SUBJECTIVE VARIABLES IN ELECTRO-PHYSIOLOGICAL RECORDING

by

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I. INTRODUCTION

“Electrophysiology” is a field of human endeavour in which the physical scientist and the medical scientist meet. The former brings to the latter the results of his own expertise for the purpose of diagnosis and therapy, and their common ground is the clinical context of their joint operations. The history of science has amply supported the contention that the source of the greatest fallacies and most frequent errors lies in the borderlands between two disciplines irrespective of their nature. The field of electrophysiology is unlikely to be an exception, particularly as the medical half of the partnership, despite adherence to Cartesian methods of scientific investigation must, on ethical grounds, inevitably subordinate procedures to the needs of the patient. Healing is still an Art, however much the physician may hide behind a statistical façade, and it may be argued subjective needs must always take precedence over objective methods. The purpose of this paper is to examine some of the assumptions which form the basis of many electronic applications in medicine.

The chief characteristic of a science, as Lord Rutherford observed, is the process of measurement, and it is precisely in this fundamental that the physical and the biological sciences part company. The physicist measuring the length of a prism is faced with a completely different set of problems to that of the biologist measuring the length of a caterpillar. To the former, at least while he works at a macroscopic level, the limitations imposed upon the accuracy of his measurement lie in the measuring instrument itself. To the latter the limitations lie predominantly in the object to be measured, and biological specimens, unlike the inert substances of the physicist, cannot be easily reduced to any arbitrary conditions. Electrophysiology therefore unites not only two different sciences but two ways of thinking which are not always recognised as being at times both divergent and discrete.
II. BASIC ASSUMPTIONS

Much of the measuring apparatus with which the medical scientist is concerned has been designed to function in a stimulus-response situation. The instrument may provide a stimulus only, as in a pulse myostimulator: it may measure a response only, as in electroencephalography; or it may provide both the stimulus and the response, as in a chronotron reaction timer. Irrespective of the precise purpose of the instrument, however, it is the overall stimulus-response situation which determines both instrumentation and methodology. This is particularly true in electro-physiology. Implicit in much of the published work on this subject is the assumption of stimulus consistency, that is, it is frequently assumed that provided the physical variables of the stimulus are constant, then the perception of the stimulus by the organism is also constant. Since no two individuals, not even monozygotic twins, have so far produced identical responses, a range of values is obtained and is known as the interindividual variation of that measure. More importantly, if the process of measurement is replicated on a single individual, a further range of values is obtained, producing an intra-individual variation which lowers the predictive efficiency of the experimental design to a considerable extent. Two further assumptions are then generally made that the standard errors of these two groups of measurements are irreducible and are not a function of the measuring situation. Such assumptions are not only unwarranted, but are the very antithesis of a scientific attitude, since by accepting such propositions the investigator immediately denies the necessity for further investigation of this phenomenon and so prevents any positive action aimed at reducing measurement variation and increasing predictive efficiency.

If the variations in measurement are examined in a comprehensive way which takes into account every aspect of the measuring situation, it will be seen that certain features of measurement variation bear a direct and positive relationship to the subjective perception of the situation. Subjective experiences mediate responses to stimuli in a way which can be investigated and to some extent predicted, but to do so it is first necessary to discard the 'black box' way of thinking, a legacy adopted by some electrophysiologists from the Behaviourist Theories of thirty years ago. To these and many others the patient is merely a passive object to which leads are attached, and the resulting records, be they encephalographs, cardiographs, myographs or any other measure, are innocently termed the resting level. This is the fourth assumption which will be examined here, and at this point it may be useful to recapitulate as statements these assumptions implicit in much published work, making clear, however, in fairness to the investigators concerned, that this does not