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## Biofeedback

It is a well known fact in biology that all living organisms owe their existence and survival to feedback controls which are an inherent regulatory mechanism. It was defined by the mathematician Norbert Wiener who said that feedback is 'a method of controlling a system by reinserting into it the results of its past performance'. For example, what is known as 'trial and error learning' amongst psychologists simply consists of the relaying back to the organism the mistakes and successes of previous trials in a particular task. If we are playing a game of skill, for example, such as darts, then it is true to say that we learn and improve our performance by observing the hits and misses of the darts on the board.

The term 'Biofeedback' simply refers to the system whereby we are able to monitor information supplied from a particular part of the body and relay it back to the organism usually via the visual or auditory senses. We can therefore tune into our bodily functions and thus learn to acquire control over them. So far research has not been able to tell us the process by which we can gain this control - we simply know that it does happen. So, if for example, we are able to listen to the waves of the brain or the beat of the heart it seems that we can begin to modify those waves if we are sufficiently motivated.

During the past ten years or so, we have heard a great deal about the amazing feats of Eastern Yogis, who after years of intensive meditation have learnt to acquire extraordinary control over various physiological functions which western doctors would have thought impossible. We have all heard of cases where Yogis have been buried underground for hours at a time and have survived by reducing their rates of breathing and heartbeat to such an extent that they have been able to endure otherwise impossible physical conditions. At the May lectures which were held last spring in London, Dr. Elmer Green, one of the pioneers of Biofeedback research in the United States, reported some work which he had seen done in India. In this case he described how a Swami had been able to stop his heart for a considerable period of time by willing it to do so, and in another case he reported the anaesthetisation of the skin by a Yogi while sitting on a bed of nails. No pain was felt and there was no blood drawn. We saw a film of a Dutchman who was able to drive a knitting needle through his biceps having wiped it on the sole of his shoe to 'sterilise' it. No blood was drawn again. While I attended the Conference of the World Academic Society for Acupuncture in Philadelphia last autumn I witnessed a man from Korea who performed the same feat, this time driving a needle through his forearm and then tying rope round it and pulling along a stationary car while so encumbered. The reason that I mention such cases is not that they serve any useful purpose in themselves, since it is obviously not helpful to teach our patients feats of this kind, but simply to show how many years of training can bring involuntary responses under control. In biofeedback we are able to produce this kind of control over autonomic functions. In our western culture we are generally not prepared to spend the time required to do this kind of thing, and so the gadgetry of instrumentation provides a shortcut to bring about the inner awareness of our autonomic bodily functions. Unconscious physical functions give off small amounts of energy which can be measured by the machines. Changes in

hand temperature will cause more or less heat to be given off from the skin. Increases in muscle tension accelerate electrical activity on the surface of the skin. A stethoscope can monitor the beat of the heart and this can be transformed on a biofeedback machine into a flashing light or a clicking or some other kind of noise so that the subject can see what is happening inside himself. In some cases people have been wired up so that they can watch several of these functions at a time and see their 'body rhythms'. When this happens they can begin to gain control of them and change the pattern if they wish to do so.

One of the most important aspects of biofeedback training for those involved in psychotherapy and natural therapeutics is that it puts the cure back in the hands of the patient. A statement made recently by a couple of eminent writers, Gay Luce and Erik Peper, reads: 'Biofeedback promises to return us to a more holistic kind of medicine in which the patient will acquire more responsibility for, and power over, his own health, no longer finding himself treated as a defective organ, but as a person in a context, with a life style and habits that affect his own body. Biofeedback puts the emphasis back on training, rather than the 'miracle pill' or surgery, and indicates that the mind itself can be trained to do most of the things that mind-changing drugs are used for.' It has been predicted that many cardiovascular and intestinal disturbances may well be brought under control by such training within the next few years, and if this hope is fulfilled it promises a revolution in medicine, which we are well advised to be prepared for and for which we should arm ourselves with as much information as possible. It may well be that a novel approach such as that of biofeedback may help to pave the way for a more general acceptance of natural methods of treating disease, and certainly it is much more compatible with the methods used by members of the Human Potential movement than those used by practitioners of orthodox medicine and psychiatry.

One of the areas in which biofeedback training appears to be most promising is that of psychosomatic medicine. It is now widely accepted that stress and anxiety play an extremely important part in the production of disease and illness, and if we can help patients to learn the art of relaxation in general and to acquire control over certain parts of the musculature in particular then it is possible to reduce the anxiety level and to improve function in a specific part of the body if necessary.

One of the ways which has been used in the United States to monitor tension is by recording the impulses given off by the frontalis muscle in the forehead. To this end, electrodes are attached to the muscle so that minute changes are recorded and transformed through an electromyograph into an auditory signal which rises when the muscle contracts and falls when it relaxes. By listening to tone the patient begins to recognise when he is becoming more tense. He is instructed to try to make the tone fall and after a short time he is in fact able to begin to do so. This type of technique has been used to help phobic patients and those suffering from tension headaches. The relaxation of the frontalis muscle is usually accompanied by a general relaxation of all of the muscles in the head area thus causing the headache to remit. Once the patient has learnt to do this successfully and is relieved of the pain, he no longer needs the machine, since the learning process is incorporated into the general system of the storage of information by the brain, and he is able to produce the result at will.

Another method of training which has proved successful is that of training patients to alter temperature of the skin in the hand. To do this electrodes which are sensitive to temperature are placed on the forehead and the right index finger. These are wired up to a meter which shows the difference between the two readings. The patient is asked to try to move, by 'mental power', the needle of the meter, thus showing that he has increased the warmth of the hand in relation to the head. By learning to keep the hand warm and the head cool, it has been shown that sufferers from migraine were able to either reduce the frequency of attacks or to eliminate them altogether. The reason for this is not clear but it appears that the regulation of blood flow is crucial in the management of this type of headache.

One study recently showed the value of monitoring the rate of respiration in dealing with tension. In this case, the subjects listened to the amplified sound of their rate of breathing. It is known that when we become anxious, tense or emotionally aroused in some way, our breathing tends to become more shallow and tighter. By training in relaxation while under such monitoring conditions the subjects learned to make their breathing smoother and deeper, and psychological tests taken before and after the training showed that the overall level of anxiety had dropped.

Dr. David Shapiro of Harvard Medical School recently carried out a study in which the blood pressure of a subject was recorded and transformed into flashing red lights which he was asked to keep going for as long as possible. When he succeeded in producing 20 flashes of the light the subject was rewarded with the presentation on a screen of a female nude from Playboy magazine. This was naturally a great incentive and the increase in the number of flashes represented a drop in the blood pressure of the subject. (Unfortunately, we are not told what kind of reward should be used for women patients.) However, it has to be pointed out that this kind of training must be supported by a reduction in the general stress in the patient's life, by way of adopting a quieter way of life, for otherwise all of the good effects will be undone.

A study carried out by Weiss and Engel at Baltimore City Hospital showed that it is possible to acquire control over dangerous irregularities of the heartbeat by connecting the patient to a cardiometer which converted the beats into signals indicated by red, green and yellow lights. When the red light was on, the heart was beating too fast and the patient had to slow it down, and when it was too slow the green light would appear and the patient had to speed it up. The ideal rate was shown by the appearance of the yellow light. With this technique the patient learnt to speed up the beat and then to slow it down and finally to keep at it a safe normal speed. This kind of training took many hours to achieve, but it was found that after the patients left hospital they could maintain the control without the use of the machines.

At Tyringham Clinic we have recently been taking small groups of patients with various difficulties in relaxation and general psychosomatic complaints and training them in systematic relaxation utilising biofeedback to facilitate the learning process. The particular method which we use is to connect them up to individual machines which register the galvanic skin response of the hand and convert the electrical resistance into a visual signal which is registered by a needle on a meter which the

patient is able to watch. When we are emotionally aroused in some way, either by fear, panic, anger, self-consciousness, or enthusiasm, the level of the resistance of the skin begins to drop and conversely when we relax the resistance rises. The machine is designed to be adjusted to the particular level of resistance of the individual patient so that deviations in either direction can be seen. The training process begins with a general explanation of the procedure and the reasons for it, so that the maximum amount of co-operation is achieved and then the patients are taken through a relaxation process, similar to the one used by Wolpe, which involves learning to contract and relax different groups of muscles throughout the body so that they become aware of the difference between tension and relaxation. This is accompanied by training in deep but regular breathing to facilitate the relaxation. After this we ask the patients to close their eyes and repeat certain phrases such as 'My toes and feet feel heavy and warm and relaxed', and 'The muscles in my legs feel loose and heavy and still', and so on. This conditioning process is known as autogenic training and was developed by Schultz. The next stage in the training consists of asking the patients to produce calming visual imagery and letting them go off into their own realms of fantasy, if they wish. The emphasis is on helping the patients to acquire the art of relaxation accompanied by pleasant, dreamy and even hypnotic states of mind in which they are aware of their surroundings but not disturbed by them. In most cases there is a marked drop on the meters of the patients, indicating that the skin resistance has risen and that they have succeeded in relaxing in that context. Many patients report a general lowering of tension and anxiety after a few sessions of training along these lines and continue to do so without the equipment.

One of the most exciting developments in biofeedback is in the field of control over brain rhythms. In the late 1920's it was discovered that minute changes in the electrical activity of the brain could be monitored on the surface of the scalp. After much research it was established that the rhythms could be classified into four main groups. These are DELTA, which has a speed ranging from  $\frac{1}{2}$  - 4 cycles per second, THETA ranging from 5 - 9 cps, ALPHA ranging from 9 - 14 cps and BETA ranging from 14 cps upwards. It has also been found that these brain rhythms correlate with certain levels of activity in consciousness. For example the Beta rhythm occurs most frequently when we are concentrating hard, processing information, thinking, feeling, seeing and doing. Alpha waves occur when the eyes are closed, when we are relaxed, dreamy or in a meditative frame of mind. Theta waves occur just before we drop off to sleep, in deep meditation and when we produce what is known as hypnagogic imagery. It is often a very creative state of mind, as is Alpha and has been found to occur more frequently in artistic people and those with a high level of creativity. Delta waves occur only in sleep. In biofeedback training we are mostly concerned with facilitating the production of Alpha waves, since one is detached from the everyday problems of life, in an altered state of awareness which occurs by letting go, by not striving with effort, and by generally calming down the nervous system. Because of this process of letting go, the mind is often able to manifest latent tendencies, and activity can occur which is not normally shown in ordinary mental processes. There has been shown a correlation between Alpha waves and performance in experiments with extrasensory perception, and the development of the Alpha rhythm increases the level of hypnosuggestibility. Training in Alpha improves the level of meditative trance and also shows marked improvement in memory learning and recall.

Work carried out by Dr. Elmer Green has shown that the development of Alpha training on normal subjects gives rise to what can be termed 'integrative learning process'. By this he means that his subjects frequently reported basic and fundamental changes in themselves after the training programme is finished. Many of them said that they felt more confident in themselves, were generally happier with life, were much less anxious, became more aware of their surroundings, their personalities seemed more integrated and less brittle, their emotional lives were more stable, and their relationships with other people were greatly improved. It is not known why this should happen - again we simply know that it does happen.

The technique by which this Alpha training is produced is to connect the electrodes of a special EEG machine to the scalp and the electrical waves are converted into an auditory signal which is at a predetermined level. When the waves exceed a certain level a bleeping sound is made and after relaxing for a few minutes the subject begins to hear more sounds which indicate that more Alpha is being produced. By letting go, the sound increases in frequency and length until one is able to produce the waves easily and at will. This training also persists long after one has ceased to use the instrument. Most machines of this kind enable one to select Theta waves after one has achieved mastery over the Alpha rhythm and so one can achieve even greater depths of meditative trance in a fairly short time.

It is not possible in the scope of such a short survey as this to illustrate all of the ways in which biofeedback can be used. There is a large amount of experimental data accumulated so far, and yet we are still only on the threshold of research in this very exciting field of medicine and physiology. There is an enormous amount still to be done, but without doubt there will be numerous discoveries which will enable us to solve many of the problems which face us with regard to health and disease, as well as to possible other areas of human research such as developing higher states of consciousness and raising the general level of awareness of our own potential as human beings.

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