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# Flexibility and Metabolic Condition

Let us discuss flexibility first as a result of strength training. The stereotype still exists in the minds of most people… bulging muscles are equated with a stiff, slow, and probably clumsy individual. In fact, the size of a man's muscles has very little or nothing to do with his actual flexibility.

It is certainly true that some individuals with large muscles do lack a normal degree of flexibility… it is also true that large muscles can be developed while doing absolutely nothing in the way of improving flexibility… and, in some rather rare cases, it is even true that the activities which built the large muscles also produced a loss of flexibility. But in the vast majority of cases, the size of the muscles has very little relationship to the existing degree of flexibility.

A trainee can build large, strong muscles while doing nothing for flexibility… or he can develop his muscles in a haphazard fashion and perhaps increase his flexibility at the same time, producing both favorable results from exactly the same exercises.

It must be clearly understood that the strength of the muscles is the only really productive factor involved in functional ability… an exerciser's muscles produce movement… his muscles perform work… his muscles are his only source of power for any purpose. In effect, and in fact, the muscles are the engine of the body. Without the strength of the muscles an individual would be utterly helpless, literally unable to move.

However, in the face of the previous clear and undeniable statement, it still remains true that an enormous number of coaches and athletes remain almost literally afraid of their muscles. Failing to understand the simple cause and effect relationships involved, or still believing a number of thoroughly disproved myths, they look upon the development of muscular strength as something to be avoided.

Functional ability is a result of at least five separate factors… 1) muscular strength… 2) neurological ability, which is genetically determined and not subject to improvement… 3) bodily proportions, which are also genetically determined and not subject to improvement… 4) cardiovascular ability… and 5) skill.

To that list of factors we can, and probably should, add flexibility… which, to at least some degree, is also genetically determined; but only to the extent that the absolute maximum possible ranges of movement are limited genetically. This simply means that some people have a greater potential for flexibility… some people can be extremely flexible, and some cannot.

Considered logically, it is immediately obvious that only one of those six factors is actually *productive*… superior neurological ability is an enormous advantage to an athlete, but only because it permits him to use his muscles in a more efficient manner; in effect, his muscles are given an advantage denied average men, but it is still the muscles that perform the work.

Ideal bodily proportions for a particular activity bestow another great advantage upon an athlete so blessed… but only because the result provides his muscles with an advantage leverage for his individual sport; and again, it is obvious that the muscles actually perform the work.

Adequate cardiovascular ability is another requirement… but no amount or level of cardiovascular endurance will produce movement; again, it is the muscles that perform the work.

Skill is also important, and can easily be the only difference between a champion and a clod… but only because the possession of a particular skill enables an athlete to use the skill and his muscles to the greatest possible advantage. And again, it is the muscles, and only the muscles that perform the work.

If we add flexibility to this list, as we probably should… then it is again obvious that we still have only one productive factor; flexibility does not produce movement… instead, it permits movement. Only the muscles produce movement.

Of a list of six factors that determine functional ability, we have two that are not subject to improvement, neurological ability and bodily proportions… and we have four factors that are subject to improvement, 1) muscular strength, 2) cardiovascular ability, 3) skill, and 4) flexibility.

And, of the same list of six factors, we have only one factor that is actually productive… all of the factors are supportive in nature; they are certainly important, but only in the sense that they serve to support or improve the efficiency of the working muscles. These factors give the working muscles an advantage of one kind or another… they permit work, assist work, improve work; but, they certainly do not perform work of any kind.

Almost all outstanding athletes are blessed with both superior neurological ability and ideal bodily proportions for a particular activity… these two factors are primarily responsible for their success. When the factors of adequate cardiovascular ability, great skill, and the required degree of flexibility for the individual sport are added, the result is a level of functional ability far above average… even when the strength of the muscles is only average. But the same man, given the same advantages, would be better at any activity if his muscles were also better than average and stronger than average.

In the vast majority of cases, however, it is almost impossible to convince such a man (or his coach) that increasing the strength of his muscles will improve his performancce. On the contrary, in most cases, the athlete and his coach are both convinced that any increase in muscular size or strength would somehow hurt his performance. They utterly fail to understand the simple cause and effect relationships that determine functional ability. Such people are literally afraid to disturb a situation that appears good… little realizing that the really outstanding athlete has far more to gain from proper strength training than an average man does.

If they make any use of strength training at all, they usually confine it to their poorer athletes… being afraid to make the slightest change in their better athletes, for fear of disturbing some apparently mysterious factor. Then they try to justify this attitude on the grounds that strength training might make a particular athlete slower, less flexible, clumsy or somehow destroy their skill.

Hogwash… pure and unadulterated hogwash. Proper strength training will improve any athlete, in any activity just short of playing checkers. The simple truth of the matter is that the better an athlete is, the more flexible, more enduring at any activity, and far less likely to suffer injury.

Sometime in the probably far distant fugure, all athletes in all sports will engage in two distinct types of training… strength training designed to improve overall strength and flexibility in general, and practice of a specialized sporting activity for the purpose of developing the required skills. Cardiovascular ability will be produced by both types of training.

But, in the meantime, millions of athletes are being denied the benefits of strength training simply and only because they and their coaches fail to understand the actual factors involved… to say nothing of the fact that literally thousands of injuries occur that could have been prevented.

During an extensive research program on the multiple effects of strength training, a project conducted at the United States Military Academy in the spring of 1975, careful tests were given for the purpose of determining the results that would be produced in the area of flexibility. Results? These showed an enormous increase in every area of flexibility, a direct result of the same strength training program that also produced an average strength increase of approximately 60 percent within an elapsed training time of only six weeks.

For purposes of comparing the results of the strength training program to the results produced by a normal football program of spring training, two groups of athletes were used… the first group called the Wholebody Group because they were trained in an overall fashion, consisted of 18 members of the West Point varsity football team… the second group, called the Control Group, consisted of 16 members of the same football squat that did not take part in the special training program.

Both groups were tested before the training program and again six weeks later, at the end of the program. And both groups were involved in spring football practice during the period of the training program; thus, any differences in flexibility that showed up between the two groups could be attributed to the strength training program.

In the first test, trunk extension, the members of the Wholebody Group increased their range of movement an average of 7.22 inches… as compared to an average of only 0.62 inches for the Control Group. So, the subjects that were involved in the strength training program increased their flexibility by more than ten times as much as the other group did from football training.

In the second test, trunk flexion, the Wholebody Group increased an average of 2.67 inches… as compared to an improvement of 0.13 for the Control Group. Therefore, in this instance, the improvement for the strength trained athletes was more than twenty times as great as for the others.

In the third test, shoulder flexion, the Wholebody Group improved an average of 5.50 inches… compared to 0.50 inches for the Control Group. Again the strength trained group improved more than ten times as much as the other group.

A fourth test was also conducted, shoulder rotation, but the results of this test were not available at the time this chapter was written. This test involves the use of a pullover machine, a goniometer, and motion pictures were made during both the before and after testing. While it was obvious at the time of testing that large-scale increases were produced, the exact figures are not yet available.

Such dramatic improvements in flexibility are certainly not an accidental result of strength training… on the contrary, they are the carefully calculated tests that were produced by a properly designed program of full-range exercises; exercises capable of providing all of the requirements necessary to increase flexbility.

Flexibility is a result of stretching… pure and simple. No other factor is involved; but stretching is possible only under certain conditions, and stretching is not provided by most exercises performed for the purpose of increasing strength.

Stretching is a result of a movement that actually exceeds the momentary existing range of possible movement… but such a range of movement alone is not enough; additionally there must be a force tending to pull the subject into the stretched position.

In effect, a subject cannot simply move into a stretched position… instead, he must be forced into a stretched position, pulled into it or pushed into it by a source of resistance that provides the required force. But he absolutely should not be forced into a stretched position suddenly; the result of such sudden movement may well be a pulled muscle instead of increased flexibility. Instead, he should steadily increase his ranges of possible movement through the use of gradually increasing resistance… thus, as his strength increases and he is able to use more weight, he will also be pulled or pushed into positions that were previously impossible.

However, producing increases in flexibility is one thing… and testing increases in flexiblity is something else. So, for the purpose of testing, we did not utilize any resistance at all in the first three tests; instead, the results were determined simply by having the subjects move throughout as great a range of movement as possible without any outside source of force to assist them.

And in the fourth test, shoulder rotation, we used a constant amount of added resistance… 40 pounds of weight were used during both before and after testing; if more weight had been used during the latter test, then additional force would have biased the results.

A great deal has been written recently on the subject of negative work as a factor in exercise, both pro and con… but it should be clearly understood that negative work is an absolute requirement for the purpose of increasing flexibility. It is negative work which provides the back pressure of force that is required to pull a subject into a stretched position; so, if negative work (or eccentric contractions) is removed from his exercises, any chance to improve flexibility has also been removed.

But even some exercises that involve negative work still fail to provide stretching, so even these exercises do absolutely nothing for flexibility; chinning exercises (or pull-ups), for example, may appear to stretch the muscle and connective tissues in the area of the shoulders… but in fact, a far greater range of possible movement in that area of the body is untouched in such exercises… simply because there is no force in the proper direction to force the involved body parts into an actually stretched position.

Dipping exercises (parallel dips), however, do provide good stretching in the opposite direction… provided there is enough resistance to force the body into a low enough position. This can be achieved best by performing dipping exercises in a negative-only fashion… by performing only the eccentric part of the movement with the muscles of the arms and chest; since such a style of training permits the subject to use far more resistance, a heavier weight will pull him into the stretched position.

It is obvious that a properly conducted program of stretch exercises can and should increase both strength and flexibility… and it will if the subject confines his attention to truly full-range exercises, and if he is careful in the arrangement of his overall program so that equal attention is given to the muscles on both sides of all joints.

And if the subject will get it out of his head that his muscles are something to be feared and thus neglected, training the muscles properly can only improve his performance… neglecting them can only hurt his performances and greatly increase his chances of injury.

## Metabolic Condition

Contrary to widespread opinion, it now appears that there are three separate levels of condition… 1) muscular strength… 2) cardiovascular ability… and 3) a previously mentioned unsuspected level of condition that I have named metabolic condition.

Muscular strength can be built to a very high level with little or no improvement in cardiovascular ability. And it is well established that the exercises and activities that have traditionally been used for the improvement of cardiovascular condition will do almost nothing in the way of increasing muscular strength; in fact, it frequently happens that cardiovascular training actually produces a loss in muscular strength.

Thus, it frequently happens that a particular athlete has only one or the other… either strength or cardiovascular endurance, but not both. It is almost certain that the two distinct types of training have been used; one type of exercise for the development of strength, and an entirely different type of activity for the development of cardiovascular ability.

Yet even when an athlete does have both strength and cardiovascular endurance, something of very great value is still missing… the third level of condition, the previously mentioned metabolic condition is missing. As a result, the athlete can work very hard for a brief period of time… or, instead, he can work at a much lower level of intensity for a prolonged period of time. But he can not work with maximum intensity for a prolonged period of time.

In effect, he can engage in brief anaerobic activities with a very high intensity of effort… or he could perform aerobic activities with a greatly reduced level of intensity for a much longer period of time.

At first glance it might well appear to be literally impossible to expect anything more from an athlete; after all, a muscle certainly cannot work with maximum intensity for much more than approximately one minute… and even then, the output will rapidly decline during the activity, simply because the athlete will be exhausting the working muscle fibers much faster than the resting fibers can recover.

In order to perform aerobic work (steady-state work) it is necessary to limit the level of intensity… the percentage of stimultaneously working fibers must not be too high. An athlete must always have enough resting fibers ready to take over and continue the work as they are needed. If the percentage of working fibers is too high, it is simply impossible for the resting fibers to recover rapidly enough to take over the work as quickly as they are required.

When the unavoidable implications of the previous two paragraphs are understood, it then seems logical to assume that muscular strength and cardiovascular endurance must always remain some distance apart… must always be developed by separate and greatly divergent types of exercise. The real facts indicate otherwise.

In the supervised research program in cooperation with the physical education staff of the United States Military Academy at West Point, New York, more than 100 military cadets were used as test subjects. To the best of our knowledge, this was the largest, most comprehensive, most carefully conducted, and probably the most extensive research program ever conducted in the area of strength training. In due course, a book will be published on the subject of this research probject; but in this chapter I am limiting my remarks to one small but very important aspect of training that was clearly demonstrated during the West Point project.

During this probject we were interested in all aspects of condition… we wanted to increase muscular strength as much as possible, and as quickly as possible… but we also wanted to produce large scale increases in cardiovascular condition… and we wished to demonstrate that both results could be produced by exactly the same style of training.

In a period of less than six weeks a group of 19 footbal players increased their strength an average of approximately 60 percent… that's right, 60 percent, an average increase of 10 percent per week, a rate of strength increase previously considered to be literally impossible by most experts. And it must be clearly understood that these test subjects were not average subjects; instead, they were highly conditioned football players who were already quite strong at the beginning of the special training program; subjects with an average height of just below 6 feet, 2 inches, and an average weight well in excess of 200 pounds.

Producing such an almost unbelievable strength increase in such a short period of time would certainly have been a significant result even if absolutely nothing was accomplished in the way of cardiovascular improvement but, in fact, an equally significant improvement in cardiovascular endurance was produced simultaneously… produced as a result of the same very brief training program that produced the spectacular strength increases.

Therefore, it appears that many of the experts have been wrong; in fact, it is neither necessary nor even desireable to conduct two distinct types of exercise programs, one program to produce strength increases and a second program to improve cardiovascular condition. In practice, it is easily possible to produce both results from the same program.

And, in order to produce the third level of condition, the previously mentioned metabolic condition, it is absolutely necessary to train in this fashion. It is necessary to train in a fashion that will unavoidably produce rapid and large-scale increases in strength, in cardiovascular condition, and in metabolic condition.

And just what is metabolic condition? It is the ability to work at a high level of intensity for a prolonged period of time… the ability to work at a level very close to 100 percent of intensity for a period of at least 20 minutes, instead of one minute previously considered possible.

Work the muscles that hard for that period of time? No, that is impossible; but, it is possible to work the overall body that hard for that period of time… or, at least, it is possible if the subject has been trained properly. Proper style of training is the subject of this chapter.

In order to produce significant increases in muscular strength within a reasonable period of time, the muscles must be trained as hard as possible… must be worked to a point of failure within a rather limited number of repetitions and over a short span of time. In practice, best results seem to be produced when an exercise is performed for at least seven but not more than twelve repetitions… and when the exercise is continued to the pont where it becomes literally impossible to perform another repetition in good form, continued to the point where 100 percent of momentarily available muscular strength is no longer capable of moving the resistance through a complete range of possible movement without a sacrifice of form.

Obviously, if such an intensity of work is employed, it is impossible to do more than one set of an exercise without a rest period between sets; thus, traditionally, the practice has been to perform one set of an exericse, then rest for three or four minutes in order to give the momentarily exhausted muscles time to recover their strength, and then perform a second set of the same exercise, then rest again, and so on. Such training will eventually build great strength, although it is not the best or fastest way even for the purpose of increasing strength; but, it will do very little in the way of improving cardiovascular condition.

Cardiovascular benefits will not result from such training for obvious reasons… 1) because the pulse rate and the level of breathing will never be brought to a very high level… and 2) because the brief periods of hard work will be spaced with rather prolonged periods of total rest (between sets) that will permit the pulse rate and level of breathing to drop before additional work is started.

Cardiovascular benefits seem to be produced best when the pulse rate and the breathing rate are both raised to a high level… and are maintained at a high level for a prolonged period of time, 10 minutes, 15 minutes or even longer. Just how long such levels need to be maintained for the production of maximum cardiovascular benefits is a question that has not been satisfactorily answered; but, a period of 15 to 20 minutes will certainly produce large scale cardiovascular benefits even when such training is repeated only three times weekly.

During the West Point project the subjects were trained only three times weekly… only one set of each exercise was performed during each workout… every exercise was continued to a point of momentary muscular failure within a limited number of repetitions, seven to twelve repetitions. Very little in the way of rest was permitted between exercises, the minimum amount necessary to prevent cardiovascular failure… and the total elapsed training time during each workout varied from as little as 14 minutes to a bit more than 30 minutes.

If such a workout is conducted too fast at first… fast in the sense that little or no rest at all is permitted between exercises, then the subject will literally go into shock and be unable to continue… not because his muscles have been required to do something impossible… and not because he has exceeded his cardiovascular ability in the normal meaning of the term… but apparently, because he lacks the metabolic ability to continue. At this point in time I do not know exactly why a subject fails under these conditions… but, obviously, such a failure clearly indicates that the subject is asking his body to perform something that is momentarily impossible.

If, for example, we work a starting trainee to a point of failure on a hip and back machine, immediately work him to a point of failure on a leg extension machine… we can reasonable expect him to quickly reach a point where he simply cannot continue, a point where he starts to show obvious signs of impending shock, which would be followed by total collapse if he was forced to continue working.

And yet, this collapse would occur at a point where neither his muscles nor his cardiovascular ability has been exceeded… the muscles we were asking to work are rested fresh, and able to perform… the pulse rate is well within safe limits… the rate of breathing is within reasonable limits; but, the subject cannot continue and will go into outright shock if forced to continue.

Just what is lacking? I do not really know, but it is obvious that a demand is being made that the body cannot meet.

If there is interest in totally unsupported theories, then I do have a theory… a theory that I have no great confidence in at this point; I think that the body may simply be unable to provide the required chemical changes that are necessary to work that hard for a prolonged period of time. The required oxygen is available, and the circulatory system is capable of distributing it rapidly enough… the required nutrients are also available, but perhaps the body cannot provide the required metabolic changes at such a pace.

In any case, regardless of the actual cause and effect situation involved, the results are obvious… the subject simply cannot continue to work.

Therefore, at the start of such a training program, a brief amount of rest must be permitted between exercises… not much rest, but some rest, perhaps one to two minutes, depending upon the individual trainee.

However, as training continues from week to week, the pace of the training should be increased… so that, after approximately four weeks, little or no rest is permitted between exercises. By that point in the training program the subject should move from one exercise to the next exercise as rapidly as possible, with very little rest between exercises.

Now, bear in mind that a fast pace of training certainly does not mean that the exercise movements themselves are performed rapidly… on the contrary, the movements should be fairly slow and perfectly smooth with absolutely nothing in the way of sudden movement or jerking. A fast pace of training simply means that no rest is permitted between exercises.

Once a subject becomes capable of training in this fashion without going into shock as a result, then it becomes possible to work his muscles to a point of momentary failure while maintaining both the pulse rate and breathing at very high levels throughout the entire workout. And, since it was impossible for the beginning trainee to work in this fashion, it is thus obvious that something besides strength and cardiovascular ability has been improved… the subject has also greatly improved his metabolic ability.

And just what advantage does such a factor give an athlete? Well, how would a coach like to have a football team that literally did not require rest for a period of 30 minutes? Such a team could return to scrimmage immediately without the necessity to huddle… thus giving their opponents no chance to rest.

As an example of just how big a factor this can be, I will cite one example, a typical example from our experience at West Point. During his seventh workout, this subject required 24 minutes for his workout… but less than six weeks later, during his twenty-first workout, he performed an identical workout in only 18 minutes even though he was then using approximately 60 percent more resistance for the same number of repetitions.

His workout length was reduced by 25 percent, while his level of resistance was increased by 60 percent… thus his rate of work per minutes was increased by more than 100 percent, more than double. Instead of doing 100 units of work in 24 minutes, or 4.1 units of work per minute, he was doing 160 units of work in 18 minutes, or 8.8 units of work per minute.

And he worked at a more than double rate while showing a far lower pulse rate… during the seventh workout his pulse rate was in excess of 200, but during the twenty-first workout his pulse rate was always below 180.

Also, at the end of his seventh workout, the subject was near a point of collapse, and it took him several hours to return to a normal condition… whereas, at the end of the twenty-first workout, the subject had improved his recovery ability to such an extent that he could have repeated the workout after a rest of about 10 minutes.

His strength was greatly improved, and his capacity for work was also greatly improved… but just what effect was produced in regard to cardiovascular ability?

Significant improvement was demonstrated on all 60 separate tests conducted for the purpose of determining cardiovascular improvements. For example, the subjects we trained improved their time in the two mile run by an average of 88 seconds in a period of six weeks; as compared to an improvement of only 20 seconds produced by the control group of matched subjects that were not trained in this fashion. Both groups were involved in spring football training.

Much more detailed accounts of this style of training will be published at a later date, and in the meantime several other large-scale projects are being conducted in an effort to determine the exact results of such training; but it must be clearly understood that this style of training is of such a high intensity that very little of it is either necessary or desirable. Do not make the mistake of assuming that longer or more frequent workouts of this kind will produce even better results. On the contrary, brief training is far more than a possibility… it is an outright requirement for good results.

It is almost inevitable that at least some *experts* will immediately jump to a hasty conclusion; whereupon, they will rush into print to deny that anything new is involved. But I hereby warn them clearly in advance that the effects and results I am concerned with here apparently are new… and while I certainly do not even pretend to understand all of the biological factors involved, I am at least aware of the obvious cause and effect.

The West Point project was not the first example of such a style of training… on the contrary, we have been training a large number of subjects in this fashion for the last several years in Florida and elsewhere. More than 400 individual workouts were conducted at too fast a pace. One subject was forced to stop near the middle of one of his workouts… forced to stop because I was trying to train him at a pace that he could not maintain.

But all of the other subjects finished all of their workouts, and even that one subject finished all of his other workouts; although, I am certain that many of them did not believe at the time that they would finish, and equally certain that most of the subjects would never have pushed themselves at the necessary pace if left to their own devices.

Such training requires close and informed supervision… close supervision to assure that the pace is fast enough, and informed (or at least experienced) supervision to assure that the pace is not too fast. The workout absolutely must not be permitted to degenerate into a race against the clock… each and every exercise must be performed properly, the exercise movements should be fairly slow, and the exercise must be continued until an actual point of muscular failure is reached; if not, then a large part of the potential strength benefits will not be produced.

Nearly four years ago, one would-be expert from another state visited our facilities in Florida for the purpose, he said, of evaluating our equipment and style of training. He spent two weeks here, but refused to follow instructions. Later, he remarked that the training did not make him sick, that he could see nothing different about it. Well, obviously, the purpose of training is not to make the subject sick, and we had gone to great lengths with this man in successful efforts to keep from making him sick… which efforts, in that case, were worse than wasted, since he learned absolutely nothing from the experience.

Properly conducted, such training will not make the subjects sick… but it can, and it will, if the subjects are pushed too hard at first. And while I am perfectly aware that several other styles and types of training will sometimes produce an apparently similar reaction, I repeat that there is a distinct, if not yet fully understood difference.

And I am also clearly aware that there is another difference of far greater importance… the third level of condition, metabolic condition, as I mean the term, apparently cannot be produced by any other style of training. An athlete trained properly in this fashion will still be going strong in any activity requiring prolonged, heavy exertion for a long period of time after his opponent is stretched out in a state of outright collapse.

This type of training would probably be of little or no value for a weight lifter, or a shot putter… but it is the best type of training by far for a football player, a basketball player, a wrestler, a soccer player, a swimmer or a person involved in any other activity requiring both strength and cardiovascular endurance.