tion of bone takes place. This is a result of the process of rarefying osteitis, and is characterized by the occurrence of numerous giant cells or osteoclasts in excavations of bony lacunæ. These vary in number according to the degree of absorption which is taking place. The absorption of the bony trabeculi is found at times on the outer surface which faces the mucous membrane or at times on that which faces the medullary spaces. Usually both conditions occur. The trabeculi are eroded by the osteoclasts and continually rendered thinner and thinner, so that the medullary spaces continually increase in size. In the extensive stages of refraction numerous trabeculi are completely eroded, and thus suffer solution of continuity. They separate then into irregular loose pieces, which may themselves be attacked later by deposits of osteoclasts, so that it may result that the bony framework of the turbinate consists of a number of loose pieces rather than of a coherent bony framework.

In advanced stages the cavities may be produced from the coalescence of adjoining medullary spaces, which by continued progression may form bony cysts. Such a cyst is usually lined with columnar ciliated epithelium and contains no glands in its interior, but a certain number of arteries, veins and microscopic erectile tissue.

Hajek emphasizes the fact that the diagnosis of rarefying osteitis is not to be made simply from the occurrence of osteoclasts. A few osteoclasts may exist on the bony framework of the normal middle turbinate and the ethmoid labyrinth. The erosion, however, of the whole bony trabeculi and, finally, their total destruction is a condition which never occurs under ordinary circumstances.

It is difficult to say why in one case hypertrophy of the bone predominates and in another absorption. It is possible that the inflammatory infiltration which penetrates the substance of the turbinates may lead in some places to stasis from compression of the veins. On the other hand, a congestion of the periosteum excited by the infiltration may produce hypernutrition and thus give rise to the hyperplastic growth.

[THE DISCUSSION IS UNDER SECTION DISCUSSIONS.]

THE LOCALIZATION OF THE MOTOR AREA BASED ON EXACT FARADIZATION.*

ALFRED GORDON, M.D.

Associate in Nervous and Mental Diseases, Jefferson Medical College, Examiner of the Insane at the Philadelphia Hospital.

PHILADELPHIA.

Faradization of the cortex is a scientific procedure unaccompanied by the slightest danger to the individual operated on. Valuable data concerning cerebral localizations have been obtained by various observers from faradization. The former results obtained by Hitzig, Ferrier, Horsley, Beevor and others can not at present be considered as absolutely accurate in view of the bipolar method which, as it was pointed out by Grünbaum and Sherrington, led to errors in localizations: diffusion of the electrical current caused a simultaneous stimulation of centers other than those experimented on. With the advent of the unipolar method advised by Grünbaum and Sherrington this difficulty is obviated and we are now able to obtain more accurate cerebral localizations.

The question of the exact delimitation of the motor area is, for obvious reasons, one of unusual interest and importance.

Pathologic material is not wanting for the demon-

stration of the approximate existence of the motor area, but as for its exact seat measured in inches or centimeters there is no depending on tumors, hemorrhages or other lesions, as they usually cover a more or less large area.

There is a tendency at the present time to limit the motor cortical center to the ascending frontal convolution and to the Rolandic fissure, in contradistinction to the old classic view according to which the motor area consists of both Rolandic convolutions. This more recent orientation dates from Grünbaum and Sherrington's experimental observations on anthropoid apes, in whom they found by means of faradization that "the motor area extends in front, but never behind the sulcus centralis."¹

Since then other investigators experimented in a similar manner on human brains, while the latter were exposed for surgical procedures. Krause, Rothmann, and Brodman abroad, Mills, Frazier, Lloyd and Cushing in this country—all are inclined to accept the English physiologists' view. Although they all arrived at the same conclusion, the number of observations are as yet too few to draw, I believe, positive conclusions as to the erroneousness of the old conception of the motor area.

FIRST CASE.

My personal investigations concern two cases in which I followed strictly the same rules as the above-mentioned observers. The results were similar, but not absolutely identical to those of others.

The first case concerns a boy (J. H.) of 16, who at the age of 14 fell off a platform and struck the right temporal region. He was unconscious at first and then during the following five days had several attacks of loss of consciousness. There was a serous discharge from the nose which was soon followed by blood. The seat of injury was swollen and painful on pressure. Three weeks after the accident he began to have attacks of petit mal and then attacks of Jacksonian epilepsy, affecting left arm and leg. As the latter were invariably confined to the same side, an operation was decided on. An osteoplastic flap uncovered the right motor area which was found intact. Dr. F. T. Stewart followed in this case the plan of other surgeons of the Jefferson Hospital in cranial measurements for determining the seat of the Rolandic fissure. A cord is placed between the glabella and inion and from its center a perpendicular line is drawn. The latter corresponds fairly accurately to the sulcus centralis. When the cortex was uncovered, the central fissure could easily be detected with both convolutions on either side.

In applying faradization I endeavored to surround myself with the same precautions as other investigators did. The apparatus was the usual large size dry cell faradic battery; one electrode was extremely small and pointed, the other was a sponge of 6 inches square with a handle. The end of the pointed electrode was covered with an extremely thin layer of absorbent cotton and during the experiment held perpendicularly to the cortex. The current was turned on very cautiously and first tested in my hands. When a slight tingling was felt and very slight contraction of the muscles of the fingers produced, the electrodes were transferred to the patient.

Cushing² advises to avoid deep narcosis, for then so strong a current is required to produce responses that several centers are likely to be stimulated at once and a complex spreading movement is produced. On the other hand, he says, if the degree of narcosis is too light, voluntary movements may confuse the observation. The other suggestion made by him is to puncture the membrane over the sulcus: the cerebrospinal fluid will escape, the membrane will settle down close to the cerebral surface; otherwise the electric stimulation will

* Read at the meeting of the American Neurological Association in Washington, May 7-9, 1907.

1. Proc. Royal Soc. of London, lxi, 1902.
2. N. Y., Med. Jour., 1907, 166.

spread and lead to erroneous conclusions. Lloyd, in his experiment,³ made the first faradic application to the precentral convolution, as excitation of postcentral convolution seems to him to act as a reinforcement to the precentral. Mills, on the contrary, applied the electrode first behind the fissure, for if it is done in reverse order "it is quite possible that one might get a response from postcentral convolution, when no response would have been obtained had the electrode been applied first to this convolution."

I have followed Cushing's and Mill's suggestions. The indifferent electrode was thoroughly saturated with a warm salt solution. The small and thin electrode was held firmly in the hand and gently applied to the cortex. At first the ascending parietal was touched through its entire length and near the central fissure. Slight contractions were obtained in the arm when the largest portion was irritated, the leg also would twitch when its upper angle was touched and the face when the lower angle was excited. The same application then was made at some distance from the fissure, contractions also were obtained, but in a milder degree. When the electrode was placed in the sulcus the contractions became more pronounced. Finally faradization of the ascending frontal very near the sulcus gave the same results as that of the sulcus itself. The entire transverse diameter of the anterior convolution gave contractions in the limbs. In comparing the degree of contractions at various distances from the sulcus, I will say that in both convolutions the contractions were more marked when the faradization was made very near the sulcus and less marked when at some distance from the sulcus. The interesting fact is that, while the same current gave by far greater contractions when applied to the fissure and ascending frontal, it nevertheless was capable of exciting the postcentral convolution, though to a much milder degree. The faradization was witnessed by the surgeon, Dr. Stewart, his assistants and Dr. William J. Dugan, who made notes in the course of my experiment.

SECOND CASE.

The second case is that of a boy of 16 who at the age of 13, without any apparent cause, developed convulsions on the left side. At the time of his admission to the Jefferson Hospital he had frequent attacks of epileptic seizures, confined to the left arm, neck and face. In view of the strictly localized convulsions an operation was undertaken by Dr. J. C. Da Costa. An osteoplastic flap revealed dilated and tortuous veins over the arm center, reminding one of angiomatous vessels. The faradization was conducted with the minutest precautions and exactly in the same manner as in the first case. Here I observed an extraordinary anomaly. Faradization produced contractions on the same side of the body and at no time on the opposite side. A half dozen applications to the precentral or postcentral convolution and the fissure invariably gave responses on the corresponding side of the body. This anomaly can be explained on the ground of absence of decussation. What also is interesting is the relative responses to faradization of the various portions of the classic motor area. While the irritation of the ascending frontal convolution and of the sulcus centralis gave more pronounced contractions in the limbs than that of the ascending parietal, nevertheless irritation of the latter was not indifferent; mild twitching of the limbs was evident.

COMMENT.

The two cases seem to prove that the motor area is not confined to the precentral convolution and the sulcus, but extends also to the postcentral convolution, although to a much milder degree. If Mills and others

believe that faradization in man enables us to determine with exactness the delimitation of the motor centers, what is the reason of the discrepancy in the results of their experiments and mine, especially when precautions in carrying out the experiments were taken on both sides equally well? The subject is, therefore, reduced to the question of whether the electrically excitable area is identical to the motor centers of the brain. Rothmann⁴ cut the decussation of the pyramids in apes. The electrical irritation of the limb centers had entirely disappeared, but the motor function of the limbs was intact. In some of the monkeys he excised a small portion of the arm centers and through some error in handling the wound an infection set in, which became a source of irritation to the remaining portion of the arm center. This ape had typical Jacksonian epilepsy in spite of the fact that electrical irritation was not obtainable.

Krause, according to Rothmann, found that in some of his cases in which an operation was done he could no more faradize, and still typical epilepsy occurred. He also found that in one case after the excision of the precentral convolution epileptic seizures still occurred. Finally, Rothmann himself observed that in total extirpation of the entire ascending frontal convolution the posterior was sufficient to produce movements of the extremities.

These facts prove, I believe, conclusively that the results obtained from faradization of the cortex can not be considered as an absolutely reliable means for an exact and precise delimitation of the motor center; the motor region is more extensive than faradization seems to prove.

Finally, if it is permissible to draw inferences from cortical irritation by means of electricity, the ascending parietal convolution participates in formation of the motor area, although to a lesser degree.

THE DIAGNOSIS OF PERFORATION OF THE BOWEL IN TYPHOID.*

CLARENCE D. SELBY, M.D.

TOLEDO, OHIO.

In the bowel perforation of typhoid fever and the bowel perforation of appendicitis we have, in a measure, allied surgical conditions. They are similar in that both result in peritonitis by the extravasation of the bowel contents into the peritoneal cavity. They are also similar in that the locations of both are, under ordinary circumstances, in the right iliac fossa. Given these anatomic similarities, why is the one so uniformly fatal and the other so uniformly successful in its issue? The surgical indications and the principles of treatment are identical, consequently, the conclusion necessarily follows that were the cases of perforation of the bowel in typhoid all accorded the prompt and active surgical care that a perforated appendix receives the outcome would be different.

To be sure, the patient with typhoid is seriously handicapped by the already existing typhoid infection, but that in itself, unless of serious degree, is no contraindication to operation. Cushing even goes so far as to advance the opinion that the operation and its anesthesia tend to terminate the attack of fever.

* Read before the Surgical Section of the Academy of Medicine of Toledo (O.), and Lucas County, May 17, 1907.

4. Berlin. klin. Wochschr., 10, 1905, 272.