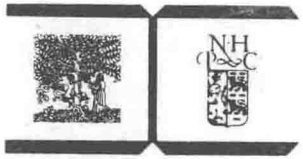
EEG Primer

EEG Primer

R. SPEHLMANN

Professor of Neurology
Northwestern University Medical School
Director of EEG Laboratories
VA Lakeside Medical Center, Chicago
and Evanston Hospital, Evanston, Illinois, U.S.A.



1981
ELSEVIER/NORTH-HOLLAND BIOMEDICAL PRESS — AMSTERDAM • NEW YORK • OXFORD

ISBN – hardbound: 0-444-80260-6
– paperback: 0-444-80299-1

Published by:
Elsevier/North-Holland Biomedical Press
335 Jan van Galenstraat, P.O. Box 211
Amsterdam, The Netherlands

Sole distributors for the U.S.A. and Canada:
Elsevier North-Holland Inc.,
52 Vanderbilt Avenue
New York, N.Y. 10017

Library of Congress Cataloging in Publication Data

Main entry under title:

EEG primer.

Includes bibliographies and index.
1. Electroencephalography. I. Spehlmann, Rainer, 1931- [DNLM: 1. Electroencephalography. WL 150 E104]
RC386.6.E43E15 616.8'047547 80-26037
ISBN 0-444-80260-6 (Elsevier North-Holland)

PRINTED IN THE NETHERLANDS

Preface

This book is written mainly for beginners in EEG. It may help several groups: Resident physicians who are in neurology training and need to learn EEG interpretation as part of this training; residents in other fields, interns and medical students who have become interested in EEG; neuroscientists who wish to understand the methods and clinical applications of EEG; EEG technicians who want to gain more insight into the test they perform; and anyone who wants to find out how clinical EEG is done and what it can do. On the other hand, even persons with some experience in EEG may find the book useful because it leads to fairly advanced levels. To make learning easier for the beginner, several methods have been adopted:

(1) Explanations start with simple concepts and build up in steps following an order which generally corresponds with the steps of recording and reading an EEG.

(2) The reader can choose the depth at which he wishes to master a topic. Each chapter is preceded by a summary. Reading all summaries takes from one to two hours and gives a rough overview of clinical EEG. Each part of the summary refers to numbered sections of the text of the text which expand on the summarized material. Each section presents the most important material at the start and then gives the details, allowing the reader to go as far as desired.

(3) The book adopts widely accepted standards wherever they are available. The text is written in the terminology recommended by the International Federation of Societies for EEG and Clinical Neurophysiology. It incorporates the guidelines of the American EEG Society for proper EEG recording. The sections on epileptiform patterns conform with the international classification of epileptic seizures recently endorsed by federations of several societies.

(4) The clinical correlation of the EEG reverses the conventional order of listing diseases and describing the attendant EEG abnormalities. In this text, abnormal EEG patterns are described first and then correlated with clinical abnormalities. This method is chosen because it corresponds with the situation of the EEG reader who faces an EEG pattern and searches for its clinical correlates. Although this approach leads to repetition of some diseases under the heading of several EEG patterns, it causes much less repetition than the conventional method which repeats a few EEG abnormalities under the headings of many different diseases. The various EEG manifestations of a disease can be found through cross-references in the text and through the index.

(5) The main goal of this text is a didactic presentation of clinical EEG and its role in the diagnosis of cerebral disorders. Therfore, I have favored the established over the controversial and preferred modern insights to historical details. References for suggested reading are listed at the end of each chapter. They emphasize the more recent publications through which the reader may find the older ones.

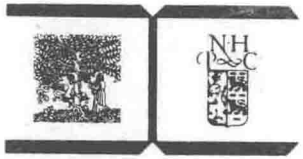
It is a pleasure to acknowledge the many sources of help I have had in writing this book. I thank the residents, students and technicans who I taught EEG reading; they asked many of the questions which I tried to answer in this text. Dr. Donald W. Klass reviewed the manuscript and gave me his critical advice. Special thanks are due to Dr. Karyl Norcross who thoroughly revised several drafts of the text. Mr. Clifford C. Smathers helped me to design the technical illustrations. Mrs. Thelma Howell typed the manuscript without ever tiring.

Contents

EEG Primer

R. SPEHLMANN

Professor of Neurology
Northwestern University Medical School
Director of EEG Laboratories
VA Lakeside Medical Center, Chicago
and Evanston Hospital, Evanston, Illinois, U.S.A.



1981
ELSEVIER/NORTH-HOLLAND BIOMEDICAL PRESS — AMSTERDAM • NEW YORK • OXFORD

Part A
Technical background

Introduction

The steps involved in recording an EEG are illustrated in Figure 0.1 and described in Chapters 1 to 7 comprising Part A of this text.

(1) *The Source* of the EEG are electrical potentials generated by nerve cells in the cerebral cortex in response to various kinds of input, including that from pacemakers of rhythmical activity in the depth of the brain. These fluctuating potentials summate and penetrate to the scalp where they can be recorded as the scalp EEG.

(2) *Recording electrodes* usually consist of small metal cups or discs which are attached to the scalp so that they make good mechanical and electrical contact. They cover the surface of the head at regular intervals.

(3) *The EEG machine* receives electrical input from the scalp electrodes which are connected to an input board. The cable of the input board terminates at the input selector switches which are used to select a pair of electrodes, or a calibration voltage, as the input of each recording channel. The input is connected to differential amplifiers which increase the size of the electrical potential differences between the two electrodes and reject interference simultaneously affecting both electrodes. High and low frequency filters are used to reduce the size of very slow and very fast potential changes and to emphasize clinically important electrical activity in the medium frequency range. A 60 Hz filter can eliminate the most common electrical interference in EEG recordings, namely that from power lines, if it cannot be eliminated by other means. The amplified electrical potentials are used to drive an ink pen, or other writing devices, up and down on chart paper which is pulled along at a constant speed.

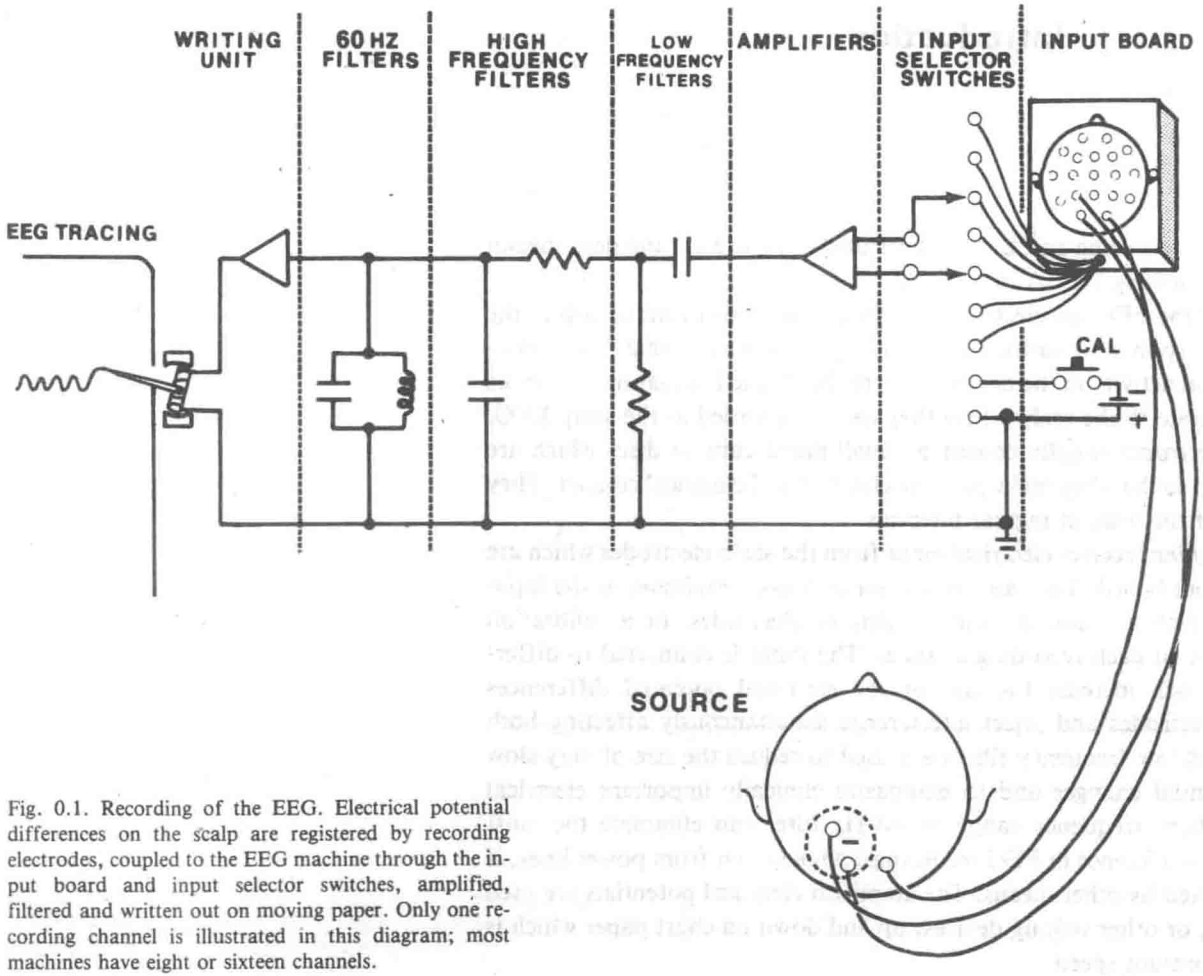


Fig. 0.1. Recording of the EEG. Electrical potential differences on the scalp are registered by recording electrodes, coupled to the EEG machine through the input board and input selector switches, amplified, filtered and written out on moving paper. Only one recording channel is illustrated in this diagram; most machines have eight or sixteen channels.

(4) *Recording strategy* uses several different combinations of electrodes, or montages, to display the potential changes from all parts of the head and to localize the origin of abnormal potential changes.

(5) *The product* of the recording, namely the clinical EEG record, must satisfy a number of technical requirements to be acceptable. Requirements for routine clinical recordings differ from those for recordings from infants and small children, for all-night sleep recordings, for recordings in cases of suspected cerebral death and for recordings transmitted by telephone.

(6) *Artifacts* are pen deflections that are not due to cerebral activity and may come from such extracerebral activity as eye movements, heart beat and muscle contraction or from electrical interference, malfunctioning recording electrodes, or defects of the EEG machine. They must be eliminated or clearly explained to avoid confusion with cerebral activity.

(7) *Other methods of recording and analyzing the EEG* use magnetic tape recorders, computers and other instruments to answer questions which cannot be answered by the conventional method of examining the pages of a paper record.