

within two days. This eruption in the three cases came on after the temperatures were normal. It is possible that it had been overlooked in the other cases. Later observations show that this petechial rash on the extremities after the defervescence of the fever occurs only in the severe toxic cases and is not uniformly present.

The disease can be differentiated from malaria by the absence of parasites, the febrile course and the blood-picture. The large mononuclears are diminished instead of increased as in malaria. It can be distinguished from dengue in being a single-phase fever, with a very large spleen, which is never present in dengue, with no severe bone aches.

It is differentiated from influenza by the absence of coryza symptoms and lung complications, by the blood-picture and the definite course. It is distinguishable from typhus by the length of the course, the milder manifestations and the absence of the rash. From typhoid and allied affections of the paratyphoid series it is differentiated by the onset, febrile course, abrupt termination and cultural blood-findings.

Drs. S. T. Darling and H. C. Clark have taken blood-cultures on different mediums of many of the cases at all stages of the disease and have failed to obtain a

LEUKOCYTE AND DIFFERENTIAL COUNTS

Leuko- cytes.	Polynu- clears	Small.	Large.	Transi- tional.	Eosino- phils.
9,800	48	37	15	..	..
4,000	54	41	4	1	..
9,800	60	28	8	3	..
4,800	64	20	4	3	..
7,000	87	10	2	1	..
.....	83	12	2	3	..
.....	60	23	2	1	5
5,800	60	11	3	..	..
5,400	88	12	4	1	..
8,400	60	25	4	..	..
3,200	65	25	10	..	..
5,000	88	4	6	2	..
4,800	80	5	4	2	..
6,200	70	18	9	3	..

growth. The stools and urines have also been cultured with negative results.

The Widal reactions have all been returned negative.

The affection seems to resemble more the exanthemas minus the constant rash, because of its definite onset and definite course. The temperature always reaches normal on the sixth day and can thus be faithfully predicted.

No medication so far tried has appeared to alter its course in the slightest. We have tried quinin and the salicylates in heroic doses, the only effect being a temporary antipyretic action.

It is probably identical with the seven-day fever referred to by Castellani in his manual of tropical medicine.

It has been described by Rogers and Crombi as occurring in the seaport towns of India and Ceylon during the summer months, May to September. Its origin here and the ten-day incubation period following the development of the third case indicate that it was probably imported by the mails from some infected port.

Leonard Rogers describes cases with a duration of seven and more days of fever and says that blood-cultures in six of his cases were positive for a bacillus related to the *B. coli* group.

As Dr. T. R. Brown and I have shown, it is not unusual to have paratyphoid with seven and eight days

of fever. And I am inclined to believe that Rogers has included some of these in his descriptions.

The epidemic is gradually spreading through the city of Panama, where I have seen several cases.

There is no doubt that this is the first time that this fever has been encountered here since the American occupation of the Canal Zone, and it will be interesting to note if it remains with us in epidemic form.

So far there has been no mortality from it, though some of the cases were very severe.

## APHASIA AND AGRAPHIA IN SOME PRACTICAL SURGICAL RELATIONS\*

CHARLES K. MILLS, M.D.

Professor of Neurology in the University of Pennsylvania

AND EDWARD MARTIN, M.D.

Professor of Surgery in the University of Pennsylvania

PHILADELPHIA

*Most Important Diagnostic Phenomena.*—Motor aphasia and motor agraphia, usually partial, anomia or parnomia, inability to copy or write from dictation when both convolutions are involved; ability to write from copy or dictation preserved when the third frontal convolution alone is involved.

*Symptom Sometimes Present.*—Partial word-deafness.

*Symptoms from Invasion of Neighboring Parts.*—Jacksonian epilepsy, usually facial or faciobrachial, inability perfectly to maintain attention, hemiparesis.

The stimulus to present this subject of aphasia in some of its relations to surgical procedure was given by a recent case in which operation was successfully performed and in which the clinical phenomena distinctly indicated implication of the cortex of the hinder portion of the third and second frontal convolutions. Similar cases have been reported by McConnell,<sup>1</sup> Mills,<sup>2</sup> Frazier,<sup>3</sup> and others, but additional reports are desirable especially in the light of the differences of opinion which have arisen since the pronouncement of Marie against the third frontal convolution playing any part in speech disturbances. This we do not believe and our conviction is based on personal experience.

The disturbances of speech and writing are very partial at first, but gradually become more pronounced. The aphasia and agraphia are rarely complete, and the same is true of the concomitant phenomena such as paralexia.

A patient suffering from a more or less destructive lesion of the region we are considering presents few phenomena of sensory or conceptual aphasia; he understands what is said to him and is able to read silently either ordinary print or script. He is not word-deaf, or only to a very moderate degree. He is not word-blind, letter-blind, number-blind or mind-blind, and has no cortical color disturbances.

Tumors involving the third and second frontal convolutions and progressively advancing sometimes give rise to a slowly deepening hemiparesis. Such growths are easily diagnosticated from tumor, hemorrhage or thrombotic softening deeply implicating the lenticular zone (the lenticula, internal capsule, external capsule, claus-

\* This article is here abbreviated. The complete article appears in the Transactions of the Section and in the authors' reprints.

\* Read in the Section on Surgery of the American Medical Association, at the Sixty-Third Annual Session, held at Atlantic City, June, 1912.

1. McConnell, J. W.: Univ. of Penn. Med. Bull., July., Aug., 1905.

2. Mills, C. K.: Philadelphia Med. Jour., April 20, 1901.

3. Frazier, Charles H.: Monograph on Tumors of the Cerebrum by Mills, Spiller, Frazier and others (1906).

trum, etc.). In these deep lesions of the lenticular zone both the motor aphasia and the hemiplegia are practically complete and are of a well-known and often described type, the aphasics usually having but a single recurring utterance or one or two such utterances. Agraphia and forms of sensorial aphasia are also important features of the symptom-complex.

The following two cases, in one of which the patient was cured by operation and in the other by the intravenous administration of salvarsan, are illustrative of the types of motor aphasic and agraphic cases most amenable to surgical or salvarsan treatment.

**Case 1.—History.**—W. B., aged 37, referred to Dr. Mills by Dr. U. G. Gifford of Avondale, Pa., was admitted to the University Hospital, Dec. 9, 1911. He denied venereal disease. The patient had suffered at intervals since childhood with severe headaches. During the six years preceding his admission to the hospital these headaches had become almost continuous. During the last two years he had had epileptiform attacks every two or three months, having had seven of these seizures during the month preceding his admission. The attacks, as described by those who had witnessed them, began with the drawing up of the right arm and both legs. In them he had both tonic and clonic spasms. Consciousness was lost

the corner of the mouth up and to the right, was impossible. Emotional expression as shown in laughing was not entirely lost on the affected side. The tongue protruded toward the right, with fine tremor.

The patient greeted the doctors on making their rounds by saying "good morning," but would not say anything else. He had some apparent difficulty in comprehending what was said to him. It was almost impossible to test for sensation, sense of position, etc., because of his lack of language. Much saliva collected in his mouth, and he did not close his right eye well, but he wrinkled his forehead almost as well on the right as on the left. Ocular movements were normal. He had some weakness in the right arm and hand.

#### MEASUREMENTS AND OSTEOPLASTIC OPENINGS

As it is always now regarded as preferable to have openings which in some of their dimensions will be at least 3 or 4 inches, only a few lines need to be determined, but these are of much importance. They are the ectal correlatives of the central fissure, the sylvian fissure and the occipitoparietal notch. With regard to the best openings in aphaso-agraphic cases these markings are all that need to be defined on the skull, with the additional determination of the distance from the midsagittal line for the superior boundary and in some instances the determina-

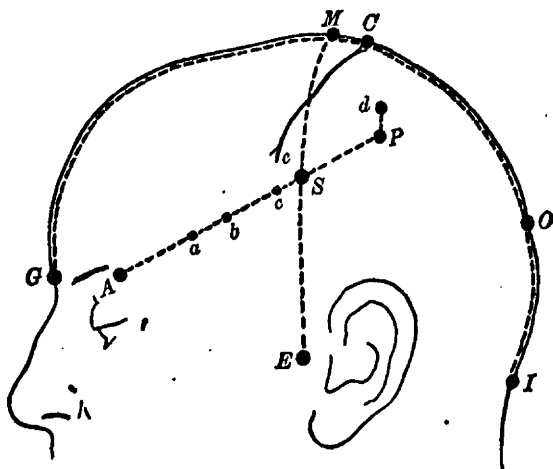


Fig. 2.—Craniocerebral guiding lines traced on a photograph of one of the casts prepared by Professor Cunningham.—(Anderson-Makins). G, glabella; I, inion; M, midsagittal point; A, external angular point; S, squamosal point; P, parietal point; E, pre-auricular point; a, commencement of fissure of Sylvius; b, bifurcation of fissure of Sylvius; d, termination of fissure of Sylvius; Ce, central fissure; O, parieto-occipital fissure; G to I is the sagittal line, A to P the squamosal and E to M the frontal.

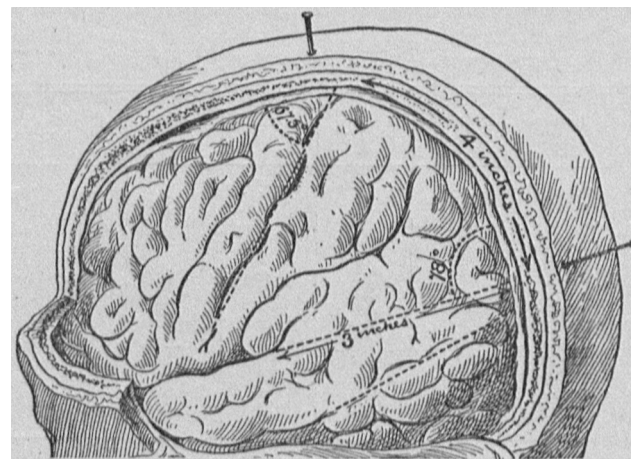


Fig. 3.—Angulation of the central, sylvian and parallel fissures.

and biting of the tongue occurred. He lost control of his anal and vesical sphincters during an attack. His speech had been failing for about one year and had gradually grown worse.

Papillo-edema was present on both sides. The patient showed decided aphasia, chiefly motor. He was inattentive, although at first he seemed to take notice of what was said to him, later appearing to become easily fatigued. When told to put his knife in the hand of the examiner he placed it in his own pocket. When given a series of letters he pronounced the first few correctly, but then seemed to lose himself or become confused and apparently did not recognize letters or numbers. This may have been due to cerebral or visual fatigue.

The patient was not object-blind, nor was he markedly word-deaf. He appeared sometimes to have difficulty in comprehending what was said to him. He was not word-blind.

When asked to spell "medicine," he spelled it correctly, but pronounced it "merchandise." He wrote his name fairly well, but when asked to write "I want to go home," he wrote, "I go go," and at another time "I want to ho." He seemed confused and threw down his pencil. He could add well, but when asked to subtract and multiply he did not do so correctly.

Dec. 16, 1911, it was noted that the patient had right partial facial paralysis. Voluntary movement, as shown by drawing

tion of the line which corresponds as closely as possible to the floor of the skull.

In our experience the Anderson-Makins measurements have always been equal to the occasion (Fig. 2).

We determined on the cadaver and have shown in Figure 3 the angulation of the central, sylvian and parallel fissures.† The angulation of the central fissure to the mid-sagittal line is of course well known and it is only necessary for us to say that in our dissection, as in those of others, we found that this angulation is not always exactly 67 degrees. The angulation of the sylvian fissure is about 78 degrees and the parallel, in its greatest length at least, nearly the same.

**CASE 1.—Operation.**—In Figure 4 is shown the opening which was used to uncover the tumor in Case 1. We regard this as the best exposure when a tumor or other operable lesion gives a symptom-complex in which motor aphasia and motor agraphia are the dominating features from partial destruction of the third and second frontal convolutions (Fig. 5).

After the opening had been made the intracranial pressure was marked; no pulsation was present over the middle portion of the field. When the dura had been removed a small, hard

† A series of osteoplastic cadaveric investigations to identify the relations of cranial areas to the convolutions and fissures beneath them was made by us with the assistance of Dr. Edward M. Williams. Pen sketches were made from photographs of these openings.

tumor was seen almost exactly in the middle of the opening. After the ligation of two large veins it was found that the growth could be separated from the surrounding brain tissue by the finger and scalpel handle. Great care was taken in enucleating the growth, but this enucleation was complete.

**Microscopic Examination.**—The growth was referred to Dr. William G. Spiller of the laboratory of neuropathology for microscopic examination, who reported that it was probably a tuberculoma, although possibly a gumma.

**Postoperative History.**—After the operation the patient had an uneventful surgical history. The wound promptly healed and the patient had no further attacks except one or two within forty-eight hours of the operation. At first his aphasia and agraphia were quite as marked as before the operation, but his powers of language gradually but steadily improved.

#### TREATMENT BY SALVARSAN AND MERCURY

One matter of much importance for both the neurologist and the surgeon to consider, in a case of focal disease of the brain, is whether the lesion which causes the focal symptoms is syphilitic, and if so whether it is amenable to constitutional rather than to surgical treatment, or whether it demands both forms of treatment. This question arises not infrequently when aphasia in some form and degree is prominent. During the time after operation when the patient in Case 1 was still under observation, another case was studied by us which

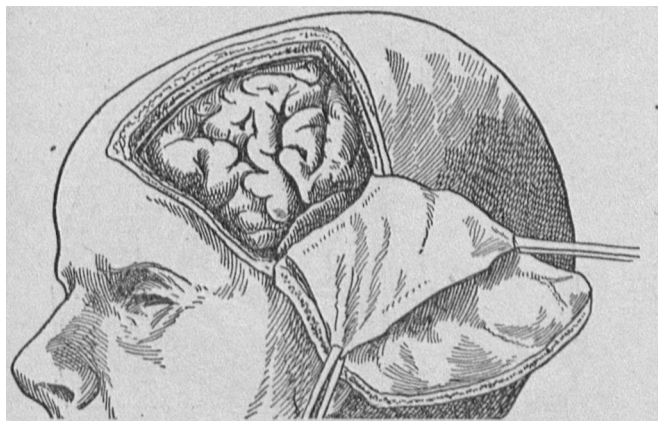


Fig. 4.—Osteoplastic opening for a tumor of the posterior extremities of the third and second frontal convolutions.

illustrated the point just presented. The patient came to us from a physician in the interior of Pennsylvania distinctly with the idea of having us determine whether medicinal treatment or operation was indicated; if the former, what the method of its administration should be, and if the latter, when the surgical procedure should be undertaken; also, of course, what the locality was of the lesion to be operated on. The patient was carefully examined, and although in some of its features the case was distinctly like the one just put on record in which operation was so successfully performed, we decided that a treatment by salvarsan and hypodermic mercurial medication was more appropriate than operative surgery. Happily the result showed that we were correct.

The reasons which determined us to favor operation in the first case were in the main the absence of a Wassermann or Noguchi reaction and the persistence of both the aphasic and parietic phenomena. Those which determined us against operation in the second case were the presence of positive Wassermann and Noguchi reactions, the paroxysmal character of the aphasic and agraphic symptoms (recurrence rather than continuance) and the absence of any increasing paresis.\*

\* For details of this interesting case the reader is referred to the full account in the *Transactions of the Section on Surgery*.

Besides the motor aphasic and motor agraphic syndrome which has been discussed and illustrated by the two cases just given, it will be found useful to recognize three other symptom-complexes which may serve the neurologist in guiding the surgeon in the selection of sites for osteoplastic operations. These syndromes are among those which in our experience have been presented in cases of operable tumor, abscess and hemorrhage, especially the former two. They are symptom-complexes representing cases which can be diagnosed and palliated or cured by surgical procedure.

#### AUDITORY APHASIAS AND WERNICKE'S ZONE

**Most Important Diagnostic Symptoms.**—Word-deafness, complete or partial, paraphasia, partial motor aphasia.

**Symptoms Sometimes Present.**—Word-dumbness, paralexia, auditory apraxia, amusia, auditory hallucinations.

**Symptoms from Invasion of Neighboring Parts.**—Hemianopsia, loss of sense of position and passive movements, astereognosis, impairment of cutaneous sensation, hemiparesis or hemiplegia.

A lesion giving the above symptoms may be described as one chiefly located in the central portion of the anterior half or two-thirds of Wernicke's zone, which is regarded as including the supramarginal or subparietal convolution, the angular convolution, the first and second temporal convolutions, and the anterior boundary of the middle portion of the occipital lobe as repre-

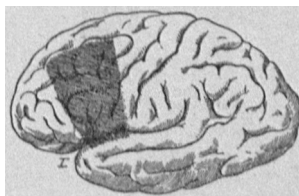


Fig. 5.—The motor aphasic and agraphic zone.

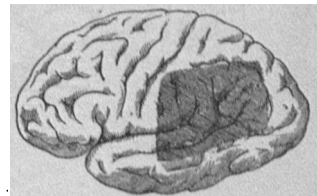


Fig. 8.—Wernicke's zone.

sented in Figure 8. A tumor or other lesion thus localized and centralized will, after its effects are well defined, have for its most important symptoms word-deafness and paraphasia. Partial motor aphasia is often present but may be very partial. Word-dumbness, also usually partial, is often exhibited, and more or less alexia or paralexia because of interruption of the connections between the higher auditory and higher visual centers. The auditory phenomena will, however, be more dominant. Hemianopsia comes on in some cases as the growth advances, and if it spread so as to involve the parietal lobe and motor regions, other symptoms may be impairment of skin sensation and of sense of position and passive movement with or without hemiparesis.

It is true that cases of destructive lesion of the first left temporal convolution have been recorded which have not given word-deafness, but these are the rare exceptions and need to be accounted for in some special way. The anomia or word-deafness in lesions of this area, while often present, is not so common a phenomenon as in lesions in the middle or more inferior portion of the temporal lobe or in the region of the parietotemporo-occipital junction. Auditory apraxia or mind-deafness, the inability to recognize objects through sound, and auditory hallucinations are present in rare instances. Mind-deafness, however, in most cases seems to require bilateral destruction of the temporal zones, and hallucinations of hearing are inconstant and in absence of other diagnostic symptoms not reliable for diagnosis.

In probably one-fourth or even one-third of the cases of destructive lesions involving the auditory portion of Wernicke's zone, word-blindness and alexia are absent, although there may be partial word-blindness and alexia, and frequently paralexia. The power to write spontaneously or from copy may be retained. Writing from dictation will of course be lost if word-deafness is complete or nearly complete.

The opening to be preferred to uncover the anterior two-thirds of Wernicke's zone in the first temporal convolution is that indicated in Figure 9. The lower border of this opening extends from a point slightly posterior to the line from the midsagittal point to the preauricular point at a level of one-half inch above the top line of the zygoma, backward for about  $3\frac{3}{4}$  inches. The anterior border of the opening reaches from the anterior end of the lower limiting line upward for about 4 inches. The superior line is drawn from the upper extremity of the anterior boundary backward for about

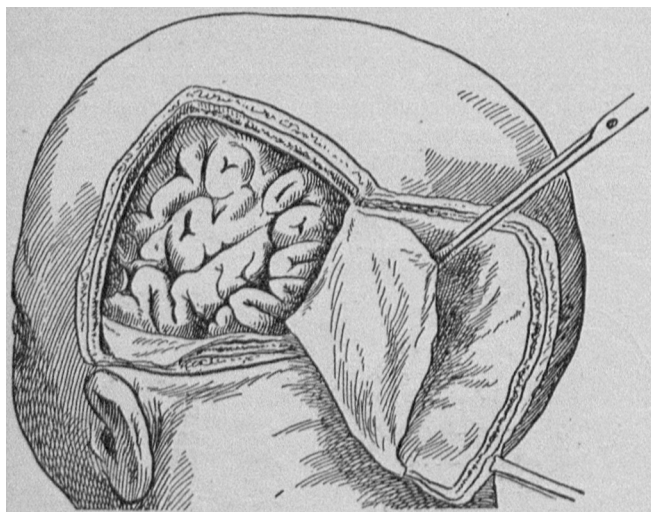


Fig. 9.—To uncover the anterior two-thirds of Wernicke's zone.



Fig. 10.—Auditory aphasic zone.

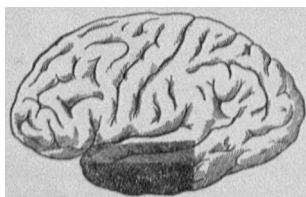


Fig. 11.—Midtemporal aphasic zone.

$3\frac{1}{2}$  inches. The line of breakage is thus formed at the anterior margin of the occipital region, being about  $1\frac{1}{2}$  to 2 inches in length. This opening will thoroughly expose the subparietal and posterior halves of the first and second temporal convolutions, as shown in Figure 10. The opening might be made with the line of breakage below or even above, but we believe it will be found most desirable to place it posteriorly as indicated in the figure and description, this from the standpoint both of convenience and of blood-supply to the flap.

#### ANOMIA AND THE MIDTEMPORAL REGION

*Most Important Diagnostic Phenomena.*—Anomia (visual or for all senses), paraphasia, paralexia, paraphasia, partial motor aphasia.

*Symptoms Sometimes Present.*—Hemianopsia, color aphasia (color dissociation), mind-blindness (visual apraxia), partial word-deafness (auditory apraxia), visual or auditory hallucinations.

*Symptoms from Invasion of Neighboring Parts.*—Word-deafness, partial word-blindness, letter-blindness, or number-blindness, hemiparesis.

The dominant feature in such a symptom-complex is anomia, or if the lesion is incompletely destructive, paronomia. This syndrome is based on the theory, which is held by us, that in the general zone of speech is situated a concept area intercalated between the sensory percept regions, auditory and visual, and the cortical motor centers for speech and writing, namely, Broca's convolution and the posterior half of the second frontal convolution. Within this area for concrete concepts is a centralized portion which has for its function the registering of the names of objects recognized. Cases are reported, for instance by Potts,<sup>4</sup> in which immediately after an acute apoplectic lesion, probably hemorrhage, the patient lost entirely the ability to name objects which he fully recognized either through sight, hearing, touch, taste or smell.

The mistake must not be made of supposing that anomia does not occur from lesions differently situated.

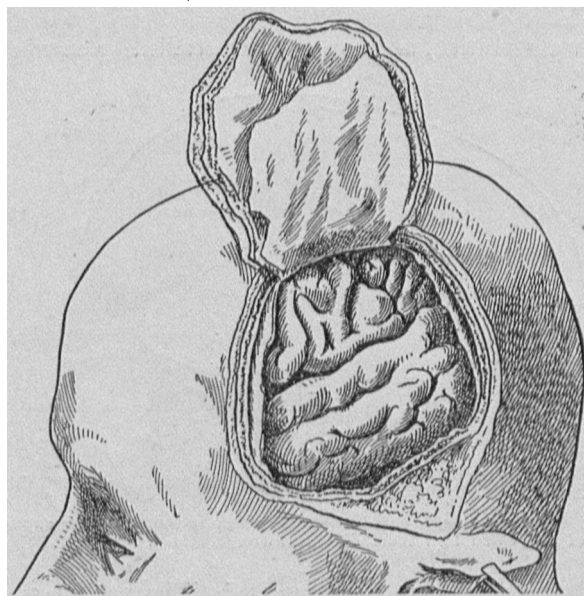


Fig. 12.—Osteoplastic opening to reach the midtemporal conceptaphasic zone.

It may be present as the result of bilateral lesions of the occipital lobe, the lesions of Wernicke's zone, cortical or subcortical, in motor aphasia, and in various aphasic complexes. The word-dumbness is indicative of a somewhat isolated midtemporal lesion only when it presents the peculiar diagnostic symptomatology which has been described in the summary at the beginning of the remarks on this region.

Abscesses of the temporal lobe associated with disease of the middle ear not infrequently give the symptom-complex of the midtemporal region, although symptoms of Wernicke's zone or of the angulo-occipital region may be present when the abscess has notably extended.

Oppenheim,<sup>5</sup> in discussing anomia or word-dumbness under Freund's title of "visual aphasia," says that this visual or optic aphasia is usually associated with alexia, hemianopsia and often with sensory aphasia, but in one case he could discover no trace of word-deafness.

4. Potts, C. S.: THE JOURNAL A. M. A., May 4, 1901, p. 1239.

5. Oppenheim: Text-Book of Nervous Diseases, transl. by Bruce, 1911.

## OSTEOPLASTIC OPENING TO MIDTEMPORAL REGION

This third opening is made with the inferior line running parallel to the zygoma and about one-half inch above it, extending from 2 fingerbreadths behind the external angular process, backward to a line through the mastoid process. The superior line, parallel to the sylvian fissure, runs forward and backward sufficiently far to intersect perpendiculars from the posterior and anterior ends of the inferior line. The breakage here is made on the superior line and the flap turned upward, as shown in Figure 12.

## VISUAL APHASIAS AND THE ANGULO-OCCIPITAL REGION

*Most Important Diagnostic Symptoms.*—Word-blindness, letter- and number-blindness, alexia, visual agraphia, lateral homonymous anopsia or hemianopsia.

*Symptoms Sometimes Present.*—Word-dumbness, visual apraxia, color aphasia (color dissociation), visual hallucinations, paraphasia, inability to copy from sight.

*Symptoms from Invasion of Neighboring Parts.*—Loss of sense of position and passive movements, astereog-

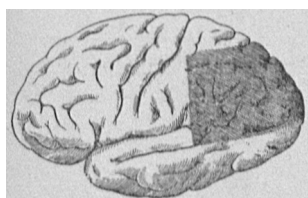


Fig. 13.—The visuo-aphasic angulo-occipital zone.

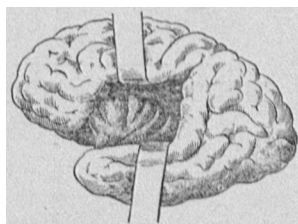


Fig. 15.—External relation of the lenticular zone, the operculum being retracted to show the insula.

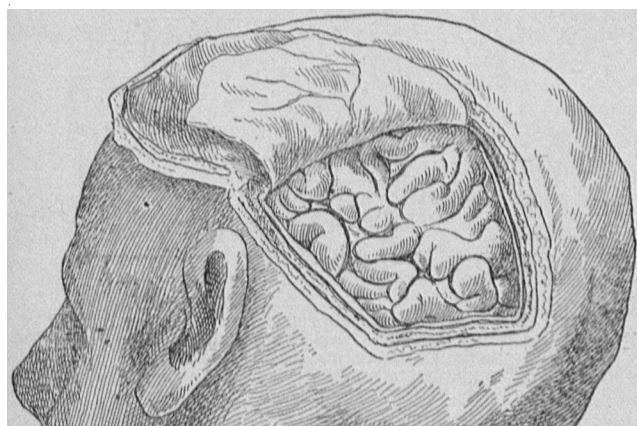


Fig. 14.—Osteoplastic flap to uncover the angulo-occipital region.

nosis, impairment of skin sensibility, word-deafness, partial or complete, inability to copy from dictation.

The aphasic symptoms of a lesion in this region (Figure 13) will be dominantly visuo-aphasic. These will be in the first place word-blindness, usually both cortical and subcortical, letter-blindness and number-blindness, alexia, visual agraphia, lateral homonymous quadrant anopsia or hemianopsia. In making this statement we accept the view that the anterior portion of this angulo-occipital area is preeminently the site of the cortical functions of word-seeing, letter-seeing and number-seeing. The hemianopsia of course results when the lesion invades deeply enough to involve the optic radiation of Gratiolet. Word-dumbness is frequently present, though usually partial. Mind-blindness like mind-deafness most frequently results from bilateral lesions, and scarcely ever shows itself in complete form except when both sides of the brain are implicated. Inability to copy of course goes with the alexia except in

the rare instances of subcortical tumors in which the cortex of the angular region is not destroyed. In such cases the patient occasionally can write, but his eyes once removed from the page cannot, when returned, recognize what he has written.

Among the interesting symptoms of lesion extending into the occipital lobe from the angular region are those of color disturbance, especially color amnesia or color dissociation. Wildbrand, Lewandowsky<sup>7</sup> and Spiller<sup>8</sup> have described interesting examples of these unusual occipital symptoms.

## ANGULO-OCCIPITAL, OSTEOPLASTIC OPENING

The surgeon in operating on the angulo-occipital region must keep in mind the peculiar shape of the skull as it approaches the occipital pole, the position of the great sinuses and the best places for breakage of the flap. The most approved opening to uncover the angular gyre and lateral occipital lobe as low as possible i., we believe, that shown in Figure 14. As here shown, the breakage is made to take place at the anterior limit of the opening. Objection may be made that the opening is larger here than at the posterior boundary and about the same size or nearly the same size as at the superior or

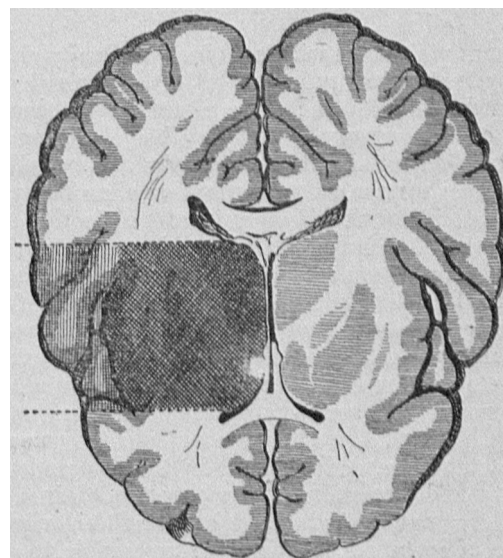


Fig. 16.—Horizontal section of the brain showing deep-seated structures of the lenticular zone on the left corresponding to the shaded area on the right.

inferior line. This method of breakage, however, gives the best opening if the surgeon finds that it may be necessary to extend it somewhat inferiorly or posteriorly. One of the doubts sometimes present when an angulo-occipital tumor is diagnosed is as to how far it is lateral and how far inferior in location, and some opportunity of demonstrating this by exploration is left when the inferior and posterior borders of the opening can be slightly enlarged. Blood-supply is not insufficient wherever the line of breakage may be chosen. It is probably somewhat better when it is placed below. A shorter line of breakage is obtained when this is chosen posteriorly, but it is not difficult for a surgeon experienced with work of this kind to break the skull for any length, especially if he assists in doing this by weakening the flap by means of the Gigli saw. If the short line of breakage is made posteriorly behind the lambdoidal suture the flap may tend to break at this suture and this

7. Lewandowsky: Monatschr. f. Psychiat. u. Neurol., 1908, xliii; cited by Spiller.

8. Spiller, W. G.: THE JOURNAL A. M. A., Dec. 18, 1909, p 2078.

may cause slight delay and necessitate a second breaking farther back. The opening here described and shown has the angular convolution nearly in its center.

#### INOPERABLE TUMORS IN APHASIC CASES

Certain aphaso-graphic cases, especially of tumor, are clearly inoperable. In these the lesion is deep-seated, either in the angulo-occipital region, Wernicke's zone, or the lenticular zone (Figs. 15 and 16). The question of diagnosis is simply one of separating a deep and destructive subcortical from a compressing and penetrating membranocortical lesion. As many cases of aphasia are due to deep-seated lesions of the lenticular zone, it is well to bear in mind the pathognomonic phenomena of such lesions. These are the completeness of the accompanying hemiplegia with such phenomena as indicate clear involvement of the capsules, internal and external, the claustrum and basal ganglia.

### THE NEED FOR GENETIC STUDIES OF PULMONARY TUBERCULOSIS

H. E. JORDAN, M.A., PH.D.

Professor of Histology and Embryology, University of Virginia  
UNIVERSITY, VIRGINIA

Close acquaintance with a particular family characterized by extensive pulmonary tuberculosis has long impressed me with the significance of the hereditary aspect of this disease. The possible importance of a hereditary factor in its propagation, it would seem, should receive more earnest attention than has yet been accorded to it by antituberculosis workers in this country. In an attempt to approach the problem from the genetic point of view I have secured the cooperation of a former student, Dr. Lewis Booker of the North Carolina Tuberculosis Sanatorium at Montrose, who has kindly undertaken the collection of pedigrees in that institution. To date, twelve such histories have been secured as fully as was possible or seemed practicable, but only three of these [Charts 1, 2 and 3] are sufficiently complete to warrant tentative deductions. In the remainder, great difficulty and uncertainty were experienced in attempting to get grandparental and collateral histories; in a number of instances it was quite impossible to get any data respecting these relationships.

Pedigree Chart 1 shows a four-generation history of pulmonary tuberculosis. Both great-grandparents had phthisis. The criticism has been made, in general, that at that early time, when this pair lived, diagnosis was crude and uncertain. I would oppose that because, while probably many mild or obscure cases escaped detection, cases that were recognized as phthisical were undoubtedly such. Consequently tuberculous pedigrees probably never err on the side of showing too great incidence. With our present highly refined and very accurate methods of detecting tuberculous infection the assumed obstacle to conclusive findings is obviated for all future time; and this improved condition emphasizes the importance of beginning extensive genetic studies by trained medical men, especially in sanatoriums, at once.

No information could be obtained regarding the mother (C) of the second generation, or of any member of her fraternity. Regarding her as probably tuberculous, a fair inference in view of her ancestry and her progeny, the chart shows a double tuberculous mating, resulting in a tuberculous fraternity of three. The last fraternity, all tuberculous, is again the result of a double affected mating. Barring the single inferential

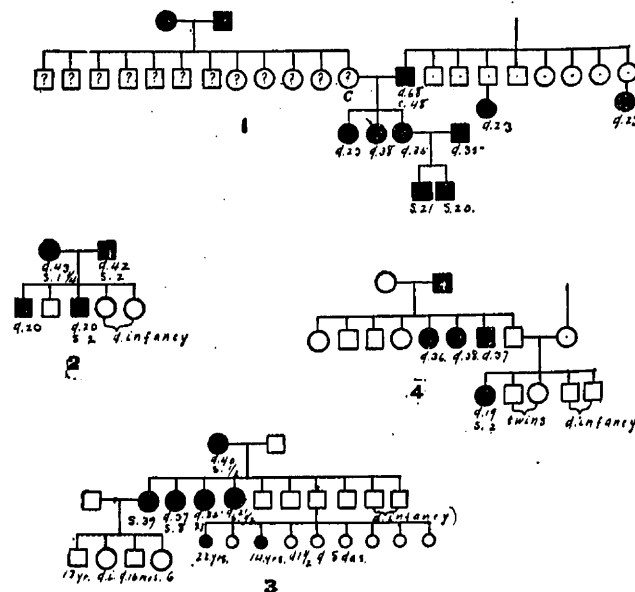
tuberculous individual (C) mentioned, this pedigree strongly suggests the circumstance of grave eugenic significance, namely, that double tuberculous matings produce only tuberculous offspring.

This pedigree indicates also the recessive nature of the assumed tuberculosis factor. It further suggests that hereditary tuberculosis is the result of the absence of something (factor; determiner) in the constitution or germ-plasm, entailing most likely a lack of resistance or a susceptibility to infection.

Chart 2 gives a second fraternity of a double tuberculous mating. It also shows a relatively heavy tuberculous incidence, varying in degree according to the interpretation placed on the infant deaths recorded.

Chart 3 gives a three-generation history of tuberculosis in which only one of the individuals in the several matings was said to have been tuberculous. The incidence of tuberculosis and infant mortality is again relatively heavy.

Chart 4 is very similar and again strongly suggests the risk entailed in tuberculous matings, even where



Charts 1, 2, 3 and 4.—Pedigrees showing influence of heredity in tuberculosis; circle indicates female, and square, male; solid black squares or circles indicate tuberculous persons; d, died at age indicated; s, sick for period indicated; c, cured for period indicated.

one of the parents is apparently normal. The F generation approximates closely an R R by D R cross (assuming the tuberculous tendency to be recessive to the normal) as does also the corresponding fraternity in Chart 3. Normals can be certainly designated as such only on the basis of a knowledge of their ancestry. Many so-called "normals" may still carry the latent tuberculosis factor which may come to reassert itself in future generations.

The objection can be justly urged that it was impossible here to estimate accurately the relative weight of infection, including virility, size and frequency of dose. It is true that in no case are the conditions of home life fully known to us. This simply serves to emphasize the importance of accurately controlling and evaluating the environmental factors in the future work urged along this line. Professor Karl Pearson's biometrical studies of phthisis, however, cogently indicate that infection is a secondary factor in tuberculosis morbidity.

The position I desire to maintain is this: An almost unanimous doubt seems to exist regarding the importance