MIND AND BODY

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The way the mind and the body are united has preoccupied men throughout the centuries. 'A healthy mind in a healthy body' and similar sayings show the kind of unity that was conceived at the time. In other teachings, the healthy mind makes a healthy body.

My contention is that the unity of mind and body is an objective reality, that they are not entities related to each other in one fashion or another, but an inseparable whole while functioning. To put this point more clearly I contend that a brain without motor functions could not think or at least that the continuity of mental functions is assured by corresponding motor functions.

Let me substantiate this point by some striking examples:

1. It takes us longer to think the numbers from twenty to thirty than from one to ten, although the numerical intervals are the same between 1 and 10 and 20-30. The difference lies in the fact that the time intervals are proportional to the time needed to utter the corresponding numbers aloud. This suggests that we actually mobilize the brain mechanism of the vocal apparatus. Thus one of the purest abstractions is inextricably linked with the muscular activity through its nervous organisation.

In counting objects we find, in general, the linkage of the motor parts of vision and verbalization keeping down the speed of thought to the rate of the motor elements.

Most people cannot think clearly without mobilizing the motor function of the brain enough to become aware of the word patterns representing the thought. It is of course possible with sufficient training partially to inhibit the motor aspect of the thinking and thus increase the facility of thinking.

2. Macular vision, that is, distinct, clear seeing, is limited to a very small area at a time. To perceive clearly the content of what we see while reading takes us the time necessary for the muscles of the eyes to scan the area under inspection. Here again, we see the functional unity of perception and motor function.

These examples indicate that an improvement in speed and clarity of thought may be obtained by reducing the extent of movement and smoothing the performance of the muscular controls.

Jacobsen asserts that when deep muscular relaxation is obtained, it is difficult, or even impossible, to think without noticing an appearance of tension in the muscles. When picturing an object even with closed eyes one senses a tensioning of the eye muscles.

Professor Guthrie believes that the continuity of thought is unthinkable without the "cues" that each muscular pattern provides for the next. Think, for example, of a forgotten poem, nursery rhyme or melody, and observe how on getting one muscular cue of the mouth and vocal chords we can proceed fluently until there is a break, i.e. a muscular pattern insufficient to evoke the next cue. At the break we mumble and try neighbouring patterns until we find the cue that starts again a fluent burst of consecutive cues.

Again note how persistently we retain the same thoughts and the same modes of action, how we use the same patterns of the speaking apparatus producing the same voice so that we can be identified by it for decades on end. This is equally true of our handwriting, our carriage. etc.; so long as there is no marked change in these, there is no change in our jokes, attitudes and moods.

We have no sensation of the inner workings of the central nervous system; we can feel their manifestations only as far as the eye, the vocal apparatus, the facial mobilization and the rest of the soma provoke our awareness. This is the state of consciousness!

There is little doubt in my mind that the motor function, and perhaps the muscles themselves, are part and parcel of the higher functions in men. This is true not only of those higher functions like singing, painting and loving which are impossible without muscular activity, but also of thinking, recalling, remembering and feeling.

Let us consider feeling in more detail. I may feel joyful, angry, afraid, disgusted. But everybody

can, on seeing me, recognize the feeling I experience.

I am buoyant, my breath even, my face at the point of smiling— I feel gay; my motor attitude is quite different when I feel disgusted— then my face is that of a man on the brink of, or immediately after, vomiting.

I clench my lower jaw, my fists, my breath is held but pulse accelerated, eyes and head move in jerks, my neck stiff—I am angry. I am ready to hurt, but I am trying not to let myself go.

I am afraid, I scream, I am trying to get away or I am frozen stiff. There is usually a clear motor pattern sufficient even for an objective evaluation of the intensity of my feeling.

Which comes first—The motor pattern or the feeling? The question has been the object of many famous theories. I would like to stress the view that basically they are the same thing. We cannot become conscious of a feeling before it is expressed by a motor mobilisation and therefore there is no feeling so long as there is no body attitude.

Re-Education

There are thus two major roads to change in a person's behaviour either via the psyche or via the soma. However, to make change real it must be brought about in a fashion which allows both the soma and the psyche to be changed simultaneously. If the approach to the treatment of change is not integral but through either the psyche or the soma separately, it will last only as long as the person has not lost the awareness of the change, i.e. only as long as he did not start to act or react in his habitual spontaneous fashion. In fact, the person has only to get involved for a few moments in his normal troubles and he will not be able to recover without further help. Scanning one's own body image, one can detect the return of the unwanted, habitual muscular function some time before it is consummated and one can either inhibit or facilitate it by an act of volition.

On acting on the significant parts of the body, the eyes, the neck, the breath, the pelvis, it is easy to effect striking changes of mood on the spot. I have achieved clear results also with a group technique which can also be self-taught.

The advantage of approaching the unity of mental and muscular life through the soma, lies in the fact that the muscle expression is simpler, it is concrete and simpler to locate. It is also incomparably easier to make a person aware of what is happening and therefore yields faster and more direct results.

A few examples may be useful. Mr. B. was in a mental home for 3 years, has had insulin treatment, electric shock treatment and analysis before these means were used. He left the home because no further improvement could be reasonably foreseen. When he was re-educated by our method and brought to make only a few more or less normal breathing movements he dreamt that he was in the W.C., the walls of which suddenly fell apart exposing him to onlookers. This dream continued for ten consecutive nights until a complete change in breathing took place. A marked beneficial change in the person's behaviour occurred during those days which was the forerunner of still further betterment.

Professor Z., who was one of the first psychiatrists to associate himself with this work, has published a remarkable case of a patient in one of his wards, on whom no useful clues were obtained after one hundred sessions of psychotherapy. At the weekly meeting of the medical staff, it was suggested to try the somatic approach. The person was put in complete flexion not unlike the position of the embryo and a certain degree of relaxation and improved breathing brought about. After four sessions a sufficient amount of significant material was obtained to warrant a definite course of treatment.

The oneness of mind and body provides a new outlook which enables one to reveal relations between hitherto unrelated facts.

Old age, for instance, begins with the self-imposed restriction on forming new body patterns. First, one selects attitudes and postures to fit one's dignity of position and thereby one rejects actions which soon become impossible.

It suffices to examine sitting on the floor or jumping, to realize how important a factor this rejection is in ageing a person. Their resumption and reintegration into normal usage has a marked rejuvenating effect not only on the mechanics of the body but on the personality as a whole.

"Reality"

The examination of the distribution of tonus throughout the body of several thousand people before and during re-education, indicates what are the norms for the definition of *health* and *normality*. Though it is difficult to do full justice to these concepts in a few words, the broad outlines can be drawn.

The head movements must have no predilection for particular directions. The "normal" head should have easy access to all directions of the anatomically possible range. The limiting factor should be the skeleton structure and not muscular impediment. It can be shown that every adult uses only a part of the theoretical possibilities of the human frame.

The healthy co-ordinated movements of the body as a whole obey the mechanical principle of least action; while the muscles work in step and perform their task with the least expenditure of metabolic energy. In view of these principles governing the operations of the whole human frame one can decide on normal and abnormal behaviour.

The practical use of these guiding principles will be discussed in greater detail in my second lecture.

To make these norms of normality of universal application the human being must be viewed in its entirety. A man is made of three entities (1) the nervous system—the core: (2) the body—skeleton, viscera and muscles—which is the envelop of the core and (3) the environment —space, gravitation, society. The three aspects, each with its material support and its activity, together give a working picture of a human being.

There is functional correspondence between the core, i.e. the nervous system and the outside material world, or even the social environment, much closer and more vital than between some adjacent parts of the nervous system itself. Think, for instance, of men going deliberately to face death in order to preserve an established social order. The social ties of a nervous system may be stronger than those with the body itself, so that some individuals sacrifice the first two parts of themselves to preserve the third.

It is to ignore reality, if one intends to make a change in the behaviour of a person and disregard even for a moment, any one of the three constituents of existence.

The core relates itself to the body through the nerves and the hormonal chemistry, and to the outside through the proprioceptive and exteroceptive nerve endings and through the senses. (There is no direct perception of the outside world by the nervous system.) The distinction between self and the outside world is a growing function. With the growth of the pyramidal tract and improvement of differentiation and voluntary activity, the system slowly and gradually sorts out the signals of information coming in from the soma and from the outside and recognises which is which.

The development of this process leads to clearer and clearer distinction between signals derived from the body—the self—and those derived from the outside world; the former classify as "I" and the latter as "NOT I"—this is the beginning of consciousness.

The principle of knowing ourselves is through the recognition of the orientation of the body. The first glimpse of awareness is the recognition that "I"—the body—is oriented to the "NOT I"—the outside. This is also the beginning of the subdivision or distinction between subjective and objective reality, which are thus organically dependent on the motor elements, the nerve, the muscle and the skeleton which are oriented by and react to the gravitational field.

We are so accustomed to the gravitational field that we have to learn about its existence and have difficulty in grasping the idea. The same is true of consciousness which is continuous so long as the sequence of orientation cues is uninterrupted. How organic orientation is to consciousness can only be realised when there is a break in one or the other or a start.

When we wake up to consciousness after fainting or anaesthesia the first thought is "Where am I?" When there is break in orientation cues sequence like when we fail to find the expected next steps there is a momentary lapse of consciousness. The jolt is so violent that for a moment we lose the ability to direct ourselves.

The term orientation is used here in its widest sense, including the distinction between "I" and

"NOT I" in the social field and all its ramifications. And of course one can see the attitude of submission, of arrogance, of insignificance and of importance in the attitude of the skeleton clearer than in anything else.

An immense field for inquiry is opened once the organic ties of social orientation are followed up into muscle, nerve and skeleton. Not only individual development or abnormality can be followed through the soma but even wider cultural and racial attitude differences, such as the introversion, the non-attachment, the indifference of the Hindu and looseness of his hip-joints and the extrovert, clinging, holding-on time-is-money attitude of the industrial nations with their utter inability to sit cross-legged. And, of course, to soften and bring to normal one's hip joints, one must spend time, look at oneself, give-up something, detach oneself from something else.

I would like to make clear some of the notions I used loosely i.e. an act can be reflective, unconscious, automatic and fully conscious or awared. Almost all activity which evolved phylogenetically with the human species is common to the entire animal world. This activity becomes more and more complex with the higher members of the tree of evolution. It can be reflective—the lowest form of action—up to awareness, the most evolved one. Thus phylogenetically aquired activity is always expressed in abstract terms and is therefore unchangeable, as there are no means to affect an abstraction. On the other hand the individually aquired action, i.e. ontogenetic action pertains to the senses. Such action can be altered as one can become aware of qualifications which are of the realm of reality, such as the extent of the effort, its co-ordination in time, the body sensation, the spatial configuration of the body segments, the standing, the breathing, the wording, etc.

The awared learning is complete when the new mode of action becomes automatic or even unconscious, as all habits do. The difference between a self-established habit and one acquired by awareness is, that when the last shows unfitness when confronted with reality or maladjustment, it easily awakes awareness and thus enables one to make a fresh and more efficient change.

In conclusion let me state my inmost belief that, just as anatomy has enabled humanity to get an intimate knowledge of the working of the body, and neuroanatomy that of some activities of the psyche, so will understanding of the somatic aspects of consciousness enable us to know ourselves more intimately. Tension is self-destructive. In the future, we should be able to direct the forces that generate tension not just to release it, but to the betterment of humanity.

TECHNIQUES —

I. INDIVIDUAL TEACHING.

I use two techniques, one in individual teaching where I use my hands to produce by physiological means the desired alignment of the different segments of the body. The effects are very difficult to describe but some sort of idea can be given.

I never deal with the affected member or articulation before an improvement in the head-neck relationship and breathing has been brought about. This, in turn, cannot be achieved without a betterment of the spine and thorax configuration. Again the pelvis and abdomen must be corrected.

In practice, therefore, the procedure is a successive series of approximations each one allowing a further improvement in the segment just dealt with.

Before one can use this technique, one must experience it oneself first; through that experience one acquires the necessary delicacy of touch and clarity of sensing which muscle group or segment needs attention first and which needs it at all.

The peripheral trouble is usually largely dissipated when the spine-head comportment is improved, so that very little work is necessary at the periphery to bring its functioning to the level of the rest of the body.

I insist on 30 to 40 sessions at a daily rate and then twice or three times a week until the major complaint is gone. Normally, i.e. in about fifty per cent of the cases, pains and inability to use a member, disappear before the daily sessions are over.

I begin with the person lying on his back. This position is meant to reduce as much as possible the influence of gravity on the body and thus free the nervous system. The reaction of the nervous system to the gravitational pull has become a habit, and while this remains so, there is no means of

bringing the muscles to respond differently to the same stimulus. Obviously then it is difficult to bring about any real change in the nervous system without reducing or eliminating the gravity effect.

In due course I go through thirty different situations up to sitting standing, walking and balancing on two wooden rollers.

Some further details will become clear with the description of the group techniques.

II. GROUP TECHNIQUES.

A group consists of 30 to 40 people. They may be people from the age of 15 to 60 or more. To take an example of one particular group I have in mind, it consisted of men and women suffering from sciatica, discal hernia, frozen shoulders and similar complaints. Most of the group were over 35 and wearing corsets for many years. Other groups may be composed of teachers, actors, singers and other still of dancers, teachers of eurythmics and so on.

I begin with lying on the back (after the same fundamental principle mentioned in the chapter on individual technique) and learning to scan one's proper body: that is, everyone examines attentively the contact of his body with the floor and gradually learns to detect considerable differences—points where the contact is feeble or non-existent and others where it is full and distinct. This training develops the awareness of the location of the muscles which produce the weak contact through their permanent excessive tension holding parts of the body up from the floor. A certain improvement in comportment can be achieved through muscular awareness only but beyond that no improvement will be carried over into normal life without increasing the awareness of the skeleton and its orientation. Here the most difficult joints are the hip joints. The awareness of the location and function in these joints is non-existent compared with that of people who sit on the ground and not on chairs. The chair sitter is almost without exception completely out of place when locating the hip joints. Moreover, he uses his legs as if they were articulated at the points where he has them in his body image and not where they are.

I usually make it clear that the work is to lead to awareness in action, or the ability to make contact with one's own skeleton and muscles and with the environment practically simultaneously. That this is not relaxation, for true relaxation can be maintained only when doing nothing. The aim is not complete relaxation but healthy, powerful, easy and pleasurable exertion. That the reduction of tension is necessary because efficient movement is effortless. The inefficiency is sensed as effort and prevents doing more and better.

The gradual reduction of useless effort is necessary in order to increase kinaesthetic sensitivity without which a person cannot become self regulating. The Fechner-Weber law shows clearly that this is so. This law states that for a wide range of human sensation and activity the difference in (I) Stimulus that produces the least detectable difference in Sensation (S) is always the same ratio to the whole stimulus.

If I hold a 20-lb. weight, I cannot detect a fly sitting on it because the least detectable difference of stimulus is from 1/20 to 1/40 (in this sense) and therefore at least half a pound must be added or subtracted from the carried weight to become aware of it. If I hold a feather the sitting of a fly makes a great difference. Obviously then in order to be able to tell differences in exertion one must first reduce the exertion. Finer and finer performance is possible only if the sensitivity, i.e. the ability to feel the difference, is improved.

Another important feature of the group work is the continued novelty of situation that is maintained throughout the course. Once the novelty wears off awareness is dulled and no learning takes place. The configuration that needs repetition is then taught in tens and even hundreds of variations until they are mastered.

All exercises are arranged to produce a neat change in sensation at the end of the lesson and usually a more or less lasting effect for some time. This enables the pupil to find connections between different parts of the body like for instance between his left shoulder blade and right hip joint, or that of the eye muscle and the toes.

To produce the mental ease necessary for the reduction of useless efforts the group is repeatedly

encouraged to learn to do a little less well than is possible when trying hard, less fast, less vigorous, less graceful, etc. They are often asked to do the utmost and then deliberately to do a little less. This is more important than it might seem. For it enables to feel progress while not tensing, the sensation is that one can do better which is inducive of progress. Achievements that otherwise may need numerous hours of work can be obtained in twenty minutes in this attitude of mind and body.

Special mention must be made of very small, barely perceptible movements that I use extensively. They reduce latent tonus (degree of involuntary contraction) in the muscles in an astonishing way; in a few minutes a member—the leg or the arm—may be made to feel longer and lighter on the worked side of the body than on the other.

The pupil keeps on feeling what the new way of action is and the sensation of the light and long member is continuously contrasted by the other which feels clumsy and awkward in comparison.

Very often only one half—the right or the left—is worked with during a lesson, and the other half is left as it was. Again, the pupil carries with him for hours afterwards two standards in his own body— a) his habitual one and b) the proposed better one. The transfer of learning is thus ascertained. One keeps feeling the difference until the clumsy side eases up, one thus learns to ease up, so to speak, from within. This promotes the transfer of learning from the action worked on, to others, completely different. The transfer of learning is essentially personal and differs from one individual to the other. One may feel the change in his speaking, the other in his way of attending or observing.

Another principle in the group technique is the scanning of the body image. This is done in two parallel ways. One consists of producing a sensation of length, width and lightness in one half of the body, by one of the means explained above, consisting of actual work, the other half of the body is brought to feel the same sensation by mental scanning alone.

The mental scanning consists in listening and becoming aware of the difference of sensation in the kinaesthetic of the muscles of the two halves and the sensation of change of orientation in space.

The other way consists of scanning the body on both sides from the start but directing attention to the sensation of the distances between different parts of the body on either side until they correspond to the actual differences.

In all voluntary acts one can distinguish two phases following each other swiftly, so that it is difficult to note the time delay between one and the other. The first is a preparatory phase—the mobilisation of the body attitude needed for the action—the second is the performance of the action. There is a minute time interval between the two which makes it possible to learn to inhibit or enhance the preparatory mobilisation by volition. It is thus possible to consummate the action or prevent it and cancel the preparatory attitude altogether. Much is being done to clarify the delay between the preparatory attitude for action and its consummation. This trains the ability to facilitate or to inhibit the consummatory phase thus improving the fluency and voluntary control of movements.

The essential differences in chronaxies, in duration of effort between white and red muscle fibres, flexors and extensors or antigravity muscles, are often shown in practice.

Extensive use is made of agonism and antagonism, alternately working repeatedly the agonist until on stopping to find that the antagonist has lengthened and become more controllable, i.e., less of the primitive all or none reaction.

Many exercises are using induction both positive and negative; in other words, using the after-effects of prolonged, sustained efforts. For example: stand close to a wall with the right side, for instance, and press with the back of the hand against the wall as if to push it away. After maintaining this pressure for about a minute one leaves off and by leaving the right arm free to do, so to speak, “as it wishes”, the right arm rises and lifts itself to shoulder height with a peculiar lightness akin to floating. On lowering the arm voluntarily and leaving it free again the same thing will repeat itself a few times with decreasing amplitudes.

But whatever the exercise or the principle used, the lesson is so arranged that without concentration, without trying to sense differences, without real attention it is impossible to follow the next stage. Repetition, just mechanical repetition without attention is made impossible and is discouraged.

Many exercises consist in trying to attend to the means of achieving a goal and not the goal itself which is an important tension reducing means.

All these exercises aim at achieving mental and physical coordination and in particular good erect posture and correct action.

ERECT POSTURE.

There is nothing simpler than erect posture. It means a vertical straight line, but all the words, posture included, convey statics, something posted and held straight. And, indeed, there are few people who do justice to the machinery they are.

On close examination it becomes clear that erection is a dynamic notion. And that erect posture is a way of functioning to which the frame continuously readjusts itself rather than a posture being maintained as a fixture or state.

Firstly, we observe that all the double organ senses, vision, hearing and smell are located in the head. As known from elementary science, two data are necessary to define unambiguously a point from a base. Thus the summit of a triangle needs two bearings from both ends of a basis to be uniquely defined.

During the evolution of the human frame, the most recurrent use made of the head was its turning towards the source of sound so that the two ears are equally stimulated. For different frequencies of sound there is a different mechanism by which equality of stimulation of the ears is established. Intensity differences, time of arrival of the sound, phase differences, etc. can be equalised through turning the head so that the eyes face the source of sound. The retinas are internally so connected that equal stimulation of them is obtained when we face the object which originally stimulates one retina more than the other. The same sort of thing happens with odours, though this is a much cruder definition of direction and distance.

Thus our relation with anything outside beyond what can be explored by the sense of touch, is determined through the movement of the head. All the information from the space around us comes through the head and our relations with the world outside us, mark the quality of the movement of the head most of all.

There are numerous mechanisms in the nervous system organising these elementary functions of linkage with the environment so that when one of the double organs is stimulated the head rotates until we face the source of the stimulation. The head is rotated on the cervical spine and the twist elongates all teguments, muscles and tendons on the left side of the neck when we turn to the right and vice-versa. The elongation or stretching of a fibre reduces its cross-section so that a nervous fibre inside is compressed, and this stimulation is used to organize the body so that it is ready to follow the head and face in the direction of the original disturbance in the environment. The twist of the neck is thus undone and the nerve fibres in the muscles of the neck are no longer compressed and the body has no more urge to turn.

Only the cervical and the lumbar vertebrae are capable of rotation round the axis of the spine, rotation in all the others is in comparison negligible. And in both these regions there are nerve fibres reporting rotation of the head to the higher centres which see to it that the body is so organised that it can rotate to reduce the twist and face the same direction as the head.

Most heads show clearly with which parts of the space around them they do rarely make contact. And the carriage of the head is characteristic of the general bearing and manner of acting of each person.

The real advantage of the erect posture is the ease of rotation around the vertical, that is, from right to left, or the other way around, which widens the human horizon. This is naturally also the most frequent movement of the head.

CORRECT ACTION.

Besides the actual configuration of the bones of the skeleton there is the muscular tonus, that is, the degree of contraction. If we examine the lower jaw, we find a curious sort of thing. It should be, by all logic, at the lowest position if the muscles of the jaw are normally to be relaxed and the normal state of the mouth open. This is, however, found only in some deteriorated nervous systems, in idiots

or in certain states of unconsciousness. The lower jaw with all the teeth has an appreciable weight, yet we have some difficulty in becoming aware that we are doing anything at all to hold up the lower jaw. The normal state of the muscles of the lower jaw is a contraction just equal to the gravitational pull on the jaw and the voluntary movement add or subtract from this permanent contraction. The muscles of the lower jaw like most skeletal muscles receive orders in the form of impulses from more than one source. The holding up is assured by antigravity mechanisms in the nervous system and there is no feeling of action, let alone effort, so long as the incitation to the muscles comes from the lower centres.

The same sort of thing obtains in the nape muscles and though the head is quite a heavy thing, in spite of the sensation that it is empty, there is no sensation of effort or action in holding the head. The centre of gravity of the head is obviously in front of the point where it is supported by the column, as the face and the anterior of the skull is obviously heavier than the back of the head, as the skull rests on the two upper cervical vertebrae, approximately between the ears.

Thus, again, there is no sensation of effort in spite of very considerable contraction of the muscles to hold the head up. The whole body is prevented from falling forward by the calf muscles. We sense no effort there either. Just a note on the way how silly is the idea to take the shoulders back. The shoulders are held up and to lower them voluntarily is equivalent to holding the lower jaw open. To draw in the abdomen is just as incorrect as pushing out and the harm it does is probably greater.

To sum up, the erect posture is a biological quality of the human frame and there should be no sensation of doing, holding or effort whatsoever. The actual posture is always the result of what the frame would do thanks to inherent mechanisms and what we have learned to do by adjusting ourselves to our physical and social environment. Much of what we have learned is to the detriment of the system, for it has been learned under the duress of affection or stress of hardship while immediate dependence on the others distorted our real needs. Long standing habitual action feels right; our feeling is, therefore, unreliable before we reeducate our kinaesthetic sense to reality tested norms.

How can it be done? First by realising the benefit ensuing from the improvement so that one can spare the time necessary. But the benefit cannot be imagined until the improvement is sensed, thus one must try simply by curiosity. People whose vitality is at the lowest ebb will not try and God himself cannot help them.

The dynamic conception of erect posture is as follows:

The body should be so organized that it can start any movement, i.e. forward, backward, right, left, down, up, turning right and left, without previous arrangement of the segments of the body, without any sudden change in the rhythm of breathing, without clenching the lower jaw or tensing the tongue, without any perceptible tensing of the muscles of the neck or fixation of the eyes. In this state the head is not fixedly held in space but is free to move gently in all directions without previous notice. If these conditions are maintained during the action, then even lifting of the entire weight is not sensed as an effort. Bend your right index gently and observe the sensation of no effort. Bend gently the wrist, the effort is the same as while bending the finger. Again bend the elbow or gently lift the arm, lower and lift the head, the trunk, the sensation of the effort is the same as lifting the index. But the work done to lift the finger is roughly 100 gr. cm., that of the wrist 1000 gr. cm., that of the trunk 500,000 gr. cm. The sensation of correctly made movements does not increase proportionately to the work done within such wild limits as 1 to 5000 and for that matter even 1 to a million, as the sensation of effort is not a measure of the work done but an indicator of the degree and quality of organisation producing the effort. This is in correspondence with the structure of the body. The size and strength of the muscles— the number of their fibres, the size of their cross-sections—go increasing from the finger (the periphery) to the centre of the body; the rate of effort is therefore equal in all the members at work. To lift or lower the trunk, the muscles of the pelvis such as the buttocks (gluteals) the thigh muscles with their enormous cross-section, as compared with those moving the fingers, come into play.

Examples *ad absurdum:*

One trying to push a house makes an enormous effort but does no work: so long as the house has not moved the work done is nil in spite of the utmost effort. On the other hand, by pushing a loaded

railway truck or a car down a slight slope one does perform work that can be measured while the effort sensed may be considerably smaller from the one sensed while pushing the house and there is no doubt that the sensation is incomparably more agreeable or even pleasurable.

Thus the sensation of no-effort in action is present not at no-work but at correctly co-ordinated work.

1) The trajectory of each bone of the skeleton when the latter moves from one position to another—such as from lying to sitting or from sitting to standing—is the same as if the skeleton were pulled up by the hand or the extended arm into one of the final positions mentioned i.e., the shortest trajectory possible.

2) The muscles operate in such a way as to bring about the final position dictated by the trajectories explained.

3) The intensity of mobilization in the ideal act is the same throughout the musculature and the stress in each one is proportional to its cross-section.

4) The three conditions together fulfill the principle of Maupertuis in theoretical mechanics, i.e., the principle of least action.

5) The total work expenditure is a minimum.

6) At each intermediate instant and position the rate of increase of entropy is also a minimum.

These conditions are sufficient to write the differential equations for each bone and muscle and the integration of them for the whole body would yield all the information necessary for each articulation to produce the correct movement.

It is perhaps worth mentioning that a movement satisfying all the above mentioned conditions satisfies also the Reversibility principle, i.e., all along the trajectory, at each point, the centre of gravity of the body and that of each particular bone can be subject to a virtual movement (as understood in theoretical mechanics). As the work done of a virtual movement is nil it is possible at every point and moment to continue the movement, to reverse its direction, or start a new movement without energy consumption.

CONCLUSIONS.

There is still a vast field left unexplored in the realm of body and mind. But a useful start has been made that provides means to make considerable changes in behaviour. There can be no improvement without change.

The most important rule to observe in practice is to attend to manipulation and orientation in their widest meaning all the time.

Though we can already provide help when things go wrong, we cannot relax our efforts before teachers throughout the world will learn in their curriculum how to develop awareness of the unity of body and mind so that higher achievements than correcting faults can be arrived at.