The Requirements for Meaningful Testing of Lumbar Function

A—Isolation of the lumbar muscles

Meaningful testing of the strength of the lumbar muscles cannot be provided without total isolation of these muscles. The forces produced by other muscles must not be confused with the forces produced by the lumbar muscles.

Forces produced by the buttocks and hamstring muscles must not be involved in tests performed for the purpose of measuring the strength of the muscles that extend the lumbar.

Forces produced by the hip flexors must not be involved in tests performed for the purpose of measuring the strength of the abdominal muscles.

Forces produced by the torso-rotational muscles located above the lumbar area unavoidably will be involved in tests performed for the purpose of measuring trunk-rotational strength . . . but the involvement of other muscles must be totally avoided.

Testing of those three types of movement can now be accomplished with such a degree of accuracy that the testing machine almost becomes a lie detector; because the test results produced by a cooperative subject will reproduce themselves with little or nothing in the way of variation from one test to another. Repeatability on the order of a one percent variation from one test to another identical test performed a few minutes later. Such accuracy is not only possible but is necessary in order to provide meaningful results.

But such accuracy of test results, and such repeatability of test results, can be produced in only one way; the tested muscles must be working in total isolation. Earlier attempts to test the strength of lumbar muscles were meaningless, because the required degree of isolation was not provided; could not be provided in the manner attempted . . . or worse, was simply overlooked or ignored. The unavoidable result being that such tests were in error by as much as several hundred percent, a high level of force produced by other muscles was attributed to the lumbar muscles.

While such a high level of force was not produced by the lumbar muscles, it was imposed upon the lumbar muscles . . . not only a meaningless test result but a dangerous testing procedure. Worthless data produced in a dangerous manner.

In order to solve any problem, you must first understand the problem; in this case, in order to test lumbar function you must first understand lumbar function. Lumbar extension is produced by muscles located along the rear of the lower spine; fairly small muscles, and relatively weak muscles, muscles that move the vertebra of the lumbar area in the direction of extension. Muscles that move these vertebra in relation to the pelvis.

In order to test the strength of these muscles in a meaningful manner it is thus necessary to anchor the pelvis; if pelvic movement is possible during the testing procedure, then meaningful test results are simply impossible.

B—Anchoring the pelvis

Anchoring the pelvis is not the only requirement for meaningful testing procedures, but it certainly is the key to accurate testing of the lumbar area . . . and it was by far the most difficult requirement to deal with.

If the pelvis is free to move, free to move even slightly, then the forces produced by the buttocks muscles and the thigh-biceps muscles will be confused with the forces actually produced by the lumbar muscles . . . because these larger, stronger muscles of the hips and legs move the pelvis in relation to the legs, and because the pelvis is connected to the lowest lumbar vertebra and thus movement of the pelvis will unavoidably move the lumbar vertebra.

And just how much movement of the pelvis can be tolerated while producing meaningful test results of the strength of the lumbar extension muscles? None, the pelvis must be anchored as if it were set in concrete. In careful tests of the strength of the muscles involved in torso-rotation we have found that an error in position of as little as one degree will produce an error in strength of as much as eleven percent . . . and if the pelvis is free to rotate even slightly during such tests, then errors in position of as much as twenty degrees are almost unavoidable, with a resulting error in the strength test in excess of two hundred percent.

So the pelvis must be anchored to a point where no detectable movement is produced . . . which is easier said than done. Absolute immobilization of the pelvis is probably impossible . . . after all, it is surrounded by soft tissue, tissue that is subject to compression, and thus subject to some slight degree of movement when subjected to high levels of force. But, at least to the degree possible, the pelvis must be anchored . . . and it can be anchored, to the extent that no measurable degree of movement is detectable.

Our first successful solution to this problem, a successful solution but not a practical solution, involved suspending the subject in the air and then forcing the thighs into a position where they could not move to the rear in relation to the pelvis. When the thighs are locked in that position, then any additional movement of the femurs is impossible, and thus any involvement of either the muscles of the buttocks or the thigh-biceps is also impossible . . . and that position will certainly anchor the pelvis to the required degree; but it just as certainly produces a posture for the subject that is both uncomfortable and intimidating . . . a difficult posture for a normal subject, an impossible posture for most injured subjects. Not a practical solution.

During tests of lumbar strength in the direction of extension, the pelvis has a natural tendency to tilt forward; that is, the bottom of the pelvis moves forward. Is pulled forward by the buttocks and thigh muscles.

During tests of torso-rotational strength, the pelvis has a tendency to twist; that is, one side of the pelvis will move forward while the other side moves to the rear.

Any such movement will unavoidably bias the test results, to an unacceptable degree.

To prevent such movement of the pelvis, the pelvis must be anchored from the front . . . the problem being that the pelvis cannot be reached from the front, the legs are in the way. You cannot provide a stabilizing force against the front of the pelvis in order to prevent the unwanted pelvic movement . . . but you do have access to the femurs, and the femurs are jointed to the pelvis.

In order to move in an undesired manner, the pelvis must move the femurs; and while you cannot block such movement of the pelvis directly, you can block movement of the femurs. Thus the key to anchoring the pelvis in a practical manner proved to be anchoring the femurs.

A very simple concept, once it is understood . . . but one that we overlooked for many years while we attempted to solve this problem in a number of ways that did not work, and in one way that worked but that was not practical. A solution that appears to have been overlooked by everybody else working in this field, and a solution that we have included in our patent applications.

Nothing else works . . . at least not in a practical manner. Until and unless you have anchored the pelvis, tests of lumbar function will be meaningless at best and dangerous at worst. Probably both.

But even when the pelvic restraint is properly designed and constructed, it is still necessary to use it properly . . . and essential that you are always sure that it is being used properly. Believing that the pelvis is not moving during testing or exercise is not good enough, you must know that the pelvis is not moving.

If the pelvis is free to move even slightly, then the strength of your hip and thigh muscles will confuse and bias the test results . . . but when it is anchored properly, the pelvis cannot move; then, but only then, you are testing the strength of the lumbar muscles in total isolation. Then, and only then, you have meaningful test results.

When seated in the machine the tops of the thighs should be approximately horizontal . . . which means that the midline of the femurs will be sloping upwards from the pelvic sockets at an angle of about 10 degrees. The knee ends of the femurs will thus be slightly higher than the hip ends of the femurs . . . which is an important consideration, not merely an arbitrarily selected position.

Two large pads are used to drive the femurs back into the hip sockets of the pelvis . . . but these are not knee pads, instead are pads that are carefully designed in order to disperse the required forces over the widest-possible area on the front of the lower limbs. Again for reasons of both safety and comfort.

But these pads do not serve to drive the femurs straight back; instead, the direction of force slopes upwards at an angle of approximately 30 degrees in relation to the midline of the femurs.

Since the tops of the thighs, and thus the femurs at that point, are prevented by the wide belt from moving upwards, this means that the belt becomes a fulcrum that rotates the hip ends of the femurs in a downwards direction.

Thus the force provided by the pads pushing backwards against the front of the lower legs serves to drive the femurs both to the rear and towards the bottom of the pelvis. In effect, and in fact, the heads of the femurs are then exerting the required levels of force in two directions simultaneously; both holding the pelvis back and holding it down . . . preventing any slightest degree of movement either forward or upwards.

In this manner, we are literally using your femurs as a required part of the machine . . . using the femurs as a means of anchoring the pelvis. The pelvis must be anchored for meaningful test results, and cannot be anchored in any other practical manner.

Additionally, located immediately to the rear of the pelvis, is a large round pad that is provided to restrain the pelvis from the rear . . . to restrain the pelvis without restricting lumbar function.

This pad is also carefully designed and constructed in order to provide the greatest-possible area of contact with the rear of the pelvis . . . again for reasons of both safety and comfort. But this pad also serves another important purpose . . . it clearly tells you that you are using the machine properly, that you are properly secured for the intended purpose. Or will instantly tell you that you are not properly secured, if that is the case. Will literally show you the problem, and tell you when it is solved.

This rear pelvic pad is mounted on its own axis so that it is free to turn, to rotate . . . but it should not rotate; if it does rotate, even slightly, then your pelvis is also rotating . . . which means that you are not properly secured in the machine.

The length of the lumbar spine changes as movement occurs.

But if it does not rotate, then you can be very sure that your pelvis is not moving either.

The rear of your pelvis is in very solid contact with the front surface of this pad . . . so the situation is very similar to one in which two gears are connected by their teeth; if one such gear rotates, even slightly, then the other gear must rotate in exact proportion to their relative sizes. Nothing else is possible short of tearing the teeth out of the gears.

When both gears are of the same size, then a five-degree rotation of one gear will produce an exactly equal rotation of the other gear; but if the radius of one gear is twice the radius of a smaller gear, then a five-degree rotation of the large gear will produce a ten-degree rotation of the smaller gear.

Exactly the same thing occurs in our machine. The pelvis providing the large gear and the pad providing the small gear. Under proper compression, the radius of the pad is only about half of the radius of a normal-sized pelvis in an average adult . . . which means that a one-degree rotation of the pelvis will produce a two-degree rotation of the pad.

Which exact degree of pad rotation can be both seen and measured if it occurs . . . because this pad is provided with its own goniometer (angle detector), which will tell you that rotation is occurring, and to what degree. Or will assure you that the pelvis is not moving, is not moving to any slightest degree.

In order to move either forwards or backwards the pelvis must rotate, and if it does then you will be aware of it instantly. But any slightest movement either upwards or downwards will also cause the pad to rotate, so you will always be aware of any slightest movement of the pelvis in any direction.

Our interest, of course, is to prevent pelvic movement . . . and the total lack of rotational movement of the pad when the subject is properly restrained will always give us the absolute assurance that the pelvis is anchored as if it were set in concrete.

C—Coaxial alignment of the effective axis of the lumbar

Tests performed for the purpose of measuring the extension strength of the lumbar muscles involve movement around five joints . . . the joint between L5 and the sacrum, and each of the joints below the other four lumbar vertebra.

Such compound rotation of joints unavoidably produces an effective axis of rotation which will seldom if ever be located in coaxial alignment with any one of the various joints. But in the case of the lumbar the situation is more complicated because the five axis points do not remain in their original positions in relation to either the vertebra or the sacrum as movement occurs.

Instead, the axis points move . . . move a surprising distance, and move in different directions in relation to each other, and move greater or lesser distances.

Additionally, because of the constantly changing location of each of these five axis points, the length of the lumbar spine changes dramatically as movement occurs . . . first shortens to a significant degree from its starting length, but then lengthens to an almost alarming degree as movement in the direction of the extension occurs past a position of normal lordosis. The greatest length, straight-line length, of the lumbar occurs in the position of greatest extension. Obviously, since the straight-line length has increased, then the length around the curve has increased even more. The distance around the curve of the lumbar spine in a large man may increase by more than an inch from its original length in a straight position.

Which means that the effective moment-arm (or moment, or lever, or lever-arm) has also changed dramatically as movement occurs.

A very complex situation indeed . . . one that is not even suspected by most people; but a situation that must be dealt with properly for the purpose of producing meaningful and accurate test results.

But, complex though this situation is, these are problems that can be solved . . . problems that have been solved, totally. The solutions providing test results with an error of less than one percent, an error so small that it is almost impossible to measure.

The center-line of the torso mass will vary greatly.

The seating and restraint structures of our lumbar-testing machine will properly accommodate anybody from a height of well under five feet to more than seven feet . . . without the need to adjust the seat either horizontally or vertically. Early prototypes of this machine did provide seat adjustments, both horizontally and vertically . . . but we later found that such adjustments are neither necessary nor desirable; but removal of these adjustments was in no sense a compromise, our machines are built with no slightest compromise in any respect. Rather, such adjustments were eliminated because they serve no purpose, are not required; the machine will fit anybody from well below five feet to well above seven feet, will fit them perfectly.

Compensation for the changing axis points of rotation, as well as compensation for the changing length of the spine is automatically designed and built into the resistance pad . . . so the computer always knows the exact length of the moment-arm of force being produced by the subject, in every position, throughout any possible range of movement, normal or abnormal, and regardless of individual differences in lumbar function.

A third goniometer (angle detector) is incorporated into the axle of the resistance pad; which instrument serves the purpose of measuring the length of the effective moment-arm in every possible position . . . instantly and automatically.

During a first test with a new subject it is necessary only to select the desired test positions within any possible range of movement and then note the figures provided by this third goniometer in those positions; then, when you punch the desired test points into the computer prior to the test, you also enter an additional number, punch in the figures provided by the goniometer. At which point the computer has all of the information that it will ever require for that subject. Doing this requires something on the order of twenty or thirty seconds the first time you do it, and will never have to be repeated with that subject.

You do not have to measure or calculate anything; the goniometer will supply the data and you give it to the computer.

Simple, in the manner provided . . . simple but absolutely essential for meaningful test results. So simple that it only took us about fifteen years to figure out how to do it.

D—Counterweighting of the moving components of the testing machine

All of the moving parts of the test machine must be exactly counterweighted; if not, then random levels of force (torque) will be introduced into the test results. And this is not a minor consideration, since an unbalanced machine may introduce several hundred foot-pounds of random torque, thus producing test results that are worthless.

Nor is that the only point to consider, since a moving mass produces kinetic energy . . . has a tendency to continue moving once set in motion. But this second point will be covered in great detail in a later section, so I will merely mention it now.

E—Determination of the center-line of the torso mass

The mass of the torso, head and arms (collectively, the torso mass) must also be counterweighted; but first you must determine the center-line of this mass.

Due to differing body shapes, the center-line of the torso mass will vary greatly from one subject to another; by as much as fifteen degrees or more when a very thin subject is compared to an obese subject. Unless this variation is compensated for, it is impossible to properly counterweight the torso mass; the unavoidable result being gross errors in the test results.

Again, this is not a relatively unimportant consideration, since we are sometimes dealing with a torso mass in excess of one hundred foot-pounds of torque, and are usually dealing with a torso mass of at least thirty foot-pounds of torque; thus, if the torso-mass counterweight is out of time with the actual center-line of the torso mass, it is easily possible to inadvertently produce errors in measurement in excess of one-hundred percent.

In fact, when dealing with a tall, obese subject with a very bad lower back, a subject with a high level of torso mass but a low level of lumbar strength, a misalignment of the torso-mass counterweight could easily make it impossible for the subject to move, thus making it impossible to test such a subject.

Weak subjects accurately tested, may produce as little as five or six foot-pounds of torque in some positions, and a heavy subject may produce more than one hundred foot-pounds of torque with his body mass; thus even a slight misalignment of the center-line of his body mass could introduce a level of torque that he could not move against, and perhaps could not tolerate. So this requirement must be provided, both for accuracy of test results and for reasons of safety.

Again, this is a requirement that is easily dealt with . . . but first you must be aware of the need.

F—Counterweighting the torso mass

Since the mass of the torso, during testing or exercise of the lumbar muscles involved in extension of the lumbar, may produce as little as a few foot-pounds of torque or as much as a hundred foot-pounds of torque, or more, and since the level of torque is constantly changing as movement occurs, it should be obvious that neither meaningful testing nor exercise can be provided for these muscles without proper counterweighting.

And again, this is another requirement that is easily provided . . . but must be provided.

G—Restriction of the head and arms

Since the head and arms constitute a very meaningful part of the total body mass, and since unwanted movement, relative movement, of either the head or arms, or both, will change the body-mass torque, it follows that the head and arms must be restrained during both testing and exercise; at least during any testing or exercise with a vertical component of movement, such as lumbar extension.

Within reason, it does not really matter what position of restraint is used for either the head or arms . . . but whatever the position, it must not change during testing or exercise. Movement of the head alone can change the body-mass torque in excess of one-hundred percent with some subjects, moving both the head and arms may produce a change in excess of two-hundred percent.

Only two factors are really necessary . . . one, the position of restraint must be comfortable for the subject . . . two, any detectable degree of relative movement of either the head or arms must be prevented.

It should also be noted that both the head and arms must be restrained before any attempt is made to determine the center-line of the body mass, and before the torque produced by the torso mass is counterweighted.

Some of the testing machines in use today produce errors of as much as several hundred pounds.

H—Elimination of the errors and the danger produced by kinetic energy

Elimination of the problems produced by kinetic energy requires two considerations, one of which is concerned with the style of performance of the testing, or exercise . . . the other of which concerns the manner in which the computer records the forces produced during testing.

Both the subject and the therapist must be aware of the consequences of kinetic energy in order to provide accurate, safe, testing procedures, and in order to provide safe, productive exercise . . . but the computer must also be able to recognize and reject as false the force that is sometimes produced by kinetic energy. The effects of kinetic energy can never be entirely avoided, but they can be reduced to safe levels; and, for accurate test results, the forces produced by kinetic energy must be entirely eliminated. Not reduced, eliminated . . . and they can be eliminated.

Since the subject of kinetic energy will be dealt with a bit later, I will not now go into any detail . . . but it should be noted that this factor has been ignored by most people for many years; the unavoidable results being worthless tests and dangerous testing procedures.

I—Measurement of force (torque)

Tests of muscular strength involve measurements of the forces produced by muscular contraction, but since it is not possible to insert a strain gauge between a muscle and its related tendon, we must be content with measurements of the torque produced by muscular contraction.

Torque is force around an axis of rotation. Torque is expressed in foot-pounds or inch-pounds, and consists of two parts . . . force and moment (or lever, or lever-arm, or moment-arm).

You can have lots of force and very little torque, or literally no torque . . . or lots of torque and very little force. The illustrations which form a part of this section should make the subject of torque perfectly clear; so all we need to remember at the moment is that attempts to measure the strength of a muscle actually involve measurements of torque.

Such measurements can be provided in several different ways, but for meaningful test results these measurements must be performed with great accuracy, literally a matter of ounces. But in practice, some of the testing machines in use today produce errors in results of as much as several hundred pounds. Errors produced by kinetic energy, produced by unbalanced body-mass torque, produced by unrestrained movement of body parts, and produced by the involvement of muscular structures that should not be involved in the testing at all.

It is possible to measure the

torque produced by muscular contraction in an accurate manner, but you cannot even begin to do so until all of the previously-listed requirements are provided.

Having done so, you have still done nothing of any value . . . until and unless the next requirement is also provided.

J—Correlation of torque with accurate measurements of position

Even an accurate measurement of torque is meaningless, unless it is correlated with an equally accurate measurement of position . . . because, changes in position produce changes in strength; even a very slight change in position can produce a very large change in strength.

During torso rotation, the strength of a subject may change in excess of one-thousand percent . . . within less than one-hundred degrees of rotation; an average change in strength, throughout the entire range of possible movement, in excess of eleven percent per degree of movement.

And while that is the most extreme example that I can quote, it is certainly not the only example . . . throughout a large part of the range of movement, the measured output of torque produced by your quadriceps may change in excess of seven percent per degree of movement.

Absolute accuracy of positional measurements is probably impossible, but it is possible to reduce any remaining errors to a point where they become relatively unimportant. Producing such accuracy is certainly not easy, but it must be provided in any tool intended for the purpose of meaningful testing of muscular strength.

Yet, again, most of the tools now being used for such purposes do not provide anything even approaching a meaningful accuracy of positional measurement . . . errors of position of as much as thirty or forty degrees are common, and errors in excess of sixty degrees are not rare; and remember, an error of even one degree will produce an error in the strength test of as much as eleven percent . . . so just what magnitude of error does a positional error of thirty to sixty degrees produce?

Several hundred percent . . . or worse.

While it isn't really possible to say just which requirement is the most important for the purpose of accurate testing . . . providing accurate measurements of position is certainly the requirement that gave us the most trouble over the last fifteen years. So I can certainly understand why a lot of other people have just ignored this factor, perhaps hoping it will go away if they don't mention it . . . and why some other people have really made no attempt to deal with it. But, until and unless you have dealt with this factor, any attempt to measure muscular strength in a meaningful manner is doomed to failure.

All subjects that fail to produce an acceptable degree of repeatability should be tested again two days later.

K—Reduction of friction in the testing machine

Friction, like kinetic energy, can never be entirely removed from any machine, but it can be reduced to a very low level . . . and should be. This factor will also be dealt with at greater length in a later section, so I will merely mention that some testing machines, and some exercise machines, have so much friction that meaningful test results of a weak subject are simply impossible, and proper exercise for a weak subject is also impossible.

L—Repeatability of test results

When, but only when, all of the above outlined requirements for meaningful testing of muscular strength have been provided, it then becomes possible to produce results with little or literally no change from one test to another. But it must also be understood that even a precise degree of repeatability is no assurance of either accuracy or meaningful test results.

Such a degree of repeatability is also a test of the subject in another sense; a test of his cooperation, since two tests performed a few minutes apart should produce almost exactly the same results . . . and will, if the subject is cooperating.

When two such tests show a difference in excess of two percent of the area under the curve, then the subject was not cooperating in one or both of the tests. Which result is to be expected with some subjects when they are first tested; to some degree because they are not quite sure what to do, regardless of how much prior instruction they have been provided, but also because some subjects are somewhat hesitant during their first few tests.

For these reasons, we do not start a research program with a subject until and unless they are repeating the tests results with almost no difference between two tests performed a few minutes apart.

At the start of a research program, all of our subjects are tested twice on the same day, with only a few minutes between tests. Ideally, such initial testing is performed on a Monday . . . and typically, some of the subjects will not duplicate their test results with an acceptable degree of repeatability. If a particular subject does repeat the tests with a difference of less than two percent of the area under the curve, and with a difference of not more than five percent at any point throughout the tested range of motion, then that subject can be started in the research program immediately. Some subjects will cooperate that well, but some will not. Totally inexperienced subjects are less likely to perform well during such first tests.

All subjects that fail to produce an acceptable degree of repeatability during the first testing session should be tested again two days later, and again should be tested twice . . . at this point in the proceedings we are looking for only one thing, repeatability of test results. Subjects that fail during the second testing session should be tested for a third time on Friday, and again tested twice . . . and so on; such initial testing should then be continued for a maximum of three weeks, with three testing sessions each week and two tests during each session. By which point, almost all of the subjects will be repeating test results with little or no variation from one test to a second test performed a few minutes later . . . but not because they have learned how to perform the tests; rather, because they are now cooperating and are thus producing meaningful test results.

The testing procedures are very brief, and produce little or no measurable degree of fatigue, thus produce little or nothing in the way of a temporary loss in strength . . . so there is no reason why the two tests should be different, if the subject is cooperating.

But if a subject has not started to repeat the test results after three weeks of initial testing, after nine testing sessions, after eighteen tests . . . then drop them from the program; such a subject probably never will cooperate, and the data produced by such a noncooperative subject is of no value.

In practice, you will probably find that almost all of your subjects will produce an acceptable degree of repeatability by the end of the second week of such initial testing.

It does not matter whether all of the subjects start the research program on the same date, or whether some start as much as three weeks after some others; what does matter, and all that matters, is accuracy of test results . . . because, without such accuracy of test results, the entire research program is simply wasted time and effort.

There are other requirements for meaningful research, of course . . . but all of the other requirements, and all of your efforts, are meaningless without accurate test results.

Some people, particularly people with some experience in strength testing using other types of equipment, may refuse to believe that such degrees of accuracy and repeatability are even possible . . . and, within the limits of their experience, they are correct; because it certainly is not possible to produce either such accuracy or such repeatability while using any other type of equipment in the world.

Unfortunately, some people, having devoted their efforts to worthless tests for a period of several years, having invested tens-of-thousands of dollars in a particular piece of equipment, having published several studies using such equipment, simply cannot bring themselves to admit that all of their efforts have been in vain, that the results of their many tests were worthless at best.

So let me be the first to admit that many years of my own test procedures were also worthless, or worse than worthless because they were misleading and thus served to point me in the wrong direction; as an individual, I have probably devoted more time, and certainly more money, to such testing than anybody else on the planet. Most of which research was never published, simply because I was not satisfied with it, had failed to convince myself of either the accuracy or the repeatability of the test results.

While it is not my intention to create controversy, nor my desire to become involved in any existing controversy, it is necessary to mention certain facts that must be established for a clear understanding of the subject. Facts, and factors, that remain largely unknown, even unsuspected . . . but things that must be clearly established, and clearly understood, before it is even possible to discuss the subject of strength testing in a meaningful manner.

At the moment, May 20th, 1987, as I am writing this, one company in this field (Cybex) is in the process of publishing attacks on some of their competitors in the form of an open letter to orthopedic surgeons; claiming a high degree of accuracy and repeatability for their own equipment and giving the clear impression that the equipment being offered by their competitors is dangerous. In response to this published attack, one therapist published his reactions . . . which were negative. He made it plain that he considered such statements an insult to the intelligence of therapists that have been using one type of equipment or another; he considered such published statements to be unprofessional.

Which attitude, in my opinion, is unfortunate; not uncommon, but unfortunate. Because new information, if it really is information, and if it really is new, and if it has any slightest value, will always run counter to many existing beliefs and practices based upon those beliefs. At the moment, in this field, many of the rather widely held beliefs are simply false . . . accepted by some people perhaps, but certainly not established, and they never will be established, because they are not true.

As it happens, the statements being published by Cybex are not true, are in fact quite the opposite of the truth. But attempting to impose any sort of censorship will serve no worthwhile purpose, may prevent the truth from becoming known.

I bring up the existence of such false beliefs only with some reluctance, because I fully realize that some people will react to my statements in a negative manner . . . but the subjects of the next few chapters cannot even be discussed without mention of some of the currently-existing false beliefs in this field.