The aim of this paper is to review the topographic analysis of the electroencephalogram (EEG). In the space available this can only be done briefly and reference will be made to the work of several investigators using this method to illustrate both techniques and applications. Only the analysis of ongoing, so-called "background", activity in man will be considered. For a more extensive account see Rémond (1960) and Petsche and Shaw (1972).

Electroencephalography has been likened to the problem of detecting what is being manufactured inside a factory building having no windows by listening to the sounds detected by a stethoscope placed on the outside wall. This apparently impossible task has caused the subject to be somewhat undervalued, if not overtly ridiculed, in some academic circles. The fact is that the EEG is of proven use as a diagnostic aid and indeed in some instances it may be vital. That it is of considerable value in studying the relationship between CNS activity and behaviour is evident from the wealth of information concerning normal and abnormal sleep patterns. It is true that in a large proportion of cases investigated by the EEG, the test has little influence on the case management but in judging the significance of this, one must not forget that lack of specificity and poor reliability is a common feature of very many medical diagnostic procedures (Cochrane, 1972).

The weight of evidence supports the hypothesis that the EEG is generated within the cerebral cortex, albeit under the influence of deeper structures in the brain. Its use for the study of the brain for diagnostic purposes is made difficult by the electrically diffusing nature of the tissues intervening between brain and recording electrodes, by the complex structure of EEG signals, and by the complex structure of the brain itself. Because of these limitations, the development of electroencephalography must be almost entirely empirical and must therefore rely on objective description of EEG signals. One way of doing this is to use well established methods for numerically describing signals, whilst taking into account the fact that EEG signals have random variable properties (Fenwick, 1972). It is being increasingly recognised, however, that what is required is objective information about the spatial distribution of these signals over the surface of the head. This spatial distribution is referred to as EEG topography, a term which is disliked or regarded as incorrect by some, but which has received official approval (Storm van Leeuwen et al., 1967). It is also used to describe the spatial distribution of EEG signals within the brain.
There are three main reasons for looking at the EEG from a topographic standpoint. Firstly, the clinical usefulness of the EEG depends on the recognition of particular patterns which have diagnostic significance and the detection of focal EEG phenomena in the hope that they reflect focal pathology. This detection of foci is made difficult because focal signs in the EEG are often masked by generalised EEG activity and because the model on which visual recognition of foci is based - the dipole model - only applies to a small proportion of practical cases. One application of topography then is to look for other localising features and other ways of detecting them.

Secondly, further advances in electroencephalography must come from a greater understanding of the relationship between the scalp electrical activity and function in the brain. Although this may depend largely on animal studies (Petsche, Rappelsberger and Trappe, 1970; De Mott, 1970), much can be learned from psycho-physiological experiments in man. Primary function in the cortex is spatially organized, so that it is reasonable to examine the association between the EEG and cortical function by topographic methods. A suitable model for such a study is that in cortical regions not involved in processing primary information, activity at the neuronal level comes under the influence of some synchronising mechanism resulting in detectable EEG waves in that region. Areas which are functionally active lose this synchronicity, with consequent reduction in EEG activity (Gastant et al., 1957; Cooper and Mundy-Castle, 1960). The largest proportion of cortex involved in the primary functions is used for vision. This may explain, on the basis of this model, why visual function appears to have such a large effect on the EEG.

The third aspect of electroencephalography where topographic methods are of value is the study of the relationship between the intra-cerebral electrical activity and scalp recording, or that between intra-cerebral activity recorded from different sites. The opportunity for such studies in man is rare, but it does occasionally occur (Cooper et al., 1965; Brazier, 1966, 1972).

It is convenient to classify methods for topographic analysis of the EEG as shown in figure 1. In the remainder of this paper, some examples of the four main members of this classification will be considered, with more emphasis on the first two of these. These are numbered in the figure.

The simplest way of looking at the EEG from the topographic point of view is to apply existing single channel analysis methods to each channel of a multichannel record, and to compare the results across channels. The latter step is done either by analysing the results statistically, or by displaying them in a two dimensional map in relative positions corresponding to their spatial derivation. This is called "within channel analysis" in figure 1.

This is an important method for relating the EEG to cortical function on the basis of the "synchronisation at rest" model described earlier. An example of this is the work in which the