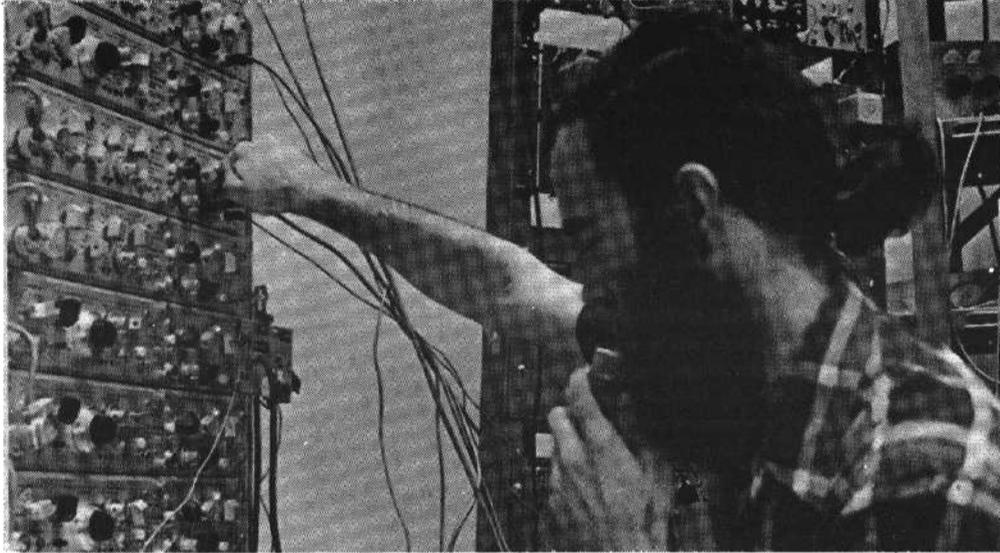


low prices. Patients with irregular EEGs predisposing to epilepsy, who get headaches or backaches from tense muscles, who have irregular heart beats at times, or who have any relevant physiological irregularities which vary with their psychological state might find these devices helpful. It would even seem in the realm of possibility to build small, inexpensive devices for feedback concerning stomach acidity, of potential use to patients with ulcers. Or feedback devices could be developed to allow a patient to listen to his intestinal functioning, to aid in proper digestive actions. Miller (1969) has shown that control over intestinal and digestive functioning can be developed very rapidly in animals.

A number of alternatives exist as to the type of feedback that would be given in these portable devices. In one potential type, most useful as a portable constant monitor, a physiological process would be monitored and the patient would receive a signal only if the process should cross a criterion indicating it was



moving in an unfavorable direction (blood pressure too high, stomach acidity too high, heart becoming irregular, etc.). In another approach, most useful as a portable means for learning or regaining control, the feedback would be more analogous to the full process. Tiny variations in the physiological parameter would be brought to the attention of the patient and the patient could then engage in mental activities which would help to bring out desirable functioning.

In the area of psychiatry and clinical psychology such devices could also possibly be used with patients who had no specific somatic complaints. Because it is now possible to simultaneously monitor overt behavior, covert moods, and physiological processes in the natural setting (Nowlis & Cohen, 1968) procedures could be developed whereby both patient and therapist could develop more understanding of the covert moods and physiological patterns of behavior accompanying exposure to various aspects of the patients' environment. Then the patient could choose internal events which he would like to have occur more regularly, or more voluntarily, in his daily life and could begin a program of training, first at some training facility, then attempting to produce the pattern in the desired situation in his natural setting. Such procedures could increase the number of patients that a therapist could see, decrease the cost of psychotherapy, and decrease the problems associated with therapists' perceiving and dealing with patients from a single value system. In this type of therapy program, patients would have an unusual degree of freedom to choose their own goals, experiment with implementing and modifying the goals as they progressed in therapy, and test the results of the therapy in a very direct way against their actual life situation.

Another psychotherapeutic use of feedback technology could be in sensitivity training. Two people could use the feedback devices mutually in a number of meaningful ways. For example, one person could learn to help a naive person to reach certain physiological states. The naive person would receive no feedback, but the other person would behave in various ways to attempt to deliberately bring about various states in the first person. Or two people could observe the effect of various kinds of behavior on each other. Or, again, two people could together attempt to control a feedback loop designed to cue them only when both were in the same desired physiological state.

Furthermore, whole groups can learn to control certain feedback devices together. For example, the portable device previously mentioned designed by Buryl Payne, now available commercially to be used in giving visual and auditory feedback as to GSR, can easily be used by a large group holding hands, with two people in the group each holding one electrode instead of each other's hand. Groups could then attempt to together learn to increase and decrease their GSR, either alone or while being exposed to various stimuli. This kind of learning situation might be quite useful to certain groups. For example, any group of people who have to work together under conditions of high stress might want to learn to keep their GSR low, first alone, and then while exposed to stress provoking messages. Presumably, each individual would be learning not only to keep his own responses low, but would also be learning ways to help his fellow team members stay relaxed.

More basic research needs to be done on understanding physiological relaxation. Most of the physiological processes which have been successfully conditioned in our various laboratories are apparently influenceable by relaxation; that is, subjects learning to generate more alpha rhythm in their electroencephalogram, or lower muscle tension in their electromyogram, or lower heart rate, or warmer skin temperature, or larger vasodilation, or lower galvanic skin responsivity all tend to say that there is an element of relaxation involved in moving the process in that direction. Interestingly, our early findings also tend to agree that a subject who, through relaxation, has learned to influence one of these processes is not necessarily making any change in the other processes apparently influenceable by relaxation — for which the subject has not been given feedback. In fact, the processes appear to be remarkably independent in spite of the similar reports of relaxation. However, because relaxation is clearly involved in some way in the learning of each, one wonders if feedback training could in any way be used as a substitute for relaxant and tranquilizing drugs with patients suffering from anxiety symptoms, especially if the patients were trained to relax by multiple physiological criteria.

#### Entertainment and Aesthetics

There are at least two, rather different, applications of feedback technique to entertainment, one of the Kahn procedure, the other of the Kamiya-Brown procedure. Both applications however are based on the same general strategy, namely that the feedback signal itself need not be just a tone or a light, but can be slides of paintings of fine art, a motion picture, recorded music, or any of a large number of aesthetically pleasing stimulations (*e.g. a video synthesizer — ed.*).

It has been called to our attention that there are now multi-media environment systems available, where as many as 12 film or slide projectors are controlled simultaneously and as many as 5 tracks of sounds. It could be both entertaining and instructive to have such a presentation controlled by a number of on-going physiological processes in a single individual, entertaining because of the person's sense of being intimately linked with the presentation, and instructive because

*Not surprisingly, you can now own your own brain wave feedback device for just a fraction of the cost of a portapak. Phenomenological Systems, Incorporated, 72 Otis Street, San Francisco, California 94103, will sell you a 4" x 2" x 1" unit for \$190.00, including one free computer analysis of a cassette tape made by plugging into the output jack of your unit. PSI has sold 1000 units this year and are well into their third generation of equipment design, fortunately with no compatibility problem. From 4 or 5 information requests per day a year ago, they get thirty to forty today. In a few years, the devices will be produced like transistor radios, for \$5 to \$10 each.*

*Like every technology, biofeedback devices have their Big Brother potential, which make surveillance cameras on the streets look benign. As physiological processes become increasingly linked to computers, someone may decide to make the communication two-way. Remember that the government has always been one of the foremost experimenters in the field of responsive environments, with propaganda, censorship, and surveillance the basic modes applied to each new technology, from time-honored newspaper censorship to modern day wiretapping. Imagine a few giant transmitters sending out patriotic vibes at the appropriate frequency, and before you can salute, the dime stores run out of flags.*

*But it's really nothing new. In the same way that so many of us have pushed aside the bullshit of broadcast television, we'll deal with what comes. Free universities will offer courses on cortical jamming techniques and Radical Software will be a hologram of How to Build an Alternate Brain Wave Network.*

-S.S.

in the past one of the most difficult aspects of psychophysiology to grasp has been the simultaneous intervariability of many physiological parameters.

Another potentially entertaining and instructive situation would be to have two or three people control with their physiological processes various aspects of the multi-media presentation. The people at first would just enjoy watching and hearing the patterns they were producing, and then could begin to test the effects of various kinds of interaction with each other on the blendings and discordances of the displays.

#### Education

One of us, like his subjects, has learned to control to at least some extent his EEG, EMG, vasodilation, GSR, heart rate, and skin temperature. The most fascinating and pleasurable experience for this experimenter was in the brief time he spent working on the skin temperature of his hands. Within ten minutes the person could warm or cool his hands, deliberately altering the direction on command when another of us signalled with a click from a nearby instrument room, the click signaling "go in the opposite direction". The experimenter could alternately cool and warm his hands even when the clicks came as rapidly as one a second. The process involved was one the experimenter had lived with all his life but had never had any insight into or voluntary control over until the ten minute feedback practice period. It was almost like discovering a new frontier, still needing to be charted and explored although close to us for millennia.

Some feel that oriental meditators are among the very few people who have developed sophisticated perceptual skills for internal processes. Such considerations might be useful in explaining why one aspect of the feedback training technique has been of particular fascination to many lay people (*e.g. Luce and Segal, 1966*) and professionals alike. This aspect is the potential application of feedback training to the western practice of eastern meditation. A number of independent studies done in India and Japan (*e.g. Anand, 1961; Kasamatsu and Hirai, 1962*) agree that there are physiological patterns which are strongly related to deep meditation, particularly in the EEG and EMG. The alpha rhythm is markedly increased in both yogic and zen meditation and is generated over areas of the cortex normally not involved in alpha production. Meanwhile, the EMG tends to fall to very low levels.

*continued* →