds

3rd set 8 reps with 110 pounds total 880 pounds

4th set 8 reps with 110 pounds total 880 pounds

Grand total 3,740 pounds

Or a "total of work" of 7,480.

It will be noted, at this point, that you would be performing almost exactly 25 per cent more work during the seventh workout than you were during the first workout.

Yet, later, during workout No. 25, you perform as follows…

1st set 10 reps with 125 pounds total 1,250 pounds

2nd set 10 reps with 125 pounds total 1,250 pounds

3rd set 9 reps with 125 pounds total 1,125 pounds

4th set 8 reps with 125 pounds total 1,000 pounds

Grand total 4,625 pounds

Or a "total of work" of 9,250.

Up to that point, your growth may have been fairly rapid—and in the meantime, your bodyweight may have increased to 175 pounds, and your upper-arm to 16 inches; but then growth stops, or becomes very slow. Because, at that point, you have reached the limits of your recovery ability.

During the first few workouts, your strength level was such that your "total of work" never exhausted your recovery ability entirely—and thus rapid growth was possible, and occurred. But, later, when your strength level was higher, your larger "total of work" finally reached a point where it exactly matched (or closely approached) the limits of your recovery ability. Whereupon, growth became literally impossible—or slowed to a snail's pace. You were simply working "too much".

The answer is **not** a reduction in the weight used—no amount of light work will stimulate muscle growth; instead, the answer is perfectly obvious, **reduce the number of sets**. If you had done only the first two sets of workout No. 25 (instead of four sets), then the "total of work" would have been only 5,000—instead of the 9,250 produced by four sets; your recovery ability would **not** have been exceeded (or entirely used up) and growth would have resulted, fast growth.

The lesson to be learned from this simple example should be obvious to almost anybody—but in fact, most bodybuilders act as if they firmly believe that an exactly opposite state of affairs exists; advanced trainees require **less** training than beginners—**not more, less**.

Beginning trainees gain faster than advanced trainees in almost all cases for a very simple reason—simply because their strength levels are such that they don't entirely use up their recovery ability in each workout. Later, when they get stronger, they **do** use up all of their recovery ability—and growth stops.

Certainly the limits of your recovery ability increase—or, at least, they should—but there will always be a limit, a limit that must not be exceeded, nor even closely approached.

A beginning trainee in good health will almost always produce a fairly good rate of progress on a program of four sets of twelve basic barbell exercises—but later, he will do much better on only three sets of each

exercise—and yet later, he will find growth impossible if he does more than two sets of the same exercise. Eventually, he may have to reduce the number of basic exercises to only eight, while still doing only two sets of each exercise; and finally, he may have to perform only two weekly workouts of two sets of each of eight basic exercises. Thus, in practice, as he becomes larger and stronger, he may have to reduce the number of weekly sets from 144 to 108—then to 72—then to 48—and finally to only 32 weekly sets. In the end, he will be doing less sets weekly than he was performing during each of his starting workouts.

There will, of course, be some individual variation—but only within certain limits, and the basic principles remain valid in **all** cases.

However—do not misread the above to mean that I am suggesting that even a beginner **should** perform forty-eight sets in each of three weekly workouts; I merely said—and I clearly meant—that most healthy beginners can actually "stand" more sets than more advanced trainees. In best practice, beginners should start out fairly light, then gradually increase the number of sets, but they should eventually reverse the process—actually reduce the number of sets, and/or the number of exercises, and/or the number of weekly workouts.

If constant efforts are made in the direction of true progress, if you try to do more reps in each set of every exercise, and if you always increase the resistance in proportion to your strength increases, then growth can be, should be—and in most cases, will be—very fast; not fast only for beginners, but fast for anybody, regardless of his existing level of strength or muscular size, right up to the top level of momentarily-existing potential.

With some few notable exceptions, advanced bodybuilders as a class are certainly an odd group—to say the least; having far too many quirks in common, sharing too many common misconceptions—far from being the "experts" they consider themselves to be, they possess less actual knowledge in regard to their chosen activity of weight training than is contained in a brief, simplified outline of progressive resistance exercise intended for a rank beginner. Assuming, of course, that such an outline wasn't written by an advanced bodybuilder—in which case, it is probably worthless, hopelessly confused, stuffed with outright nonsense.

But a lack of actual knowledge—and/or a belief in outright myths—is not the only characteristic of the average advanced bodybuilder; fear, self doubt, a hesitant approach to almost everything, a sometimes fairly well concealed cauldron of boiling emotions, an outright (but strongly denied) conviction of personal inferiority—these and similar character traits are very commonly encountered in the ranks of advanced bodybuilders. In almost all cases, bodybuilding is rudely pushed into a resented second place—many such people would train twenty-four hours a day, seven days a week, if they could, most such people would do nothing in the way of worthwhile work if they could possibly avoid it, almost all such people restrict their interests and limit their conversations to bodybuilding activities.

Then, having reached the "top"—as only a very few bodybuilders ever do—most such people are surprised to find that there is nothing there, no rewards, no applause, literally **nothing**. Average people look upon them as freaks, most girls avoid them or ridicule them, nobody outside a very narrow circle of close associates has any respect for them—so, was it worth the price?

Apparently many thousands of young men—and many men not so young—seem to think so, because they keep trying, following the same path to nowhere, heeding the same lies, paying attention to the same worthless advice, believing the same myths; and the pitiful part of it is that they very goal they are seeking can be reached much more quickly without any of the sacrifices that most bodybuilders impose

upon themselves. But since I don't honestly think that I can reach many—if any—advanced bodybuilders through the medium of the written word, and since it is very difficult to reach them even when given an opportunity to communicate with them in person, I consider almost all advanced bodybuilders lost causes—men doomed to continue in ignorance, fated to run their hearts out on a treadmill of mistaken beliefs.

By the time they do reach to top in bodybuilding circles, most such men have wandered too far astray to find their way back to actual sanity—even if offered a guiding hand of fact; which is not meant to imply that advanced bodybuilders won't listen to new ideas (ideas new to them)—on the contrary, most advanced bodybuilders are anxious to hear all of the details of any idea that even appears new to them. But having heard it, perhaps having discussed it or read about it for months in all possible detail, they will seldom try it—or if so, impose their own restrictions, their own "changes", so that in practice the idea is not being tried at all.

Regardless of how often you tell an advanced bodybuilder that, for example, "…you must **not** do more than two sets of this exercise in each workout," he will still be tempted to do from four to ten sets; and if left to his own devices, **will** do from four to ten sets—then, later, will claim, and will probably honestly feel, that he tried the suggestion, but that it didn't work for him. When, in fact, he hasn't tried it at all.

It takes most advanced bodybuilders several years of almost constant training to reach the top—and having done so, they then look upon their own training routine as being ideal; nor do they even seem to notice that literally dozens of other trainees in the same gym are following exactly the same routine—with little or nothing in the way of results. Where one man eventually produces results—dozens of others do exactly the same thing, train the same way, train the same amount, follow the same diet, use the same drugs—**but fail**.

If a training method is actually productive, then it doesn't work for only one man out of dozens, or even thousands—a good training method will work well for almost anybody; the degree of final results will largely be determined by individual potential even when a good training method is used—but progress towards the muscular size-strength limits imposed by individual potential can be, should be, and with an actually good training method and routine will be very rapid, in all cases involving healthy individuals.

Within a year of the first widespread availability of the new Nautilus training equipment, it is already apparent that most advanced bodybuilders simply refuse to use this equipment in accordance with the very carefully stated instructions; there are exceptions, of course, and almost all of the people who are using the equipment properly are making literally spectacular progress, the best progress they have ever experienced—but most advanced bodybuilders use the equipment exactly as if it was a barbell. Which might not be so bad if they even knew how to use a barbell properly—which they don't, using a barbell far too much, far too often, and not "hard enough".

For the above reasons and for other reasons, I will not outline detailed training programs for advanced men—knowing, as I do, that few if any advanced bodybuilders would even bother to try such suggested programs, and that probably no single advanced bodybuilder would actually try it in the manner described; instead, most of them would do "three times as much," at least "twice as often as they should," and would not train "hard enough", and afterwards would complain that they tried it, but that it didn't work.

But I will point out the fact—and it is a fact—that any advanced bodybuilder who is using a total of much if any more than 90 sets a week is training too much, and that most people will gain best on a training routine of 50 sets a week, or less.

And I will also point out the fact that any set that stops much if any before a point of muscular failure is a wasted set—will do little or nothing to stimulate growth, but will exhaust part of the recovery ability and thus make growth more difficult.

But in the meantime, scattered all over the country, at least a few hundred advanced bodybuilders are training "right"—and the word of their progress is gradually spreading; within another year, a few thousand trainees will be training properly—then tens of thousands. But even fifty years from now, many advanced bodybuilders will still be beating their brains out with twenty or thirty weekly hours of training—still not aware that only ten per cent of that amount of training would actually produce far better results.

"If constant efforts are made in the direction of true progress, if you try to do more reps in each set of every exercise, and if you always increase the resistance in proportion to your strength increases, then growth can be, should be—and in most cases, will be—very fast; not fast only for beginners, but fast for anybody, regardless of his existing level of strength or muscular size, right up to the top level of momentarily-existing potential."

Chapter 36: The Ultimate Physique

During the time that he was in DeLand for a brief visit, a recent Mr. America told me that he was one of two surviving triplets—and that his brother actually has better calves than he does, even though the brother has never trained with weights. Later, I saw both brothers together—and the untrained man does have the best calves; which simply means that the former Mr. America has managed only to reduce both the size and muscularity of his calves by several years of hard training. His outstanding calves are a result of heredity—and would probably have been better than they are if he had never trained them.

Yet, later, upon hearing that I had mentioned this fact in an article for Iron Man, this man called in an attempt to reach the publisher of that magazine—in order to lodge a strong complaint, demanding that this fact not be published. Why? Since it was the man in question who pointed it out to me in the first place.

Apparently because, now, he intends to give the credit for his calf development to a machine to be touted by an associate of his—a man who has already joined forces with several other men in an attempt to copy some of my machines.

But my point here is this; a lot of what can be done in any individual case is entirely dependent upon heredity—some people, like the man mentioned above, will have outstanding development in at least some body parts with absolutely nothing in the way of training, and some people will never reach an equal degree of development, regardless of how they train, no matter what they eat, in spite of any and all efforts in that direction.

But most people can reach a degree of muscular size-strength that is probably far beyond anything they might believe—and given good heredity, some few men can reach a level of size-strength that is almost unbelievable to anybody. Now please note, I am not talking about what is, or what is not, "desirable"—I am merely talking about what is possible; that which is highly desirable to some people might be actually repulsive to some other people—but since most of the readers of this bulletin are probably interested in at least attempting to reach their own particular limits of muscular size, the following points should be of interest.

To begin with, most of the claimed measurements of top bodybuilders are simply untrue. The largest muscular arm that I ever measured—or saw—was Sergio Oliva's, which, accurately measured, "cold" was 20 1/8 inches. Arnold Schwarzenegger's arm was 19 7/8, slightly pumped—probably 19 1/2 "cold". Bill Pearl's largest arm, his left arm, was 18 5/8 at a bodyweight of 222 in 1960—at the 1971 NABBA Mr. Universe contest in London, his publicized arm size was listed as 20 1/4, but it was obvious to me that his arms were actually smaller than when I measured them in 1960, and it was obvious to anybody who saw the two men side by side that Sergio's arms literally dwarfed Bill's arms, and now you know how big Sergio's arms were at the time.

Casey Viator's arms were 19 15/16 at their largest when he was training in DeLand—and were 18 1/16 when he first came to DeLand, immediately after the Mr. America contest in 1970.

But the "appearance" of size of an arm is only partially dependent upon its measurement; Bill Pearl's forearms look very large, but in fact are not very large—Boyer Coe's forearms look quite small (in comparison to his upper arms), but in fact are actually larger than Bill Pearl's. The insertion point of Bill's

forearm muscles is far down the arm, near the wrist, and as a result the major mass of his forearm muscles occurs near the middle of his forearms—making them appear large; Boyer's insertion point is much closer to the elbow, thus his forearms are largest up "high" and don't appear as large as the actually are.

Many other factors also affect the appearance of size—the overall size of a man, the size of his head, the length of his arms, the shape of his arms, etc. Thus, an arm might measure 17 inches and look quite large, or measure 18 inches and appear to be a little above average size. But in fact, an actually muscular arm that measures a full 18 inches is enormous—a 19 inch arm is simply huge—and a 20 inch arm almost defies belief; claiming 20 inch arms—or even larger measurements—is common today, but I have measured many of the largest muscular arms in the world, Pearl's, Coe's, Schwarzenegger's, Viator's, Oliva's, Caputo's, and many other men's arms, and I have measured only one 20 inch arm—and while I haven't measured the arms of literally "everybody" on the bodybuilding scene, I have seen all of the better-known bodybuilders standing immediately next to one of the men I have measured, and the arms of Oliva and Schwarzenegger literally dwarf the arms of any other men I have seen.

In many cases, the actual mass of an arm may be quite large while the measurement may not be so large; if the biceps and triceps are "longer" than normal, then the bulk of muscle may be far out of proportion to the measurement—and the same thing is true in regard to the forearms. Both Casey Viator and Sergio Oliva have very long forearm muscles—and while both of these men have much larger than average forearm measurements, the actual mass of their forearm muscles is even greater than the measurements might indicate; Casey's forearms are nearly 15 1/2 "cold", straight, at right-angles to the bone—Sergio's forearms are a bit over 15 1/2 measured in the same manner. By comparison, Bill Pearl's largest forearm was 13 3/4 inches.

Sergio Oliva's biceps muscles are so long that he has much less than the normal range of movement around the axis of the elbow, something on the order of 120 degrees of rotary movement—as opposed to nearly 160 degrees of movement in the average man; he simply cannot "bend his arms" as far as most men can—but this has litter or nothing to do with his degree of development, it is, instead, a result of much longer than average biceps muscles. Arnold Schwarzenegger's arms are almost as large as Sergio's, and he shows no signs of restricted movement around the elbow joint. Secondly, since the greatest thickness of Sergio's forearms occurs near the middle of his forearms, it happens that this also serves to restrict his movement—instead of fitting into the normal hollow of the biceps just above the elbow, the mass of his forearms meets the middle of his biceps.

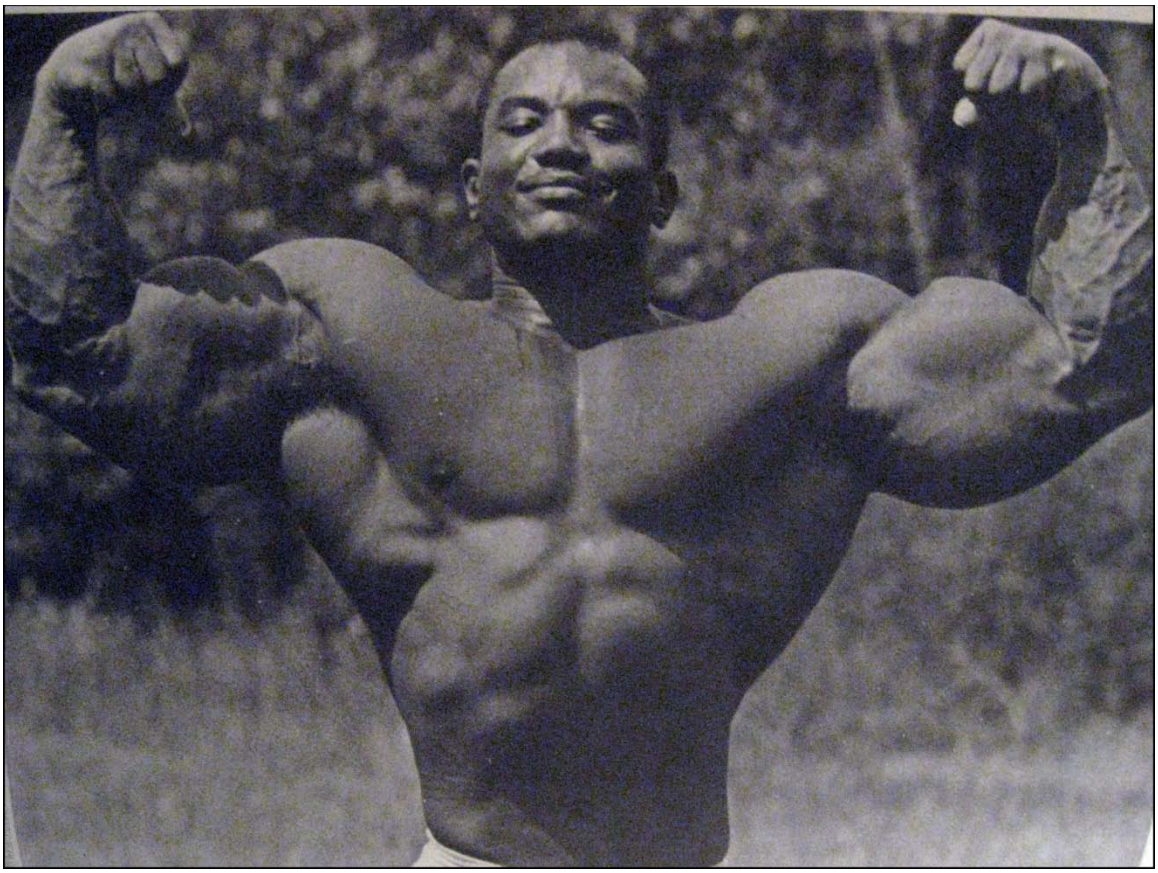
Thus, while his arms are the largest muscular arms I ever saw, Sergio's arms are actually "larger than they measure"—the mass of muscle is far greater than the measurement would normally indicate; which, of course, is a result of heredity—not something that can be changed, and not a result of his training. While his training obviously produced his present size, his heredity made it possible.

His limited range of movement, however, prevents Sergio from fully contracting his biceps into the high "peak" displayed by many advanced bodybuilders—he simply can't bend his arms far enough to reach the required degree of contraction; this it might well be that Sergio's arms would measure more than they do if they were actually a bit smaller—if this reduction came in the form of "shorter" biceps and/or "higher" forearms.

But, regardless of their measurement, Sergio's arms are so big that they literally must be seen to be appreciated—and some people, upon first seeing them, are almost unable to believe their eyes; in a recent full-length picture of Sergio, the width of the flexed upper arms exceeded the height of Sergio's head—his arms were literally larger than his head, a size ratio never before approached by anybody else.

Is that, then the "ultimate physique?" For most people, it is far beyond the limits imposed by individual potential; but it is almost certain that somebody will eventually exceed even Sergio's present size and proportions. I recently measured the "cold" upper arm of a 19 year old boy in New York at 19 1/2 inches, and with continued training this boy can almost certainly exceed Sergio's measurements—but he is at least six inches taller than Sergio, so even with Sergio's measurements he would not have Sergio's almost unbelievable proportions, would not give the "impression of size" that Sergio does.

I am reasonably certain that Sergio could attain even more size with continued training—while maintaining or improving his present degree of muscularity (muscular definition), and if so, then his proportions would be almost unreal. But in the meantime, until he does get larger, or until somebody at least matches his present proportions, Sergio certainly does represent the "ultimate physique".



Chapter 37: Proper Form

The form—or "style of performance"—required for producing good results from weight training is a much talked about, but little understood, point of importance. The "amount of work performed" and/or the "power produced" will in most cases be the same regardless of the form used—but at the point, similarities cease.

If, for example, you are doing curls with a barbell—using 100 pounds for ten reps—the amount of work performed will be the same regardless of how you perform the movements, and the amount of power produced will be the same if the "speed of movement" is the same; but if cheating methods are used, then it won't be the bending muscles of the arms that are performing all the work—or producing all of the power. You will, in that case, be working your lower back muscles, your shoulders, and even your legs—and very little of the work will be done by the arm muscles, But the muscles you are trying to work; as a natural result, little or nothing in the way of arm development will result from any amount of exercise.

But the above is not meant to imply that "cheating" methods should never be used—on the contrary, they; should be used, they should be used in almost every set, and in every exercise where they can be used to an advantage; but they should be used only at the end of a set, only when several repetitions have been performed in perfect form, only when it becomes absolutely necessary to cheat in order to continue, and you should cheat only to the degree necessary, cheat to make continued movement possible, not to make it easy.

In a curl, for example, the first six or seven repetitions should be performed in literally; perfect form—with no body-swing, no heave, no leaning back under the weight at the end of the movement; the arms should raise the weight throughout the entire range of movement, with no assistance from other muscles. But if the selected weight is proper, it should become impossible to continue while maintaining perfect form after six or seven repetitions have been performed; if you can perform eight (or more) repetitions without cheating, then the weight is too light and should be increased for the next workout.

But, regardless of the number of repetitions you can perform in perfect form, don't stop at any particular number, and don't stop simply because cheating becomes necessary; instead, do as many repetitions in perfect form as you can—and then do two or three more repetitions, which will require cheating. But cheat as little as possible, cheat the absolute minimum amount required—if the weight swings up rapidly and flops into the top position, then you are doing nothing worthwhile, nothing of any value for the arms at least, simply burning up energy for no good purpose.

If you can perform only four or five repetitions without cheating, then the weight is too heavy—and should be reduced; in most cases, try to select a weight that will permit seven reps in perfect form—then do a total of ten reps, cheating only as much as absolutely necessary during only the last three reps. Or, if your "guide figure" (the number of repetitions you are trying for) is 15 reps, then use a weight that will permit about 12 reps in perfect form; in effect, use a weight that will permit 70 to 80 percent of the number of reps called for in the guide figure—then cheat two or three extra reps.

And remember—while it is necessary to produce maximum-possible power in order to stimulate growth, it is **not** necessary to do so while you are actually strongest, actually able to produce the "most" power; the same degree of muscle-growth stimulation will be produced if such maximum-power production

occurs only near the end of a set of several repetitions, at a point where your actual power production may be quite low—at a point where the earlier, non-maximum repetitions have weakened you momentarily.

Thus, while you could move quite fast during the first repetitions without cheating, restrict your actual speed of movement to a speed well below what you could do—until at least the fourth repetition. In effect, the first three or four repetitions will move slower than necessary—but after the fourth repetition, move the weight as fast as possible without cheating; which movement will be, in fact, quite slow. In this manner you will **not** be producing maximum possible power during the first three or four repetitions—but you will be producing maximum possible power during the last several repetitions; and you will be **greatly** reducing the danger of injury. Also remember—you are most likely to hurt yourself during a "first" repetition simply because you are strongest at that point; and so long as good form is maintained—including properly performed cheating methods—you become less likely to hurt yourself as you continue with the set, the second rep is less dangerous than the first rep, the third rep is less dangerous than the second rep, etc.

Although, of course, it is possible to hurt yourself in any rep; but in practice, most injuries occur during first reps—and these injuries that occur during later reps are usually caused by using poor form.

It is not, however, necessary—nor desirable—to use an extremely slow speed of movement during the first few reps of a set; if, for example, you could curl a barbell in one-third of a second, then it is not necessary to restrict your speed to a point where the first rep takes two or three seconds—instead, perform the movement at a speed where perhaps one second is required for the complete "upwards" movement.

Nor is it necessary to attempt to measure the time required; you can, rather easily, "feel" the required speed—you will almost always know if you are actually moving as fast as possible, or not doing so.

Thus, during the first three or four repetitions, move at a speed that you "know" is below maximum possible speed—below **momentarily** maximum possible speed. And during later repetitions, move at absolutely maximum possible speed—but using good form, avoiding jerking; a speed that will be quite slow in fact.

For safety—and for producing good progress—form is one of the most important points; **never** sacrifice form in an attempt to use more weight or perform more repetitions—but **always** use as much weight as you can, and **always** perform as many repetitions as you can, in good form.

Chapter 38: What to Expect

Ultimate development, as I have pointed out repeatedly, primarily depends upon individual potential—which is hereditarily determined. But such ultimate development will not result without proper training—good heredity merely makes good results possible, it doesn't produce them.

More than a generation ago, a well-known, greatly respected—and probably well-meaning—scientist clearly stated in print that he could, "…take any child at a very early age, and make him into anything I desire." (Or words to that effect) Meaning, simply, that environment was "everything"—and that heredity was "nothing", or almost nothing.

He probably believed what he was saying—and, unfortunately, a lot of other people believed what he said also; then, later, for political and/or "humanitarian" reasons it became popular to believe such outright hogwash, such a self-evidently false statement—and, now, most of the really worthwhile developments of civilization have been all but destroyed by people who have based their actions on this belief. Race-hate talk? Don't be ridiculous—a simple statement of the fact that people are different, sexually different, individually different, and racially different; the average "Nordic type" couldn't duplicate the muscular definition of the average Negro short of almost literally starving himself to death—and the average Negro couldn't rid himself of the fat stores in the area of his buttocks without starving himself.

Also—the average Negro has "high" calves and "high" forearms, and regardless of the size of his calves or forearms they will never look as big as they really are; yet Sergio Oliva is a Negro, and he has very "low" calves and very "low" forearms—perhaps the best forearms in the world, and calves that compare favorably with anybody's.

But Sergio is not a typical Negro insofar as his muscular shape is concerned—and he is not even typically "human" insofar as his muscular size is concerned; he is an individual, like all of us, simply a very outstanding individual, a very unusual individual, a rare type of individual—almost one of a kind.

Insofar as physical "types" are concerned, there seem to be two rather distinct categories—the type that easily develop large limbs but never quite bring their torso muscles into proportion—and the type that build large torso muscles and never reach a proportionate degree of development in their arms and legs. And, of course, a third—rather rare—type that can build overall size and maintain good proportions; Sergio is an example of this third type—Casey Viator is an example of the first type (a "big limbs" type)—and Ellington Darden is an example of the second type.

Such differences are hereditarily determined—and if all of the muscular structures of the body are developed as much as possible, then the final proportions may or may not be pleasing; but if the final result is not pleasing, then all you can do is purposely neglect the development of some of the muscles—in order to restore good proportions.

By contemporary physique standards, a man with ideal proportions insofar as function is concerned would stand no chance of winning—not, at least, if all of his muscular structures were developed as much as possible. Which is unfortunate, since it simply means that the people who "look strongest" are actually not as strong as they look—and nowhere near as strong as some men who don't look very strong at all. Perhaps our standards are wrong; but it is certainly not surprising that bodybuilders and weight-

lifters have gradually drifted apart—which is wrong, because appearance of strength, or actual strength, depends primarily upon heredity, but increasing one increases the other, in direct ratio.

Nobody could reasonably expect a man who was only five feet tall to become a champion basketball player against opponents that are seven feet tall—but people do expect bodybuilders with outstanding muscular size (which size in many cases, is a result of very poor leverage factors) to be very strong; which is also unreasonable.

So don't expect unreasonable results; but you can expect—and you can produce—results far beyond what most people believe possible. The greatest danger—and it is a danger, today—is falling into dangerous training habits so widespread at the moment, the use of drugs, the exotic diets, over-attention given to training itself, or simply believing any of the hundreds of outright myths so firmly supported by most bodybuilders and weight-lifters. By and large, if you have been fortunate enough to avoid such contact up to now, the best thing you can do is to stay entirely away from "experienced" trainees—most of who can tell you nothing of any value, and almost all of whom will lead you astray.

But while it is neither necessary nor desirable to seek the advice of experienced trainees, it does not follow that nothing of any value can be gained from the experience of others; on the contrary, the experience of others can save you—and should save you—an enormous amount of personal experimentation. Thus, for example, it is not necessary to invent, design, and build your own tools—a good available tool already exists, the barbell; nor is it necessary to invent specific exercises—which already exist. But it is necessary to choose which exercises to use—since you can't use them all—and it is necessary to decide how to use these exercises, how much to use them, and how often to use them; and in these areas, advanced trainees will merely lead you astray in the direction of their individual bias. This bulletin is designed to lead your thinking in the direction of a logical approach to the matters involved; you can reasonably expect nothing more from me—nor from anyone.

But you can expect to encounter stumbling blocks along the way—obstacles that, in the end, you must overcome for yourself. And you can expect to encounter some problems that will never be solved—since, at this point in history, physiology is certainly not yet an exact science.

Chapter 39: A Realistic Goal

Exercise is certainly a requirement for normal health—yet, over the years, an outright mythology; concerning exercise has arisen; in the opinion of the average person, the results produced by exercise are somehow "different" from muscular size-strength that comes from regular work. Thus we commonly hear the terms "real strength" and "natural strength"—and the size-strength produced by exercise is looked upon as temporary, or useless, or even dangerous.

Part of such opinions are an expectable result of jealousy—perhaps brought into the open by the fact that outstanding muscular size, unlike high intelligence or great wealth, cannot easily be hidden from the view of others. Comic strip characters are almost invariably given the physiques of advanced bodybuilders—but such development is always presented as "natural"—supposedly, they just grew to such proportions; if they were required to train in order to build or even maintain their muscular size, then that would somehow change their image in the public mind.

Because of this widespread feeling, most advanced bodybuilders soon find themselves living apart, confined to the company of other bodybuilders or of people attracted to bodybuilders for some reason. In our present society, it is almost impossible for the average person to stand out in any way—yet most people are encouraged to stand out, and then considered freaks if they do. A lot depends upon your individual desires—how much attention you want, or can stand—and a lot depends upon your ability to view things in a practical light; I am reminded of Mark Twain's "two-headed stranger"—upon seeing him, one boy remarked that he wouldn't want to be like that, but another boy viewed the possibilities in a more practical light, he said, "…Oh, that would be dandy, eat for two but only stump toes for one."

Twenty-odd years ago, when I was in hard muscular condition at a weight of over 200 pounds at a height of just under 5 feet 8 inches, I made it a point to **never** appear in public in anything except loose-fitting, long sleeved shirts—and as a result, most of the people who knew me were unaware that I had ever trained; a friend of mine surprised me one day when I was loading a film magazine—with my shirt off—and he was literally shocked. We had flown together, traveled together, and he had known me for years—yet he never suspected that I trained with weights. Arnold Schwarzenegger and Bill Pearl both make a habit of wearing loose-fitting clothing—and in spite of their size, these men can and do pass in a crowd unnoticed. But most advanced bodybuilders do everything they can to call attention to their size—and then seem to be surprised by the reactions they produce.

In general, unusual muscular size will **not** attract favorable attention; thus, if your well-being depends upon the opinion of others, then attracting attention because of your physique will almost always hurt you far more than it will help you—in the public mind, a man with an outstanding physique "has nothing else," or, even, "can have nothing else." Which, of course, is outright stupidity—but stupidity that can and will hurt you if you are unaware of it.

Attracting actually favorable attention—untainted by jealousy—seems to be almost impossible; so, in the end, it comes down to what you desire—or can stand. But it should be remembered that the price of attracting attention as a result of your physique is always high.

Insofar as "just how much" muscular size-strength you can build—which seems to be the only question of importance to most trainees—it does not now appear that anybody has ever reached his actual limits;

and, paradoxically, it appears that most trainees literally prevent themselves from closely approaching their limits of muscular size—primarily by overtraining.

Almost without regard for your starting condition, size of bones, or even your age (within reasonable limits), you should be able to quickly build a level of muscular size-strength that will amaze most people—and some few individuals can reach a muscular size that would amaze anybody; but it now seems to be clear that quickly reaching such a degree of development requires an actually very small amount of training—and please note that word "requires", since it should be clearly understood that more training will literally prevent better final results.

Without single exception up to this point, we have been able to add from 3/8 of an inch to 1/2 inch to the cold measurement of the upper arms of advanced bodybuilders within a matter of a very few days of proper training—even when these same individuals have been unable to add as much as 1/8 inches to their arms as a result of several years of steady training. Having reached what they consider their maximum-possible muscular size, such men are literally shocked to find themselves suddenly growing again—growing fast. Sergio Oliva's arms were huge before he ever heard of DeLand, Florida—but look at the picture of him in this bulletin, his arms were never before "that big." Franco Columbu was one of the strongest men in the world before he came to DeLand for two weeks of training, but his arms were not as large as they should have been to be in proportion to his other muscular structures—ten months later, when I saw him in New York, his arms were a full inch and a quarter larger. After ten years of steady training—two years with no gains at all—Chuck Amato has gained nearly two full inches in arm size. Casey Viator, starting with arms that were already huge, added a full inch and a quarter to his cold upper-arm measurement. Dozens of other men have done as well—or better; from very brief training.

Eventually, somebody with outstanding potential will start training properly right from the start of his career—and two or three years later, we will see an example of muscular size far beyond anything ever produced up to this point. Will such size be attractive—or even desirable? Attractive? To the average person, certainly not. Desirable? That, of course, is a matter of individual taste; but such an example will be, at least, valuable for scientific purposes—as an example of what can be done. At this point, we don't even know what such a man will look like; since changing the size of a muscle unavoidably changes the shape of the muscle, nobody can yet say just what a fully-developed muscle will look like.

But I can tell you at least this much; if an advanced bodybuilder had suddenly appeared on the scene 400 years ago, he would probably have been burned at the stake—and if you have the potential for unusual muscular size, and if you actually build such size to a maximum-possible degree, you will undoubtedly be looked upon as an outright freak.

In my opinion, a realistic goal is far better—build as much size as you need, but not enough to put you in a class with the freaks; but if becoming a freak is your goal, then there is only one way to do it—and overtraining is **not** the way.

Chapter 40: The Present State of The Art

Someone once said that, "…nothing can stop an idea that's time has come." And the time has certainly come—the time for improvements in both methods and systems of training, tools and the use of tools. The new Nautilus Machines are not the only new development on the scene at the moment—because the time is right, quite a number of people are working on totally new concepts in the field of exercise; and, as is only to be expected, each new development has its own supporters—and according to those supporters, each new development is the "best".

But the above is not meant to imply that I am talking about people attempting to copy the ideas of other people—although, of course, there is (always will be) a certain amount of that, too; rather, I am talking about new, but different, ideas—different approaches to the same problems.

The barbell is a good tool, a tool that is capable of producing an almost unbelievable degree of muscular development—but a barbell is not a perfect tool; after reading Bulletin Number 1, and after reading this far in this bulletin, intelligent readers should be aware of most of the basic shortcomings of the barbell—so I will not again list those shortcomings here. But I will outline the problems involved in providing an actually perfect form of exercise.

The main trouble seems to stem from the fact that humans are "rotary animals: powered by "reciprocal muscular structures," living on a planet with "reciprocal resistance".

In effect, we are designed to work against rotary resistance—yet, in practice, we seldom encounter anything except reciprocal resistance. Did you ever wonder, for example, why screws are designed with a "right hand" thread? Because most people are right handed, and because right handed people have more power for making clockwise movements than they do for making counterclockwise movements. When you are turning a tool in a clockwise fashion, with your right hand, then the primary function of the biceps is aiding the work—and you are strongest.

And why is your thumb located on the "top" of your hand instead of on the "bottom"? Because, with the thumb located as it is, it serves as an anchor for the entire hand during clockwise movements of the right hand. Try twisting your hand hard in a counterclockwise direction and see what happens; in such cases the thumb is of little or no assistance for maintaining a firm grip—to be of assistance for movements in that direction, the thumb would have to be located at the bottom of your hand, directly opposing your little finger.

Nor would a centrally located thumb—opposed to your middle finger—be a satisfactory compromise; during twisting movements to the right (clockwise) with the right hand, it is the top of the hand that needs to be anchored—the bottom of the hand is pressed even harder against the object being gripped during such movements, but the top of the hand would be pulled loose if it was not anchored by the thumb as it is. The left hand is provided for strong counterclockwise movements—and for that reason, it is a mirror image of the right hand, rather than a duplicate.

Before it is even possible to design a rational exercise tool, it is necessary to fully understand exactly what the actual functions of human muscular structures are—it is not enough, not nearly enough, to design a tool that will simply provide resistance; a pick and shovel will provide more work than you can stand, but will do very little in the way of building muscular size-strength.

Normal levels of muscular size-strength occur as a part of normal growth, and little or nothing in the way of exercise is required for reaching such normal levels of development; but we are here concerned with abnormal levels of size-strength—we wish to build maximum-possible levels of size-strength, and in the shortest possible period of time, and as a result of the least possible effort. In short, we are looking for the most productive method of exercise.

A healthy body will provide levels of size-strength that it (the body) feels is adequate to provide for normal requirements—and a bit more, as a reserve for emergency utilization. And so long as the existing levels are adequate, so long as impossible demands are not made upon the body, no additionally size-strength will be provided—because it is not required. Thus, to produce growth in excess of normal growth, we must make demands in excess of normal demands—and then, if it can, the body will provide the size-strength required to meet these demands. But, please note that "**if it can**."

The body is a very complex factory, constantly making literally hundreds of delicate chemical changes—converting fuel and oxygen into the many chemicals needed by the various parts of the system; in a healthy body the system works perfectly—being capable of meeting all requirements and still maintaining a reserve ability for emergency use. But there is always a limit to the amount of such chemical conversions that the body can make within a given period of time—and if you exceed that limit, the body will eventually be overworked to a point of total collapse, or even to the point of death.

You could, for example, run for ten minutes—and then rest for twenty-three hours and fifty minutes—and then run for another ten minutes, and so on; because, in twenty-three hours an fifty minutes, the body can easily recover from a ten minute run.

And you could run for thirty minutes—and then rest for twenty-three hours and thirty minutes, and so on.

And you could run for one hour—and then rest for twenty-three hours, and so on.

But you could not run for sixteen hours—and then repeat such a run after only eight hours of rest. And if you tried to, you would steadily (and quickly) grow weaker—because you would be exceeding your recovery ability.

If you started out with daily runs of ten minutes, and gradually increased the amount of daily running, your "running ability" would increase—up to a point; having reached that point, you could then continue with daily runs of a certain length (which length would vary on an individual basis)—and afterwards your "running ability" would remain unchanged. So long, at least, as you **did not increase your speed**.

But, having reached a point where your daily runs exactly matched your tolerance for running, if you then started running for the same period of time but ran **faster**—then, obviously, you would also be running **more**, and would thus be exceeding your tolerance for running. In which case, your running ability would gradually be reduced—and, finally, if you continued running, you would reach a point of collapse.

Because you would be making demands on your system for chemical changes which the body could not provide—you would be exceeding your recovery ability. The result would be, could only be, "negative growth"—and actual loss of muscular size-strength.

The "recovery ability" of the body provides normal growth—and it also provides abnormal growth, if such abnormal growth is required, and if the recovery ability is able to meet the requirements.

It should be clearly understood that it is easily possible to totally exhaust the recovery ability, or even exceed the recovery ability, while doing absolutely nothing to stimulate abnormal growth. Obviously, then, to be productive, an exercise must stimulate abnormal growth as much as possible—while disturbing the recovery ability as little as possible; an ideal exercise would be infinitely hard—and infinitely brief—would provide maximum-possible growth stimulation, while leaving the recovery ability in the best possible shape to meet the requirements for growth.

A barbell is far more productive than previously-existing exercise tools simply, and **only**, because it provides harder exercise—but a barbell still leaves a lot to be desired; because, while barbell exercises are harder than free-hand exercises (for example), they still are not as hard as they should be.

With the relatively unimportant exceptions of such movements as wrist curls, side raises, shoulder shrugs, and a few other barbell (or dumbbell) exercises, most barbell exercises work only a part of human muscular structures; in most cases, a barbell literally cannot provide resistance for all of a muscular structure—because barbells provide reciprocal resistance, and most major movements are made in a rotary fashion such that a barbell provides no resistance at all during a large part of the movement.

Picture, if you can, a large rubber band that has been stretched to twice its normal, relaxed length—and imagine that the rubber band is an extended muscle, the biceps muscle of the upper arm; a stretched rubber band, or an extended muscle, has power potential, or "stored power," power that has not been used, power that cannot be used without reducing the length of the rubber band (or muscle).

While the similarity of a stretched rubber band to an extended muscle is not exact, there is enough of a similarity for the following example.

So long as the rubber band remains in a stretched condition, then it is literally impossible to use up (or reduce) its power potential—and as long as a muscle remains extended, then it is impossible to make use of the entire power potential of the muscle. Muscle fibers perform work by reducing their length—and it should be obvious that a maximum reduction in length of all of the fibers in a particular muscle would unavoidably result in a maximum reduction of the overall length of the muscle. But a muscle cannot reduce its length without producing movement of the involved body-part—and if maximum possible muscle-length reduction has occurred, then it obviously follows that maximum possible body-part movement will also have occurred. Thus it is immediately apparent that **all** of a muscle cannot be involved in any form of work in any position except a position of full contraction—full muscular contraction, with its related full body-part movement.

Thus a position of full contraction is an obvious prerequisite for total involvement of a muscle. **All** of a muscle cannot become involved in work in any other position.

However, while a position of full contraction is an obvious requirement for "total work," it does not follow that such a position will produce total work. Because muscle fibers do not become involved unless they are actually needed. Thus it also logically follows that a second prerequisite for total work is an imposed resistance heavy enough to require the involvement of all of the available muscle fibers.

But regardless of its weight, a barbell imposes absolutely no resistance on muscles in their fully contracted positions—disregarding the above listed minor exceptions.

With Nautilus Machines we have introduced exercises that provide resistance in all positions—continuous resistance that works a muscle from a position of full extension to one of full contraction.

But continuous resistance is not enough—although it is a long first step in the right direction. Since the strength of a muscle—both the "input of strength" and the "output of strength"—is not constant, is not the same in all positions, it is obvious that the resistance must vary in exact accord with variations in the output of strength.

One current approach to solving this problem—**not** the Nautilus approach—involves the use of the "inertia reel" principle; by limiting the speed-of-movement, it was felt that maximum-possible resistance would be provided in all positions. Which works fairly well in theory—but not well at all in practice.

With that system, there is no actual resistance; instead, even a very small effort will move the bar—but the bar will only move at a certain speed, regardless of how hard you are pushing (or pulling). In theory, then, if you pull (or push) as hard as possible in all positions—throughout the movement—the resistance will always be "right," will always be maximum-possible resistance in any and in all positions. One of the obvious shortcomings of the system, however, is the fact that you are limited to a particular speed-of-movement—the speed-of-movement can be set at almost any speed you like, but once set it becomes constant throughout the movement. The people who are producing such devices, of course, point directly to this actual shortcoming as one of the major "advantages" of such resistance—which, under the circumstances, I suppose, is all they can do except admit the truth of the matter.

Another shortcoming of this system is the fact that such "resistance" is not omni-directional; in effect, you still have no resistance at the end of the movement—you have no resistance in the fully contracted position, no resistance in the only position where it is even possible to involve all of a muscular structure.

Thirdly, there is no "negative work" provided by such a form of resistance; in effect (in a curl) you can only curl "upwards"—but having reached the top, there is no resistance for the downwards movement.

Which, as is only to be expected, the supporters of such devices point to as yet another "advantage"—but which, in fact, may well be either an advantage or a disadvantage, and at this point in time **nobody** knows whether it is an advantage or a disadvantage. **But**—we do know that "negative work" causes far more muscular soreness than "positive work" does; which means that such resistance probably wouldn't cause as much muscular soreness in a previously untrained individual—but which may also mean that it isn't as productive as it should be.

"Negative work" is lowering a weight—"positive work" is raising a weight. If you curled a dumbbell "up" with your right hand, and then placed it on a table that was level with the top position of the curl—and if you then took the dumbbell in your left hand and lowered it back to the low starting position—your right hand would be performing positive work (raising) and your left hand would be performing negative work (lowering), and the right hand would be working about five to seven times as hard as your left hand was.

If you curled a dumbbell in such a fashion until you reached a point of exhaustion, your left arm would be much more likely to become sore as a result of such work than your right hand would—even though the left arm did much less work. Nobody seems to know "why" this is true—but it is true. Nor does anybody know "why" a muscle becomes sore in the first place—although we do know how to make a muscle sore, we don't know what actually takes place with the muscle to create soreness; and, since there are no nerves in a muscle that are capable of registering pain, it may well be that it isn't the muscle itself that actually gets sore. But if not the muscle, then what does get sore? We don't yet know.

We easily could have incorporated such a form of resistance into the Nautilus machines—but we long ago rejected the idea; because careful tests with such "restricted speed" resistance clearly indicated that it was vastly inferior to a form of resistance that can be moved at any speed—and since speed is a result,

and a factor, of power production, it should be obvious that limiting speed of movement to any arbitrarily selected speed is certainly not desirable.

Also, since even a very small amount of effort will produce the same speed of movement that a maximum effort would have produced, there will always be a temptation on the part of the trainee to do less than he should—or he may work at a reduced level without even being aware that he is doing so.

In short, if there are any actual advantages to this type of resistance then I am not aware of them—advantages insofar as productivity is concerned, I mean. However, since such exercise machines do not require any actual weight, they are much lighter and thus the freight is quite a bit less—so, if you are primarily interested in saving a few dollars in freight charges, then you should buy such a machine; but if you are interested in results, you should not.

And, since the machines of this type that have come to my attention are very flimsy in construction, they are also lower in price than other types of machines—which makes it possible for salesmen of such machines to offer fairly low prices while still making a profit of 30 per cent to 40 per cent on each sale; and since, with such windfall profits at stake, many people would lend their support to almost anything, it is not surprising that many people who should know better (and probably do know better), and who should be interested in results (but apparently aren't), are giving such glowing testimonials for such equipment.

Normal human movements involve several factors—raising weight, lowering weight, acceleration of weight, deceleration of weight, supporting weight—and all of these factors except supporting weight are possible at any speed within a very wide range of speed varying from almost imperceptible movement to movement that is too fast to follow with the eye. All of which factors are fully provided for in Nautilus machines.

Nautilus machines may—and usually will—make a previously-untrained subject very sore if he uses the equipment to a point of exhaustion during his first few workouts; and such soreness may be (or may not be) a disadvantage—but Nautilus machines certainly will stimulate muscle growth to a greater degree than any other device that we are aware of, and will do so within a very limited "amount" of training, so that the recovery system of the body is not exhausted to the point that growth becomes impossible.

The inertia reel principle of physics can be used by anybody—in any of several ways—and it has been used for many years, we used it during the Second World War as a restraining device for shoulder straps in bombers, a device that would permit movement at normal speed but would stop sudden movement in event of a crash; so it certainly isn't new, not even new to me—and its only advantage is one of cost and light weight, which slight advantage is more than negated by its inherent and unavoidable disadvantages insofar as productivity is concerned.

Our primary interest is in function—productivity, the ability to produce maximum-possible results in the way of muscular size-strength increases; and we will use literally **anything** that will increase productivity in our machines—which does make our machines heavier, and which does make our machines somewhat more expensive, but which also makes them literally many times as productive as any other tool intended for the same purpose.

And if you think not, then train for one full year in any fashion you like—using anything except Nautilus equipment—and then come to DeLand and try to follow one of our better trainees through a workout, using whatever resistance you can; and—a very few minutes later—you will be on the floor, in a state of outright shock.

Which, of course, is not a "requirement"—since, with the use of a fairly short break-in period of training at below-maximum intensity, anybody can train properly with Nautilus equipment without encountering shock, without getting sick, and without much in the way of muscular soreness.

Thus, at the moment—at the present state of the art—if you can't use Nautilus equipment, then use a barbell; and if and when **anything** comes along that will improve productivity, it will immediately be incorporated into Nautilus equipment.

Chapter 41: The Next Step

Attempting to look into the future is frequently more exasperating than rewarding—but in this case, we are, I think, far enough along the path to see the final goal; which goal—I also think—will not be reached by significant improvements in equipment.

"Teaching old dogs new tricks" may not be impossible—but it is a difficult, thankless job at best; in the end, the eventual acceptance of new equipment and training systems will depend primarily upon an upcoming generation of trainees—men who have not been so thoroughly brainwashed that they are literally "afraid" to learn.

The most productive training routines of the future will be built around equipment very much like Nautilus Machines that are already in large-scale production—and in the end, I think we will find that less than two hours of weekly training will produce best-possible results, training based on not more than three, and probably two, weekly workouts.

Every year, thousands of children are poisoned by mothers who decide that, "...if one pill is good, six pills will be better." Which inclination to equate "more" with "better" is, I suppose perfectly natural—but dangerous. Such mistakes will always occur—in physical training and in all fields; but, gradually, ever-increasing numbers of people will see the light—and, eventually, most people will train properly, instead of overtraining.

Trying to look into the future, I can see no important changes in the functions of present Nautilus equipment—some changes in materials, perhaps (the use of leather for covering the padded areas of some of the machines, for example), or simple alterations in appearance; but I do not now anticipate important changes in the working geometry of any of our present machines—which is already as close to being perfect as we can make it.

What we do see is this; with continued use of the machines, it becomes increasingly clear that training "too little" is almost impossible—so long, at least, as training is hard enough, is properly performed. In aviation circles we learned long ago that "too little" instruction is much better than "too much"—flying lessons must not be too long, must not be too often, and if a student does not solo after a rather brief training period then it is unlikely that he ever will solo. And while the parallel with weight training is not exact, it is close enough to serve for this example.

Just as too much flight instruction will prevent a student from learning, too much training will literally prevent growth—and just as a flight student who does not solo within a reasonably short period of instruction will probably never learn to fly, a trainee who does not quickly learn a proper method of training will probably never train right. The reasons are both physiological and psychological—and both factors have been covered in adequate detail earlier.

"The most productive training routines of the future will be built around equipment very much like Nautilus Machines that are already in large-scale production—and in the end, I think we will find that less than two hours of weekly training will produce best-possible results, training based on not more than three, and probably two, weekly workouts."

NAUTILUS

TRAINING PRINCIPLES

BULLETIN NO. 3

Chapter 1: What to Expect from Exercise

Eugene "Mercury" Morris of the Miami Dolphins professional football team is a product of heavy, progressive exercise. At a bodyweight far below the average in professional football, he is one the strongest athletes in the history of that sport…and one of the fastest.

His strength, and his speed…are in large part direct results of exercise. Proper exercise.

When Morris reported to the Dolphins' training camp in 1973, he was approximately seven pounds heavier than he was a year earlier…but at a bodyweight of 197, he was stronger than he ever was before. And faster. During preseason trials, he ran the fastest 40 yard dash in his career.

Some people might feel that he was faster…"in spite of his increased bodyweight." But in fact, he was faster **because of his increased bodyweight**.

Which is not always the case. If Morris was a gymnast, for example…then the increased bodyweight might have reduced his speed of movement. Which is not meant to imply that exercise should not be used as a part of a gymnast's training; on the contrary, it should be heavy, progressive exercise should form an important part of the training of all athletes, in every sport.

And, if Morris was a gymnast, …then increased bodyweight might, or might **not**, be an advantage. Primarily depending upon where the bodyweight was added. Stronger, and thus larger and heavier, torso and arm muscles might help the performance of a gymnast…but heavier legs would almost certainly hurt his performance. Addressing the strength of a conditioned athlete almost always involves an increase in bodyweight…in some cases, this is an advantage…in other cases, an unnecessary burden that adds nothing to the performance ability.

But there is certainly no implication that exercise should not be used as a part of a gymnast's training; on the contrary, it should be…heavy, progressive exercise should form an important part of the training of **all** athletes, in **every** sport.

Increasing the strength of a muscular, conditioned athlete almost always involves an increase in bodyweight…so developing maximum strength in the arms and shoulders of a basketball player would not be desirable, since the penalty of increased bodyweight would not be justified in that sport.

Properly performed exercise will improve the condition, the overall system…of any athlete. And the conditioning results of exercise are produced regardless of what part of the muscular structure is being exercised. Working the arms has exactly the same effect on the heart and lungs as exercise involving the legs…if the total amount of work and the pace is the same.

The heart and the lungs don't know, or care which muscles are working…foot-pounds of work performed and the pace of training are all that matter for conditioning purposes.

But strength increases are specific to a very high degree. Heavy exercise performed for the right arm will do very little for the left arm…and almost nothing for the legs. While it is perfectly true that some degree of "lateral effect" does occur, it is very limited in its results.

"Lateral effect" is growth produced in, for example, an unworked left as by exercise performed by the right arm.

And it is also true that an even greater degree of "indirect effect" is also produced by exercise…but again, it is limited in its results.

"Indirect effect" is growth produced in one muscular structure by exercise performed by the other muscles.

However, if we accept the limited results of lateral effect and indirect effect, then the strength increases resulting from exercise are almost specific in nature. Work must be performed by the muscle you are attempting to strengthen.

So, for our purposes here, it is safe to assume, that the conditioning results of exercise are general…and the strength increasing results are specific.

All Athletes need conditioning exercises, although some sports require much higher levels of conditioning…and all athletes need strength-building exercises. But in all sports activities, the training must be tailored to the requirements of the individual.

It must be clearly understood that you are dealing not only with the requirements of a particular sport…but also with the requirement of an individual athlete. Your goals should be, and the possible results from exercise are…

1. a level of condition required by the particular sport…
2. maximum strength in all if the musculature involved in that sport…
3. at least a reasonable level of strength in all of the muscular structures of the body… and
4. maximum possible flexibility.

When those four goals have been reached, then you have accomplished all that exercise is capable of doing for a healthy athlete…a great deal, far more than most coaches even suspect.

But don't expect exercise turn an inferior athlete into a super athlete…proper exercise will improve any athlete, and will improve some athletes to a degree that must literally be seen to be believed; but it cannot change bodily leverage, and it cannot improve "reaction time", and it cannot give an individual the judgement required by an outstanding athlete.

At some point in the distant future, coaches will look back on present athletic training practices as the "dark ages" of sport; and will seriously wonder how anybody survived several years of professional sport without permanent injury. And, quite honestly, not many players do. Within the last year I have heard two supposedly informed estimates of the number of serious knee injuries resulting form each year if football at all levels…one estimate was 23,000…the other was 63,000. But regardless of the actual number, it is far too high. And to a large degree unnecessary…many such injuries could be prevented by proper exercise.

Future, large-scale improvements in training practices will come primarily from a better understanding of exercise…but such improvements will not come soon.

At the present time (1973), most coaches are finally becoming aware that exercise offers something of value…but very few coaches have any real idea of the actual value of exercise, and even fewer know how to go about producing the results they are seeking.

You can make your athletes stronger, faster, and you can greatly reduce the chances of injury…and this book will tell you exactly how to go about producing those results, step by step, in very simple terms.

Repetition is unavoidable…and in any case, repetition is a required part of the learning process; so there will be a great deal of repetition throughout this book…in particular, you will be told repeatedly to "train harder", and to "train less". But repetition is necessary to make you understand exactly what is meant by "hard training"…and repeated examples are required to make you accept the fact that a large "amount" of training is neither necessary nor desirable.

And…the whole field of exercise still suffers, and it suffers badly, from the old myths that have survived from the last century. Such myths must be rooted out and exposed, and they will be in the following pages…but this also requires repetition.

So long as any of the old myths still linger on in your mind, you will deny yourself and the athletes under your control at least part of the potentially great advantages of exercise.

You can expect a great deal from exercise, probably far more that you even suspect…so expect a lot, and if your training is properly conducted, your results will almost certainly exceed your highest expectations.

"All Athletes need conditioning exercises, although some sports require much higher levels of conditioning…and all athletes need strength-building exercises. But in all sports activities, the training must be tailored to the requirements of the individual."

Chapter 2: The Correct Amount of Exercise

Question…"How much exercise is enough?"

Answer…The **minimum** amount that will produce the desired result.

Any exercise in excess of the minimum amount **required**, will be wasted effort at best…and counterproductive at worst.

For an athlete, too much exercise may well be worse that no exercise at all.

Yet, simple from the apparently natural inclination to equate "more" with "better"…many coaches still train their athletes far too much. To the point that they are literally preventing results.

One very simple but badly misunderstood point must be understood right at the start…it is utterly **impossible** to train "hard" and train a large amount at the same time. You have no choice in the matter; you can have one or the other…you can **not** have both. If you insist on a large amount of training, then you will be forced to reduce the intensity of training.

In some cases, an apparently large amount of training is required; it depends upon the sport, and upon the circumstances. A distance runner must train, at running, more than a sprinter. No amount of 40-yard sprints will properly train a man for a 20-mile run.

But on the other hand, frequent practice of 20-mile runs will literally prevent a sprinter from improving his performance.

And in either case, there is a definite limit to the amount of training that either man can do…while improving, or even maintaining, his level of performance.

If the distance runner runs too much, his times will get worse instead of better…and the same thing will happen to the sprinter.

The sprinter must train with very high-intensity, he must run as fast as possible…for a short distance.

The distance runner must **not** train in such a fashion; if he attempts to run at a maximum level of intensity then it is extremely unlikely that he would last a full mile…much less twenty miles.

So the amount of training, and the intensity of training, must be directly related to the particular sport…and they must be balanced in relation to each other. If you increase the intensity, then you **must** reduce the amount of training…you have no choice in the matter.

Yet, during the last few years, the trend has been in exactly the wrong direction in many sports…not in all sports, but in some sports. In a few sports, the results of overtraining are so obvious that it is utterly impossibly to miss the implications. And in those sports, current training practices come fairly close to a practical balance between the intensity of training and the amount of training.

This balance is probably best in the sport of Olympic weightlifting…and I think I can demonstrate just why this is so. Weightlifting is one of the few sports in which the athlete is constantly made aware of his momentary ability…so a loss in strength is immediately obvious.

To lift a maximum weight, an athlete must perform at the highest possible intensity of effort…but if such maximum intensity is involved in every workout, then the workouts must be brief and infrequent. If not, then losses in strength will be produced instead of gains.

So weightlifters have been forced to limit the amount of their training…and even if they fail to understand the exact cause and effect factors involved in this relationship between intensity of training and amount of training, they are at least aware of practical implications.

As soon as the football season is finished Mercury Morris starts losing weight…because he stops training. His "normal" bodyweight is considerably below his "conditioned" weight…so his weight drops when he stops training.

A muscle will not grow beyond its "normal" level unless such growth is stimulated by heavy exercise…but exercise is also required to maintain an existing high level of muscular mass. So a strong athlete will lose muscular size, and thus strength, if he stops training entirely.

At least two factors will influence the rate at which such losses of strength will occur…

1. the difference between an athlete's normal weight and his "conditioned" weight…and
2. the length of time that an athlete has remained in good condition.

If a loss of bodyweight does not occur when training is stopped, then this is clear proof that fatty tissue is being added…and this usually what happens in practice. So it is important to reduce the amount of calorie intake in direct proportion to any reduction in the amount of training.

But it is equally important to avoid the trap of equating gains or losses to changes in bodyweight. It is easily possible to lose strength while gaining weight…or gain strength while losing weight…so progress must be measured in the basis of performance. If strength is increasing, then progress is being made…regardless of what may be happening to the bodyweight.

After three or four months out of training, Morris may have lost 20 pounds in bodyweight…and perhaps as much as 30 pounds of muscular mass (lean body mass, or LBM).

But upon resuming hard training, his bodyweight starts climbing rapidly…and his muscular mass increases are even faster than his bodyweight increases. Because proper training produces a rapid increase in lean body mass (LBM)…and a simultaneous reduction in fatty tissue.

During less than two months of regular, hard training, Morris gained approximately 25 pounds in bodyweight…but his actual increase in LBM was probably on the order of 40 pounds.

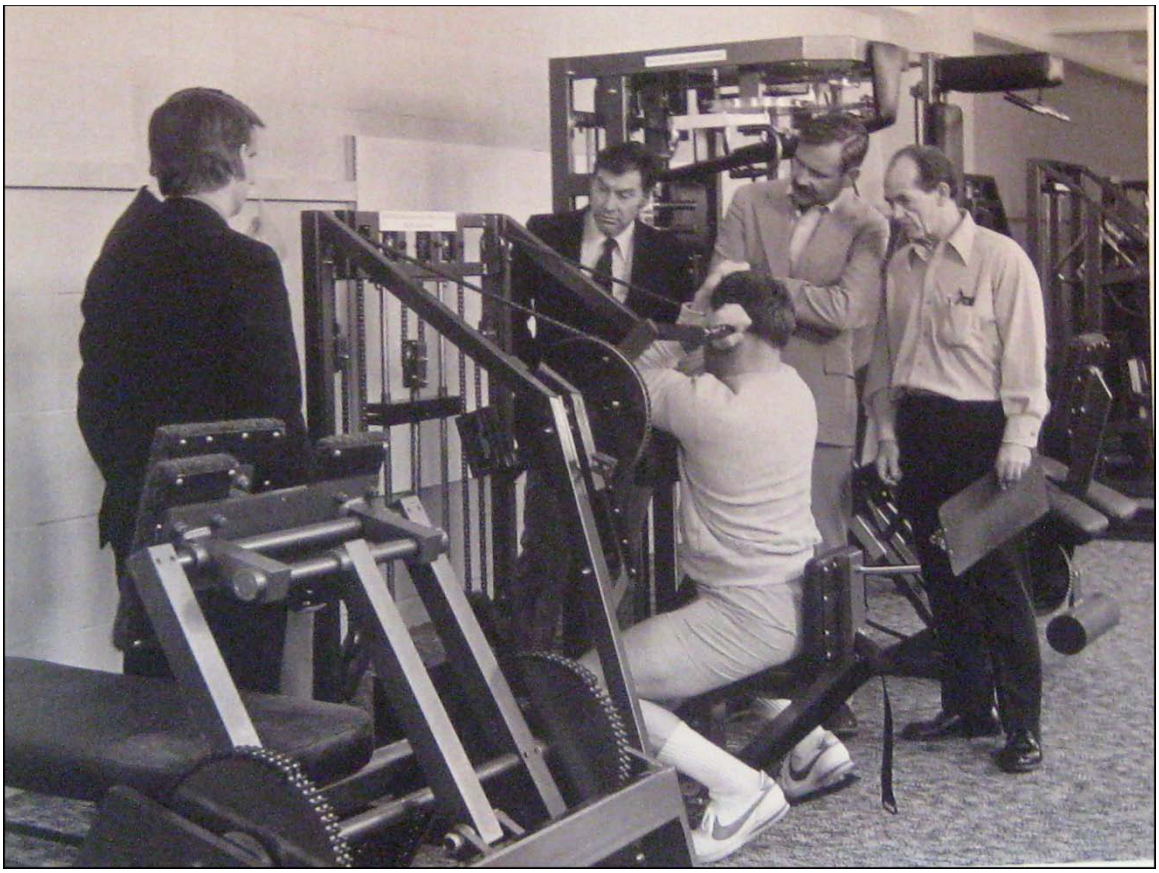
When he resumed training in the summer of 1973, Morris weighed approximately 170 pounds…less than two months later, he weighed 197 pounds. At the start of his renewed training, he trained three times weekly…for approximately 40 minutes during each workout. But two months later, he had reduced his weekly training to two workouts of approximately 30 minutes each.

Such a reduction in the amount of his training was an absolute requirement for continued progress…the stronger the athlete becomes…the greater the load imposed upon his overall recovery ability.
During the Colorado Experiment (detailed in a later chapter), Casey Viator gained a total of 45.28 pounds in a period of 28 days…while reducing his starting level of body fat by 17.93 pounds. So his net gain in muscular mass (LBM) was 63.21.

Conducted under strict laboratory conditions in the Physical Education Department at Colorado State University, this Experiment clearly established the fact that very rapid increases in LBM can be produced while simultaneously reducing the level of fatty tissue.

Viator's results were produced by a total of 7 hours, 50 and ½ minutes of training within a period of exactly four weeks. Fourteen workouts with an average time of 33.6 minutes.

A large amount of training is neither necessary nor desirable…on the contrary, best possible results can only be produced by a very brief training schedule. Additional training will reduce the production of worthwhile results…and as an athlete grows stronger, his training program must be reduced.



Chapter 3: The Best Type of Exercise

Just what is best type of exercise?

The "best" for what purpose? Properly conducted exercise is capable of producing a number of worthwhile results…

1. increased cardiovascular ability, or "condition"…
2. increased strength…
3. increased flexibility, or range of movement…
4. increased speed of movement…
5. increased muscular mass…
6. reduced fatty tissue…
7. improved circulation…

Additionally, for reasons directly related to several of the above factors…exercise can greatly reduce the chances of injury.

So the choice of a type of exercise must be based upon the desired results.

In later chapters, we will cover every known type of exercise in great detail, step by step, point by point, in very simple terms.

But in the meantime, a clear understanding must be established regarding certain basic points that are involved in any type of exercise. First…we must define the terms, and establish certain guidelines common to all types of exercise.

As mentioned above, exercise can greatly reduce the chances of injury…but exercise is also capable of causing injury. So the best type of exercise is the type that is most likely to prevent injury…and least likely to cause injury.

Jerky movements are directly responsible for a very high percentage of injuries caused by exercise…and jerky movements are of absolute no value for the purpose of developing strength. So exercise performed for the purposes of increasing strength should always be smooth. Sudden movements and rapid accelerations should be avoided.

In later chapters covering exact styles of performance, you will be informed that movements should be "as fast as possible in good form" in many exercises. But many people overlook the most important part of that sentence…**in good form**.

Or they fail to realize that "as fast as possible" may be, in fact, quite slow. And in most cases, if the resistance is as heavy as it should be, **fastest possible movements** will be **quite slow**.

Sudden, jerky movements greatly increase the forces involved in exercise…adding nothing to the exercise except the danger of injury.

So it should be clearly understood right from the start that the form, or style of performance, is one of the most important factors in exercise. Without good form, there is little or nothing of value left in exercise.

The sport of Olympic weightlifting is based on sudden movements, so in that case we have an exception…but that is the only exception. All other athletes should avoid any sort of sudden movements during their strength-training programs.

So careful observation of proper form will produce best results in the way of increasing strength, and will go a long way in the direction of avoiding injury.

And for the purpose of preventing injury, an exercise should involve stretching in the extended positions of the muscles being worked. Such stretching will also produce the benefit of greatly increased flexibility…which flexibility will in itself go a long way towards preventing injury.

So the best type of exercise is one that involves full-range movement…movements that starts form a fully extended "pre-stretched" position and continues to a fully contracted position.

Anything less than a full-range movement will provide exercise for only part of a muscle…and will do little or nothing in the way of improving flexibility. Proper exercise, truly full-range exercise, will increase the range of movement of any athlete…in any sport. Increasing his strength, increasing his flexibility, increasing his speed…and greatly reducing his chances of injury. In a later chapter, we will cover the requirements for a truly "full range" exercise in great detail…but for the moment, it is necessary only to be aware that full-range movement is an important factor in any type of exercise.

Finally…the best type of exercise for any purpose is Progressive exercise.

But just what is progressive exercise?

An exercise is progressive only if it exposes the athlete to constantly increasing workloads…the intensity of effort **or** the amount of training must be increased in proportion to increasing ability. As an athlete becomes stronger, he must work harder, **or** more…**but not both**.

For the purpose of increasing cardiovascular ability, the amount of training must be increased…up to a point, to a point, to a point far beyond the starting level of ability. But in this case, the intensity of training must **not** be raised to rapidly…nor too high. If an athlete is running for the purpose of improving his cardiovascular stamina, his results will be related almost directly to the amount of running…within reasonable limits.

But if he runs as fast as possible, thus involving maximum intensity…then it will simply be impossible to run as much as he should.

In general terms, there are two styles of training…

1. …"steady-state" or aerobic exercise…and
2. "non-steady-state" or anaerobic exercise.

But a great deal of confusion exists in regard to these actually very simple points…confusion that I will attempt to eliminate, here and now.

A particular exercise can only be performed in one of two possible ways….either way, but not both ways at the same time. Walking at a pace that could be maintained for hours is steady-state exercise. But running at a pace that can be maintained only briefly is non-steady-state exercise.

But…and this is a very important point that seems to be generally misunderstood…it is easy possible to arrange a training program in such a manner that an athlete produces the potential benefits of both styles of training.

Steady-state training is necessary for cardiovascular benefits…and non-steady-state exercise is required for meaningful strength increases…but you can produce both results from the same training program.
Three paragraphs above, I stated that…" a **particular** exercise can only be performed in one of two possible ways"…and that remains true. **But**…it is easy possible, highly desirable, to arrange the training schedule in such a way that the **muscles** are being worked in a non-steady-state fashion while the **heart** and **lungs** are being worked in a steady-state fashion.

Strength training is usually performed in spurts…a very brief but very hard exercise is followed by a rest period. And conditioning training is usually performed at a much lower intensity, but for a much longer period of time…at a pace that will permit at least several minutes of steady exercise.

As a result of these widely practiced styles of training, many people have assumed that nothing else is possible, but in fact, there is no slightest reason why both styles cannot be combined into the same training schedule. At least in the training of active athletes…with Olympic weightlifters again being the only important exception.

Steady-state training will **never** produce much in the way of meaningful strength increases…but nonsteady-state training will do little or nothing for cardiovascular ability. However…a particular muscle can be worked to a point of momentary failure in a very brief period of time, in a non-steady-state fashion…and then another muscle can be worked immediately.

If the program is properly outlined, every major muscular group in the body can be worked in a nonsteady-state fashion…while training the system as a whole in a steady-state fashion.

This is not merely a theory…it works. Works far better than any other style of training that we have ever tried…and we have tried everything we ever heard of that seemed to offer even the possibility of worthwhile results, and quite a number of things that were obviously of no possible value.

In later chapters, exact training schedules will be outlined for athletes in almost all sports…but in all cases, certain points are basic to any type of worthwhile exercise. In the next few chapters, we will take the most important points one by one…until and unless these points are clearly understood, no real understanding of the value of exercise is even possible.

"In later chapters covering exact styles of performance, you will be informed that movements should be "as fast as possible in good form" in many exercises. But many people overlook the most important part of that sentence…**in good form**."

Chapter 4: The Two Most Important Factors in Exercise

The degree of results that **can be** produced by any form of exercise will always be limited by individual potential…in plain English, "you cannot make a silk purse out of a sow's ear."

But within the limits imposed by individual potential, the degree of results that **will be** produced will largely be determined by the quality of coaching that an athlete is exposed to.

So the most two important factors in exercise may well be **individual potential**… and **quality of coaching**.

This book can obviously do nothing towards improving the potential of your athletes…but it can go a long way in the direction of giving you the information required for the intelligent coaching of athletes engaged in supplementary training for any sport.

But proper coaching consists of far more than an informed coaching staff…an **active** coaching staff is a factor of at least equal importance. Don't expect your athletes to coach themselves, not many of them can…and even fewer will.

And this is particularly true when applied to the subfield of supplementary training…which many athletes tend to view as unrequired drudgery. Most truly outstanding athletes will do a surprisingly good job of coaching themselves when engaged in an activity directly related to their sports-specialty…but will also tend to view supplementary strength-training as something of far less importance, failing to realize that such non-directly related training can well be the difference between success and failure at their chosen sport.

The actual cause and effect relationships involved in exercise are really quite simple…but widely misunderstood, even viewed with suspicion or doubt in areas where there is no slightest room for any reasonable doubt.

This book will attempt to remove those doubts…on the only why that such doubts can be removed, by providing plain-language information based upon established facts.

Physiology simply means "the **physics** of biology"…or "biological **physics**". But this seems to have been largely forgotten or overlooked.

Certain basic laws of physics apply with equal validity in all situations…which means that the human body and the engine of an automobile have a great deal in common. Clearly understanding the functioning of one will take you a long way in the direction of understanding the functioning of the other.

In later chapters, repeated comparisons will be made between the human "engine" and the engine of an automobile. In many cases it is not necessary to know exactly "why" something works as it does, but it certainly is necessary to know "how" it works…just what cause produces exactly which result.

At this point in time (1973), nobody seriously claims to know exactly "why" a muscle responds to exercise by growing stronger. But we do know how to produce this result.

Practical experience has clearly and repeatedly established the fact that proper exercise is capable of producing literally enormous increases in muscular strength.

And practical experience has also established the fact that no amount of low-intensity exercise will produce the results that come from an actually small amount of high-intensity training.

We can conjecture to our heart's content about exactly "why" this is so…but in the meantime we can also make good practical application of the fact that it is so.

Nobody in their mind even pretends to understand gravity either…but a lack at understanding does not prevent us from making practical use of the known effects of gravity.

In the end, the ability to anticipate results is of far more importance than any amount of theory. Which is not meant to imply that an actual understanding is of no value…on the contrary, a clear understanding is sometimes of enormous value, since it may lead to even greater improvements in practical applications.

But don't be afraid of using simple cause and effect relationships of demonstrated value in cases where you don't understand just why a particular cause produces a certain effect…if you want the effect, then make use of the cause.

This book will attempt to make you aware of the "causes" involved in exercise…and equally aware of the "effects" to be expected. For any practical application of exercise, that is all of the knowledge that is required.

But we will also go rather deeply into the many theories that have been formulated in attempts to explain the undeniable and obvious results of exercise…if only because many readers may be among the ranks of those people who must constantly strive to understand just "why" something works as it does.

Many such points can be explained, in very simple terms, in an undeniable manner…but certain other points remain unclear, in theory at least.

So far as the athlete is concerned, it is usually good practice for the coach to avoid theory as much as possible. Tell your athletes exactly what to do, and how to do it…and inspire confidence that results will follow. And if the training is properly outlined and practiced…then results will follow, good results, and quickly.

But don't expect your athletes to coach themselves. You must know what you are doing…and you must be there, on the spot, during all training periods.

Best results from exercise come only from constantly increasing workloads…the production of such results requires pushing from somebody, and few athletes can or will push themselves hard enough. As a coach, that may well be the most important part of your job…and if you reduce the level of pushing to the point that "everybody makes the team", then you won't have much of a team.

But don't make the still common mistake of pushing your athletes to train more…instead, push them to train harder.

Chapter 5: How Much Should an Athlete Weigh?

An athlete should weigh as much as possible…as much as possible without limiting any of the factors of performance required by his individual sport.

If added bodyweight increases a sprinter's speed, and it will if the additional weight is in the form of muscular tissue (LBM), and if it is added to the legs and hips…then the extra weight is desirable.

But an equal mass of muscular tissue added to the arms and shoulders of the same athlete would certainly not be desirable, because it would contribute nothing to his performance and would add the burden of extra weight…giving, in that case, a net loss in performance.

And a gymnast would offer an example of an almost opposite situation…in the case of a gymnast, LBM added to the legs would reduce the level of performance, while LBM added to the muscles of the arms and torso would increase the level of performance.

In short, an athlete should add muscle where he needs it…and where it will contribute directly to his particular sport. And he should not add weight where it will hinder his performance.

And in almost all cases, fatty tissue is merely an added burden that limits performance.

It should be clearly understood that a proper muscular development for any sport will seldom be a truly proportionate development…on the contrary, a certain degree of "lopsided" muscular development is a requirement for high levels of performance in almost all sports.

Heavy progressive exercise will increase the strength of any athlete…but it will also increase the muscular mass, which will always increase the bodyweight of a muscular individual. So exercise should be applied selectively…should be devoted to the production of strength in muscular structures that will directly contribute to the sport of the individual.

Which does **not** mean that any athlete should ignore any part of his body…on the contrary, all athletes should train all parts of their body. But the development of muscular structures that are not directly involved in a particular sport should be limited…such "non-contributing" muscles should be strengthened to a reasonable level, but no attempt should be made to attain maximum development in those areas of the body.

In fact, almost all athletes **in any sport**…can train, and **should train**, in an almost exactly similar manner. With only one difference…exercise that involve directly contributing muscles should be worked with maximum intensity, thus assuring maximum strength and maximum performance…but muscles that do **not** contribute to the particular sport should be trained with a lower order of intensity, thus assuring great flexibility and reducing the chances of injury, while avoiding the penalty of excess, "non-contributing" bodyweight.

It is easily possible to increase the strength of an athlete without increasing his bodyweight.

And it is even possible, if not quite so easy, to increase strength while actually reducing bodyweight.

But little or nothing can be done to increase the actual "strength" of a particular muscle without also increasing the mass, and thus the weight, of the same muscle.

And there is no slightest paradox involved in the above three statements…although a great deal of confusion exists in this subject.

At least some of this lack of understanding results from the common habit of relating bodyweight or bodily measurements to muscular mass…which is a mistake.

Additional misunderstanding stems from widespread confusion on the subject of strength. Just what is "strength"? How do you define it? Ask a dozen people and you may get a dozen different answers.

A previously untrained individual may fail to bench press 150 pounds the first time he tries it, and then handle 200 pounds a week later. But has his "strength" really increased by a third in such a short time?

Not likely. It is far more likely that he has simply learned the correct style required for that particular lift.

So before any meaningful discussion of strength is even possible…we must first define "strength" as it will be used hereinafter.

It is my opinion that strength is best defined as…"the ability of a muscle to produce force."

And only then, when we have removed such confusing factors as leverage and skill, does it become possibly to accurately measure increases in strength resulting from exercise…or losses in strength resulting from a lack of exercise or from other factors.

It has long been recognized by physiologists that the "strength" of a muscle, as defined above…is **directly related** to its cross-sectional area. Which cross-sectional area is directly related to its mass. Which mass is directly related to its weight.

If a muscle was formed in the shape of a sphere, then increasing the cross-sectional area would result in a disproportionate increase in its mass, or weight.

But, instead…a muscle is shaped more on the order of a "limited-length" cylinder. So increasing its cross-sectional area will thus result in a direct, proportionate increase in its mass, or weight, or "size".

Thus…for all practical purposes, the size of a muscle is in direct proportion to the strength of the same muscle.

Which certainly does **not** mean that the 16-inch arm of one man will be exactly equal in strength to the equal-sized arm of another individual.

When two or more individuals are compared, then many other factors become involved…the length of limbs, and thus the leverage advantages or disadvantages…the attachment points of muscles, again a leverage factor…variations in neurological efficiency…differences in skill…the ratios of muscular tissue to fatty tissue. And many other factors.

Thus, in fact…it is almost literally impossible to accurately compare the actual strength of two or more individuals.

But, for the purposes of exercise it is not necessary to make such comparisons. All that is required is the ability to measure an individual's momentary level of strength in order to compare it to his strength at another point in time.

The simple fact that Bill can bench-press 300 pounds while George can handle only 150 pounds in the same lift tells us nothing of value…and it certainly does **not** tell us that Bill is "twice as strong" as George.

"Able to bench-press twice as much"…certainly; but twice as strong? Not necessarily.

George, the apparently much weaker man, may have arms exactly twice as long as the arms of Bill…in which case the "strength" would be equal, since the man with the longer arms would be moving the weight twice as far as the other man.

Then, too, it depends upon the speed of movement. And upon many other factors…far too many factors for any sort of meaningful comparison.

But …if we compare each man only to himself, then we have a far better chance to produce meaningful measurements of actual strength. If George can bench-press 150 pounds on a particular date…and then, a year later, can bench-press 300 pounds…then he has doubled his strength. If the speed of movement is the same in both cases…and if the form, or style of performance, is the same in both cases.

In the field of athletic training, apart from the sport of weightlifting, the measurement of strength has only one meaningful application…for the purpose of measuring progress produced by exercise.

Neither the coach nor the athlete should care just "how much" an athlete can bench-press…so long as the athlete can handle as much as he as an individual, is capable of using in good form.

Trying to set a "standard" of performance for all athletes is a mistake…even when such a standard is based upon the bodyweight of athletes.

Instead…train your athletes in such a fashion that all of them will develop as much strength as possible. As much as possible for themselves, **as individuals**.

No intelligent coach expects a lineman to run as fast as a much lighter backfield man…but instead, both types of players are trained to run as fast as they can, as individuals.

Strength training must be conducted with the same sort of consideration for individual differences in size, in weight, in leverage…and when such consideration is lacking, then any attempt at comparison will be meaningless.

Train your athletes as individuals…for the individual sport. And let the bodyweight be what it may.

"An athlete should weigh as much as possible…as much as possible without limiting any of the factors of performance required by his individual sport."

Chapter 6: The Relationship of Muscular Size to Strength

One of the persistent myths in the field of exercise concerns the relationship of muscular size to strength…and having raised the point in the preceding chapter, we will probably be well advised to put it to rest immediately.

Which may not be so easy…simply because many people have such strong beliefs on the subject, and not without what appear to be good cause for such beliefs.

Which is certainly **not** intended to imply that there is, in fact, any slightest reason for any doubt on the subject; the facts are simply beyond dispute…a muscle, any muscle, is strong in direct proportion to its size. This is a well established point in physiology…a simple physical fact.

Even if, as happens to be the case, not a well known fact.

But enormous confusion has resulted on this score because a great number of factors besides actual muscular "strength" are involved in "demonstrations of strength" or "tests of strength".

Secondly…it is very difficult to measure the actual size of a muscle, and this adds even more confusion to the subject.

So…if we have no practical means of testing actual "strength"…and if we also have no accurate method of measuring actual muscular size…then just how do we propose to compare them? When we are not sure of either. When both are in doubt.

No wonder the subject is confused.

But, as long as such confusion lingers in your mind…you may be denying yourself some of the real value of exercise.

Let's take the matter of leverage first. Or, rather…one of the factors of leverage, since there are several.

If a man with very long forearm performs a barbell curl with 100 pounds he may raise the weight a distance of 3 feet…and if so, he has performed a total of 300 "foot-pounds" of work in that one repetition (movement).

But if a man with much shorter arms curls the same 100 pounds, he may raise the weight a distance of only 2 feet…and thus he performed only 200 "foot-pounds" of work.

The weight was the same, the movement (or exercise) was apparently the same…but the amount of work performed was certainly not the same. The longer-armed man performed 50% more work than the shorter-armed man…and burned 50% more calories, and produced 50% more heat, and required a 50% greater oxygen increase.

Obviously, then, the exercise was not the same in both cases…or, at least, the load imposed to the two men was not the same.

If the speed of movement was exactly the same in both cases…that is to say, if the curl was completed in exactly one second (for example) in both cases…then the longer-armed man was also producing exactly 50% more power than the other man.

And if the distance from the axis of rotation (the elbow) to the center of the bar was compared…18 inches to 12 inches…it would be obvious that the longer-armed man was also producing 50% more torque.

Yet…if the curl was accepted as a "test of strength", then it would appear that the two man were equally strong.

But…of the test was conducted in such a fashion that all the above factors were allowed for, then it would be obvious that the longer-armed man was 50% stronger.

If, for example, the longer-armed man had the bar tied to the top side of his forearms (the "top" side during a curl) at such a point that the center of the bar was exactly 12 inches away from his elbow axis…thus making this distance exactly equal to the distance from the shorter-armed man's elbow to the bar when doing a curl…then the test would be valid. At least in relation to the matter of leverage.

And if this was done, then the longer-armed man would be able to curl 150 pounds with **exactly the same ease** that he previously curled 100 pounds. Clearly providing the he was, in fact, 50% stronger than the other man.

Or, at least…he would thus prove that could demonstrate a 50% higher level of strength.

But this would still not prove that his muscles were stronger than the other man's…such proof would be lacking a number of reasons.

For one thing, recent research has clearly indicated that some men can activate a far greater than average percentage of their muscular mass in a single, maximum attempt.

In fact, it may eventually be shown that some super athletes, when compared to equal sized but neurologically inferior men, can demonstrate the ability to activate five times as much of their muscle mass.

With the clear understanding that the following figures (percentages) are not intended to be accurate, but serve merely as examples, let me attempt to make the above point a bit easier to understand.

To begin with, it should be understood that **nobody**, under any circumstances short of electrocution, can activate 100% of the mass of any muscle. When you are trying as hard as possible, even under emergency circumstances, you are using only a rather small part of any particular muscle at a given instant in time.

Under "normal" circumstances, you involve an even lower percentage of the muscle in a maximum effort…but you never involve it all.

Let us assume for this example that you can involve 30% of your muscular mass in a maximum attempt, and let us call that an "average" neurological ability.

Your identical twin, if he was neurologically superior, might be able to activate 40% of his muscular mass under similar circumstances, and this would make him a third "stronger" than you.

Or, if he was a neurological superman, as many super athletes obviously are, then he might be able to activate 50% of his muscular mass…in which case he would be two-thirds "stronger" than you.

But if he was neurologically "below average", then he might be able to activate only 20% of his muscular mass…and he would thus be weaker.

Or…if he was "neurologically inferior", then he might be able to activate only 10% of his muscular mass.

But…in all cases, the actual "strength" of muscle would be exactly the same. Even though the super athlete was involving five times as much muscular mass as the neurologically inferior man.

In all five cases, the size of the muscle would be the same…and thus the actual muscular "strength" would be the same. If all five men were wired up in such a way that their entire muscular mass could be electrically activated into a truly 100% maximum effort…then the output force would be the same in all cases.

So, these neurological differences being as great as they are…we are again faced with a factor that makes comparison of strength to size very difficult, and lends confusion to the subject.

But it should be understood that any one of the above five examples of men ranging from the neurologically inferior to the super athlete could increase his muscular size, and thus increase his strength, by exercise.

Exercise will **not** improve the neurological factors…so the inferior man might well produce literally huge muscles and still be weaker than the super athlete. But he would be stronger than he was at a smaller muscular size.

And, because of genetic neurological superiority, the super athlete may be able to demonstrate great strength in spite of the fact that his muscular size is only average. But gain…he too will be stronger if he increases his muscular size.

Thus we see examples of men with huge muscles and very little ability to demonstrate strength…and opposite examples of men with very little muscular mass but great strength.

And for that very reason, great confusion exists regarding the relationship of muscular size to strength.

And also for that very reason, it is sometimes very difficult to convince the super athlete of the value of exercise. Because his inborn neurological superiority makes him "naturally" stronger than most men of his size…he jumps to the conclusion that larger muscles are of no use to him. Or he may even sincerely believe that larger muscles would hinder his performance in some fashion.

And, in any case, he is already stronger than almost everybody else…even without exercise. So why should he bother?

But a man with such natural advantages can profit from exercise to exactly the same degree that anybody else can…and if he can be induced to build his muscles to their maximum level of size, and thus to their maximum level of strength, then he will almost literally be a superman.

So if you with to increase your strength…then build your muscles as large you can. Having done so, you may not be as strong as another man with small muscles…but you will be as strong as you, as an individual, can get.

Dick Butkus of the Chicago Bears spent several days training under my supervision in Colorado, during the previously mentioned Colorado Experiment…and afterwards, trained in our Florida facility for a period of several weeks.

Dick had never previously done any sort of systematic exercise…during eight years of professional football, his exercise had consisted of running and football drills, with a few days practice of the bench-press prior to each year's "strength test".

Yet, when I first started training him in the summer of 1973, it was immediately obvious that Dick is a very strong man, far stronger than many men who have trained heavily and regularly for years.

Although I had no way to test his neurological efficiency, it is almost certain that it is far above average. But some his other "natural advantages" are obvious at a glance…

1. he is tall, but not too tall…
2. …for his height, he has a long torso and short legs…
3. his hips are wider than average.

All of which bodily proportions offer enormous advantages for strength, because they improve some of the leverage factors.

Upon looking at him for the first time, I remarked…"If I was going to design a man to fill his slot in football, the result would be little if any different from the real Dick Butkus."

But he could have been better. A proper program of heavy exercise could have given him far better "fatty tissue to muscular mass" ratio…making him stronger, faster, and far less likely to suffer injury. And without changing his bodyweight.

Even a few weeks of very hard but very brief training produced significant increases in his strength, enormously increased his flexibility, and helped his speed.

Less than a month ago, Dick signed a five year "no cut" contract with the Bears…but a few months earlier, the rumors were flying throughout the rather limited circle of professional football to the effect that he was through, physically unable to play. Football is a dangerous sport…Dick could be seriously injured in the next game, but when he reported to camp this summer, he was ready to play.

No amount of strength is absolute protection against injury…but a stronger man always has the edge, is less likely to be hurt in any given situation.

Mike Reed of the Cincinnati Bengals is another example of a man who never trained for strength…until recently. During his first two years with the Bengals, he missed nine games because of knee injuries; he was out during four games one season und missed five games during the other season.

But last year, following a few months of hard training, Mike played every game…with no knee problems.

In Mike's case, a program of heavy exercise reduced his bodyweight by nearly twenty pounds…while greatly increasing his muscular mass and strength, and with a marked increase in speed. Before training, Mike was carrying excess fatty tissue…which contributed nothing but extra weight. Removing a total of perhaps 50 pounds of fat, and replacing perhaps 30 pounds of it with muscular tissue resulted in a 20-pound bodyweight loss, but an enormous improvement in performance.

But sometimes the situation is almost exactly opposite. In the spring of 1973, the Buffalo Bills sent Lou Ross to us for a three month training program; at a height of 6 feet 7 inches, he weighed just over 240 pounds, far too light.

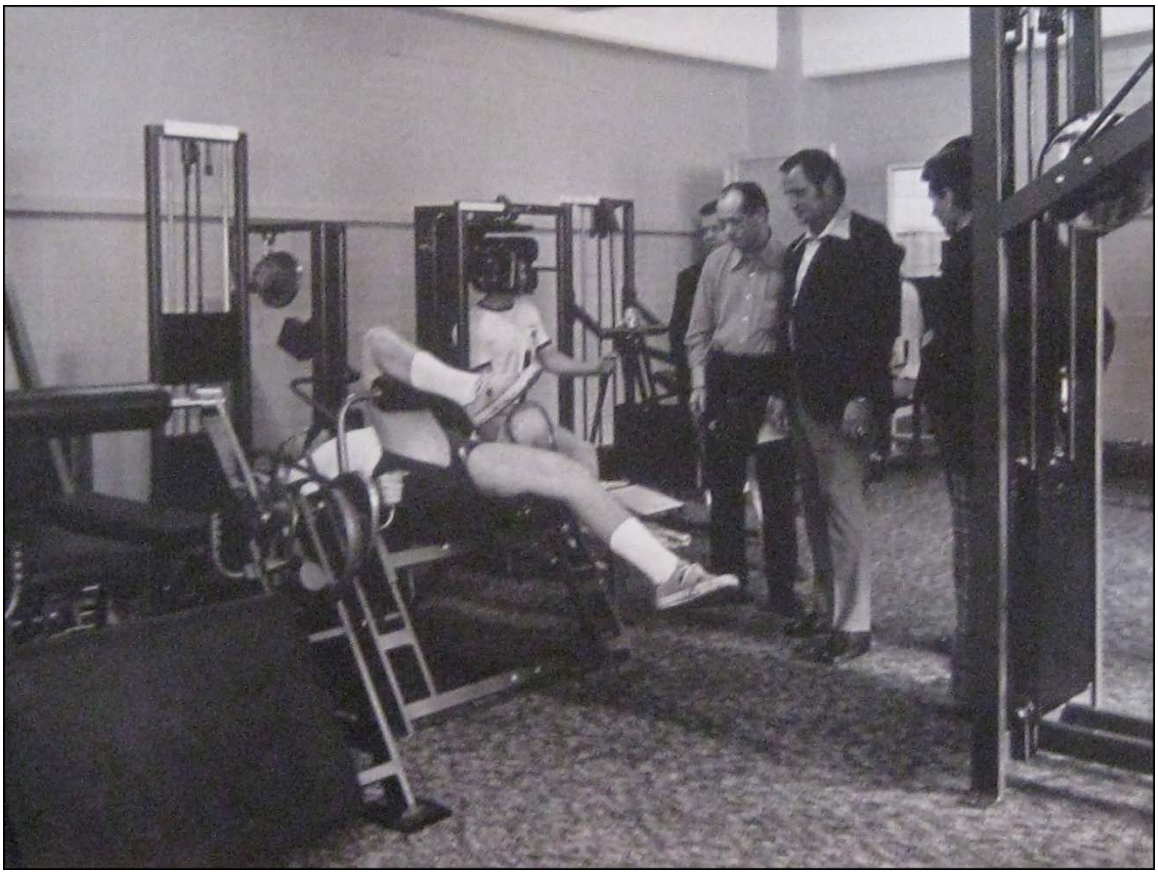
Two months later, he had added approximately 15 pounds of bodyweight, perhaps 40 pounds of muscular tissue (having burned of 25 pounds of fat, having replaced it with an equal weight of muscular mass, and having added an additional 15 pounds of muscular tissue)…and had enormously increased his strength.

Mike Reed improved by losing weight…Lou Ross improved by adding weight. But both men reduced fatty tissue and added muscular mass. In Lou's case we have some exact figures on his performance improvements…in two months, while increasing his bodyweight by approximately 15 pounds, he added 5½ inches to his high jump, and reduced his time in the 40 yard dash by two-tenths of a second.

Lou was tested by the Bills before they sent him to Florida, and then tested by them again after two months of training under our direct supervision…and the Bills coaching staff is the source of the above figures.

Having been tested at the end of the first two months of training, Lou returned to Florida for another month of training…and he continued to improve rapidly, but I don't yet have his final figures for the entire three months of training.

Individual athletes are just that, "individuals"…and with individual requirements, individual potential; but any athlete can improve in any sport as a direct result of exercise. And where increased strength is a requirement, this means adding muscular mass…which may or may not mean additional bodyweight. This being primarily determined by the starting level of fatty tissue.



Chapter 7: Avoiding Injury and Preventing Injury

Exercise should help to avoid injury…not cause injury. But it can do either. It can strengthen the muscles and the joints of an athlete to such an extent that the possibility of a directly sports-connected injury is greatly reduced.

OR…if improperly performed, it can cause an injury that might never have occurred on the playing field.

Exercise can **cause injury** in at least two different ways…

1. an athlete may injure himself while performing an exercise, an injury that is a **direct** result of exercise…or

2. an athlete may hurt himself on the field as an **indirect** result of exercise.

Injury that is directly caused by exercise will usually be obvious, you will normally be aware of such an accident when it happens und will thus know where to place the blame. But **indirect** injury may not be so easy to recognize…since it will not result from a single cause and effect type of situation that makes itself known immediately.

For example, if an athlete pulls a thigh muscle while performing squats in the gym, you will know exactly where to place the blame. But if, instead, he pulls a hamstring on the field…you might not realize that the injury was an **indirect** result of exercise. And it might not be…**but it could be**.

If an exercise program results in a disproportionate muscular development in antagonistic muscles, then it is almost literally asking for trouble. For example, if you develop great strength into the muscles of the frontal thigh, while doing little or nothing to increase the strength of the rear of the thigh…then you might actually cause an injury. An injury that would probably occur on the field, and that probably would not be blamed on exercise.

Unfortunately, since the blame for such indirectly caused injury is seldom placed where it belongs, it is utterly impossible to even estimate the number of such injuries with any reasonable degree of accuracy…but I am personally convinced that the number would be quite high.

Thus, the **known** injuries from exercise, when added to the **unknown** injuries equals a high but unsuspected total.

Balanced against this unknown total, we have only another **unknown** factor in the way of compensation…since, obviously, it is also impossible to estimate the number of injuries that were **prevented** by exercise. After all, who can even guess just how injuries “might have happened?”

So on the surface it may well be appear that exercise merely causes injuries…while offering nothing in the way of value in return.

But in fact, simple common sense also makes it obvious that a stronger man is less likely to be injured in any given situation…and that a more flexible man is also less prone to injury.

Many years ago, when I first started flying, a student pilot was required to practice spins, and proper recovery from spins. Then somebody decided that more people were being killed as a result of such training than as a result of accidental spins. Whereupon, they stopped teaching students spins and spin recovery.

Now, somebody else has suddenly noticed that quite a large number of supposedly well-trained pilots are killing themselves as a result of accidental spins…probably because they don't know what to do if an accidental spin occurs, never having been taught the proper procedure. In such situations, it is almost impossible to come up with anything even approaching a reliable set of statistics…and I will personally be very surprised if any meaningful statistics are ever produced to indicate the actual value of exercise for the purpose of preventing injuries. So, in such cases, we must simply rely on common sense, self-evident truth, obvious fact…call it what you may.

And injury is caused when a **force** is imposed upon a muscular structure (or a joint) to the degree that the **force** exceeds the **breaking strength** of the body part, the muscle or joint. That much is undeniable…and thus it follows that the injury would **not** have occurred if the breaking strength had been greater than the force.

If a rope has a breaking strength of 100 pounds, then it will not break as a result of 50 pounds of force. But if its breaking strength is only 40 pounds…then 50 pounds of force must break it.

You, as a coach, can do little or nothing to reduce the forces that will be imposed upon your athletes on the field. But you certainly can increase the breaking strength of their muscles and joints.

In some cases, the forces will be so great that no possible level of human strength would be high enough to prevent injury…but even in these cases, the extent of the injury may well be reduced as a result of exercise-developed strength. Thus exercise will reduce the level of damage in many cases…as well as preventing injury in many other cases.

So much for "preventing injury"…even in the lack of statistics to prove the value of exercise for the purpose of preventing injury, it is obvious that exercise does help prevent injury and that it also reduces the extent of damage in many other cases.

But we still need to look at the subject of "avoiding injury". We need to be aware of the factors that cause most training injuries, the type of injuries that are directly caused by exercise. Almost all of which injuries could be easily avoided.

Again…such injuries result when the force exceeds the breaking strength of a muscle or joint. So the force that is involved in exercise should be as low as possible without reducing the productivity of the exercise.

Which may, at first glance, appear to present a paradox…since exercise consists of exposing muscles and joints to force. But in fact, no paradox exists…it is easily possible to produce maximum-possible strength from exercise while avoiding at least a large part of the force that is usually involved in exercise. Unrequired force that does absolutely nothing in the way of increasing strength, while causing almost all injuries that are a direct result of exercise.

Bad form, or style of performance, is the culprit in almost all such cases…and this usually involves sudden, jerky movement. Which jerking greatly increases the forces imposed on the muscles and joints.

But in practice, thousands of athletes train in a way that may well be the most dangerous manner…meanwhile believing that their style of training is quite safe. **And**…meanwhile avoiding the most productive part of their exercises under the totally mistaken impression that they are thereby helping to avoid injury.

So they train in a dangerous manner, while considering it safe…and avoid an actually productive style of training, because they wrongly consider it dangerous.

Most people are absolutely convinced that a "hard" exercise is a "dangerous" exercise…and sometimes, in a few special situations, this may be true. But in most situations encountered, in exercise, it is exactly the opposite of the truth…it is utterly false.

Remember…force causes injuries.

It matters not at all how hard it "feels"…all that matters is the force in relation to the breaking strength. Since we are never aware of the exact, momentary breaking-strength, all that we can do is reduce the force as much as possible, while still working the muscles as hard as possible.

And again there is no paradox involved, as the following example will clearly prove.

If you walk into the gym with the momentary ability to curl 150 pounds…and if you actually curl 150 pounds…then you will be working as hard as you can at that point of time…and you will also be producing maximum-possible force.

And if it happens that the momentary breaking strength of your tendons is only 140 pounds…then you will injure yourself. Under those circumstances, injury is unavoidable.

But, if instead, you used a barbell weighing only 120 pounds…and if you performed several repetitions with this lighter weight…and if the form was good and the movement fairly slow…then you would probably never produce more than 125 pounds of force, which would be less than the breaking strength of your tendons…and the injury that was unavoidable with 150 pounds is thus avoided.

During the first repetition with this lighter weight, the resistance would "feel" lighter…because, at that point in the exercise, the resistance would be well below the momentary strength level of your muscles.

During later repetitions, the same resistance would feel much heavier, much "harder"…but in fact, the weight has not changed. All that has changed is your momentary strength, which has been reduced as a result of the first few, seemingly light, repetitions.

And when you reach the final repetition, it will feel very heavy indeed…but again, the weight remains the same.

In fact, if the exercise is performed from the first to last in good form, then the actual force will be lowest in the final repetition…because the speed of movement will be less at that point.

So the final, seemingly hardest repetition will feel very "hard"…and it is probably only natural for people to feel that it is the most dangerous repetition, because it feels that way. But in fact, it is the safest repetition in the exercise…because, at that point in the exercise, you are no longer strong enough to produce a force high enough to hurt yourself. Not, at least, if you avoid jerking.

As a result of the widespread misunderstanding that exists in regard to these actually very simple points…misunderstanding that has probably resulted from the fact that nobody ever bothered to consider the actually-involved factors in the light of physical law…most athletes avoid the final, seemingly hardest, repetitions. Mistakenly believing that they are thus avoiding injury…when, in fact, all they are avoiding is the most important and most productive part of their exercises. And the safest part as well.

Exercise builds strength by exposing muscles to an "overload"…to a level of work that is beyond the limits of momentary ability. Or, at least, well inside the existing level of reserve ability…far beyond the limits of normal ability.

But it is neither necessary nor desirable to expose a muscle to a maximum workload when it is fresh and strong…and doing so is dangerous.

If, instead, the muscle is "pre-exhausted" by the performance of several repetitions against a resistance that is well below the starting level of strength…then, later in the exercise, when a point of muscular failure is reached, the forces involved will be greatly reduced.

Upon reaching a point of momentary muscular failure, the resistance will certainly feel much heavier than it did at the start of the exercise…but that is merely an illusion produced by the fact that your **momentary** ability has declined to the point that you are unable to produce enough force to move the weight.

In the example given above involving a curl with 120 pounds, 125 pounds of force might have been produced during each of the first few repetitions…but at the end of the set, when movement is momentarily impossible, you may be producing only 110 pounds of force, or less.

And if 125 pounds of force didn't hurt you…then 110 pounds of force certainly won't hurt you either. Regardless of how it "feels" at the moment.

The breaking strength of a muscle (or tendon, or joint) doesn't decline during an exercise…it remains unchanged during exercise. All that happens is that your muscles become progressively weaker until they reach a point where it is impossible for them to continue with the available resistance.

If an injury is going to be produced by an exercise, then it will usually occur during the first few repetitions…simply because the forces are highest at that point in the exercise.

With the exception of Olympic weightlifters, athletes should **never** be required to lift as much weight as possible for a single, maximum-attempt repetition…such lifts are not required for building maximum strength, and they greatly increase the danger of injury.

Chapter 8: How to Get the Best Results from Exercise

There are really only a few important points that must be clearly understood…and if these points are understood, then getting the best results from exercise is very simple. Or it could be, and it should be, and it would…if people weren't involved.

The breeding, the feeding, and the training of animals is almost an exact science by comparison to the same subject involving people…because, in the care and training of animals you are not involved with the opinions of the animals. Something works…or it doesn't work…and you don't have to ask a horse what he thinks about it.

Which is certainly not meant to imply that athletes are "animals"…but it is meant to imply that their opinions seldom add anything apart from problems in the field of exercise.

One of the strongest men in the history of the world recently told me that literally **anybody** could produce the same level of strength that he did…"if they trained in exactly the same way, and if they were as **devoted** to training as he was."

And then he went on to add that he had given up everything else in life in order to devote himself entirely to his training…no job, no home life, just training.

But the fact is that his results were produced almost literally "in spite of his efforts."

He gives no slightest credit to the fact that he is 6 feet 4 inches tall and the he weighs well over 300 pounds…and while it may be true that some of his size is a result of his training, it is certainly true that his genetic potential made such size possible in the first place.

The man is an outright freak…a genetic freak. And, to at least some degree, so are most of the other outstanding athletes in every sport. Seven-foot basketball players certainly are not "average" men…and neither are 300-pound weightlifters…and you could not even begin to turn the average man into either one of them by exercise, nor by anything else.

So, when such an individual appears on the scene with set opinions about "why" he is so strong, the result is usually merely added confusion in a field that is far too confused already. Which is not meant to imply that being large makes a man stupid…but size doesn't automatically impart knowledge or judgement, either…and it frequently does result in bias.

When a man has devoted five or six hours a day to training, six or seven hours a day for a period of several years…and when he has eventually produced an outstanding level of strength…then it apparently becomes almost literally impossible for him to admit that his training methods were anything less than perfect.

And when you tell such a man that, in fact, most of his efforts probably did nothing except delay his production of results…don't be surprised if his reaction is stronger than disbelief.

Such men, like all men, want credit for their efforts…and giving credit for their strength to an accident of birth may seem, to them, to somehow reduce the value of their efforts.

Also…being forced to admit that 95% of your past efforts were wasted, or even counterproductive, is a very hard thing to do. And if you have managed to produce a high level of performance, it is probably only natural to try to use your ability as "proof" of the value of your methods.

And many other people are quick to believe the opinions of such "champions", also…and then are surprised when the methods suggested the champion don't work for them as well.

Men with an unusual level of ability are just that, "unusual"…far above average. Proper training can and will improve the ability of any athlete, in any sport…and this applies to the unusual men as well as to the average man. But the unusual man has certain natural advantages…a larger frame, the potential for great muscular mass, superior leverage, outstanding neurological efficiency, or some other genetically produced advantage.

Given any one of those natural advantages, a man will probably be stronger than average…given all of them, and he may well be almost superhuman.

As a coach, you cannot produce such men…you can only look for them. And having found them, then you can try to get them to train properly…which may well be harder than finding them.

Many, perhaps most, of the men that I haven't known who belonged to this upper strata of the physical world refused to train at all…being wrongly convinced that exercise was of no value, to themselves, at least. But in fact, such men have far more to gain from proper exercise than an average man does. If an average man doubles his strength as a result of exercise, he may still not be strong enough to compete with the champions…but if a naturally superior athlete doubles his strength, then a new and much higher level of performance is suddenly thrust upon the scene.

And when that happens, people rush to the new champions for "advice"…and he gives it freely, and it usually means literally nothing. But for a while, people attempt to duplicate his results by practicing his training methods…almost always with miserable results.

Every time this happens, and it happens often…more "secrets" are revealed to the hopefuls, more "information" is made available to coaches and athletes.

Under the circumstances, it is surprising that the overall situation isn't more confused than it is…or maybe there is a limit to the amount of confusion that can exist at any point in time, and perhaps we have reached that limit of confusion.

But for whatever reason, the situation certainly is confused…and the primary purpose of this book is to bring at least a few of these confused opinions into the light of a logical approach and expose them for just what they are.

Yet…herein exists a danger. Because such misinformation is so widespread, so often repeated as "fact", so apparently "accepted", that almost all coaches have fallen prey to at least a few of these myths…and when you come right out and tell them that many of their pet beliefs are utterly false, you run the danger of closing their minds to anything you have to say.

So I might be well advised to make no mention of such controversial matters…but, unfortunately, such an avoidance of the truth is simply not possible in this field if you are sincerely interested in producing worthwhile results. Because it just so happens that the most common beliefs are related to factors of great importance…and it also happens that most of these beliefs are utterly false, in most cases the exact opposite of truth.

But what does research show?

Quite frankly…research show almost anything you want to see, and the opposite, and a number of results somewhere between.

I am personally not even aware of a single long-range, large-scale, properly conducted program of research that has ever been conducted in the field of exercise anywhere in the world at anytime. But I am well aware of a large number of research programs that have been conducted under such haphazard conditions that almost any conclusion could have been reached.

Which should certainly not be misread to imply that I am "anti-science"…on the contrary, I am strongly in favor of the truly scientific approach to problem solving. But I am also well aware that such a truly scientific approach is seldom found in practice…at least in the field of exercise.

Before the Colorado Experiment (which will be covered in later chapters), I was firmly convinced that blood-pressure and electrical activity inside a working muscle would be higher while the muscle was performing negative work, during an "eccentric contraction". By comparison to positive work, "concentric contraction."

But careful measurements of both blood-pressure and electrical activity that were made during the Colorado Experiment indicated that I had been wrong…in fact, according to those tests, both factors where **lower** during negative work. Which surprised me.

I had also expected that electrical activity would increase markedly during an exercise…that is to say, I thought it would be fairly low during the first repetition, higher during a second repetition, and far higher during a final repetition.

But again I was wrong. While it does increase repetition by repetition, it increases only slightly…far less than I expected.

Which surprised me again…but pleased me, because it taught me something. It taught me that I don't understand the significance of such tests…and it taught me that a large number of other people don't understand these tests either, because I have read literally dozens of widely varying opinions on the subject.

Then, about a month later, while talking to a friend on the telephone, I was re-surprised on the same subject…because he conducted tests of the electrical activity during exercise, and also compared this factor in negative work to the same factor in positive work. And his results were the opposite of those that we produced.

So I called Dr. Elliot Plese, who conducted the tests during the Colorado Experiment, and told him what I had heard from my friend...and then I was surprised yet again. Because in the meantime Dr. Plese had conducted some additional tests, and his results were also the opposite of the first ones…at least in regard to electrical activity.

Thus, at this point in time, the situation in regard to such test is left firmly up in the air…if they have any significance, then I don't yet understand it. And I don't think anybody else does either.

But such a lack of understanding certainly has not prevented a number of people from making claims based on such tests, using results of such tests as "proof"…some proof.

Commercial bias is obviously responsible for a large part of the phony research that has been so common during recent years…but to at least some degree, the scientific community is itself to blame for what I can only describe as an "attitude of fear". An attitude that makes many scientific workers literally afraid to speak up plainly…and an attitude which leads them to look in all directions for "loopholes", just in case their theory turns out to be something less than perfect. Such writing is frequently justified on the grounds that they are "being fair"…or "trying to look at all sides of a question". Which would be fine, if it was true…but it seldom is.

So I would like nothing better than to totally ignore the "theory" of exercise…and I would, except that many readers would refuse to accept simple facts presented in plain English.

Certainly I am interested in theory…but I am far more interested in results, and I am practical enough to make very good use of obvious facts even when I can't explain them even to my own satisfaction.

So you will be exposed to a bit of theory in later chapters…but you will be exposed to a great deal more in the way of simple, practical, "how to do it" instructions.

Instructions dealing with tested and proven methods, methods that work…even if we don't always know exactly why they work, or even how they work.

So the best results from exercise can be produced by following the simple instructions contained in the last few chapters of this book…but you can't skip to that point immediately; because, if you fail to read the chapters that come before the chapters of instructions…then you probably won't have all of the information required to make proper use of those instructions.

And you certainly would still be restricted by many utterly false beliefs…the most important of which I will attempt to put to rest in the next several chapters.

Chapter 9: Improving Flexibility

Improvements in flexibility are a direct result of stretching…and heavy, full-range exercise provides a degree of stretching that is impossible to equal in any other way.

But the resistance must be heavy…heavy enough to pull the involved muscles and joints into positions at least somewhat beyond an average range of movement. If the resistance is too light, the required stretching will not occur, cannot occur.

And the exercise must be truly full-range…the range of movement of the resistance must actually exceed the possible range of movement of the athlete.

Several years ago, we designed and built an exercise machine for the major muscles of the torso…in an attempt to provide direct, full-range resistance for several large muscular structures that cannot be worked properly with any sort of conventional exercise. The first such machine had a range of movement of 160 degrees…and at first, that was more than enough for the people who were using it.

But we quickly discovered that the use of this exercise increased our range of movement…and within a short period of time, a matter of a few weeks, the available range of resistance was no longer enough.

So we rebuilt the machine, increasing the range of available resistance…and again it was enough at first. But within another few weeks, it wasn't enough…so we rebuilt the machine and increased the range of resistance for a third time.

Eventually, starting with a range of movement of 160 degrees, we had increased the range to a point in excess of 240 degrees…having increased the range of movement by more than 80 degrees, and also having increased the flexibility of some of the athletes that were using this exercise by more than 50 percent.

All of the athletes using this exercise increased their flexibility, but some produced greater increases than others…and it was **not** the slender, underweight athletes who produced the greatest flexibility. Instead, it was the much heavier athletes.

A surprising result? Not at all…if the actually involved factors are carefully considered. The lighter, weaker men could not use enough weight to pull themselves into an extreme range of movement…while the larger, much stronger men could.

So we produced large, heavily muscled athletes who were far stronger and **much more flexible** than much smaller men.

During the Colorado Experiment, Casey Viator, at a bodyweight well in excess of 200 pounds at a height below 5 feet 8 inches, repeatedly demonstrated that he was far more flexible than any other athlete that we tested…and we tested a large number of athletes engaged in a number of sports that require flexibility, including most of the members of the Colorado State University wrestling team and several gymnasts.

So, directly contrary to the old myth about becoming “musclebound”, heavy exercise can actually make an athlete more flexible…and as I have mentioned above, an exercise must be heavy if it is intended for the purpose of improving flexibility.

We hear a lot about “short” muscles…and “long” muscles…many people used to believe, and some people still do believe, that weightlifting developed short muscles, and that swimming developed long muscles.

But the fact is, of course, that the length of a muscle is determined by genetic factors that are unchanged by exercise. No form of exercise will do anything in the way of reducing or increasing the length of a muscle…all that exercise will do, all that it can do, is increase the width of a muscle.

Which is not meant to imply that the length of a muscle has no significance…on the contrary, the length of a muscle to a large degree determines its potential mass, and thus its potential strength.

Only certain shapes are possible in nature…and some shapes are impossible. And shape is determined by “aspect ratio”…aspect ratio being the relationship between length and width.

What this means to you, as a coach, is that you can go a long way in the direction of estimating an athlete’s muscular mass merely looking at him…if you know where to look, and what to look for.

First, let me attempt to make this point clear by using one or two examples that are unrelated to muscles…which examples, I think, will make a full understanding easier.

If a man was only 3 feet tall, then you would not expect his shoulders to be 24 inches wide…the result of such shoulders on a man of that height would be a ridiculous shape, literally an impossible shape.

There is; of course, a certain range of possible shoulder width for a man of that height…but there is a definite limit on both ends of the scale, a maximum possible width and a minimum possible width.

A bit of thought makes it obvious that the “length” of the man (his height) determines the maximum possible width…that his height **limits** his width.

Or, take another example…the width of a man’s head in relation to its height.

Some men have apparently long, narrow heads…other men have short, wide heads. But again, there is a definite limit to the possible range of shapes. You will never see a man with a head 12 inches long and only 3 inches wide…such a shape is impossible in nature, for a human at least. Nor will you ever see a man with a head only 8 inches long but 12 inches wide…another impossible shape.

The length of a man’s head limits the width…it may not be as wide as it could, but it certainly will not be any wider than it can be.

The same thing is true with a muscle…the length limits the width.

Casey Viator has very long forearm muscles…so he has the potential for the development of unusually large forearms. And his forearms are unusually large.

A friend of mine from California, Ron Peters, is eight inches taller than Casey, and his forearms are longer than Casey's…but the actual length of his forearm muscles is much less than Casey's. So his potential for muscular mass in that part of his arm is far below Casey's potential.

Both men have outstanding development of the upper arms, and both men have long muscular structures in their upper arms…a length of muscle that does not produce great muscular mass, but that makes it possible.

The muscular structure of the calves in many is typically very short…and as a result, massive muscular development in those muscles is literally impossible. Even when such short muscles are developed to their maximum possible size, they still will not be very large.

You can do nothing to change the length of your athlete's muscles…but you can be aware of it, which awareness might prevent you from expecting impossible results. Which information might make it possible for you to recognize the potential for great muscular mass when you see it.

Disproportionate development of one at a pair of antagonistic muscular structures can, however, result in a situation where greater relaxed tension is created on one side of a joint…and it might then appear that the large muscles had been shortened by exercise.

And, while no actual shortening has occurred, such a condition should be a clear warning that a dangerous situation exists. Because, if the full strength of the stronger muscle is used, it might result in injury to the weaker muscle.

So every attempt should be made to outline a program of exercises that will assure proportionate development in antagonistic muscles.

Chapter 10: Increasing Speed

Speed of movement is determined by a number of factors…and by relationships between these factors.

It is obvious that a man with such weak leg muscles that he could barely stand unsupported would not be able to run very fast, if at all…so increasing the size, and thus increasing the strength, of his leg muscles would also increase his speed. Even though it increased his weight.

Does that then mean that increasing the bodyweight of an athlete will always increase his speed? Certainly not…it simply means that it might, or might not, depending upon circumstances.

The result of increasing an athlete's bodyweight would be determined by the following factors…

1. it would depend upon the type of tissue that made up the increased bodyweight, fat or muscle…

2. it would depend upon where this tissue was added…

3. it would depend upon starting bodyweight, and the starting level of strength…

4. it would depend upon the particular sport.

The body will only permit a certain degree of disproportionate muscular development… which means that it is utterly impossible to develop maximum-possible size and strength into the muscles of the legs without also increasing the size and strength of the arms.

And this means that there is a very definite limit to the "desirable" size and strength for many athletes. For example…increasing the strength of a runner's legs will make him faster, up to a point; but, beyond a certain point, it will become impossible to produce additional strength in his legs without also increasing the weight of the torso and arms…and since the "noncontributing" weight of muscle in the torso and arms will increase the mass that must be accelerated and moved during running, it is possible for a point to be reached where the burden of extra weight cannot be compensated for by the increase in leg strength.

If nothing else changed, then increasing the strength of a runner's legs would always make him faster…but in practice, other things do change.

So…an athlete should increase his muscular size and strength up to the point that such increases are also increasing his speed. When increased strength produces no increase in speed, or a loss in speed, then you have gone too far…which situation is easy to correct.

Simply stop exercising for a brief period, or restrict exercise to fairly light movements, and reduce the diet proportionately…the body will not remain maintain a level of strength that is not required, and it will judge requirements by demand. In simple terms, "if you don't use it, you'll lose it."

Speed of movement is also determined by a number of factors that are not responsive to exercise…the length of limbs…neurological efficiency…and a number of other factors. You can do nothing to help these factors.

But you can do a great deal to help the factors that are responsive to exercise…you can increase the strength of the muscles that directly contribute to performance…you can reduce the fatty tissue to the lowest practical level…you can improve flexibility…you can improve circulation…you can improve "condition"…and you can greatly reduce the danger of injury. In combination with a reasonable diet, exercise can influence all of these factors…and the net result will be a marked increase in speed.

Having done all that can be done to help all of these factors, some men will still be fairly slow…but they will be much faster than they were before.

The antics and outrages of a rather large number of "bodybuilders" have done an enormous amount of damage to the entire field of exercise…causing many coaches to look upon the subject with great suspicion, or even outright hostility. Part of the problem has arisen from the fact that the current image of the "body beautiful" is based upon a body type that is almost the opposite of what it is supposed to represent. Most leading bodybuilders are far stronger than average men…but far weaker than they should be, if due consideration is given to their muscular mass.

But a lack of proportionate strength is not a particular bodybuilder's fault…nor is it a result of an incorrect method of training…Instead, such "less than expected" strength is a direct result of poor leverage factors that are not subject to change.

The ideal body type for great strength calls for shorter than average legs, a long torso, wide hips, and fairly narrow shoulders…which is almost the direct opposite of the "Mr. America" type of body.

So a bodybuilder's increased muscular mass will always make him much stronger than he would have been with smaller muscles…but he still may not be as strong as another man who has much less muscular mass but better bodily leverage.

Nor does the size of a muscle indicate the neurological efficiency with which if functions…a point covered in an earlier chapter. A man with outstanding neurological efficiency may be able to demonstrate twice as much strength as another man who has far more muscular mass but a lower order of neurological efficiency.

I am sometimes tempted to believe that the almost unbelievable muscular mass displayed by some bodybuilders is to at least some degree an attempt on the body's part to compensate for a low order of neurological efficiency, or poor body leverage, or both.

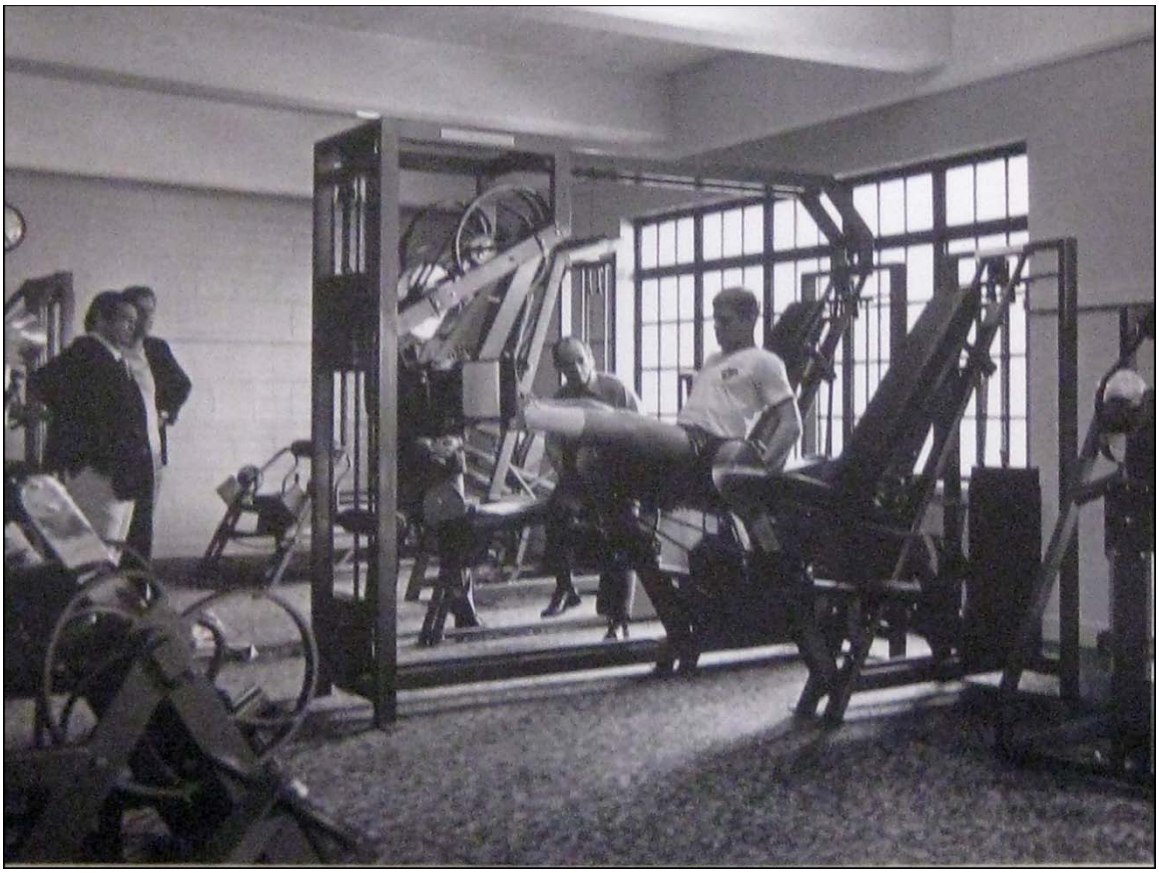
Bodybuilders are notorious for being "weaker than they look"…and with good cause in many cases. But there are exceptions, usually to be found among the shorter, stockier bodybuilders…who seldom reach the top physique competition, simply because their actually more functional bodies don't fit the pattern of what a physique star is supposed to look like.

Bodybuilders are also notorious for being slow, and clumsy…which charges are frequently overstated. But again, not completely without cause.

Part of this widespread opinion obviously results from a habit that many bodybuilders have of constantly flexing their muscles in an attempt to make themselves appear even larger than they are…which also makes them appear stiff, and clumsy, and slow.

So bodybuilders as a class are certainly guilty of bringing upon themselves the present lack of respect that they encounter in many circles…and they are also responsible for the fact that many coaches still look upon exercise of any kind as something to be avoided if possible, because it might make their athletes slow, “like bodybuilders.”

As a consequence, many coaches are denying themselves and their athletes the actually great benefits of exercise…for fear of making their athletes slow, they are literally preventing them from becoming faster.



Chapter 11: Improving Endurance

Up to this point, in previous chapters, I have pointedly avoided the use of the word "endurance"…because it has a different meaning to different people. Although a common word, it is commonly misunderstood.

Endurance, as I will use the word hereinafter, means "muscular endurance"…the ability of a muscle to perform repeatedly with a less than maximum load during anaerobic (nonsteady-state) work.

I will enlarge upon the above definition later, but first I want to mention some factors that endurance is not related to…not, at least, in the sense that I will use the word in this book. Endurance is not related to the heart, or the lungs. It has nothing to do with cardiovascular or cardiopulmonary ability.

When most people use the word endurance, they are really not talking about the ability of the muscles at all…instead, the usually mean "wind" or "condition".

If an athlete is forced to stop an exercise, or any physical activity, because his "wind" has failed him…it does not necessarily follow that his muscles have also failed.

Weightlifters and bodybuilders, who usually do little or nothing in the way of exercise that improves their "wind", or cardiovascular ability could not perform a low resistance, high repetition exercise even if they tried. But they would be forced to stop by the failure of their lungs…not because of a failure of the muscles.

So such people do have "muscular endurance"…but they usually have very little "cardiovascular endurance"…or cardiopulmonary endurance…or wind…or condition. Call it what you may, it amounts to the same thing.

Several years ago, during a demonstration of basic exercises given for the purpose of teaching the members of a high school football team proper form required in these exercises, my son performed 17 repetitions of the squat while using 250 pounds.

And during a strength test of this same football team, the strongest member of the team barely managed one repetition with 255 pounds…just 5 pounds more than my son used for 17 repetitions.

Whereupon, the coach remarked to me…"Well, your son has more **endurance** than my boys, but my boys are stronger than he is."

Which, of course, is ridiculous. The ability to perform 17 repetitions with a given weight, clearly and undeniably establishes the fact that you could have performed one repetition with a considerably higher weight.

In fact, only one day or two earlier, my son had performed 11 repetitions in the squat with 320 pounds during a demonstration for the coaches of this team. Including the same coach that made the above mentioned remark.

Which example is not meant to imply that the above mentioned coach is stupid…on the contrary, the individual in question probably has a better than average knowledge of this type of exercise. But, like all of us, he has accepted certain widespread beliefs as "fact"…and never really stopped to think about them logically.

As a result of this widespread misunderstanding, most people, when they use the word "endurance", are really thinking of the ability of the heart and lungs.

But when I use the word endurance I am speaking of a particular muscular ability.

If a man goes into a gym when he is fresh and rested, and if he performs a maximum-attempt bench-press with 300 pounds…and if he immediately tries to perform a second repetition, but fails…then he has tested his "strength" in the bench-press.

But probably without realizing it, he has also tested his "endurance"…because, in fact, the two factors are directly related. If you are aware of one, then you should know the other. Because, the existing momentary level of one factor clearly indicates the momentary level of the other.

"Strength" and "endurance" go up and down in direct proportion to each other. If you increase your strength 50 percent, then you have increased your endurance by the same amount, and vice versa.

For example…if, after a year of training you find you can perform 10 repetitions in the bench-press with 250 pounds…or one repetition with 300 pounds…then you should be aware of your individual "strength to endurance" ratio, and thereafter you should always be able to accurately estimate one factor by testing the other factor. Because they will go up or down while maintaining that same relationship.

In the above example the ratio is 5 to 6…which is about an average ratio, although a certain amount of variation will be noted on an individual basis.

A ratio of 5 to 6 means that your strength for ten repetitions will indicate your strength for one repetition, at that ratio…if you can perform 10 repetitions with 5 pounds, then you can 1 repetition with 6 pounds.

For example. Let us assume that you can perform 10 repetitions with 100 pounds in the curl, and you wish to know your strength level for one repetition in the curl. Merely divide 100 pounds by 5…which will give you a figure of 20…and then multiply 20 by 6, which will give you a figure of 120. And 120 pounds would be your ability for one repetition.

Or…if you could bench-press 300 pounds for 10 repetitions...divide 300 by 5, which will give you 60…then multiply 60 by 6, which will give you 360. And 360 would be your strength level for a single repetition.

A ratio of 5 to 6 may not be your particular, individual ratio…but that is a close figure for almost anybody. And it is a fairly simple matter to determine your own ratio for yourself…and having done so, you can afterwards use it as a constant and very accurate gauge of your actual strength for a single repetition.

But please note carefully that this ratio will apply **only** in cases where you are dealing with pure "strength"…if a particular exercise involves skill, or great speed, or balance, then you might fail in a situation where your strength was high enough but your form was off at the moment.

So don't attempt to apply this ratio to quick lifts like the clean and jerk or snatch, or any other lift except a simple movement involving little or no skill.

And once you are aware of your own individual ratio, you have the advantage of knowing your existing strength level at all times…without the necessity, and without the danger of testing it.

But, as this point I want to mention that this ratio will hold true only during anaerobic work…only if the resistance if fairly high.

You are performing anaerobic work when the resistance is high enough to prevent continuous work at that level of intensity, and at that pace. If the work can be continued more or less indefinitely, then you are performing aerobic work.

If you bench-press 300 pounds and…then fail when attempting a second repetition…you failed with the second repetition because the muscles did not have enough time to recuperate. The fuel and oxygen that were stored in the muscles were enough to permit the first repetition, but were depleted to some degree by the first repetition…and the amount of fuel and oxygen that remained was not enough to permit a second repetition.

As soon as the existing stores of fuel and oxygen that are stored in a muscle are depleted by work, the body immediately starts replacing them…but such replacements takes time, and if you work the muscles so fast that you are using up the stores of fuel and oxygen faster than they can be replaced, then the muscle will eventually reach a point of failure.

A single repetition or an exercise, regardless of the actual weight involved, never uses up all of the available fuel and oxygen stored in the muscles…but it does use part of them. And if the lift is heavy enough, then the remaining, unused stores are not enough to permit a second repetition with the same resistance.

If, instead of taking your maximum weight, you used a somewhat lighter weight…then you could probably perform several repetitions. A number of repetitions are now possible for several reasons…

1. the first repetition uses part of the fuel/air, but leaves enough for a second repetition…

2. the second repetition uses exactly the same amount of fuel/air as the first repetition did, and leaves enough for a third repetition…

3. but the reserve is being rapidly reduced because the individual repetitions are using up the fuel/air faster than the body is replacing it…

4. so, eventually, you reach a point where the momentary supply of fuel/air is not enough to permit another repetition, and then you fail. Such work is anaerobic...or "nonsteady-state."

However, if the weight was much lower, then the fuel/air requirements for each repetition might not be as high as the body's ability to replace it…in which case you could continue almost indefinitely. In this case, the work is aerobic…or "steady-state".

In general, aerobic (steady-state) work is required for improving cardiovascular ability, "wind", or "condition"…the ability of the heart and lungs. And such work will do very little in the way of building strength.

And, in general, anaerobic (nonsteady-state) work is required for increasing muscular mass and strength…and, as usually practiced in weightlifting in bodybuilding circles, such work will do little or nothing for improving cardiovascular ability.

With the clear understanding that the following figures are **not** intended to be meaningful in any sense except for my purpose in the following example, I will attempt to show in simple mathematical terms just what happens during a set of five repetitions of anaerobic work.

Let us suppose that your starting level of fuel/air was 500 "units"…and let us also suppose that one repetition of the bench-press burns up 60 units of fuel/air…and let us suppose that a level of 360 units of fuel/air is required to bench press 300 pounds.

First repetition…	
With a starting level of:	500 units
The first repetition consumes:	60 units
Leaving only:	440 units
But the body replaces:	20 units
Giving a momentary level of:	460 units

And so on repetition by repetition, so that by the time you reach the final repetition, the fifth repetition, the situation is a follows.

Fifth repetition…	
With a starting level of only:	380 units
The fifth repetition consumes:	60 units
Leaving only:	320 units
And again the body replaces:	20 units
Giving a momentary level of:	340 units

But 340 units is not enough to permit you to continue…since a level of 360 units is required to permit a repetition with that amount of resistance. So you fail.

But you just barely fail…you could almost do another repetition, but not quite.

Such work is anaerobic work…the type of work required for the development of muscular mass and strength.

An understanding of the above example should also make it clear why the final repetition feels so much harder than the first repetition. During the first repetition you are using a much lower proportion of your momentary ability…and during the last repetition, you are using very close to 100% of your momentary ability. So, repetition by repetition, the intensity of effort is constantly increasing…although every other factor remains unchanged.

When such anaerobic work is performed regularly, you are exposing your muscles to the “overload” principle of exercise…and they will respond by increasing their size and strength.

Apparently the body attempts to maintain a certain (but unknown) percentage of reserve ability, probably as a hedge against emergency needs…if you force the muscles to work at a level close to the limits of momentary ability, then little or nothing is being left for emergency use, and the body tries to re-establish the previously existing percentage of reserve strength. And the only way it can provide the reserve strength is by increasing its muscular mass, and thus its strength.

And…anything you do that results in increasing your strength, will also increase your muscular endurance in direct proportion, since strength and endurance are, in a sense, one and the same thing.

““Strength” and “endurance” go up and down in direct proportion to each other. If you increase your strength 50 percent, then you have increased your endurance by the same amount, and vice versa.”

Chapter 12: Why Exercise Increases Strength

Exercise increases strength by creating…"a need for growth"…by making demands which cannot be easily met by the existing level of strength.

If the existing level of strength is adequate for the workloads encountered, then there is no need for growth, and the body will not provide something that isn't required. Not in the way of muscular size and strength, at least.

Within rather broad limits, you can do almost anything you want to with a program of proper exercise. As stated in an earlier chapter, the limits of muscular growth are determined by individual potential; but within those limits, you can produce striking degrees of physical improvement in almost literally **anybody**.

And producing such improvements doesn't take years of steady training…and it doesn't require devoting your entire life to a gym…and it doesn't mean that you have to give up all other physical activity…and it doesn't require working yourself into a state of nervous exhaustion. Quite the contrary, on every point. Best results from exercise can come quickly…from very brief and infrequent workouts…while continuing any other type of physical activity…and while improving both strength and your stamina, giving you more energy for your other activities, instead of less energy.

The very purpose of exercise is, **or should be**, to improve your physical ability, to make you stronger, give you more muscular endurance, produce improved cardiovascular ability, raise your stores of energy. And it will, if your program of exercise is logically planned and properly executed.

But far too often, exercise becomes "an end in itself". When, instead, it should be an aid to other physical activity.

Exercise should constantly improve your ability, both your strength in the actual exercises themselves, and your overall ability in other physical activities. But in practice, what frequently happens is a far cry from what could have happened, what should have happened. Instead of producing an ever-increasing feeling of strength and wellbeing, an improper program of exercise will leave you feeling constantly tired, with little energy for anything else.

Which result should be a clear warning that something is wrong.

But it is a warning that is frequently ignored. Usually from a misunderstanding of the cause and effect factors involved in exercise.

Some degree of physical discomfort form muscular soreness is only to be expected when a previously-untrained individual starts training…but such soreness should be entirely gone within a matter of a very few days, and it should not return as long as regular training is continued.

And it is also perfectly normal for a previously-untrained individual to feel tired as a result of his first few workouts…but this feeling of tiredness should not continue. And if it does, then you are overtraining, your workouts are exceeding the recovery ability of your system.

Even after years of steady and proper training, you should be tired at the end of a workout…but you shouldn't remain tired. Twenty minutes later, you should feel perfectly capable of going through the entire workout again, immediately.

And you should be able to, if you tried…but don't try. It takes very little exercise to stimulate growth, but too much exercise will prevent growth, or even produce losses in strength and muscular mass.

While the exact difference is not entirely understood, it is obvious that high-intensity exercise is somehow "different" from exercise of a lower intensity…it makes demands upon the system that are not quickly met.

When a muscle is working close to its limit of momentary ability, a complex change in body-chemistry occurs…a sort of "chemical supercharging" takes place. And while it is not necessary to understand just how this happens, it is important to be aware that it does happen. Because it makes demands upon the system that are never encountered during low-intensity exercise; and if this factor is ignored, then a situation is created in which growth becomes impossible.

A muscle itself is apparently capable of an almost infinite amount of work, if the intensity of work is low enough…but high-intensity work makes demands upon the support system of the body that cannot be quickly met. And if more high-intensity work is performed before complete recovery has occurred, then losses in strength and muscular mass be will produced instead of gains.

Failing to understand this point, many people deny themselves the potential benefits of exercise by overtraining…or, in an attempt to avoid overtraining, they reduce the intensity of their exercises to a point that growth is no longer being stimulated.

In either case, growth will not occur. Growth cannot occur if the body is overtrained, and will not occur if the intensity of work is too low.

While exercise is obviously capable of producing enormous increases in muscular mass and strength, it apparently does not produce a proportionate increase in the ability of the support system of the body.

Which means, in practice, that a stronger man literally cannot stand as much high-intensity work as a weaker man can. When regular training is first started, and after the initial "break in" period of muscular soreness, a beginner will grow rapidly from high-intensity training even if he trains three of four times as much as is actually required.

Apparently, a weak individual is unable to exceed the recovery ability of his system…he seemingly isn't strong enough to impose a demand upon his recovery ability that can't be met.

Obviously there is a limit, beyond which recovery would be impossible, but a beginner is seldom if ever able to reach that limit in practice.

However, as he becomes stronger as a result of regular training, he starts making demands upon his recovery ability that cannot be so easily met…his ability to make such demands increases more rapidly than his ability to meet the demands.

And eventually, when a level of far greater than average strength has been produced, he becomes capable of making demands that cannot be met. At which point, the amount of training must be reduced.

Such demands upon the overall recovery ability are obviously related to the intensity of exercise…and have little or no relation to the amount of exercise.

If the implications of the above, brief sentence are fully understood…it then becomes possible to produce good results from exercise. But without such an understanding, good results are impossible.

But how do we define "good results?"

Unfortunately "good results from exercise" is a relative term, and far too many factors are involved to permit a simple definition. Good results for one man might be very poor results for another man.

But we can, at least, recognize "constant results"…and we should be aware that **no results** does not equate **good results**. Thus a lack of progress is, or should be, a clear warning that something is wrong.

Yet thousands of people train for years with little or nothing in the way of results to show for their efforts.

Which is a satisfactory state of affairs if training is being conducted for the purpose of maintaining an existing level of strength.

However, in fact, that is seldom the case. Instead, the majority of such trainees are almost desperately trying to increase their strength…**and failing**.

Or failing for all practical purposes, because any resulting increase in strength is produced so slowly that it doesn't justify the efforts.

For the production of good results…exercise must **stimulate growth**, and **permit growth**.

Stimulating growth is related to the intensity of exercise.

Permitting growth is related to the amount of exercise.

In the next two chapters, we will examine the above two factors in detail.

"The very purpose of exercise is, **or should be**, to improve your physical ability, to make you stronger, give you more muscular endurance, produce improved cardiovascular ability, raise your stores of energy. And it will, if your program of exercise is logically planned and properly executed."

Chapter 13: Stimulating Growth

There is an obvious threshold in exercise…a threshold below which, no increase in strength will be produced. Regardless of the amount of exercise. It might well be called the "threshold to results."

This threshold is related to the intensity of effort. It has no relationship to the amount of exercise, except that intensity limits the possible amount of exercise.

If the intensity of an exercise is below this threshold, below a certain level, then you can train for years with nothing in the way of resulting strength increases. But if the intensity is above a certain level, then strength increases will be produced rapidly. And it seems that the higher the intensity, the faster the strength increases will be produced…or, at least, they will be if you don't make the mistake of overtraining, of training too much.

Unfortunately nobody knows exactly what level of intensity is required to produce maximum strength increases.

Another troublesome factor is introduced by the fact that it is almost impossible to measure the intensity of an exercise.

And yet a third factor adds even more confusion to the situation…the simple fact that most people have absolutely no idea what you mean when you use the word "intensity". Intensity is probably best defined as…"percentage of momentary ability."

The key word is that definition being **momentary**.

Maximum intensity simply means that you are producing as much muscular force as you are **momentarily** capable of doing…that you are working as "hard" as possible…moving the available resistance as fast as possible…or pulling as hard as possible against a resistance that you can't move.

So it is possible to measure maximum intensity. When you are doing all you can at that moment, then the intensity is 100%.

But just how do you measure a level of intensity that is anything less than 100%.

During almost all forms of exercise, the level of intensity is constantly changing, as the following example will show.

At the start of an exercise, you might be capable of producing 500 pounds of force…but if you used 500 pounds of resistance, then you could perform only one repetition. So, instead, you use only 400 pounds of resistance…which will permit several repetitions.

Thus, during the first repetition, you are required to produce only 400 pounds of force. When, at that moment, you could have produced 500 pounds…so the intensity level was 80%. The first repetition did **not** produce a maximum level of intensity, but it did reduce your momentary strength.

So, when you start the second repetition, your momentary level of strength might be only 450. But again you are required to produce only enough force to lift the available 400 pounds of resistance, so the intensity is still not 100%. But it is higher than it was during the first repetition.

During the second repetition, the intensity level is 90%…because you are then using a higher percentage of your **momentary** strength.

And again your momentary strength level will be reduced, perhaps to a point where you are capable of producing only 400 pounds of force.

Thus the third repetition will result in an intensity of 100%…because, at the moment, you are required to produce 400 pounds of force in order to lift the weight, and that figure represents 100% of your momentary ability.

The only factor that changed during the three repetitions was intensity, everything else remained constant. The weight was the same in all three repetitions, the distance of movement was the same, and the speed of movement was the same.

The amount of work performed was also exactly the same during each repetition. The energy consumed, the heat produced, the oxygen required…everything remained constant, except the level of intensity.

It should now be obvious that intensity is not related to the amount of work, nor the production of power.

Instead, intensity is a relative term…directly related to the percentage of your momentary ability that you are actually using.

It is my personal opinion that an intensity of effort of 100% will produce the fastest rate of strength increases…and if not, then something very close to 100% is required. But my opinion is based strictly on experience, and cannot be supported by tests or research, because no practical tests exist for the purpose of measuring intensity.

It might well be…it could be…it is possible that a level of intensity somewhat below 100% is all that is required for producing maximum strength increases. But even if we knew that to be true, how could we measure it? How would we know that we were producing the proper level of intensity?

So…even if we knew that, for example, a level of intensity of only 90% was just as productive as a higher level, this information would be of no use to us. Because we would never be able to measure it, we would never know if we were producing that level of intensity.

In effect, not knowing just where the "threshold to results" is to be found, we must always be sure that we are going high enough to reach it…and the only way to be sure is to go as high as possible, to a point of momentary muscular failure, which is the only point where we can be sure of our level of intensity.

If you have performed as many repetitions as possible, and if the last repetition was almost **impossible**, and if another repetition is impossible…then your level of intensity reached 100% during the final repetition. Having done so, you have stimulated the muscles as much as you can…additional exercise on that day for the same muscles is neither necessary nor desirable.

But if, instead, you stopped even a few repetitions short of a point of momentary muscular failure, then you may have done little or nothing to stimulate muscular growth or strength increases.

Maybe you did, although I don't think so…and maybe you didn't; but in either case, you can never be sure. Whereas, if you had continued to a point of muscular failure, then you would be sure.

Years ago, people performed thousands of repetitions of calisthenics…with little or nothing in the way of resulting strength increases. Because the intensity of effort is far too low during such exercises.

Later, much better results were produced by the use of Indian Clubs. Even though the amount of exercise was greatly reduced. Better results were produced because the intensity was increased.

More recently, even better results were produced by the use of barbells. And again, the amount of exercise was reduced.

Step by step, the available resistance was increased…so it might appear that the better results were produced by the increased resistance. But that appearance is misleading.

The increased resistance was a requirement, a prerequisite…but it was not the actual factor responsible for the improved production of results.

Instead, the increased resistance made it possible to work at a higher level of intensity…and it was the raised intensity that improved the results.

During calisthenics, when no added resistance was available, it is possible to perform literally thousands of repetitions…and as a result, such exercises are normally terminated far short of an actual point of muscular failure.

You might become winded, or the muscles might start hurting so much that you are unwilling to continue…but the muscles could continue, so you have failed to reach a level of high-intensity.

With Indian Clubs, the added resistance makes the situation somewhat better. It is no longer possible to perform as many repetitions as you could during unweighted calisthenics, so you are likely to approach an actual point of muscular failure. The number of possible repetitions is still far too high, but the increased level of intensity will greatly improve the production of results.

With a barbell, the great increase in available resistance makes it impossible to perform more than a few repetitions…or it will of you use enough weight, and you should. You should use **enough** weight, but not **too much**.

Thus it becomes possible to reach an actual level of momentary muscular failure…and it becomes **necessary** to reduce the amount of exercise.

When you increase the intensity of exercise, then you must reduce the amount of exercise. A widespread failure to understand this simple point has done more to damage the cause of exercise than any other factor of which I am aware.

It is easily possible for a man to walk 30 miles a day for a period of years…but doing so will do little or nothing to increase his strength.

But it is **not** possible for a man to run 30 miles a day at top speed…and even attempting to do so will produce losses in strength.

The "amount" of work would be exactly the same in either case…but the "intensity" of work would not be the same.

And the faster you run, the less you can stand to run…a sprinter does not train, literally **must not train**, like a distance runner.

Sprinting requires a brief but very high-intensity effort, and if such a level of performance is repeated frequently then losses in strength (and thus losses in speed) will be produced.

Growth of a muscular mass, and thus an increase in strength, is stimulated by high-intensity work; but such work makes demands on the recovery ability of the body that cannot easily be met, so the amount of such high-intensity work must be strictly limited.

Failing to understand this relationship between the "amount" of work and the "intensity" or work, most trainees are tempted to do more than is required. But the result is not merely a waste of time and energy; instead, the result is usually a total lack of results…or, at best, very poor results.

Because…you can **not** have both. You can perform a large amount of work…**or**, you can perform high-intensity work. But not both.

So if you insist on increasing the amount of exercise, then you will be forced to reduce the intensity of exercise; you have no choice in the matter.

But even when the implications of high-intensity exercise are clearly understood, practical application is still not easy. Because high-intensity exercise is certainly **not** an "easy" way to train.

In an earlier chapter, I mentioned that the forces involved, and thus the chances of injury, are actually **reduced** in the final, seemingly hardest, repetition. Yet many people are still tempted to avoid the last few possible repetitions under the mistaken impression that they are thus avoiding the most dangerous repetitions…when in fact, the last few repetitions are actually the **safest** repetitions, and by far the most productive ones.

Chapter 14: Permitting Growth

Be it clearly understood at the start that I am fully aware that one example proves little or nothing. But a single example can at least trigger a thought pattern that leads out of a blind alley…and having emerged into the light, you then have the opportunity to carefully examine the involved factors in an attempt to establish a cause and effect relationship.

So the following example from my own experience is not offered as proof of the conclusions that followed; but it did turn my thinking in the right direction…and now, twenty years and thousands of examples later, the cause and effect relationships have been carefully examined and the unavoidable conclusions have been firmly established.

Even in 1939, when I first became seriously interested in progressive exercise, there were at least a few outstanding examples of muscular size and strength. Examples produced by "weight lifting", as it was called then. But these examples proved nothing beyond the obvious fact that such results were at least possible. The men who had produced such apparently good results certainly had opinions in the subject of exercise…but there were almost as many opinions as men, widely differing opinions.

Now, thirty-four years later, there are far more examples of unusual muscular size and strength…and even more opinions on the subject of how to duplicate such results.

So instead of improving, the situation has become worse…finding a reliable source of factual advice on the subject of exercise is more difficult now that it was when I first became involved in the field.

Like almost everybody else, I started out by trying to follow the advice of self-proclaimed "experts"…of which experts there was no shortage, even then. But I was at least smart enough to realize that some of the advice being offered was ridiculous, so I wasn't forced to try everything for myself.

And I also realized that instructions must be followed exactly if a valid test is being conducted, so I wasn't forced to waste a number of years of effort before reaching a conclusion in regard to a particular piece of advice.

So I tried the systems of training that appeared to offer some promise, and I followed instructions to the letter, and I reached certain conclusions…and I tried to apply the lessons thus learned to my own training. But of even more importance, I also tried to understand the cause and effect relationships involved.

For a period of several years I experimented upon myself, and I produced a certain degree of worthwhile results; but I also produced a feeling that something was "wrong" with the system of training I was using…and it was, but it took me several more years to find the solution to the problem.

And in the end, the answer was not the product of a flashing bit of logical insight; instead, it was forced upon me literally be accident.

Like almost everybody else, I had been guilty of overtraining, of training far too much, of equating "more" with "better". And the evidence had been in plain sight all the time, but was ignored because it wasn't understood.

For years I had been stimulating growth, but I had not been **permitting** growth. I created the need for growth, but denied the means.

Starting at a bodyweight of 132 pounds, I increased my weight by exactly 40 pounds, to a bodyweight of 172 pounds; but regardless of any continued efforts, I reached a firm sticking point at that bodyweight.

Over a period of nearly fifteen years my training was conducted in an "on again, off again" fashion. I would train hard for a few months and then would stop training entirely for another few months, or even years. During a long layoff from exercise of any kind, my bodyweight would drop to 160 pounds, and would remain at that level. But as soon as I started training again my weight would increase very rapidly…up to a point, a certain, exact point, beyond which I could not gain.

So my bodyweight varied between 160 pounds and 172 pounds…28 pounds of the weight I had added by exercise remaining as a permanent gain; but 12 pounds of it being temporary, remaining only as long as I continued training.

During those years I gradually settled upon an exact training routine that was seldom varied. I trained three times weekly, for a period of more than three hours during each workout, using twelve basic barbell exercises and performing four "sets" of each exercise. A total of 48 sets during each workout.

The number of repetitions in each set was normally from eight to ten, but I always trained as hard as possible, performing as many repetitions as possible and stopping only when I reached a point of momentary muscular failure.

If I was able to perform ten or more repetitions during a particular workout, then I increased the resistance during the next workout, and I constantly pushed in an effort to progress…always trying to increase either the amount of resistance or the number of repetitions, or both.

Even a few weeks of such hard training would rapidly increase my bodyweight to a level of 172 pounds, with muscular measurements and strength levels in proportion; but no amount of continued training would produce the slightest evidence of progress beyond that point.

Having been "up and down" several times over a period of fifteen years, I finally reached a point where I could exactly predict my muscular measurements and strength levels at any given bodyweight…but I couldn't get any heavier, nor stronger.

Since I didn't think I had reached the limits of my potential, I felt that something was wrong…and it was, but it took me a long time to find the answer.

Eventually, when I did find the answer, it was literally forced upon me by accident. At the age of about thirty, having been "up and down" approximately a dozen times over a period of years, I was again stuck at a bodyweight of 172 pounds and had produced no sign of progress during several weeks of steady, hard training.

I was ready to quit again, convinced that I was wasting my time and efforts, when I decided to try something new…instead of stopping training entirely, I decided to cut my workouts in half, to reduce the amount of training by exactly 50%.

Previously, upon reaching this same sticking point I had always stopped training entirely; but this time I simply reduced the amount of training. Otherwise, everything remained the same; the same three weekly workouts, the same exercises, the same arrangement of exercises…except the number of sets, instead of the previously practiced four sets of each exercise I performed only two sets of each exercise.

And I immediately started growing, rapidly growing. Within a week I added nearly ten pounds of bodyweight, increased the size of my arms exactly half an inch, and greatly increased my strength…quickly reaching a bodyweight, muscular size, and strength level that I had previously found impossible to attain.

After the first week I was forced to stop training for nearly a year, I was flying internationally and a change in my schedule made it impossible to continue training; but the experience of that final week of training had not been overlooked, the implications were simply to obvious to miss…a 50% reduction in the amount of my training had produced progress that had previously been impossible.

During the following year I had neither the time nor the opportunity to train, but I did have a lot of time to think about the implications of that brief experiment. So when I started training again I decided to try an even greater reduction in the amount of training…instead of performing 4 sets of 12 exercises, I used only 2 sets of 8 exercises, thus reducing the length of my workouts from 48 sets to only 16 sets.

The change in the production of results was almost more than I could believe; while training only a third as much as I had previously, I produced far better results…growth was apparent as a result of every single workout, and I quickly reached my previous sticking point and passed through it with no slightest pause.

The previously practiced longer workouts had obviously been stimulating growth…but they had not been **permitting** growth, at least not beyond a certain point.

Now, approximately twenty years after that first clear lesson was forced upon me by accident, the cause and effect relationships involved in my early training experience are simply undeniable; in the meantime having been confirmed and reconfirmed by thousands of other examples. But it certainly does not follow that this same lesson has been learned by everybody. On the contrary, the seemingly natural inclination to equate “more” with “better” still persists; so many thousands of trainees still make the same mistake that I made more than thirty years ago.

And in the light of my own experience, I can certainly understand why they make such a mistake…after all, I continued making the exact same mistake for nearly fifteen years before the truth of the matter finally came trough to me by accident.

So it was a hard lesson for me to learn…and perhaps I am expecting a bit too much of other people when I expect them to learn the same lesson quickly and easily. Some people do, but some don’t…and some apparently never will, remaining firmly if falsely convinced that a literally enormous amount of training is an absolute requirement. When the fact is that such training will literally prevent the production of worthwhile results.

But when a genetic freak comes upon the scene with an outstanding degree of muscular size and strength and loudly proclaims himself an “expert”, and points to his own results as undeniable proof that his methods are best…and when he firmly states that he devotes almost every waking hour to his training…then I suppose that it is perfectly natural for many people to pay attention to his words.

So perfectly natural it may be, but it is almost always a mistake. I have yet to meet a single example of such a man who had even a basic understanding of the actual cause and effect relationships involved in exercise. Such people are simply statistical standouts, genetic freaks…and have produced their obvious results almost in spite of their efforts, rather than as a result of any real knowledge.

And it must be understood that “outstanding results” or “obvious results” do not prove the value of a particular method…until and unless they are considered in relation to the amount of time and effort that were involved in producing them.

Everything has a price, and everything has a value…if the price paid by many trainees is really the required price, then the results are simply not worth it. But in fact, the actual price required for the production of maximum possible results from exercise is quite low…literally must be low.

Eventually, this will be understood by almost everybody…but in the meantime, millions of people are wasting billions of hours of training time, while doing much more in the way of preventing the results than they are in the direction of producing results.

Having thus wasted at least a thousand hours of my own time, I can understand just how this has come about…but having finally learned my lesson, I now produce far better results form a tiny percentage of the previous training time.

Finally, in an effort to determine just how little training was actually required for the production of large scale, rapid increases in muscular size and strength, we conducted the Colorado Experiment during the month of May, 1973. In the following four chapters, this experiment will be covered in detail.

Chapter 15: The Colorado Experiment Part 1—Purpose of the Experiment

In the previous chapter, I mentioned the circumstances that first led me to suspect that too much exercise might be as counterproductive as too little exercise. During the twenty years that have followed that realization, an enormous amount of information has come to my attention from a variety of sources…the results of research in a number of related fields…improvements in available equipment…and of perhaps greatest importance, enough time to carefully examine as many as possible of the related factors.

More than thirty years ago, when I first became interested in exercise, almost nothing in the way of factual information existed on the subject…but now, the situation may well have reversed itself; perhaps "too much" information is now available…so much information that it has become almost impossible to absorb it all.

Another problem being introduced into equation by the fact that only most of the information is fragmented, exists only in apparently unrelated bits and pieces…an almost unavoidable result when due consideration is given to the actual number of factors involved, physical factors, physiological factors, biochemical factors, neurological factors, psychological factors, an almost infinite number of factors.

Under the circumstances, I realized long ago that the final answers would not emerge during my lifetime; but I also realized that the trend in current training practices was in exactly the wrong direction. While I perhaps didn't know exactly what was "right"…I certainly could see a number of things that were "wrong".

If for no other reason, I was clearly aware that many current training practices were wrong simply because they weren't logical, because they attempted to deny established physical law.

For example; from my own personal experience, and from the experiences of many other people, I was aware that a very rapid rate of muscular growth was at least possible. Why, then, I was forced to ask myself, couldn't such a rate of growth be maintained right up to the point of individual potential?

A physical law simply states that a given set of circumstances will produce a particular result, invariably. If the law is valid, then the result must be produced…and if the result is not forthcoming, then the only logical conclusion is that the circumstances were not those that were required.

So, if we do something once, and a particular result is produced, then the same result should always be produced…and if it isn't, then that is clear proof that the circumstances were changed in some manner, even though such a change may have evaded our attention.

In my own case, a certain type and amount of exercise produced a particular result…for awhile, up to a point. But beyond that point, exactly the same type and amount of exercise produced no apparent result at all. Obviously, then, some factor had been changed, the circumstances had been altered.

Eventually I realized that the change in circumstances occurred within my own system, growth was produced as long as I was working within the limits imposed by my recovery ability. But if the demands exceeded the ability of my system to meet them, then growth was literally impossible.

A certain "balance" was obviously required; if the recovery ability exceeded the demands, then growth was at least possible, and if it was being properly stimulated then it would occur…but if the demands exceeded the recovery ability, then growth was impossible, regardless of the stimulation provided.

Practical experience also made it obvious that increases in strength resulting from exercise were not matched by equal increases in the recovery ability. In effect, as we became stronger, we were working closer to the limits of our recovery ability…and, eventually we reached a point where our recovery ability was being entirely dissipated in restoring the energy potential consumed by our workouts, so that nothing was left for growth.

Realizing that a constantly depleted recovery ability made growth impossible, and being unable to increase the recovery ability, the only choice remaining was a reduction in the demands.

When such a reduction in demands was made, the result was immediate growth…because we had thus restored the required conditions for growth.

Having thus been forced to recognize that there was a limit to the amount of exercise that we could stand, we then turned our attention in the direction of trying to determine just how little exercise was actually required. Since we could not increase one factor (the recovery ability) in order to restore the required balance, we were forced to reduce another factor (the amount of exercise) in order to produce the same result.

A logical conclusion, literally an unavoidable conclusion, and a conclusion that was fully supported by practical application. But since it was also a conclusion that ran directly contrary to widespread opinion, I realized that it might not be readily accepted.

So we decided to conduct an experiment under conditions that could not be disputed, realizing in advance that efforts would probably be made in the direction of trying to deny the results…if for no other reason that the fact that many people seem unable to admit that their own theories might be wrong.

Since we have our own training facility in Florida, it would have been far more convenient to conduct the experiment here; but we realized that doing so would leave us open to charges of misrepresentation after the fact. So, instead, the experiment was conducted in Fort Collins, Colorado, under the supervision of Dr. Elliot Plese in the Colorado State University's Department of Physical Education Laboratory.

Literally dozens of utterly phony "research projects" have been highly advertised during the last thirty years, so I think we can be excused for going to rather great length in our attempts to avoid any slightest chance of misrepresentation. Additionally, since commercial interests amounting to hundreds of millions of dollars of annual revenue might be threatened by the facts that we hoped to establish by the experiment, a certain amount of caution was obviously called for.

Even in the face of the fact of daily flights conducted in the city limits of their home town, it took the Wright Brothers several years to gain acceptance…and such hesitation existed even in a situation where no slightest threat to established commercial interests was involved. So we were not foolish enough to

think that human nature has changed enough in the meantime to bring about instant acceptance of something as dramatic as hoped to do.

But we also realized that it had to be dramatic in order to attract the attention that we feel it deserves. The results of the Colorado Experiment will probably be a controversial subject for years to come, but in the end the facts will be clearly established and accepted by almost everybody; so perhaps controversy is a necessary evil, required to bring the truth into the open.

We hoped to establish several points during the course of the Colorado Experiment, and we also hoped to add to our own store of knowledge…now, after the fact, I am still not sure whether we demonstrated more than we learned, or vice versa. We certainly demonstrated what we set out to demonstrate; but in the process we learned a great deal as well.

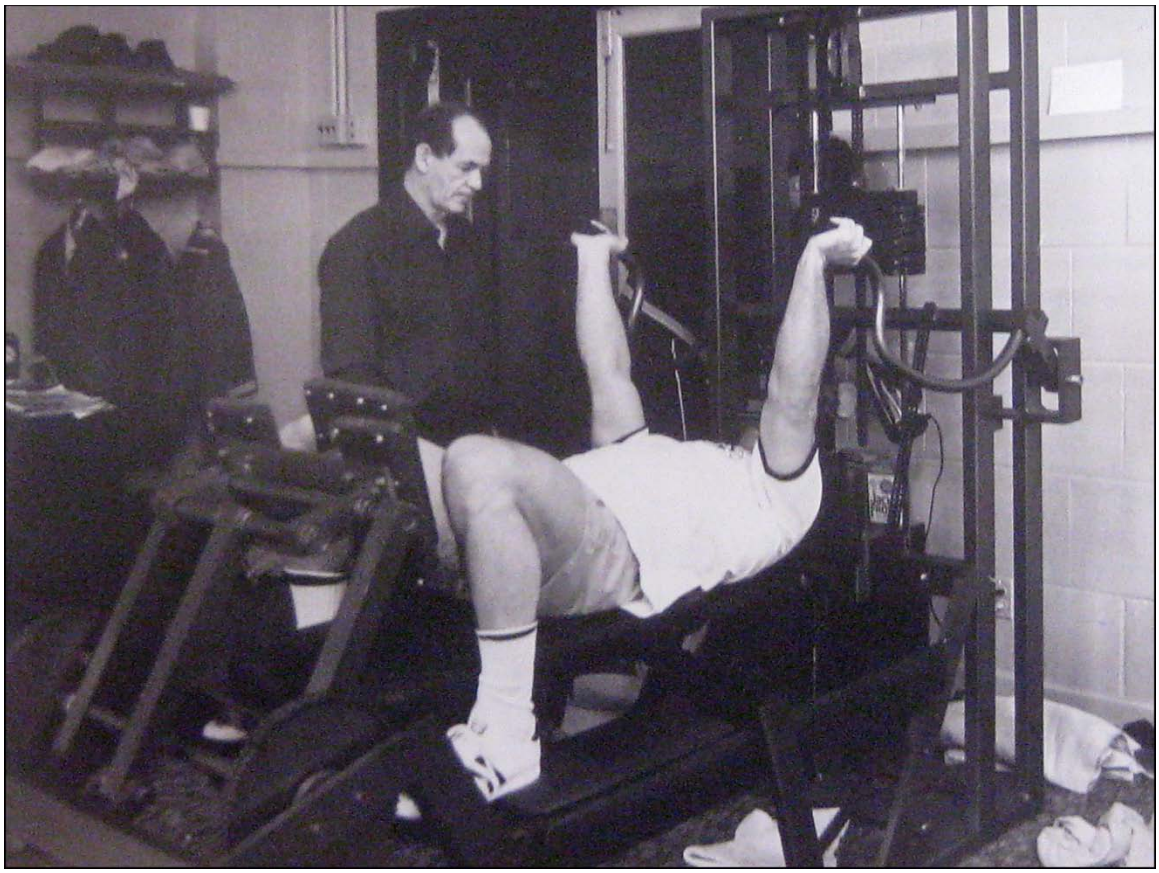
Among other things, we hoped to demonstrate that

1. very brief workouts are capable of producing rapid and large scale increases in muscular mass and strength…

2. nothing apart from a reasonably balanced diet is required…

3. the so-called "growth drugs" are not required.

But in the course of the experiment we also learned that it is possible to produce large scale increases in muscular mass while actually **reducing** the starting level of fatty tissue. I had always felt that adding fat while increasing muscular weight was neither necessary nor desirable, but I had not previously realized that it was literally possible to increase muscular tissue rapidly while simultaneously reducing fatty tissue. So the experiment was far more than just a demonstration, it was a learning process as well.



Chapter 16: The Colorado Experiment Part 2—Background of the Experiment

by Dr. Elliot Plese

Late in 1970 my attention was called to a supposedly new concept in exercise called Nautilus, and a few months later, in June 1971, I visited the Nautilus plant in Florida for the purpose of examining the equipment being manufactured there, and for the secondary purpose of discussing the involved training principles with Mr. Jones, the inventor of the Nautilus equipment.

If the equipment appeared to offer improvements by comparison to conventional exercise machines and barbells, it was my intention to conduct a research project in which such a comparison could be made under controlled conditions.

After observing the training in progress at the Nautilus facility, and after talking to Mr. Jones for a number of hours over a period of three days, and after questioning several other people who had been using the new equipment for various lengths of time, I reached the conclusion that this new theory of exercise and the equipment that was required for its practical application was indeed worthy of serious investigation. In particular, I was impressed by the speed of the workouts, and the overall brevity of the training. Even if the final results proved to be no better than these produced by other methods, I realized that the reduction in training time was an enormous improvement in itself.

At the time of my visit to Florida, Casey Viator was being trained by Mr. Jones for the 1971 Mr. America contest, and after seeing him, I had no doubt that he would win. Which he did. Casey was 19 years of age, and weighed 218 pounds at a height of less than 5 feet, 8 inches. The mass of his muscular structures was far more than anything I had expected, but I was even more impressed by his strength and functional ability. His flexibility exceeded a normal range of movement to a marked degree.

During his last training session prior to the contest, Casey performed only three exercises for his legs, and the entire portion of his training devoted to his legs was completed in less than four minutes. He performed only one set of each exercise and moved immediately from one exercise to the next. Upon testing his pulse rate at the end of the brief leg training session I found it to be approximately 170.

The entire workout was continued at the same fast pace, and repeated checks indicated that his pulse rate seldom if ever dropped below 140 and never climbed above 180. Having devoted a number of years to research projects that were primarily concerned with cardiovascular conditioning of athletes, I realized that Casey was in marvelous condition, and I also realized that the possibilities for applying such a method of training to athletes in almost any sport were apparently unlimited.

I had previously been led to believe that exercise was necessarily divided into two distinct categories, exercises intended for cardiovascular conditioning, and exercises intended for the purpose of increasing strength. But it appeared these previous conclusions were in error, because the Nautilus training I observed in Florida seemed to be performing both functions, building strength and improving cardiovascular condition at the same time. While Casey was undoubtedly the strongest man I had ever seen, he was also in splendid condition. During the leg portion of his workout he started by performing

more than 20 repetitions of the leg press with 750 pounds, stopping only when another repetition was impossible. He then moved immediately to the next exercise and performed 20 repetitions of the leg extension with 225 pounds. And this was immediately followed by the final exercise, 13 repetitions of the full squat with 503 pounds.

Each exercise was terminated only upon reaching a point of failure, and no rest was taken between exercises. It was an impressive demonstration of body strength and condition, to say the least.

Two football players from Alabama, the Anderson brothers, Dennis and Walter, were spending the summer in Florida for the purpose of training under the supervision of Mr. Jones, and they trained in exactly the same manner that Casey did, using very heavy resistance and moving immediately from one exercise to the next.

A long talk with one these brothers, Dennis Anderson, brought forth the following information. A year earlier, a four week training program of Nautilus exercises increased his strength in the squat by exactly 50% from 6 repetitions with 280 pounds to 6 repetitions with 420 pounds. Similar strength increases were produced in all areas of movement, as a result of eleven brief workouts performed over a period of 28 days.

His brother Walter, produced equally good results from the same training program, and was also very enthusiastic about the new style of training. “Dennis and I trained with weights for four years,” he told me, “but we gained more from four weeks of Nautilus training than we did from all of our barbell workouts put together. When we went back to school after a month down here, our coach couldn’t believe the condition we were in. And we were faster, too.”

Ellington Darden, a graduate student from Florida State University, was visiting the Nautilus facility at the same time, and he made an interesting comment, “The results are undeniable; but it would be interesting to know what percentage of the results are produced by the Nautilus machines, and what percentage are a result of pushing by Mr. Jones.”

To which Mr. Jones replied, “You can’t push with a rope. No amount of pushing will produce results by itself; the machines are tools, and like any tool they must be used properly if you expect to produce good results. All I do is make sure they use the machines properly; and if that takes pushing, and it sometimes does, then I push.”

Everything I saw in Florida tended to confirm an impression that Nautilus training was perhaps the most significant development in the field of exercise, so I continued to communicate with Mr. Jones after my return to Colorado. Several months later, we agreed to conduct a 28 day test of high-intensity training under my supervision in the Colorado State University Exercise Physiology Laboratory, using Mr. Jones as the only subject. Initially, no thought was given to the use of Casey Viator as a second subject, since he was already very near the limit of his muscular potential.

Casey’s involvement in the experiment came about by accident. In January of 1973, Casey lost part of one finger in an industrial accident, then nearly died when an injection produced an allergic reaction. The result being a loss in bodyweight and strength; on the day of the accident he weighed just over 200 pounds, but lost approximately 18 pounds before being released from the hospital.

Because of the nature of the injury, he was unable to resume training for a period of nearly four months, and during that time he lost an additional 17 pounds, reducing his bodyweight to approximately 167 pounds at the start of the experiment on May 1st, 1973. But in spite of the loss in bodyweight and

several months out of training, Casey proved to be surprisingly strong. During an initial strength test conducted immediately prior to the first workout of the experiment, Casey's performances were recorded as follows…

Leg press:	32 repetitions with 400 pounds
Standing Press:	8 repetitions with 160 pounds
Supinated-grip chinning:	7 repetitions with 50 pounds
Parallel dipping:	12 repetitions with 50 pounds

A universal machine was used for both the pre-experiment strength tests and the later post-experiment tests, since we were interested in determining strength increases that would not be affected by skill. For the same reason, the above four exercises were selected as tests; since these movements are all basic exercises.

All strength tests were performed in strict style, and were carried to a point of muscular failure.

Bodyweight was determined by weighing nude on a calibrated scale. Muscular measurements were recorded with a paper tape crosschecked for accuracy with a steel tape. And percentage of bodyfat was measured by Dr. James E. Johnson, using the Whole Body Counter in the Department of Radiology and Radiation Biology. Resting pulse rate, breathing rate, and blood pressure were measured and recorded, and a number of tests were conducted with an electromyograph.

Exactly similar tests were conducted with the second subject, Mr. Jones. With one rather surprising result; his bodyfat level was the lowest ever recorded in our laboratory during a number of years of conducting such tests, and we could find no record of a lower level in any of the literature. Yet Mr. Jones was not in an emaciated or weakened condition; on the contrary, he was in very good condition for a man of any age, and almost unbelievable condition for a man of his age.

The bodyfat levels of both subjects were very low at the start of the experiment; Casey Viator's starting level of bodyfat was 13.8% and Mr. Jones recorded a level of only 6.3%.

Sixteen Colorado State University athletes that were measured for direct comparison purposes recorded the following levels of bodyfat.

Best, Allen—19 years / 221.9 pounds / 29.7% bodyfat

Beyhl, Randall—20 / 256.5 / 38.1%

Chearno, Rick—21 / 234.3 / 20.7%

Craig, Jim—20 / 244.9 / 36.3%

Gallas, Dan—18 / 232.3 / 28.2%

Jones, Kim—21 / 229.7 / 16.0%

Kirk, Tracy—22 / 213.1 / 31.2 %

Kuhn, Greg—20 / 223.7 / 28.2 %

Lang, Andy—22 / 248.2 / 34.5%

Larson, Robert—20 / 236.5 / 38.3%

Newland, Ed—21 / 288.0 / 39.8%

Norman, Dave—20 / 180.2 / 16.4%

Price, William—20 / 204.2 / 26.2%

Simpson, Al—21 / 267.1 / 35.7%

Tracy, James—20 / 217.7 / 31.2%

Wallace, Tom—20 / 229.7 / 19.7%

The average body fat level of these sixteen subjects was 29.3 percent. Five other subjects from Florida, members of the party brought to Colorado by Mr. Jones, were also measured with the following results.

Jones, Eliza—29 / 118.14 / 27.8%

Orlando, Nick—32 / 186.34 / 16.9%

Butkus, Dick—30 / 257.27 / 35.2%

Perry, Houston—52 / 223.83 / 46.2%

Perry, Katie—40 / 145.31 / 42.7%

Dick Butkus, a professional football player for the Chicago Bears, came to Colorado to start a training program under the supervision of Mr. Jones; unfortunately, his schedule did not permit him to stay in Colorado long enough to establish a trend in his bodyfat level resulting from the training.

But an interesting point may have been illustrated by another member of the party, Houston Perry. Mr. Perry had just lost approximately 30 pounds as a result of a well advertised diet, yet his level of bodyfat (46.2%) was higher than that of any of the other subjects. It appeared that his loss from the diet had consisted of a loss in lean body mass rather than bodyfat. This subject had been employed by Mr. Jones for less than a week, as a pilot, and had never performed any type of systematic exercise.

When compared to the other subjects, it is obvious that both Jones and Viator had very low starting levels of bodyfat; and I fully expected to see a marked increase in body fat content during the experiment; but in fact, quite the opposite occurred. While rapidly increasing in bodyweight, in muscular mass, and in strength, a steady loss in bodyfat was recorded for both subjects. To me, this was the most significant result of the experiment.

Chapter 17: The Colorado Experiment Part 3—Conduct of the Experiment

Insofar as I can determine, there is no known drug that will improve the performance, or increase the muscular mass, of a healthy individual. Furthermore, I would like to go record at this point by stating…"I do not believe that such drug will ever be discovered. I think that such a result from any chemical is impossible."

I am fully aware that some drugs can improve the condition of a weakened individual, in cases of sickness or accident…but I also believe that a state of normal health is possible only in the presence of a very delicate chemical balance that is regulated automatically by the system. If any chemical is added for the purpose of upsetting this balance, the result can only be counterproductive.

In effect, there is no such thing as a "super chemical balance"…if the chemical balance is normal, you are healthy…if not, you are sick…and it matters not whether the state of imbalance is produced by too much or too little of a practical chemical. This has been proven repeatedly in literally thousands of tests conducted with animal subjects, and no slightest evidence exists in support of an opposite result with either animal of human subjects.

Certain hormones will help add muscular mass to a steer, or a gelding…but they will **not** produce the same result with a bull or a stallion. When an animal has been castrated, removing the testicles produces an abnormal situation where normal growth is impossible, giving such an animal the hormone drugs merely tends to restore a normal situation, a situation that would have existed naturally if the animal had not been castrated.

In such cases you are merely removing something and then trying to replace it in another manner; first creating a subnormal condition and then trying to restore normal health.

Yet the widespread bias in favor of such so called "growth drugs" borders on hysteria. Even suggesting that the use of these drugs is anything less than necessary automatically labels you a fool in some circles. And there is certainly no doubt that a lot of people are being fooled on this subject; but you can **not** fool your endocrine system, and when you add an unrequired chemical for the purpose of disturbing a normal balance, you are **not** improving the situation.

Pointing to recent strength records as proof of the value of such drugs actually proves nothing. The fact remains that the single strongest human recorded in history established his records ling before the drugs were ever used. Paul Anderson established records prior to 1958 that have never been approached and androgenic-anabolic drugs were apparently first used in athletic circles in 1960.

Bob Peoples established a deadlift record thirty years ago, lifting nearly 800 pounds at a bodyweight of approximately 180; today, a very few individuals have reached or passed that level of performance…but most of them weigh nearly twice as much as he did, and some of them weigh more than twice as much.

Men who establish such records are merely statistical standouts, literally genetic freaks; they are **not** the products of drugs, regardless of their opinions on the subject.

Great strength is a result of two factors…

1. individual potential, which cannot be improved…and
2. hard training, which will increase the strength of almost anybody.

But a third factor exists as a prerequisite…**normal health**, without which, reaching the limits of potential strength is simply impossible. So you can improve a sick individual in some cases, but you can **not** turn a normal individual into a superman by chemical means. Such a result is impossible, and ridiculous on the face of it.

In a later chapter I will cover the use of such drugs in sports in far greater detail; for the moment, it is enough to go on record that drugs are of no value to a healthy athlete. But I am clearly aware that my position on drugs will be considered proof of my ignorance by many people; and that some others will consider it proof of my hypocrisy. In plain English…some people will call me a fool, and others will call me a liar. Simply because, at the moment, thousands of people have been so brainwashed on the subject of drugs that they have literally become "true believers", looking upon themselves as the only ones in possession of the truth, and considering anybody who takes a different position either a fool or a fraud.

Equally strong superstitions exist on the "need" for high-protein food supplements, and the "requirement" for several hours of daily training; with exactly the same amount of actual proof that exists in support of drugs, **none**.

But again, these beliefs have taken such firm root that it is almost impossible to discuss the real facts with the believers; in many quarters, such beliefs have produced nothing short of a fanatical religion.

So we wanted to clearly demonstrate that rapid increases in both muscular mass and strength could be produced without the use of drugs, with nothing in the way of a special diet, and as a result of very brief training, and we wanted to so under circumstances that would make both the results and the conditions undeniable.

Certain factors are required for the production of increases in muscular mass and strength; these factors are

1. high-intensity exercise…and
2. normal health.

Nothing else is needed, and nothing else was provided in the Colorado Experiment.

Thirteen Nautilus Machines were transported by truck from the factory in Florida to the Exercise Physiology Laboratory at Colorado State University. Seven of them were standard production-model machines, identical to thousands of other Nautilus machines. But six of the machines were prototypes…"first of a kind", experimental machines of a type that we have named **Omni Machines**.

The Omni series of Nautilus Machines provide the user five options in the style of exercise that can be performed…

1. "normal", which involves both positive and negative work…

2. negative-only…

3. positive-only…

4. negative-accentuated…

5. "hyper", which involves maximum-possible positive work and even heavier negative work in the same repetition.

The Omni Nautilus Machines were never mentioned in print prior to the Colorado Experiment, and never have been previously used outside our training facility in Florida. Dr. Elliot Plese was aware of their existence, but had never seen them, the only prior use having been the training of professional football players under strict supervision and with no publicity.

For a period of approximately a year before the Colorado Experiment we conducted research to clarify the relative merits of "negative" exercise as compared to "positive" exercise, and the Omni Machines were a result of this research, designed in such a manner that a user could restrict his exercise to any particular style desired.

Positive exercise, or positive work, is produced when you are lifting a weight. Physiologists also call this **concentric contraction**, but I prefer the less confusing term.

Negative exercise, or negative work, is involved when you are lowering a weight. This form of work is also called **eccentric contraction**, and again I prefer the other term; primarily because "concentric" and "eccentric" sound too much alike and are frequently confused.

Most forms of exercise involve both negative and positive work; if you curl a dumbbell, you are performing positive work while the weight is going "up"…and negative work while the weight is going "down".

If you do parallel dips, positive work is involved as your body is raised…and negative work as you lower your body.

Your muscles have distinct "strength levels"…your **positive** strength level is the weakest…your **holding** strength level is considerably stronger…and your **negative** strength level is the highest.

This simply means that you can "hold" more weight than you can "raise"…and that you can "lower" more weight than you can "hold". For example, You might find that you can curl 100 pounds in good form, and that anything heavier is impossible…however, if someone handed you 120 pounds, you could hold it motionless in any position of curl. You would not be able to raise it higher, but you could prevent it from dropping. That would clearly demonstrate that your "holding" strength level was higher than your "positive" strength level.

And…if, instead of 120 pounds, you were handed 130 pounds, you might find that you could lower it under control. It would not jerk your arm straight; instead, you could delay and slow its descent…even though you could not stop the downwards movement. This would demonstrate that your "negative" strength level was higher than your "holding" strength level.

Such relative strength levels are encountered in many daily activities but are frequently overlooked; for example, it should be obvious that you can walk down a flight of steps with a far heavier weight than you can carry up the same steps.

Both positive and negative work is involved in almost all sports activities, and even in our daily lives; but since we will cover the differences in positive and negative work in great detail in later chapters, it is now only necessary to establish that there is a difference.

The great value of "negative-only" exercise was at least suspected many years ago, but performing such style of exercise was difficult; because no equipment existed for the purpose, and it was necessary to involve a number of assistants to lift the weight, rendering such exercise impractical at best.

In negative-only exercises with conventional equipment, the trainee "lowers" a weight that has been lifted by assistants; which makes unassisted training impossible. But even with help, such a style of training is difficult; because a strong man can handle more weight in a negative-only style than two assistants can lift. Many years ago, Bob Peoples, one of the strongest deadlifters on record, was forced to use a tractor to lift a weight so that he could then lower it in a negative-only fashion; and he eventually became so strong that he was forced to help the tractor lift the weight.

Making use of assistants to lift weight, we tried negative-only exercises for a period of several months…with outstanding results. But eventually, several of our trainees became so strong that we were forced to design and build equipment that would lift the weight for them, since we were rapidly exhausting our source of possible helpers. The Omni Machines were designed to solve the "helper problem", and they did.

For a period of about two years immediately prior to the Colorado Experiment, several companies in the exercise equipment business had been making what we considered to be grossly overstated claims on behalf of so-called "Isokinetic" exercise, a form of exercise limited to positive work.

The nature of an isokinetic device is such that negative work is totally removed…in fact, with isokinetic exercise, negative work is not only removed but is literally **impossible**.

Having thus produced exercise devices that removed negative-work potential, the makers of these machines apparently felt called upon to announce that negative work is somehow "bad", of no-value, dangerous, and counterproductive. From all appearances it would seen they were trying to convince the buying public that an actual shortcoming of their machines was somehow an advantage.

But the truth of the matter is that full-range exercise is utterly impossible without negative-work potential.

And it also happens that the intensity of work provided by negative work is far higher than it is in positive exercise.

So, by removing negative-work potential from their exercises, they were thus making full-range exercise impossible and lowering the intensity of exercise at the same time.

It should be clearly understood that we do **not** consider positive exercise "bad"…but we are clearly aware that negative exercise is better.

When the negative-work potential is removed from an exercise, there is no force available for pulling the muscles into the essential "prestretched" position at the start of an exercise, and no "back pressure" available to provide exercise in the fully-contracted position at the end of the movement; thus there is no resistance at either end of an exercise, and without resistance there is no actual exercise.

We will return to a comparison of negative exercise to positive exercise in later chapters; at this point it is necessary only to establish the fact that we were aware of the relative merits of these two vastly different forms of exercise prior to the Colorado Experiment.

It was my original intention to use negative-only exercise entirely during the Colorado Experiment, to avoid any slightest use of positive exercises; but circumstances made this impossible, since we were scheduled to start the experiment on a particular date and a delay would have involved a postponement of a year or more, and because we did not have a wide enough variety of negative-only equipment for such a program.

But it should be understood that my original intention to use negative-only exercises was **not** based on any thought that such a program could produce the best possible degree of results; on the contrary, we wished only to demonstrate that negative-only exercises could produce very good results.

As it turned out, we were forced by circumstances to use several types of exercise…

1. negative-only…
2. negative-accentuated…and
3. normal.

But we did **not** use positive-only exercises.

The positive part of exercise certainly has value…but it also imposes limitations. It is thus essential to recognize the potential value, but equally necessary to be aware of the unavoidable limitations imposed by positive exercise.

Positive work has a far greater effect upon the heart and lungs, so improving cardiovascular condition requires positive work; but negative work is an absolute essential for full-range exercise, and thus a requirement for improving flexibility…and negative work is also better for the purpose of increasing strength. So you need both positive and negative work.

Unfortunately, when both positive and negative work are involved in the same exercise, as they are in all "normal" exercises, you are limited by the requirements to use a weight that you can lift…which weight will not be enough for a proper negative exercise.

In order to perform positive work, you must be able to lift the weight; if you can't lift it, then no work is possible. But proper negative exercise requires a weight so heavy that you can **not** lift it. Obviously, then, your positive strength level limits your ability to perform negative exercises properly…when both forms of work occur in the same exercise.

If the weight is right for positive work, then it is too light for negative work. But if it is right for negative work, then it is impossibly heavy for positive work. So you can have one or the other, but not both…not at least, with a proper level of resistance.

Thus, when performing exercises in a normal manner, you are unavoidably limited to a level of resistance that is usable during the positive part of the work…which will not be, literally can **not** be, heavy enough for proper negative work. In order to avoid this limitation imposed by positive work, you must remove the positive part of an exercise entirely…when training with conventional equipment, at least.

But…when the positive part of an exercise is removed in order to provide a proper level of resistance for negative work, the result is a form of exercise that has very little effect upon the cardiovascular system. So negative exercise is better for strength building purposes…but worse for improving cardiovascular ability.

The Omni Nautilus Machines were designed in such a way that both limitations were removed; the Omni Machines provide the proper, high level of resistance for the negative work…but do not reduce the cardiovascular work from the exercise. Because, with the Omni Machines, you are still performing the positive part of the work…but doing it with muscular structures that are not involved in the negative part of the exercise.

In fact, the use of an Omni Nautilus Machine Increases the cardiovascular part of the work; because the level of resistance is raised in both the negative and positive parts of the exercise.

So the Omni Machines solved both problems, removed both limitations; providing us with the required high level of resistance for the negative part of the work, and at the same time increasing the cardiovascular effect of the exercise.

For example. In a normal exercise such as the bench-press, you perform both positive and negative work; positive work while lifting the weight and negative work while lowering it. Which style of exercise will have an effect upon your cardiovascular system, and will produce some degree of muscle growth stimulation.

Changing this to a negative-only style of exercises greatly improves the strength building part of the work, but reduces the effect on the cardiovascular system.

However, with the Omni Machines, you would raise the weight with your legs, and lower it with your arms. By taking advantage of the greater relative strength of the legs, you are thus able to use a weight that would be impossibly heavy for the arms, a weight that you could **not** lift with the arms; but you can lift it with the legs, and having done so, you can then lower it in a negative-only fashion with the arms. So you are still doing the positive part of the work, and since you are using more resistance than you can handle in a normal fashion you are thus doing even more positive work; while retaining the advantage of the negative-only style of training for the arms.

The fact that the legs are doing the positive part of the work while the arms are performing the negative part is of no slightest concern; since the heart and lungs neither “know” or “care” which muscles are performing the positive part of the work. Cardiovascular effects of exercise are produced to the amount and pace of work…so some muscles must be performing positive work for the cardiovascular results, but it doesn’t matter which muscles.

Writing for a national magazine nearly a year before the Colorado Experiment, I pointed out the proven value of negative-only exercises for building strength…and I also mentioned the fact that such exercise was of little or no value for improving cardiovascular ability. Which was true at that time, since the available equipment made it necessary to totally remove positive work from the exercises in order to

use a proper level of resistance for negative-only work. So, at that time, it was an "either/or" situation…you could have one or the other, but not both.

But the introduction of the Omni Machines changed the situation; it then became possible to increase the resistance to the high level required for negative-only exercise, while increasing the cardiovascular effect at the same time.

In the Colorado Experiment, we were primarily interested in producing rapid and massive increases in muscular mass, together with corresponding strength increases; in order to demonstrate that such a rapid rate of growth was possible…and, secondly, in order to demonstrate that such rapid growth could be produced as a result of very brief workouts.

Increases in cardiovascular ability can be supported on the basis of before and after tests, but increased muscular mass can be seen…provides a more dramatic, more obvious result, the type of result that is sometimes required to make a point.

With the use of "self-powered" machines that do not yet exist in practical form, it would be possible to provide the required high level of resistance for proper negative-only exercises while totally removing the positive part of the work; and if such machines had then existed, we would have used them in the Colorado Experiment…well aware in advance that doing so would have produced little or nothing in the way of cardiovascular benefits, but being willing to pay that price in order to demonstrate that positive work is not required for producing rapid increases in muscular mass and strength.

But since such "pure negative" machines did not exist, we were forced to use normal exercises, some negative-accentuated exercises, and some negative-only exercises performed on the Omni Machines…and a few pure-negative exercises that required the help of assistants to lift the weight.

The end result being that even the Colorado Experiment was not a clear demonstration of the superiority of negative-only exercise for strength building purposes, because other styles of exercises were also involved…and thus it remains impossible to say for sure just what percentage of the results was produced by a particular style of exercise.

Which I not meant to imply that no support for the superiority of negative-only exercise exists; it does, but it remains necessary to repeat and reconfirm our privately conducted experiments under laboratory conditions while being observed by impartial, or even hostile, witnesses. And such experiments must be limited to "pure-negative" exercises, with control groups of subjects using "pure positive" exercises for comparison.

Until and unless that has been done, and repeatedly…many people will remain in doubt on the subject of the relative merits of the two distinct forms of exercise. So it will be done, and done repeatedly…and in fact, it already has been done, but unfortunately such comparisons have not yet been given the publicity that they deserve. But in the meantime, already being clearly aware of the advantages of negative exercise, we can and do avail ourselves of these advantages while many other people are still trying to decide what to do.

The unfortunate part of the situation results from the fact that most people simply don't know the real facts, and when they are exposed to a barrage of advertising listing the so-called "advantages" of a positive-only form of exercise, they tend to become confused. In the end, the truth will be known…but in the meantime, millions of dollars will have been wasted on equipment of little or no real value, and thousands of trainees will have devoted years of training time to an almost worthless form of exercise.

The facts are clear, and undeniable…but the stakes are high, so the facts will be denied in some quarters for years to come.

It would be easily possible for Nautilus Machines to be built with a so-called "isokinetic" form of resistance, thus providing positive-only exercise…and doing so would greatly reduce the cost of the machines, thus affording a much wider market and far greater profits. Be it clearly understood that there are no patents protecting such a form of resistance, it is freely usable for any purpose by anybody.

But incorporating such a form of resistance necessarily means **removing** negative-work potential, which in turn means that a full-range exercise is then impossible. Because there is no force to provide prestretching at the start of an exercise, and no back-pressure to provide resistance at the end of an exercise.

And it also means a loss of the very high level of intensity that is encountered only in negative work, and with it a loss of a great part of the growth stimulation that is provided by high-intensity work.

So Nautilus Machines will never be built with such a form of resistance…since doing so would greatly reduce their value.

The claims of the people who are now selling and promoting various types of positive-only exercise devices strongly remind me of a man who has designed a new type of automobile…without understanding the function of an automobile. Having removed the engine on the grounds that an engineless car would be cheaper, he might then point to the result as an "improvement."

In an almost exactly similar situation, the makers of positive-only devices have removed the most important factor required for growth stimulation, negative work…and are now pointing to the result as an improvement.

Perhaps these people simply don't understand the actual factors involved in exercise, or perhaps they don't care about the facts…take your pick. But in either case, it is a poor choice; on the one hand, their ignorance is showing…and on the other hand, they are engaged in outright fraud.

Eventually. Ignorance will be corrected…or fraud will be stopped; but in the meantime the public suffers.

Unfortunately, neither ignorance nor fraud are new in the field of exercise; on the contrary, exercise has been so deeply mired in both ignorance and fraud that the actual value of exercise has been overlooked to a great degree. Many—perhaps **most**—people look upon the entire subject of exercise with great suspicion, and with good reason; because, to them, exercise means a fanatic strutting on a beach, or an obviously phony advertisement for overweight women.

Almost nothing is perfect, and we certainly do not consider our present style of training perfect…so we will be more than glad to improve it in any way we can, if and when the necessary information is available to us. But perfect or not, the style of training that we are using now is by far the most productive type of exercise known. And any attempt to compare it to a positive-only form of exercise is utterly ridiculous, on the order of comparing an automobile to an ox-cart.

A strong statement…but, if anything, an understatement; since the two forms of exercise are literally worlds apart.

Nearly twenty years ago, using conventional training equipment, I eventually reached a muscular bodyweight of 205 pounds of less than 5 feet, 8 inches. Five years ago, I was able to reach a muscular bodyweight of 180 pounds after nearly five months of steady training…at which point, additional growth was obviously impossible, for myself as an individual at that age.

Yet, four years later, and four more years removed from an age when my muscular potential was highest…I was able to duplicate those strength increases as a result of only six weeks of negative-only training.

In effect, I produced the same results…but I did so when four years older, at a stage in my life when that four years meant a significant loss in individual potential…and I did so from a tiny fraction of the previously required training time, since my negative-only workouts were much briefer than my previous workouts.

Up to this point in time, every single subject that we have trained in this fashion has produced a similar increase in his previous rate of growth.

When you have been training an individual for years, and when he has already reached a point where his strength is far higher than the average, and when you suddenly switch him to a negative-only style of training…and he immediately starts growing much faster than he ever did before, and rapidly reaches a new high in strength; then that is a significant result. And we have done that repeatedly.

And even while such a result is no proof that our method is yet perfect, it certainly is proof that it is an improvement.

So the Colorado Experiment was more in the way of a demonstration than an experiment…since we knew well in advance that we could do what we set out to do; but as it turned out, we did even more that we set out to do…while producing rapid increases in muscular mass, we also removed a large amount of bodyfat. Which was a result that surprised even us.

The Colorado Experiment was conducted entirely with Nautilus equipment, using as much negative work as it was possible to perform under the circumstances with the available equipment. The workouts were fast and brief, and in almost all workouts we performed one “set” of each exercise.

Each exercise was carried to the point of momentary muscular failure, and all exercises were performed in good form…stopping at both ends of the movement, and avoiding jerking.

We had overlooked only one factor of importance, the altitude. Coming from sea level immediately before the start of the experiment, we were not prepared for the 5,000 foot altitude of Fort Collins, and we were forced to reduce the pace of our workouts…which probably added at least two hours to our total training time during the 28 days.

But in spite of that handicap, Casey Viator still produced a muscle-mass increase in excess of 63 pounds, as a result of less than 8 hours of training…which is certainly significant.

"Positive work has a far greater effect upon the heart and lungs, so improving cardiovascular condition requires positive work; but negative work is an absolute essential for full-range exercise, and thus a requirement for improving flexibility…and negative work is also better for the purpose of increasing strength. So you need both positive and negative work."

Chapter 18: The Colorado Experiment Part 4—Results of the Experiment

by Dr. Elliot Plese

On May 1st, 1973, a strength test was conducted in the weight-room at Colorado State University. Two subjects were tested, Arthur Jones and Casey Viator. At the suggestion of Mr. Jones, a Universal machines was used for the tests; because, as he said, "If we use our own equipment for the strength tests, a question may then be raised on the subject of basic strength increases."

A secondary reason for using a Universal machine was the fact that similar exercises performed with a barbell require more skill, and since we were primarily interested in measuring basic strength it was desirable to reduce the factor of skill as much as possible.

Exactly 28 days later, on May 29th, 1973, a second strength test was conducted with one of the subjects, Casey Viator; the other subject, Arthur Jones, was not tested at the end of the experiment, because he became sick on the night of May 26th and was admitted to the hospital with intestinal flu. Which sickness prevented him from completing the experiment as planned. However, all of the workouts that were performed by Mr. Jones were observed and timed by myself and a number of other witnesses, and his rapid increases in strength was obvious from workout to workout.

Having started at a bodyweight of 144.1 on May 1st, Mr. Jones was weighted immediately before his workout on May 26th; in a period of 25 days his bodyweight had increased to 162.375, a net gain in bodyweight of 18.275 pounds. But his bodyfat level had been reduced in the meantime; a bodyfat measurement in the Whole Body Counter on May 23rd indicated a loss in bodyfat of 1.825 pounds, so it is reasonable to assume that his actual gain in lean body mass (muscular tissue) was approximately 20.1 pounds.

But even if we take the figures recorded on May 23rd, the results are very impressive. During the first 22 days of the experiment Mr. Jones gained 13.62 pounds of bodyweight while reducing his bodyfat level by 1.82 pounds, a net gain in lean body mass of 15.44 pounds.

It was the original intention of Mr. Jones to train his entire body, performing one set of an exercise for each major muscle group; but upon arriving in Colorado for the start of the experiment, he was obviously suffering from a deep chest cold. The effects of the cold, in combination with the altitude and his age, made it apparent that he would not be able to train as much as he had planned. I suggested that the experiment be postponed for a month, but that would have been impractical because of other obligations. As a result, Mr. Jones restricted his workouts almost entirely to exercises for the upper body, the arms, the shoulders, the chest, and the back. A few light exercises were performed for the legs, but only enough to maintain muscle tone in that area of the body.

Which makes his gains in muscle mass even more remarkable, since it is well established that rapid weight gains are best produced by heavy exercise for the legs and lower back, a type of exercise that was not involved in his workouts.

The localized nature of his muscle-mass increases was very obvious, with little or no change in the size of his legs but large scale increases in the muscle mass of his torso and arms. His arms increased by one and five-eighths inches (1 5/8 inches).

In the lack of a post-experiment strength test, an accurate determination of his strength increases was impossible; but a reasonably accurate estimate can be based on the changes that occurred in the amount of resistance used in his workouts, since all exercises were continued to a point of momentary failure. For example, during the 1st workout on May 1st, he performed 7 repetitions on a Torso/Arm machine with 225 pounds; then 15 days later, during the 9th workout on May 16th, he performed the same number of repetitions (7) with 300 pounds, indicating a strength increase in that area of movement of exactly 33 1/3 percent. Very similar strength increases were obvious in all areas of movement that were exercises heavily.

Having seen him at the start of the experiment, I seriously doubted that he could produce much in the way of improvement in such a short period of time; but I was wrong, he gained steadily but rapidly, and was actually gaining faster near the end of the experiment. While the other subject's rate of gaining decreased near the end of the experiment, Mr. Jones showed a faster rate of gains during the final two weeks of his training. Which may have been due to the fact that his chest cold limited his gains during the first two weeks.

The following chart will clearly indicate the actual gains and the rate of gaining of both subjects.

Casey Viator

Date	Bodyweight	Gain	Daily Average
5/1/73	166.87	Start	Start
5/15/73	195.8	28.93	2.06 pounds per day
5/18/73	199.72	3.92	1.30 pounds per day
5/23/73	205.81	6.09	1.21 pounds per day
5/29/73	212.15	6.34	1.05 pounds per day

Arthur Jones

Date	Bodyweight	Gain	Daily Average
5/1/73	144.21	Start	Start
5/8/73	148.28	4.07	0.58 pounds per day
5/18/73	153.23	4.95	0.70 pounds per day
5/23/73	157.83	4.60	0.56 pounds per day
5/26/73	162.37	4.54	1.51 pounds per day

It should be noted, however, that the final bodyweight figure recorded for Mr. Jones is somewhat misleading; all of other weights were recorded early in the morning, with an empty stomach, but the final bodyweight listed for Mr. Jones was recorded several hours after a normal weighing time, immediately before his final workout. Previous comparisons had indicated a difference of approximately 2 pounds in this subject's bodyweight during that span of time; he was approximately 2 pounds heavier just before a workout, by comparison to his bodyweight recorded early in the morning of the same day.

So it would be reasonable to deduct two pounds from his final bodyweight, and if we do so, then the resulting gain would be only 2.54 pounds instead of 4.54 pounds. And the rate of gaining would be 0.84 pounds per day instead of the listed 1.51 pounds.

But in either case it is obvious that his gains were steady throughout the period of training, and equally obvious that his actual rate of gaining was increasing near the end of the experiment.

During the first two weeks of the experiment, Casey Viator gained 28.93 pounds, an average of 2.06 pounds per day. During the final two weeks he gained 16.35 pounds, an average of 1.16 pounds per day. So his rate of gaining declined by approximately 43% during the final two weeks; which was only to be expected. But even during the final six days of the experiment he was still gaining in excess of a pound a day.

Neither subject produced sudden spurts of growth that might have indicated dehydration prior to the start of the experiment; on the contrary, the actual gains and the rate of gains displayed by both subjects remained remarkably steady throughout the experiment.

But remarkable as they were, the bodyweight gains do not indicate the actual results; because both subjects reduced their starting level of bodyfat during the experiment, indicating that they were rapidly adding bodyweight while reducing bodyfat at the same time, a result that I previously considered impossible.

While increasing his bodyweight by 45.28 pounds, Viator reduced his starting level of bodyfat by 17.93 pounds, indicating an actual increase in lean body mass (muscular tissue) of 63.21 pounds.

The results produced by Mr. Jones have been listed above, and when due consideration is given to the great difference in age in these two subjects, I think the final results are equally remarkable.

For his part, Mr. Jones expressed dissatisfaction with his own results; saying that he fully expected to increase his bodyweight by at least 30 pounds. And he promised to repeat the experiment at a later date under better conditions, at an altitude of sea level and without the starting handicap of a chest cold. He also expressed the belief that his starting bodyweight was too low; he feels that he would have gained better from a starting bodyweight of approximately 155 pounds.

Casey's strength increases were fully on a par with his increases in muscle mass, as the following chart will show.

Strength Test	**May 1st**	**May 29th**	**Increase**
Leg Press	400/32	840/45	+440 = 110%+
Chinning	217/7	287/11	+70 = 32%+
Standing Press	160/8	200/11	+40 = 25%+
Parallel Bar Dipping	217/12	312/16	+95 = 43%+

During the initial strength test, leg presses were performed to a point of failure on a Universal machine, using 400 pounds; with 32 resulting repetitions. Four weeks later, Viator used 840 pounds in the same exercise, and performed 45 repetitions; the increase in resistance was thus 110%, but the fact that he also performed more repetitions indicates that his actual strength increase was even higher.

Chinning was performed with a supinated (palms up) hand grip, with 50 pounds added to bodyweight in the form of a barbell plate fastened to the waist with a belt. In the final test, 75 pounds of added resistance was used, but in the meantime the subject had increased his bodyweight by 45 pounds, so the actual increase in resistance was 70 pounds. So his strength had clearly increased by 32% on the basis of added resistance, and even more than that when consideration is given to the fact that he also increased the repetitions from 7 to 11.

In the standing press, the increase was 25% on the basis of increased resistance, but the actual increase was even higher, since he also increased the repetitions from 8 to 11.

In the parallel dipping, 50 pounds of weight was added to bodyweight during the initial test, and 100 pounds during the final test, and again the subject had added 45 pounds of bodyweight in the meantime, giving an actual increase is resistance of 95 pounds. On the basis of the increased resistance his strength increase in this movement was 43%, but again he increased the repetitions as well, from 12 to 16, thus indicating an even greater strength increase.

It should also be noted that Viator was still suffering limited use of his right hand as a result of the accident that occurred during the previous January, and this affected him to some degree in all exercises involving the hands, chinning, pressing, and dipping.

APPENDIXES

Appendix 1: Routines

All of the workout routines in the Bulletins are listed here in order of appearance.

Bulletin No. 1, Chapter 27: "Break-In" Training

"Break-In" routine. See page 78 for instructions on performance.

1. Full squats: 1 set, 20 repetitions
2. Standing press with barbell: 1 set, 10 repetitions
3. Regular grip chinning on bar: 1 set, 5 repetitions
4. Bench presses with barbell: 1 set, 10 repetitions
5. Regular grip curls with barbell: 1 set, 10 repetitions
6. Stiff-legged deadlifts: 1 set, 15 repetitions
7. Calf raises on one leg: 1 set, 10 repetitions
8. Sit-ups with bent knees: 1 set, 10 repetitions

Bulletin No. 1, Chapter 37: The Pre-Exhaustion Principle

Examples of pre-exhaustion sequences. See pages 99-100 for instructions on performance.

Frontal Thighs:

1. Leg presses: 1 set, 20 to 30 repetitions
2. **Rush**—Thigh extensions: 1 set, 20 repetitions
3. **Rush**—Squats: 1 set, as many repetitions as possible

Deltoids:

1. Dumbbell side raise: 1 set, 10 repetitions, followed by partial repetitions
2. **Rush** – Behind-neck presses: 1 set, 10 repetitions

Latissimus:

1. Stiff-arm pullovers: 1 set, as many as 50 repetitions
2. **Rush**—Behind-neck pulldowns: 1 set, 12 repetitions

Bulletin No. 1, Chapter 39: Conclusions

Basic routine with conventional exercises. See page 105 for instructions on performance.

1. Standing presses with a barbell or with heavy dumbbells
2. Full squats
3. Stiff-legged deadlifts
4. Heavy barbell curls
5. Regular-grip chinning
6. Parallel dips
7. Barbell wrist-curls
8. One-legged calf raises

Suggested alternate exercises:

9. Leg presses
10. Thigh extensions
11. Thigh curls
12. Pulley triceps-curls
13. Behind-neck “pulldowns” performed properly, with a narrow, parallel grip
14. Shoulder shrugs
15. Standing side-raises with dumbbells
16. The proper use of a “gripping” machine
17. Incline and decline presses with heavy dumbbells
18. Stiff-arm “pullovers” on a decline bench
19. Behind-neck presses
20. Sit-ups on a decline bench
21. Leg-raises on a steep incline bench
22. “High pulls”—or front rowing with a barbell
23. Side bends with a dumbbell
24. Bent-forward rowing with a barbell

Bulletin No. 1, Chapter 41: The Next Step

Upper torso sequence with Nautilus machines. See page 113 for instructions on performance.

1. Pullover-type Torso Machine: 1 set, 15 to 20 repetitions
2. Behind-Neck type Torso Machine: 1 set, 12 to 15 repetitions
3. Torso/Arm Machine, pulling the bar to a behind-neck position: 1 set, 10 repetitions
4. Torso/Arm Machine, using a reverse grip, this time pulling the bar to the chest: 1 set, 10 repetitions

Bulletin No. 1, Chapter 43: Training With Conventional Equipment

Routine with conventional exercises. See Page 119 for instructions on performance.

1. Full squats: 2 sets, 10 repetitions
2. One-legged calf raises: 3 sets, 20 repetitions
3. Barbell standing presses: 2 sets, 10 repetitions
4. Behind-neck chins: 2 sets, 10 repetitions
5. Bench presses: 2 sets, 10 repetitions
6. Regular-grip chins: 2 sets, 10 repetitions
7. Parallel dips: 2 sets, 10 repetitions
8. Barbell curls: 2 sets, 10 repetitions
9. Pulley triceps-curls: 2 sets, 12 repetitions
10. Wrist curls: 2 sets, 15 repetitions
11. Regular-grip chins: 1 set, 10 repetitions
12. Parallel dips: 1 set, 10 repetitions
13. Stiff-legged deadlifts: 2 sets, 15 repetitions
14. Dumbbell side raises: 2 sets, 10 repetitions

Bulletin No. 1, Chapter 43: Training With Conventional Equipment

Routine with conventional exercises for an underweight individual desiring to increase overall size and strength. See Page 120 for instructions on performance.

1. Stiff-legged deadlifts: 1 set, 15 repetitions
2. Full squats: 2 sets, 10 repetitions
3. Barbell standing presses: 2 sets, 10 repetitions
4. Regular-grip chins: 2 sets, 10 repetitions
5. Parallel dips: 2 sets, 15 repetitions
6. Barbell curls: 2 sets, 10 repetitions
7. Wrist curls: 2 sets, 15 repetitions
8. Stiff-legged deadlifts: 1 set, 15 repetitions

Bulletin No. 2, Chapter 21: The Recovery Factor

Cycle routine with biceps and triceps pre-exhaustion sequences. See Page 190 for instructions on performance.

First cycle:

1. Standing curl with barbell: 1 set, 10 repetitions
2. Nautilus Triceps Machine: 1 set, 12 repetitions
3. Nautilus Curling Machine: 1 set, 12 repetitions
4. Wrist-curls with a barbell: 1 set, 15 repetitions
5. Reverse barbell wrist-curls: 1 set, 15 repetitions

Second cycle:

6. Nautilus Triceps Machine: 1 set, 12 repetitions
7. **Rush**—Parallel dips: 1 set, maximum-possible repetitions
8. Nautilus Curling Machine: 1 set, 12 repetitions
9. **Rush**—"Front pulldowns" on a Nautilus Torso-Arm Machine, using a close grip: 1 set, 10 repetitions
10. Wrist-curls with a barbell: 1 set, 15 repetitions
11. Reverse barbell wrist-curls: 1 set, 15 repetitions

Bulletin No. 2, Chapter 34: A Simple Example

Routine for beginner with only a barbell, squat rack, chinning bar and parallel bars. See Page 247 for instructions on performance.

First week "break-in" routine:

1. Full squat: 1 set, 20 repetitions
2. One-leg calf raises (1 set for each leg): 1 set, 20 repetitions
3. Standing presses, with a barbell: 1 set, 10 repetitions
4. Regular-grip chins: 1 set, 10 repetitions
5. Parallel dips: 1 set, 10 repetitions
6. Standing curls, with barbell: 1 set, 10 repetitions
7. Stiff-leg deadlifts, with barbell: 1 set, 15 repetitions

Routine starting second week:

1. Full squat: 1 set, 20 repetitions
2. One-leg calf raises: 1 set, 20 repetitions
3. Standing presses: 1 set, 10 repetitions
4. Regular-grip chins: 1 set, 10 repetitions
5. Standing presses (a second set): 1 set, 10 repetitions
6. Regular-grip chins (a second set): 1 set, 10 repetitions
7. Parallel dips: 1 set, 10 repetitions
8. Standing curls: 1 set, 10 repetitions
9. Parallel dips (a second set): 1 set, 10 repetitions
10. Standing curls (a second set): 1 set, 10 repetitions
11. Stiff-leg deadlifts: 1 set, 15 repetitions

The following is a condensed version of Arthur's recommendations for style of performance from Bulletin No. 2, Chapter 6: A Few Simple Facts:

1. Limit your weekly workouts to three training sessions for the entire body—including the legs.

2. Limit the length of your workouts to a total of not more than two hours each—a weekly total training time of six hours; and in almost all cases, even better results will be produced by a total weekly training time of less than four hours—or even as little as two hours.

3. Seldom perform more than two sets of any one exercise—and **never** perform more than three sets of any one exercise.

4. Make unceasing efforts to progress—always attempt to produce at least some sign of progress in every set of every exercise.

5. Pay particular attention to the "form" of your exercises—do not permit the style of performance to degenerate into a mere "going through the motions."

6. In general, select the "hardest" exercises—and perform them in the hardest manner possible; if a particular style of performance makes an exercise easier, then it almost always makes it less productive.

7. **Never** terminate a particular set simply because you have completed a certain number of repetitions; a set is properly finished only when additional movement is utterly impossible.

8. If you can perform your "guide number" of repetitions—or **more**—then that is your signal to increase the resistance in that particular exercise at the time of your next workout.

9. Judge your progress by measurable strength increases; when you can perform the same number of repetitions with twice as much resistance, then your muscles will be at least twice as big as they were at the start—and probably more than twice as big.

10. An advanced trainee does **not** need "more" exercise than a beginner; he simply needs "harder" exercise.

11. An intelligently selected, reasonably balanced diet is all that is required—and you **must** have both carbohydrates and fats; the amount of food is of more importance than any other factor of diet—if the diet is well rounded. If you are adding fat, then you are eating too much—too many calories; if you are losing weight, then you are not eating enough

12. Do not make any attempt to compare yourself with any other individual.

13. Building maximum-possible degrees of strength in all of the major muscular structures of the body will also unavoidably produce maximum-possible degrees of muscular size; so work to increase your strength—and control your degree of existing muscularity by regulating the amount of your diet.

14. "Spot reductions" of fatty tissue is an outright myth—a physical impossibility. Build the muscles of your abdominal area by training them in exactly; the same way your exercise your other muscles… get rid of any fat in that area by simply reducing your intake of food—or by increasing the "amount" of overall exercises.

15. Do **not** make the mistake of trying to add muscular size by "bulking up"—adding fatty tissue; such fatty tissue is not muscle and cannot become muscle.

16. Avoid so-called "growth drugs" like the plague.

17. Have confidence in your training; if you are too sick to make muscular gains you should be in the hospital—**any** healthy individual can do so.

Appendix 2: Basic Points

The following is the complete list of Basic Points from Bulletin No. 2, Chapters 25-33:

1. Above-normal levels of activity trigger growth stimulation.

2. Having been stimulated, growth will occur if the requirements are provided.

3. Fat deposits are an overall situation, with naturally heavier concentrations in some parts of the body.

4. The addition of fat is a result of a positive calorie balance; reduction of fat is produced by a negative calorie balance.

5. Maximum-possible power production is required to stimulate maximum-possible muscle-mass increases; the "intensity of effort" should be as high as possible.

6. The actual "amount" of exercise should be as limited as possible in line with other considerations.

7. The system has a natural tendency to return to previously established and accepted (accepted as "normal") levels of ability.

8. The longer a particular level of ability is maintained, the greater the degree of permanence.

9. There is no practical difference in increased levels of ability resulting from fast growth and gains produced by a slower rate of growth.

10. Previously established—but lost—levels of ability can be rebuilt far more quickly than they were initially.

11. Training programs must be truly progressive—with constant attempts to increase the power potential.

12. Two sets of each of a few basic, heavy exercises are best for promoting fast gains in strength-size.

13. Muscular functions are interrelated to such a degree that it is almost impossible to isolate the function of one particular muscle.

14. The value of exercise should be judged upon a basis of power production.

15. Compound movements are usually superior—for developmental purposes—to isolation movements.

16. Individual muscle fibers perform on an "all or nothing" basis; and only the number of fibers that are actually required to move a particular amount of resistance are involved in any movement.

17. A set that is terminated prior to the point of failure will not involve (cannot involve) all of the available fibers; at least not to a significant degree.

18. Every set of every exercise should involve work as far as possible inside the existing level of the "surplus of fibers" reserve ability.

19. Careful attention should be given to the actual rate of progress, in order to prevent a gradual and probably unnoticed reduction in the intensity of effort.

20. Accurate charting of progress can only be based on measurable strength increases.

21. There is a direct relationship between the size of a muscle and the strength of the same muscle.

22. Faster rates of growth will result if growth is proportionate.

23. Greater overall growth will result if the largest muscular structures of the body are worked heavily.

24. Not more than three weekly workouts should be performed; three "overall" workouts.

25. A slight decrease in the intensity of effort in exercise will result in a disproportionately great reduction in the production of results.

26. It is impossible to measure relative intensity of effort less than maximum-possible (100 percent) effort; thus impossible to be sure of the actual intensity of effort if anything less than 100 percent effort is being employed.

27. The first repetition is actually the hardest repetition—in spite of appearances to the contrary.

28. The first repetition is by far the most dangerous repetition.

29. Momentarily maximum-possible power should be produced in each set of every exercise—but **not** during the first three or four repetitions.

30. "Stopping short" of the point of failure will not reduce the danger of injury—but it will enormously reduce growth stimulation.

31. Workouts are for the purpose of "building size-strength," not for the purpose of demonstrating strength.

32. Supporting heavy weights—but **not** moving them—will increase the strength of connective tissue; and will do so without much danger of injury.

33. Sudden movements against resistance are the most dangerous types of movements—and the actual amount of the resistance is of little or no importance.

34. "Jerky" movements should be avoided at all costs.

35. You cannot judge the intensity of an exercise by the "feel"—except in relative terms; but you can judge the value of a movement by the "feel"—because relative intensity is the only factor of any real concern insofar as inducing growth-stimulation is concerned.

36. You cannot learn the proper method of training a race horse by asking a race horse.

37. If left up to their own devices, most trainees will not train properly.

38. In order to produce maximum-possible results, "somebody" has to push the trainee, any trainee; some trainees can and will push themselves—most will not, or cannot.

39. The moment-arm of the resistance must be considered in order to determine the actual resistance imposed on the muscles.

40. All exercise movements are rotational in nature.

41. The resistance imposed upon the muscles in all conventional forms of exercise is constantly changing as movement occurs.

42. There is literally no resistance in the finishing position of many conventional exercises.

43. Exercises involving maximum power production must be performed at a fast pace, with little or no pause between repetitions.

44. The number of repetitions should be at least 6 and not more than 20 in all sets—and at least 8 and not more than 12 in some exercises.

45. Increasing the "intensity of effort" requires a disproportionate reduction in the "amount" of exercise.

46. A point of failure must be reached as a result of muscular failure.