Minutes, State Hospital Superintendents' Meeting, Nicollet Hotel, Priday Morning, April 20, 1951

The meeting was called to order at 9:30 A.M. by Dr. Hossen. After a brief administrative session, Dr. Haurence Kolb of the Mayo Clinic talked on the <u>Anatomy and Physiology of the Frontal Lobes</u>. The essentials of his presentation follow.

Information on the anatomy and physiology of the frontal lobes dates back over a hundred years. In 1807 a French anthropologist stated that the frontal lobes were the seat of intellectual functions. Some years later the German neurologist, Hitzig, stated that abstract thinking was a function of the frontal lobes, and later an Italian investigator, Bianchi, came out with a classification of three factors, emotion, intellection, and social behavior, seemingly controlled by the frontal lobes. This classification seems to hold good even today. During World War I many German neurologists and physiologists were interested in the listurbances produced by firontal lobe injury. Förster emphasized the lack of initiative seen in such patients, and Kurt Goldstein noted the impairment of ability to synthesize, the distractibility and the "catastrophic reaction" so often seen in these patients. Other investigators noted the tactlessness and supherla, and Kleiss advanced the hypothesis that the injury to the convolutions of the frontal lobe produced intellectual deficit, while injury to the orbital surface was responsible for emotional changes.

Perhaps the most important study of the functions of frontal lobes was performed by a Swedish investigator, Rylander. His investigation was undertaken because of the disagreement about function expressed by American neuro-surgeons. Bendy and Vincent denied that extirpation of the frontal lobes caused personality changes. Penfield, on the other hand, had long personal experience with his sister who had undergone a unilateral frontal lobectomy, and carefully noted the personality changes he observed. Rylander carefully studied a number of patients by means of psychiatric interviews and psychological tests administered to the patients and to a series of control subjects. In addition to his interviews and tests, he went into the community to get personal information on these patients from friends, acquaintances, business associates and relatives, both before and after unilateral lobectomy had been performed. He stated that changes of a very important nature occurred in the social, intellectual, and emotional fields, and pointed out that basic personality traits always seem to be accentuated after frontal lobe removal.

Many physiological studies were carried out. Malmo found that animals whose frontal lobes had been extirpated showed reduced distractibility in an environment in which light was decreased. Kahn and Thempson studied memory loss in humans and found that this was reproductive rather than associative in nature. Other investigators noted the hypermotility which often came as a result of frontal lobe damage, particularly on the orbital surfaces.

Important experimental work was done in 1936 by Jacobsen of Yale University. He produced experimental neuroses in chimpanzees and after bilateral frontal lebotomy these animals no longer had emotional outbursts when failing the tasks set for them. This paper was presented at an International Neurological Congress in Paris, and within six months, Egas Moniz, who heard the paper, had performed pre-frontal lebotomies on six schizophrenic patients. His experience with these led him to state in his original paper that the longer the illness, the poorer the results to be expected from the procedure.

It is disappointing to note that, despite the fact that approximately ten thousand operations have now been done in the United States. anatomical studies have been published in but four cases by Freeman and Watts. They examined these brains in detail and found the most conspictious degenerative changes occurred in the medial dorsal nucleus of thalmus. This was also confirmed by English investigators, and following this lead, an American neuro-surgeon, Spiegel, developed a procedure known as thalamotomy. The investigations of Freeman and Watts showed that the central part of the medial nucleus of the thalmus projected to the tip of the frontal pole. The lateral portions of this nucleus projected over the convexity of the frontal lobes, while the medial portions portions projected to the orbital surfaces of the frontal lobes. There were very few changes in the smaller thalamic nuclei. British investigators have also described a dropping out of cells in layer three of the frontal cerebral cortex following the procedure. There seemed to be no changes in the long association fibers. Anatomical studies have also shown that the demonstrated extent of the lesion has little correlation with the surgeon's opinion of what he had accomplished. This is especially true of the trans-orbital lobotomy which in one case resulted in only small puneture wound of the orbital surfaces of the frontal lobes, but considerable clinical improvement. There seems to be little relation between the pathology produced by operation and the improvement in mental states, that is, there is no "standard lesion."

An attempt has been made to differentiate frontal lobe functions in various in the Columbia Greystene Project. Gyrestomies were performed in many different locations. Improvement occurred when areas nine, ten and forty-six were removed. It was believed that these could be identified anatomically after the method of Yon Economo and Brodmann. However, Bailey and Yon Bonin do not believe that this is the case. They have produced a greatly simplified architectonic chart which was obtained through a detailed study of a non-injured brain. Checking on each other's ability to differentiate areas, they have found that only frontal, temporal and parietal areas can be differentiated with any consistency or certainty. They believe that the amount of tissue removed seems more important so far as its effects are concerned than the area from which the tissue has been removed.

The physiological studies have yielded a good deal of data, but much remains to be done. Sensory changes seem very important. Although is not eradicated, complaints of pain almost coase after the operation. The change seems to be a qualitative rather than a quantitative one. It has been observed by Freeman and others. Patients with tabes, radiculitus, cancer, and other painful conditions have been operated. Their complaints of pain have diminished and in many instances patients addicted to drugs for relief of pain have been able to discontinue their use. Despite this qualitative change, work at the Boston Psychopathic Hospital showed a more rapid withdrawal from a painful stimulus (heat) after operation than prior to operation. These observations have seemed to confirm what Frend noted about hysterical pain, that is, one must consider not only the perception of the pain itself, but the affective connotation and associations to the painful stimulus. The lobotomy operation seems to meparate the painful associations from the perception of the stimulus itself. On the other hand, "painful affects" are not relieved by any surgery on the peripheral nerve or spinal cord. Lobotomy, for example, will relieve phantom limb pain without reducing the sensation of the phantom limb. Conversely, resection of the postcentral gyrus will eradicate the phantom limb sensation, but leave the

pain emanating from the phantom limb intact. This would indicate that one's conception of body image is located in the parietal region, blectric shock has also been used with success in cases of intractable pain.

Electroencephalographic changes have proven of great interest. Chhen has done considerable study of the first thirty patients operated by Presman and Watts. There were followed for periods ranging from four to six years. Immediately after operation slow wave delta activity was noted over the cortex. This disappeared in one to three months. It was seen following the unilateral lobotomy, most marked on the side of the operation, but evident also on the opposite side. Slow waves on hyperventilation persisted many years after the operative procedure. In one patient, who developed convulsions, electroencephalographic changes were only evident after the onset of the seizures. This would indicate that these brain wave changes may come about as a result of the seizures, instead of constituting their cause, as is now supposed. Electroencephalographic changes showed no correlation with clinical improvement.

Many studies of autonomic function have been undertaken. Dr. Magnus C. Petersen has found that there is a tendency toward earlier and greater secretion of gastric hydrochloric acid on histamine stimulation. Also, some patients have shown greater tolerance to glucose. Greenblatt and others have shown altered response after operation to sympathicomimetic drugs and to carotid sinus pressure. The latter procedure frequently produced convulsions and electrocardiographic changes in patients. There was also a greater response to cold and a greater response to epinephrine and related substances.

Urinary incontinence often seen may be due to a disregard of the social obligations of the patient or, as suggested by Greenblatt and others, to an increased stretch reflex in the bladder resulting in a hypertonic bladder with frequent emptying. Dr. Kolb believes that both these may be true, although the evidence for hypertonic bladder should be substantiated with cystemetric studies. There are also good indications for more careful study of the motility of the gastro-intestinal tract, and the operation might be tried on cases of anorexia nervosa which do not improve with psychotherapy or other forms of treatment.

Halstead has demised many new techniques for testing frontal lobe function. He finds that adaptation to new situations, which he terms "biological intelligence," constitutes a walid measure of frontal lobe function. He has found that lobectomy is much more damaging to these functions than is lobotomy. In many instances, the presence of psychosis vitiates his pre-operative test results. The operation, however, seems to produce signs of frontal lobe damage in that the subjects use fewer objects in grouping tests, have difficulty placing objects in recalling situations, make more errors, and have "catastrophic reactions" in response to test failures.