Agriculture and to the preparatory work and organization done by Mr. D. K. McE. Kevan and his small staff. The entire proceedings of the Easter school, including the techniques demonstrated and the discussions of papers, will be published shortly (by Butterworth's Scientific Publications), edited by Mr. Kevan.

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A CONDITIONING LABORATORY FOR THE INVESTIGATION OF PERSONALITY AND CORTICAL FUNCTIONING

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A SOUND-PROOF conditioning laboratory has been established at the University of London Institute of Psychiatry (at the Maudsley Hospital, London, S.E.5) in the Department of Psychology. At present the laboratory is equipped for eye-blink conditioning (the unconditioned stimulus being an air puff and the conditioned stimulus a tone), psychogalvanic reflex (P.G.R.) conditioning and cardiac conditioning. The subject is seated at a small booth with his head resting against a padded head-rest and his feet on a foot-rest, so that his field of vision is largely confined to the walls of this booth. All stimuli are rigidly standardized, being delivered and recorded electromechanically; the relative durations and times of onset of the stimuli are controlled by electronic timers. Thus the total experimental conditions are accurately standardized and capable of precise duplication by workers in other laboratories.

A novel feature of the conditioning apparatus is the method of recording the eye-blink movements. Hitherto, various mechanical or electromechanical methods have been used, both in Great Britain and elsewhere. Almost all these methods involve attaching an artificial eyelash to the eyelid or placing electrodes on or near the eyelid. Such methods are inconvenient for the subject and especially unsuitable for psychiatric patients. The present method requires no direct contact with the eye or eyelid. It is based on photoelectric principles and is to be described in detail elsewhere. A small photoelectric cell, sensitive in the visible region of the spectrum, is mounted on one lens of a pair of plain-glass spectacles. As the eyelid blinks, so the amount of light reflected on the cell cathode changes. The varying e.m.f. generated in the photo-cell is then fed into a linear amplifier and used to drive the recording pen of a recording milliammeter.

The major experiment carried out at the laboratory has been a follow-up and elaboration of an observation originally made by Pavlov. Before discussing this observation, it is first necessary to review briefly the main tenets of Pavlov's theory of cortical functioning. Pavlov's theory[1] emphasizes two basic processes, namely, 'excitation' and 'inhibition'. The excitatory process is said to be produced during the formation of a positive conditioned reflex. As evidence for a state of excitation being present in the cortex, Pavlov cites the fact that a stimulus which was not originally used as a conditioned stimulus may be able in certain instances to elicit the conditioned response. This is supposed to be because the excitatory process, originating largely in the sensory areas of the cortex which received the impulses from the conditioned stimulus source, irradiates the adjacent areas. A similar argument, based on experimental findings, is used by Pavlov to explain the formation and irradiation of the inhibitory process. It is necessary to stress here that the inhibitory process, as conceived by Pavlov, is a positive process and not merely the absence of excitation. As to the physiological nature of this process, Pavlov admits his ignorance. The term 'inhibition' is perhaps an unfortunate one, since it is used by contemporary psychologists and physiologists in at least three different senses. There is the psychiatric usage of the word, as generally applied to the withdrawn, introverted individual; there is the neurological usage of the word; and there is the present Pavlovian usage.

Pavlov experimented solely with animals. He noticed that a certain kind of dog (which he called the excitatory kind) appeared to be more excitable than other dogs; such dogs developed stable positive conditioned reflexes with ease and retained them readily. Another kind of dog (which he called the inhibitory kind) was, on the other hand, timid, cowed and cautious. These dogs developed positive conditioned responses poorly and they were easily disrupted. After further consideration and experiment with these two kinds of animals, Pavlov concluded that the excitatory type of dog which formed conditioned reflexes readily possessed a predominance of cortical excitation, and that the inhibitory type of dog which formed conditioned reflexes poorly possessed a predominance of cortical inhibition. In his later years Pavlov[2] studied—but never investigated experimentally—psychiatric patients. In particular, he made an observation concerning two kinds of neurotics, the neurasthenic and the hysteric. He concluded that the neurasthenic possessed an exaggeration of the excitatory process and the hysteric an exaggeration of the inhibitory process. Unfortunately, he never followed this observation up, and it has been largely neglected by psychologists and psychiatrists ever since.

It is possible, however, to predict that the neurasthenic patient should condition readily and that the hysteric should condition poorly. The concept of neurasthenia, as used by Pavlov, would seem to be included in the present-day concept of 'dysthymia', as developed by Eysenck[3], which comprises the anxiety states, the obsessive compulsives and the reactive depressions. As well as being neurotic, all dysthymics have in common a marked predisposition towards introversion. Similarly the hysterics—and psychopaths—as well as being neurotic have a marked tendency towards extraversion. Implicit in this classification is the mutual orthogonality of the two dimensions of neuroticism and introversion–extraversion. Using eyelid and psychogalvanic reflex conditioning, it has been experimentally demonstrated in this laboratory that, as demanded by the theory, the dysthymic patients condition readily and the hysteric and psychopathic patients condition poorly.

Spence[4] and his co-workers have demonstrated that anxious subjects are superior to non-anxious in the development of conditioned eye-blink responses. Similar results were obtained by Welch and Kubis[5], using psychogalvanic reflex conditioning. This may

be because they are more neurotic than non-anxious subjects, or it may be because they are more introverted. If the former were true, then all neurotic subjects would condition better than normal ones; if the latter were true, then dysthymic neurotics would condition readily and hysteric and psychopathic neurotics would condition poorly. Thus the present experiment is a crucial one. It would seem that conditionability is related to introversion–extraversion (which in its turn is related to cortical excitation–inhibition) and not to neuroticism. Support for this conclusion is given by the fact that introverted normal subjects condition better than extraverted normal subjects. If conditioning is related to cortical excitation, then drugs such as caffeine should increase conditionability, and drugs such as sodium amytal should decrease conditionability. The tentative conclusions from a small pilot study carried out in this laboratory upon sixteen subjects, using intravenous sodium amytal, would suggest that, as predicted, one effect of this drug is to reduce the conditionability of the subjects.

In this preliminary study of sodium amytal and conditioning, the effects of practice and of varying the size of the amytal dose were also considered. An additional variable incorporated into the experimental design was the effect of using a placebo injection. All these variables were related to changes in personality as measured by questionnaire scales such as the Maudsley Medical Questionnaire (neuroticism) and Guilford's *STDCR* scales (introversion–extraversion and neuroticism). Another interesting finding is that this drug apparently has an effect upon the retention of, or ability to form, conditioned eye-blink reflexes as manifest in the re-test situation. In a future study it is hoped to confirm and relate this finding to certain aspects of learning by rote carried out under comparable experimental conditions.

Pavlov demonstrated that certain cortical operations in his dogs resulted in an increase in inhibition and a consequent decrease in conditionability. This would suggest that certain types of brain damage in human subjects, or certain brain operations, such as prefrontal leucotomy, would also result in a decrease in ease of conditionability.

Perhaps it is of interest to mention here that Mrs. A. Petrie, of the Institute of Psychiatry, has carried out an investigation into the effect on personality of a variety of brain operations[6]. Her published results to date have shown that the personality measurements associated with the dysthymic type change consistently in the direction of extraversion after excisions in the frontal lobe but not after excisions in the cingulate and certain other areas. Included in one of her current projects—carried out in association with Mr. R. A. Willett at this Institute—is an investigation into changes in eye-blink conditionability following on these brain operations.

The programme of the conditioning laboratory includes further experiments with drugs which act as cortical excitants or depressants, and with drugs which increase or decrease sympathetic nervous activity. It is hoped to relate the changes in personality and in conditioned response behaviour caused by these drugs to simultaneous changes in the subjects' electro-encephalograms. It is also hoped to condition reflexes other than those already mentioned. If sufficient reflexes are investigated, covering both central and autonomic nervous systems (each subject would be conditioned upon each reflex separately), then it should be possible to establish the existence or otherwise of a general factor of conditionability in man.

[1] Pavlov, I. P., "Conditioned Reflexes" (trans. by G. V. Anrep) (London: Oxf. Univ. Press, 1927).

[2] Pavlov, I. P., "Lectures on Conditioned Reflexes", 1, "The Higher Nervous Activity (Behaviour) of Animals" (trans. by W. H. Gantt) (London: Laurence and Wishart, 1927); 2, "Conditioned Reflexes and Psychiatry" (trans. by W. H. Gantt) (New York: International Publishers, 1941).

[3] Eysenck, H. J., "The Scientific Study of Personality" (London: Routledge and Kegan Paul, 1952); "The Structure of Human Personality" (London: Methuen, 1953).

[4] Spence, K. W., and Taylor, J., *J. Exp. Psychol.*, **42**, 183 (1951). Spence, K. W., and Farber, I. E., *J. Exp. Psychol.*, **45**, 116 (1953).

[5] Welch, L., and Kubis, J., *J. Psychol.*, **23**, 83 (1947); *J. Nerv. Ment. Dis.*, **105**, 372 (1947).

[6] Petrie, A., "Personality and the Frontal Lobes" (London: Routledge and Kegan Paul, 1952).

THE WATER SUPPLY OF LONDON

THE easy way of providing a bacteriologically pure domestic water supply is to own or control a gathering ground in a remote and uninhabited district—say, in central Wales—to prohibit farming on it and the access of the public to it, and after storage, to treat this water by filtration and chlorination before it is distributed. The extension of farming during the Second World War and, since then, the increasing numbers of people who want to walk, cycle or motor in the less-inhabited parts of Great Britain have made it difficult to adhere to this policy in its extreme form; the Central Advisory Water Committee of the Ministry of Health recognized this in a report published a few years ago, and recommended that, though the public should not have general access to the banks of storage reservoirs, they should be allowed access to the remainder of a gathering ground*.

Even with this relaxation, however, the water undertaker with a catchment area in a remote district is still in a much more fortunate position than the water authority of London—the Metropolitan Water Board—which supplies about one-sixth of the population of Britain. Its raw water is drawn mainly from the Thames and the Lee—rivers, alkaline in reaction, flowing through lowland farming country, and polluted by sewage effluents and industrial discharges—bacteriologically unsafe, therefore, at the source, and an excellent medium for the growth of algæ. From this raw material the Board produces a treated water acknowledged to be of the highest quality. How this is done is explained in the informative and detailed reports of the Board's Director of Water Examination, of which the thirty-fifth has recently been issued†.

Partly, of course, it is done by providing first-class treatment plant and by carrying on continuous research to improve the design and operation of it. But, in addition, the Director of Water Examination has on his staff teams of bacteriologists, biologists and chemists who keep an almost continuous watch on the quality of the water, from the river to the consumer's tap. The amount of work involved in this is prodigious; during 1952, for example, more than forty-five thousand samples of water were examined bacteriologically.

* Central Advisory Water Committee: Report of Gathering Grounds Sub-Committee. (London: H.M.S.O., 1948.)

† Metropolitan Water Board: Report on the Results of the Bacteriological, Chemical and Biological Examination of the London Waters for the Years 1947–1952. (Thirty-fifth Report.) Pp. 116 + 2 plates. (London: Staples Press, Ltd., 1955.) 15*s*. 6*d*.