Ain Shams University
Faulty of Medicine

" Evaluation of topographic EEG in Schizophrenics and Affective patients and Correlation with psychometric studies. "

A Thesis

By

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For partial fulfilment of M.D. Degree in psychiatry.

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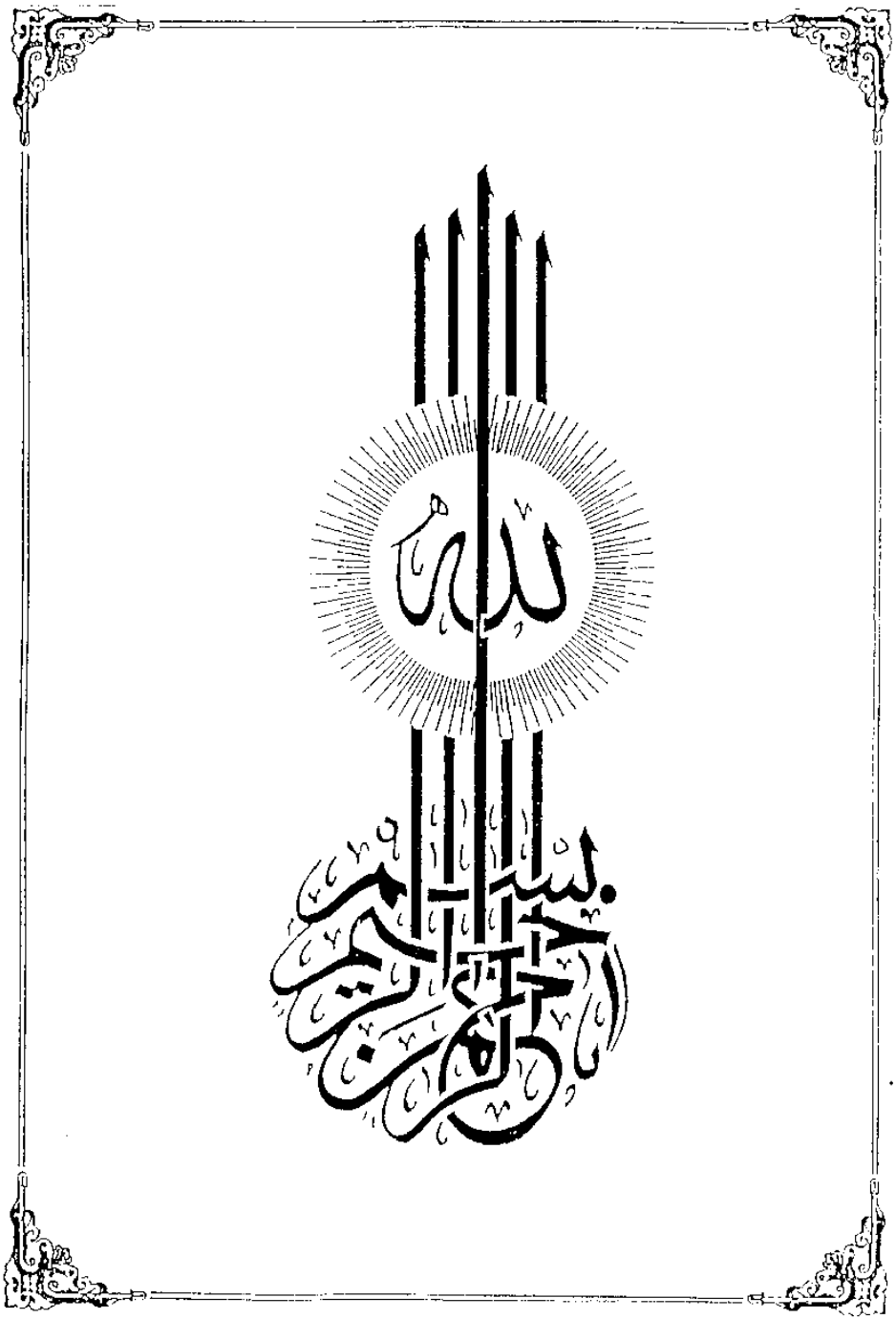
اللهم إني أعوذ بك من علم لا ينفع

(صدق النبي محمد صلى الله عليه وسلم)



Dedicated to

MY MOTHER

who taught patience and persistence.. .. ..

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Adel Wagih Serag Eldin
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Historical introduction

".. How a small plant has grown into a remarkable tree..!!!??"

The Roots

"... different regions of the cortex have different restricted functions and therefore their size must be correlated with different traits of character, which can thus be determined from examinations of models of the skull ..."

Franz Joseph Gall

German anatomist (1758-1828)
The founder of "Cranioscopy"

"... In every brain hitherto examined, the galvanometer has indicated the existence of electric currents of varying direction pass through the multiplier when the electrodes are placed on 2 points of the external surface. The electric current of the grey matter appear to have a relation with its function..."

Richard Caton
Liverpool, 1874

"... If one could observe the activity of the brain through the skull, one would see a continuously changing light-spot whisking over the hemispheres and surrounded by darker shaddows arrested sometimes here, sometimes there and then again jumping to other regions ..."

Pavlov, 1926

I. THE ROOTS

For more than 100 years and exactly at the August 1874 meeting of the British Medical Association in Edinburgh, Richard Caton, of Liverpool, presented his much setteled paper entilted 'The Electric Currents of The Brain'. He used a Thomson reflecting galvanometer, designed originally for the reception of telegraphic signals over the atlantic cable. The procedure involved observation of movement of the spot of light on the galvanometer scale as the dots and dashes were received. This was the first observation of distinction of electrical activity of the brain. Caton didn't detect currents from electrodes placed on the skull or exposed brain in ra-

Richard Caton (1842–1926)
The discoverer of the electroencephalogram
'Feeble currents of varying direction pass through the multiplier when electrodes are placed on two points of the external surface, or one electrode on the grey matter, and one on the surface of the skull.'

bbits and monkeys (After Geddes, 1987).

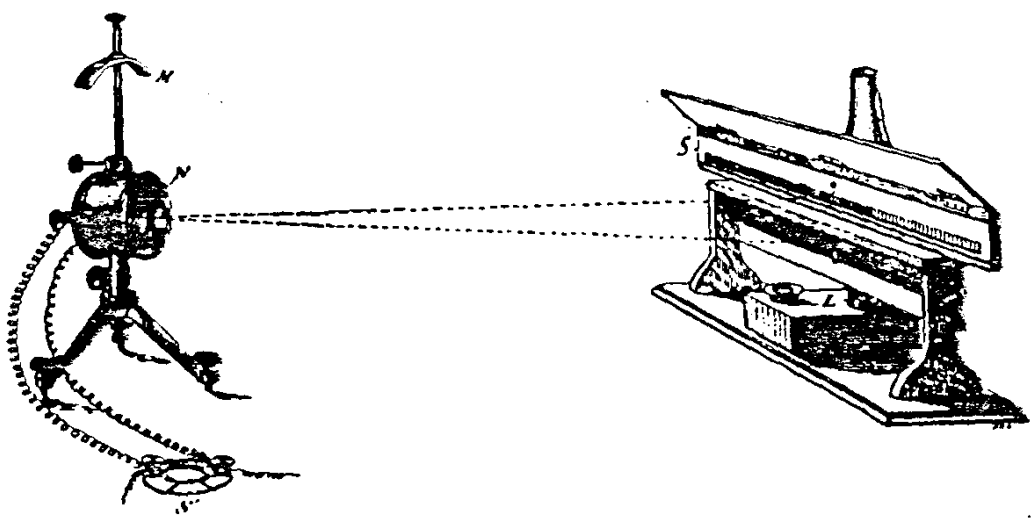
Regardless what did Joseph Gall said...,what did Caton see..., and that Pavlov stated, it was the beginning steps to that we have now.

Hans Berger (1873-1941)

Toward the end of the last century, a young german, Hans Berger , who was serving in the army, slipped from his horse as it stumbled down an embankment, and he hardly escaped serious injury. That evening he was astonished to receive a telegram from his father asking if he was well, because his sister had a feeling that he was in danger. This event led Berger to change his studies from astronomy to psychiatry at the university of Jena, where he received his doctorate in 1897, just at the time that, Sigmund Freud was writing the interpretation of dreams in Vienna. Berger was obssesed with the relationship between material events in the brain and mental phenomena in which he included telepathy(Blackmore, 1977).

The stringe galvanometer, which came into general use about 1906, introduced a new era in electrical recording

and more confirmations of Caton's original findings were made.



The Thomson (Kelvin) reflecting galvanometer. (From American Telegraphy, W. Maver and Co., New York, 1897.)
one of the first primitive machines used for electrical recording (cited in Geddes, 1987)

Berger was led to search for correlation between electroencephalography and psychiatric observations. He had observed that when placing 2 electrodes on the cranial lacuna of a man who had been trepanned a year previously, and linking these to the terminals of the galvanometer, the needle ossilated. He soon noted that similar variations was shown on the surface of the intact skull (Hector , 1980) .

Berger hoped to prove that electrical responses in the brains of men are correlated to consiousness and might even be the physical medium by which thoughts could be telepathically transmitted. He was frustrated at first by failure, but in 1924 he managed to record a signal with metal electrodes stuck to the head of his young son Klaus.

But what a strange signals they were! whenever Klaus was relaxed and inattentive, Berger picked up a feeble but definite ripple of electrical potential with a regular frequency of about 10 cycles each second he called it the alpha rhythm.

Hans Berger.

THE FIRST PUBLISHED ELECTROENCEPHALOGRAM OF A HUMAN BEING
Time signal (lower line): 10 c/s.

Much more exciting, Berger later found that these electrical activity of brain certainly were influenced by conscious experience. He wrote " In many experimental subjects, opening of the eyes ... caused an immediate change in the EEG and during mental tasks e.g. when solving arithmatic problem , the mere meaning of the task sometimes caused the same change.'. Until 1929 when he felt safe to publish his conclusions that the manifestations he was recording with his primitive instrument reflected in reality the voltage ossilations of the brain(Berger, 1929). Throughout his life he, was convinced that the EEG has something to do with the mental processes. This belief set him clearly apart from

the general conviction of his colleagues and successors who believed that the EEG represents the noise of the metal apparatus. Over the ensuing decade, he recorded from a wide variety of patients including many with psychiatric disorders, and evolved an electrode theory about the psychophysiological significance of EEG. His findings were published between 1929 - 1938, principally, in a series of papers in the archiv fur Psychiatrie und Narvekrankhecten; these are availabe in English translation by Gloor(1969).

Although Berger took many precautions to avoid contamination of his records by artifacts, his original publications were received with scepticism. The initial reluctance of physiologists to accept Berger's work in part became of legitimate doubt about reliability of techniques and in part because of the unfamiliar form of brain potentials themselves. A galvanometer that is sufficiently sensitive for the indication of heart potentials of the order of millivolts is not a satisfactory instrument for the examination of brain potentials which may be 10 to a hundered times less . No electric amplification was used and the optical system whereby, the first recorded ossilations of a mirror galvanometer on moving film might well have been susceptible to mechanical vibrations. Thus, some of the Berger's early photographic records showed only the merest ripple of cerebral activity; and while the EEG and the action potentials of muscle and peripheral nerves were well enough known , the fluctuating rhythmicity and relatively smooth contour of the

brain potentials had little resemblance to them . Furthermore, the electric activity of the former bore a distinct relationship to their physiological activity, whereas the rhythms from the brain appear to be greatest during mental relaxation. These considerations contributed to the general view that Berger's records were artifactual (Kiloh et al, 1974)

After the date of Berger's first publications, many laboratories in many countries took up this work and knowledge of this field grew rapidly. A great deal of information was being gained from animal experiments but many workers went ahead at this time with the study of human EEG: Kreindeler in Romania, Dietisch and Kurnmuller in Germany, Adrian and Walter in England, Baudouin and Fessard in France and Davis and Linox in America (Brazier, 1977).

The technique of EEG reached a 2nd stage in 1935 when writing with ink made it possible to record long, immediately readable traces without the delay necessiated by photographic development (Hector, 1980).

Adrian and Mathew 1935, confirmed Berger's findings and by a demonstration to a physiological society, insured their recognition.

A lot of exhaustive effort was done by these researchers in this era. Whereas, there was almost alawys attempts

to record the electrical activity from the human brain , the question of the ultimate source of these electrical signals that could be detected from the scalp!!. What is the exact nature of the neural generators that are responsible for the brain electrical phenomena being measured? This remains a highly controversial issue. In many respects for more progress has been achieved in the evaluation of technology to record this brain electrical activity than in our understanding of its nature. According to the electrical activity,consideration is given to two regions of the brain of particular relevance to the EEG phenomena- the thalamus and reticular formation (Kiloh et al, 1974). Despite many theories,the function of the glia remains uncertain (Ganong, 1983). Cerebral potential recorded by the electroencephalograph are weak: from 10-300 microvolts(uV). They change polarity or direction from about once every two to forty times per second (0.5-40Hz). The electric potentials of the neurons of the convexity are reduced and diffused by cerebral coverings: meninges, bone, muscels and skin (Hector,1980).

But,

Technology in Berger's days didnot permit direct recording of few microvolts picked up in electroencephalography: those have to be amplified almost a million times!!..