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RECURRENT "ATTACKS" OTHER THAN MIGRAINE AND INFANTILE CONVULSIONS PRECEDING "TRUE" EPILEPSY *

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In this study, the records of 500 patients with epilepsy seen in private practice were reviewed for the purpose of noting all recurrent attacks preceding the true seizure and determining, if possible, their relation to epilepsy. The same series of cases has been utilized in previous studies.[1]

The original series of 500 comprises only those cases of epilepsy in which there were no physical conditions. Even cases in which other conditions were most likely merely complications were excluded: e.g., rheumatic arthritis and otitis media. Sixty-four records were found in which recurrent "attacks" other than infantile convulsions and migraine were noted. They are divided into ten groups, according to the nature of the symptoms. It can, of course, be taken for granted that some of the "attacks" recorded have little or no relation to epilepsy. Others probably are related to the subsequent epilepsy. In general, one may assume that those attacks which later become part of a classic convulsion probably were forerunners of epilepsy. Our problem becomes, then, one of differentiating this forerunner of a "debutante" attack (Herpin) from nonpreepileptic forms. This problem already has been considered, especially by Herpin [2] and Gowers.[3] These authors, however, have not paid particular attention to such attacks as forerunners. They have found them chiefly as incomplete forms or variations of petit mal attacks after true seizures had commenced. In this connection, Herpin's work is most thorough and illuminating.

The difficulty of getting an accurate estimate of infantile convulsions in an epileptic group [1] is not so great as in getting accurate data of

* Submitted for publication, Nov. 3, 1927.

* Read at a meeting of the Chicago Neurological Society, Jan. 19, 1928.

1. Patrick, Hugh T., and Levy, David M.: Early Convulsions in Epileptics and in Others, J. A. M. A. **82**:375 (Feb. 2) 1924; The Diagnosis of Epilepsy, ibid. **79**:1009 (Sept. 23) 1922.

2. Herpin: Les accès incomplèts d'épilepsie, Paris, 1857.

3. Gowers, W. R.: The Border-Land of Epilepsy, Philadelphia, P. Blakiston's & Company, 1907.

attacks such as are covered in this paper, in spite of a number of factors previously considered, chiefly the absence of the parent at the time of history taking and the memory factor. At least in regard to infantile convulsions, direct questions were asked. The recurrent attacks considered in this paper are the spontaneous contributions of the patient and depend on certain chance factors. Besides, as compared with an experience as objective and dramatic as an infantile convulsion, they are subtle and elusive symptoms. Consequently, the number found in the records, sixty-four, doubtless falls far below the actual number. In pointing out the possible preepileptic significance of these "attacks," it is hoped that more attention will be paid to them, and that in this way the large number of mild periodic attacks, later eventuating in the complete seizures, can be definitely recognized and the patient treated at the optimum time.

Although all of these attacks show considerable similarity in some respects, their obvious heterogeneity made it seem advisable to present them in groups. While this plan tends to minimize confusion, it still serves to emphasize the polymorphism of these preepileptic or initiatory symptoms, for the sixty-four cases can be divided into ten fairly logical groups.

The classification by characteristic and related symptoms, including the number of cases in each group, was:

Group 1: Attacks of "dizziness," "falling sensation," "dazed feeling," "faintness" and fainting—seventeen cases.

Group 2: Attacks of vomiting, or belching, epigastric sensation, and sensations of rising gas, of "trembly" and "queer" feeling in the abdomen—thirteen cases.

Group 3: Attacks of hot flushes and pallor—three cases.

Group 4: Sensory "attacks" in the face, head and body—three cases.

Group 5: Attacks of throat spasm, asphyxia and thirst—three cases.

Group 6: Attacks of cross spells, "erratic spells," screaming, crying and laughing—five cases.

Group 7: Attacks of "dreamy states," "lonesome feelings," "queer feelings," "frightened feelings" and change of consciousness—eleven cases.

Group 8: Attacks of insomnia, drowsiness and night terrors—three cases.

Group 9: Attacks of sudden disturbances of gait, "jerking of extremities" and "shivering"—three cases.

Group 10: Attacks of "visions," "darkness" and "buzzing in the ears"—three cases.

GROUP 1: ATTACKS OF "DIZZINESS," "FALLING SENSATION," "DAZED FEELING," "FAINTNESS," "FAINTING"

TABLE 1.—*Data in Seventeen Cases*

Case No.	Age	Sex	Family History*	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
1	11	M	Negative	Negative	At age of 4, began to have momentary dizzy spells, without falling, one a day to one a month; more severe at age of 6 when confused for a few minutes following each attack; these continued to age of 8, with increasing frequency; past few months, one attack daily	8	..
42	13	M	Negative	Seven mos. pregnancy; strabismus since age of 3; nocturnal enuresis	At age of 8, momentary dizzy spells, would say "papa, I'm dizzy," and almost instantly, "I'm all right now"; second attack one year after first; gradually more frequent to 2 or 3 times a day; at age of 8 also lagging at school; also nocturnal attacks for past year	10	..
51	25	M	F. epilepsy; br. migraine	Negative	Since childhood, attacks in which appeared "dazed"; saw everything blue; lasted a few seconds; frequency blue; lasted a few seconds; frequency, once in from 3 weeks to 2 months	..	21
64	24	M	Negative	Negative	At age of 12, slight attacks began in which "all around him would become dense," would breathe heavily, slightly dizzy, dazed for a few seconds, not unconscious, recovered in a minute; about once in 4 months to age of 17; after 17 years of age increased frequency of these and a new type of attack in which he had a cold chill, the air felt close; unconscious for part of a minute; never fell; recovered, though remained confused for five minutes; frequency about once in 2 months until major convulsions at age of 21 years	17	21
22	43	M	Negative	Negative	Since age of 13, slight dizzy spells without loss of consciousness; immediately preceding spells sense of dead dull pain across coccyx and sacrum, "so slight paid no attention to them"; once every morning; three months ago after a hot day spells became more severe, followed by light-headedness lasting an hour or more and sometimes by staggering and dyspnea; last night a spell in which fingers and ears became white and cold for 5 or 10 minutes; never lost consciousness	43	..
35	29	M	Negative	Negative	At age of 19, brief dizzy spells without loss of consciousness about once daily; afer a year, "confusion" at first momentary, later lasting a minute or more, about once daily and independent of other attacks; attacks of "confusion" feeling occur 2 or 3 hours before the grand mal seizures which began at age of 26	..	26
33	24	F	Negative	Negative	At age of 20, dizzy spells which "changed" in three years to attacks of momentary unconsciousness with groaning sound and tasting or chewing movements following the attack	23	..
20	35	M	M., two br., two s., migraine	Migraine since age of 15	At age of 35 (six days before onset of grand mal), developed "sinking spells," feeling as though about to faint with feeling of fulness over forehead, peculiar choking sensation in throat, voice husky, speech deliberate, face pale, sour taste in tongue, and dyspnea during attacks; of from 2 to 10 minutes' duration, though no loss of consciousness; face flushed and perspired after attacks which occurred every 2 hours during the day; three or four times during the night awakened by peculiar taste in tongue, and a feeling of "goneness" comes	..	35

* In this and subsequent tables the abbreviations indicate: f., father; m., mother; b., brother; s., sister; p.g.f., paternal grandfather; p.g.m., paternal grandmother; m.g.f., maternal grandfather; m.g.m., maternal grandmother; p.u., paternal uncle; m.u., maternal uncle; p.a., paternal aunt; m.a., maternal aunt; p.c., paternal cousin; m.c., maternal cousin.

TABLE 1.—*Data in Seventeen Cases—Continued*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
27	60	M	Negative	Pneumonia at age of 8 and 45; typhoid at age of 18; suppurative otitis media several times to 25 years ago	About ten years ago spontaneous dizzy spells occurring one or two times weekly, also occasional attacks diplopia, same frequency, lasting from 1 to 20 minutes	..	58
23	43	M	M., one s., two br., migraine	Torticollis since birth (forceps)	Since age of 38, slight attacks of sudden "blurring" and feeling dazed, few seconds' duration; sensation as if going to fall, though never did; no loss of consciousness; average frequency about twice daily	43	..
15	59	M	Negative	Excessive alcoholism until 12 years ago, over period of 3 years	(At age of 12, one attack of a sudden unconsciousness while on a horse; no fall); Since age of 54, about once a month, dizzy spells in which feels like falling, feels "blank, has no thoughts"; no loss of consciousness; sometimes followed by slight nausea with hiccup of several minutes' duration; these continued to 1½ years ago, when patient was 57	..	57
12	14	F	Sister has fainting spells; M. and p.g.f., migraine	Nocturnal enuresis to age of 12	Fainting spells in childhood.....	..	13
11	21	F	Mother, m.g.m., 2 m.a., 2 sisters, migraine	Chorea at age of 14; since then school work poor	Since age of 14, slight dizzy spells several times a day; fell to floor 2 or 3 times and immediately got up again; no loss of consciousness	..	19
13	25	M	Mother has migraine	Negative	At age of 15, fainted in a theater; long time coming to; since then agoraphobia; since age of 17, on rising, brief dizziness and sometimes fainting spells nearly every morning	..	18
57	16	F	M. and b., migraine; m.a., epilepsy	Arthritis; endocarditis; frequent tonsillitis at age 12; tonsils and adenoids removed at age of 12	At age of 15, while combing hair, sudden "blackness," dropped comb, was dazed a few seconds, then recovered; since then five other "dazed spells"; grand mal 14 months after onset; of these one only was followed by "dazed spells"	..	16
21	26	M	Negative	Bad accident at age of 11, unconscious, delirious 4 days, then stupor 1 week	At age of 17, four months before grand mal, "dizzy spells" which continued to age of 24 independent of grand mal seizures; latter have persisted	..	17
5	18	M	Five b. and s. died in infancy; four are well	At age of 5 fainted when a sliver was removed	At age of 18, six months before first examination, awoke suddenly at night frightened; three weeks later, on a hot day, tired, sudden feeling of faintness and an orange fell out of his hand; since then, 10 attacks of feeling faint, with pallor (six mos.) mostly after getting up in the morning; two months following these attacks, petit mal; and two months following petit mal, grand mal; further course: bromides administered at age of 18; free from attacks for two years when had one grand mal seizure; none after that for four years (age of 24); then omitted medicine and had one grand mal seizure, after which no attacks while taking medicine until one year later	18	18

Comment.—Typical of the "dizzy spells" in group 1 are: the momentary character, the paucity or lack of accompanying symptoms, the gradual increase in frequency, with the added element of confusion and change or loss of consciousness. They differ in this respect from other attacks of dizziness or vertigo as in the following excerpts from twenty-eight records of nonepileptic patients showing similar symptoms, but in relation to organic changes, alcoholism and the psychoneuroses.

DIZZINESS OR VERTIGO IN NONEPILEPTIC CONDITIONS; TWENTY-EIGHT CASES[4]

DIZZINESS OR VERTIGO WITH ALCOHOLISM

CASE 1: Dizziness in man, aged 45, related to sprees; discontinued alcohol five months ago and is now almost free from the effects; physical examination gave negative results.

CASE 2: Dizziness, vertigo and alcoholism in a man, aged 41, related to sprees; stopped when he ceased drinking; physical examination gave negative results.

DIZZINESS OR VERTIGO WITH MENTAL SYMPTOMS: HYSTERIA PSYCHONEUROSIS, PHOBIA OR PSYCHOSIS (CASE 13 ALSO TRAUMA)

CASE 3: Hysteria, vertigo in woman, aged 69; dizziness since age of 67 in attacks of a week's duration, related to emotional shock and other psychic factors; physical examination gave negative results.

CASE 4: Psychasthenia, vertigo in man, aged 33; swimming feeling in head, especially with postural change and aggravated by much business worry; physical examination gave negative results.

CASE 5: Psychasthenia, vertigo (?) in a man, aged 35; attacks of dizziness aggravated by postural change since age of 32, gradually worse, once almost fell; also syphilophobia (latest note in record shows the man well for eleven years following the first examination).

CASE 6: Psychasthenia, vertigo (?) in a man, aged 45; onset at age of 43, gradually increasing dizziness aggravated by turning the head; slight difficulty in hearing; much fear of falling.

CASE 7: Psychasthenia, vertigo in man, aged 32; attacks in which he lay down on the floor with indigestion, fear of dying, dizziness and difficulty in breathing; onset five months before; also a number of attacks lasting several seconds; also crying spells.

CASE 8: Psychasthenia, stammering, dizziness, in a man, aged 25; attacks of dizziness, onset seven weeks before, lasting from several seconds to a half hour, in which he felt as if falling to one side; slight middle ear deafness; examination otherwise gave negative results.

CASE 9: Psychasthenia, vertigo in a woman, aged 66; onset two weeks before of dizzy spells and sinking sensations during which she was unable to lie on her side; also depression and symptoms of psychasthenia.

CASE 10: Psychasthenia, vertigo (?) in a man, aged 27; one week before had dizziness while in bed, which was aggravated by turning to either side; also three weeks before had the idea that a knife was coming in and out of the mouth; hearing normal; much business worry.

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4. Only the essential facts relating to this study are taken from the anamnesis.

CASE 11: Psychasthenia, phobia, vertigo in a man, aged 28; onset of vertigo at age of 26, in attacks lasting fifteen minutes; since then more or less constant; also phobias and insomnia; physical examination gave negative results; a report two years later stated that "vertigo" was of "little importance."

CASE 12.—Psychasthenia (?), manic-depressive psychosis, vertigo in a man, aged 61; at age of 15 had attacks of "swimming sensation" in head and feeling of confusion (disorientation) of several minutes' duration, to age of 31; then well for twenty years; at the age of 51, similar attacks; onset with a primary depression; otitis media on the left side.

CASE 13: Vertigo, hysteria, traumatism in a youth, aged 17; constant dizziness with anosmia (except for ammonia) following a fall at the age of 17 in which he had an epileptiform convulsion.

Comment.—In both cases 1 and 2, dizziness or vertigo was related to sprees and was alleviated by discontinuing the alcohol; also the attacks were of long duration, or more or less constant.

In cases 3 to 13, the attacks were of long duration, fifteen or more minutes, or described as more or less constant, in contrast to the momentary phases of preepileptic vertigo; related to posture according to the patient even though this was not verified by physical examination; attended by a feeling of fear, worry, phobia, precordial distress, difficult breathing or obsession. In case 7, after a long attack (fifteen minutes' duration) when patient was 32 years of age, several lasted only a few seconds.

VERTIGO WITH ORGANIC CHANGES IN THE CENTRAL NERVOUS SYSTEM

CASE 14: Dizziness, hyperacusis, arteriosclerosis in a woman, aged 72; since age of 40 had had attacks of dizziness with nausea and falling, of several minutes' duration, several times daily but no loss of consciousness; physical examination revealed evidence of arteriosclerosis, especially of the ocular fundus.

CASE 15: Vertigo, aural vertigo (?), thrombosis in pons in a woman, aged 67; a stroke at the age of 66 with dysphagia, dysarthria and dizziness, though no loss of consciousness; since then, on and off, dizzy spells with tinnitus; systolic blood pressure, 212.

CASE 16: Nervousness, dizziness, thrombosis in pons in a woman, aged 66; one month before awoke with dizziness, object rotation and vomiting; the dizziness was aggravated by change of position (she had taken barbital because of insomnia for the preceding three weeks); no tinnitus; no headache.

CASE 17: Vertigo, thrombosis (?), nephritis in a man, aged 59, with deafness in the left ear fifteen years before; for the past seven months had had attacks of dizzy spells in bed, with perspiration, could not stand during attacks, and later with a slight stagger; the attacks of dizziness lasted all day; systolic blood pressure, 182.

CASE 18: Vertigo, arteriosclerosis in a man, aged 48; otitis media on the right side six months before; since then attacks with falling to the right, necessitating holding for support, dizziness all day, slight nausea, no vomiting; occasional diplopia since onset.

CASE 19: Vertigo, arteriosclerosis, thrombosis; age of patient not given; attacks with lying on the side, aggravated by turning to the side; speech indistinct; systolic blood pressure, 230; recovered with administration of sodium nitrite, 2 grains (0.13 Gm.).

CASE 20: Diabetes, cerebellar thrombosis (?), vertigo in a woman, aged 64; diabetes since age of 49; vertigo with vomiting for two days at age of 63, since then has been dizzy, aggravated by turning the head; tinnitus on the left; gait uncertain.

CASE 21.: Dizziness, headache, abscess of cerebellum (?) in a man, aged 36; deafness in left ear, tinnitus, mastoid pain, dizzy spells, of ten minutes' duration; onset not stated; physical examination gave negative results except that the dizziness was caused by turning the eyes.

CASE 22: Tabes, vertigo in a man, aged 45, whose three sisters have epilepsy; since age of 44 had had attacks of vertigo with nausea of several seconds' duration, once in from two to seven days; also a history of alcoholism.

CASE 23: Traumatic paralysis of third nerve, vertigo in a man, aged 49; paralysis of the third nerve, with vertigo, disturbance of gait and diplopia.

Comment.—In all these cases except two (22 and 14) the vertigo or dizziness had been prolonged, the shortest attacks being recorded as lasting ten minutes; others lasted for days; there was also an influence of posture, often with pathologic process of the ear and always with evidence of organic change.

In case 22, vertigo with tabes, there was a history of three instances of epilepsy in the family, and a history of alcoholism in the patient in addition to evidences of neurosyphilis. The attacks were momentary with long intervals between, however, and in this particular resemble those in the group of cases of epilepsy. In case 14, the attacks were also brief, of several minutes' duration, and were attended by a fall, though no loss of consciousness had occurred since the age of 40 in a woman, now aged 72.

CASES DIAGNOSED AS VERTIGO

CASE 24: A woman, aged 42, with a history of migraine; attacks of dizziness of a few minutes' duration, preceded by a heavy feeling in the head during the past year; objects appear to move slowly from left to right; during the attack has to hold on or to sit down; nausea lasting one half to one hour follows; many attacks without headache; physical examination: turning the head brought on dizziness; hearing, normal.

CASE 25: A woman, aged 34, had had attacks of dizziness lasting all day, during which she left "dazed and dizzy" on moving the head; attacks followed by nausea and vomiting, with relief; during the attacks objects appeared to turn from right to left; physical examination revealed evidence of toxic labyrinthitis, no deafness; vestibular tests gave negative results.

CASE 26: A man, aged 74, from the age of 54 to 56 had a period of worry, insomnia and inappetence; at age 71, an attack of dizziness with staggering and falling; several occurred in one day and usually he staggered to the right; in the second attack he had to go to bed for two or three days; attacks were aggravated by posture; no nausea; no tinnitus; no loss of consciousness; hearing, normal.

CASE 27: A woman, aged 62, had had tinnitus for the past year; recent attacks of dizziness with vomiting, of from one to two days' duration, during which objects seemed to turn from right to left; unable to walk; fell to one side; hearing, normal.

CASE 28: A man, aged 47, at age of 27 had a first brief attack; attacks recurred with a frequency of from two to three times a year, then with gradually increasing frequency; attacks consisted of dizziness, nausea (without vomiting) and tinnitus in the left ear, and were of from two to three seconds' duration; six weeks before had an attack lasting two hours, with nausea and vomiting, which were aggravated by turning the head to the left; since, similar attacks occurred, in one of which he had to crawl on hands and knees; a competent otolaryngologist reported: "ear examination negative, except left static apparatus decreased reaction."

Comment.—In all true (objective) vertigo the following points may be noted: long duration, object rotation, tinnitus, nausea or vomiting and difficulty in locomotion. All recurrent attacks of momentary dizzy spells should, according to this account, be regarded with suspicion as possible forerunners of epilepsy and be thoroughly investigated. When confusional states are later added to such attacks, they may already be in the form of petit mal.

The possible relationship between fainting attacks and epilepsy, though probably distant, has been covered previously in that it has been shown to be in correlation with infantile convulsions.[5] The relationship between fainting and similar attacks with epilepsy has been noted by previous authors.[6]

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5. Patrick, Hugh T., and Levy, David M.: Relation of Infantile Convulsions, Head-Banging and Breath-Holding to Fainting and Headaches (Migraine?) in the Parents, Arch. Neurol. & Psychiat. **19**:865 (May) 1928.

6. The following authors have reported on the relationship between fainting and similar attacks with epilepsy:

Armstrong-Jones, R.: Epilepsy and Some Kindred Attacks, Practitioner **107**: 381 (Dec.) 1921. This article deals with syncopal "attacks."

Hutchison, R.: Fainting Attacks in Children, Brit. J. Child. Dis. **13**:11 (June) 1916. The author cites ten cases and differentiates them from petit mal. One case observed was followed by confusion but was not followed up.

Echeverria, M. G.: On Epilepsy, New York, William Wood & Company, 1870, p. 38. The author notes: "Paroxysm may occur without muscular spasm; it does not, however, without a disturbance of the vasomotor elements in its inception; and hence paleness of the face or loss of consciousness or vertigo, not infrequently are the whole symptoms of the epileptic attack in the early stage of the disease.

Tracy, E. A.: Incipient Epilepsy: Its Diagnosis and Treatment, Sec. Nervous and Mental Diseases, A. M. A., 1921, p. 30. The author notes: "Careful history taking has uncovered the fact that in a considerable proportion of the cases of chronic epilepsy investigated in children, there was a period extending from six months to two years or more during which the child had fainting spells or sudden weakness."

Herpin (footnote 2). According to Herpin: "Symptoms occurring during interval of grand mal such as cramps, jumps, twitchings, spasms, partial convulsions, vertiginous attacks, cephalic sensations, visual hallucinations or other subjective phenomena, are the major or complete seizures reduced to their initiatory symptoms or sensations." He observed "incomplete attacks" chiefly in the intervals between "true" seizures.

GROUP 2: ATTACKS OF VOMITING OR BELCHING, EPIGASTRIC SENSATIONS, SENSATION OF RISING GAS, OF "TREMBLY" AND "QUEER" FEELING IN ABDOMEN

TABLE 2.—*Data in Thirteen Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
7	32	F	P.a., f. and m., fainting spells	Negative	At age of 6 had scarlet fever with nephritis during which three convulsions occurred, shortly after convulsive seizures she began to have attacks of pressure sensation in epigastrium with nausea, no vomiting; duration a few seconds; frequency, one in two or three days, until age of 11, when menses began; before first menstrual period had intense hemicrania with nausea and vomiting of few hours' duration, "probably unconscious for awhile"; similar headache usually one week before each menstruation at age of from 11 to 17; at age of 17, typical petit mal in which aura is always epigastric pressure	17	..
8	19	M	F., alcoholic; m., migraine	Negative	At 8 years of age attacks in which, for about 10 minutes there was a sensation of gas in left iliac region with excessive flow of saliva followed by belching; frequency about one a week for three weeks, then none for a year, and then about once a week	..	14
3	42	M	Negative	Horse kick on right temple; not unconscious; chorea at age of 6; acute rheumatism; 3 attacks between age of 9 and 15; periodic headaches since age of 15	At 8 years of age, attack of sudden feeling of nausea in chest, rising to head; then confused and dazed for five or ten minutes, during which time would try to talk, but could not; not unconscious, felt "mentally weak" several hours afterward; occurred twice at night, otherwise in day about once in from two weeks to two months until age of 42	..	42
55	24	F	M. and one s., migraine	Convulsions at age of 6 with meningitis; recurrent headaches since age of 14; dysmenorrhea	Between 11 and 14 years of age, attacks of nausea "from stomach upward"; momentary; no loss of consciousness nor dazed feeling; once monthly with increasing frequency to age of 20 when two or three times a month; grand mal at age of 22 with aura of nausea	..	22
32	36	M	M., migraine her half-s., epilepsy	Gonorrhea at age of 28	Between 14 and 15 years of age, about six attacks of "queer feelings" in abdomen followed by headache; present petit mal attacks are brief lapses in which everything becomes confused, but he retains consciousness; stops whatever he is doing; never falls; slight stare; "afraid to speak" during attack	35	35
48	32	F	Negative	Long labor; asphyxia	At age of 16 or 17, attacks in which "wave" came up from abdomen over face, which flushed; mouth full of saliva; heart rapid; few seconds' duration several times a day in three day periods; during these days dull headache and anorexia; these attacks continued to age of 22 when major convulsions began	..	22
36	35	M	F. and s., migraine	Convulsions two or three times in infancy; fainted at age of 12, 14 and 20	At age of 16 or 17, during two summers on farm working for vacation, would occasionally have attacks in which fingers would get numb, and this sensation passed through body; unable to speak for a moment; dizzy and pale; in one attack, evidently dazed and had headache; from four to six months before first major convulsion had much headache with aura of hemianopia	..	31

TABLE 2.—*Data in Thirteen Cases—Continued*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
29	36	F	Negative	Negative	At age of 26, attacks of "queer sick feeling" passed over her like wind (made gesture from below up) and in course of time not so frequent (three to four times a day) though longer; since 34 years of age, attacks with loss of consciousness, of which attacks mentioned were aura; grand mal since age of 35	34	35
52	56	M	One s. with migraine	One of twins	When about 25 years of age, fainted after a plaster was applied to back; since then wife noticed that he would become nauseated and feel faint when he had any pain; for past three or four years would fall asleep at odd times, even in the midst of conversation; two years ago fainted when in bathroom; was all right in a few seconds	..	54
61	40	F	Negative	Irregular menstruation	At age of 35, since birth of last child, occasional "trembly feeling in abdomen" whenever irritated by noises; four years ago had attacks of hot flushes lasting a few minutes, in which the face turned red and everything "felt loosened up"; aura of the major convulsion is this feeling and a feeling of "oppression" in abdomen and chest	..	39
16	54	F	Negative	Negative	At age of 38, a sudden attack of right hemiplegia (partial) without aphasia (is right handed); could walk again in a few days and dragged leg a few weeks; since then occasional attacks in which she would belch gas; this was accompanied by a "lifeless" feeling, though never dazed; no headache; five years ago, some months after an operation on the left knee, fainted and fell out of chair, well in a few seconds	..	51
39	65	M	M. and 1 b., migraine	At age of 12 to 15, migraine with vomiting	At age of 58, attacks of sudden slight nausea, dazed a few seconds, then well- about one in two months to age of 64	..	64
38	60	F	Negative	Seven mos. ago depression of 5 weeks' duration	At age of 50, peculiar sensations in epigastrium spreading upward to head, lasting a few seconds; twice daily for 3 months, when same attacks were followed by loss of consciousness	50	..

Comment.—In seven of the thirteen cases the momentary character of the sensation is noted: pressure sensation in the epigastrium, nausea, and especially rising wavelike sensations in the abdomen (cases 7, 3, 55, 48, 29, 39 and 38). This momentary duration alone differentiates such symptoms from those of psychasthenia or gastric ulcer, besides the usual differential criteria. Confused or dazed states were added to these momentary attacks long before unconsciousness was noted in cases 42, 36, 16 and 39. Salivation was noted as part of two of these attacks (cases 8 and 48). Throughout the entire series, the frequency of such added symptoms as fainting, recurrent headache and infantile convulsions should be noted. In combination with attacks of the character described, they reenforce the suspicion of an epileptic character. In six of the thirteen cases in this group, the recurrent attacks became a phase of the complete epileptic seizure (cases 7, 55, 36, 29, 35 and 38). These attacks, with added confusional states or any change of consciousness, should, in the light of

these observations, be regarded as epileptic unless proved otherwise. In this connection, case 3 should be noted especially. Case 36 is probably a preceding migrainous attack, in which the headache was of minor consideration. When general symptoms occur in the "preepileptic" attack, the matter of classification is purely arbitrary. Case 36, for example, could have been placed in group 1 because of the dizziness, or group 4 because of the numbness in the fingers; similarly with many others in each group. The placing was determined by the symptom that appeared most characteristic. No case was put in more than one group.[7]

GROUP 3: ATTACKS OF HOT FLUSHES, PALLOR

TABLE 3.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
30	9	M	M., periodic headaches	Negative	Since age of 7, suddenly turned pale about once a month; past summer, attacks more pronounced and sleep afterward; first fall (with involuntary evacuations) six months after onset	7½	..
58	24	M	Negative	Accidental fall; lay unconscious five hours; nocturnal enuresis to age of 4	At age of 10 or 11, occasional pallor and momentary confusion several times that year; well after that to age of 18 when developed petit mal	18	24
14	28	F	Negative	Negative	At age of 24, attacks two or three times daily of hot flushes of face preceding menstruation, continuing during first two days of menstruation; at age of 26, character of attacks changed	26	..

Comment.—Of these three cases, the first two appear significant in that the attacks were momentary and followed by sleep or confusion states. In case 14, nothing in the description of the attack appears suggestive of a possibly partial or preepileptic seizure; it may, of course, have no such relationship. However, it must be repeated that the possible significance of these apparently mild upsets were unknown at the time to the physicians who recorded them in the anamnesis; they therefore escaped further investigation. Many such attacks were probably overlooked.

7. Turner, W. A.: Three Lectures on Epilepsy, Edinburgh, J. F. McKenzie, 1910. Turner gives examples of epigastric auras, choking sensations, salivation and feeling of fear, which also were independent attacks without loss of consciousness. He regarded the speed of the upward march of the epigastric sensation to the head as indicative of epilepsy. Gowers (footnote 2). The "ascent sensation" stomach to chest, throat and head is characteristic. The duration of Gowers' vasomotor attacks are from fifteen to twenty minutes and they have other characteristics of pseudo-anginal attacks.

GROUP 4: SENSORY "ATTACKS" IN FACE, HEAD, BODY

TABLE 4.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent First Symptoms Preceding Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
40	30	M	M., migraine; One s., infantile convulsions	At age of 9 or 10, an accident with horse; unconscious?	At age of 10 or 11 until age of 13 or 14, several attacks in which throat, tongue and lips seemed paralyzed; some drooling; could make only inarticulate sounds; lasted a few seconds; had one at night; no unconsciousness	..	13
17	24	M	M. and 1 s., migraine	Negative	Since age of 14, attacks of creeping sensation around right corner of mouth of from a half to one minute duration; no other sensation; no loss of consciousness; once in from two weeks to six months; none between ages of 19 and 21; then more frequently, and daily since; at age of 24, major convulsion beginning in right corner of mouth	..	24
19	43	F	Negative	Acute rheumatism with endocarditis 7 and at 35; periodic headaches for one year preceding menstrual periods; (double mitral murmur)	At age of 28, attacks of prickling sensation in side of face, lasting about five seconds, with "far away feeling" and nausea, with "regurgitation" of a mouthful; no loss of consciousness; could talk during attack; four or five attacks daily for three days a week preceding and following menstruation; none for past ten years, but past six months prickling sensation in tongue preceding petit mal; three years ago husband noticed that occasionally she was pale and during pallor answered irrelevantly; during these attacks she says she knows what is being said to her, but cannot speak; past two years, these attacks began with feeling of lump in throat, also swallowing movements, drooling; in past year, after these attacks, two or three minutes' duration, an hour elapses before fully regains consciousness; occur at any time of day or night	40	..

Comment.—Of the three "sensory attacks" recorded, two were followed by drooling, speech disturbance or change of consciousness, though no complete loss of consciousness. In cases 17 and 19, the sensory attacks became the aural phase of the epileptic seizure. The time interval between first "preepileptic" and the "true" seizures should be noted in cases 17 and 19—ten and twelve years, respectively. A sensory aura, especially a rising sensation of numbness beginning in the finger tips, has been frequently described for epilepsy and migraine, and a differential diagnosis worked out by Gowers and others. As independent attacks preceding epilepsy, they are rarely mentioned, if at all.

GROUP 5: ATTACKS OF THROAT SPASM, ASPHYXIA, THIRST

TABLE 5.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
2	44	M	G.g.f., epileptic; f., eccentric	Negative	At age of 37 to 38, frequent spasmodic attacks of pharyngeal muscles without dimming of consciousness; in sleep, from several an hour to one a week; duration up to 10 seconds (timed); ceased three years ago when major seizures began	..	41
46	10	F	F., migraine	Negative	At age of 8, would suddenly run to parents and say "water" or if in school would suddenly run to drink water, during which times would feel dizzy; as soon as she had a drink felt all right; major convulsions at age of 9 with an aura of a feeling of thirst	..	9
6	43	F	Negative	Infantile convulsions at age of 6 months; at age of 35, colitis and operation for gallstones	At age of 35, attacks in which suddenly felt asphyxiated, beginning with peculiar feeling in epigastrium just before going to sleep; about once every two nights; later, also occurred during the day; never unconscious; continued to talk or write during them; after one or two years was well until major convulsions at age of 43; now has both types	..	43

Comment.—In case 2, one wishes for more information and suspects a petit mal attack with momentary loss of consciousness. Herpin has noted that auras on the face and region about the mouth are unusually brief. Both types of attacks in cases 46 and 6 became part and parcel of the epileptic seizure, in case 6 alternating with major convulsions. Such momentary attacks as are described under group 5 are rather unique and at once suspicious.

GROUP 6: ATTACKS OF "CROSS SPELLS," "ERRATIC SPELLS," SCREAMING, CRYING AND LAUGHING

TABLE 6.—*Data in Five Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
4	13	F	M., migraine	Born asphyxiated; attacks of jaundice in childhood; fall at 6 months of age, probably unconscious; a few vomiting spells when teething	Since age of 2, cross spells coming on suddenly without cause, lasing several days or only an hour; at age of 6 or 7 about once in three months would scream in sleep; at such times the mother would find her limp in bed; typical major convulsions at age of 8, also petit mal at age of 9	9	8
24	30	M	P.g.m. and f.	Negative	At age of 2, sudden screaming spells in which he would lie on the floor, kick and dig at his arms for from 30 seconds to 1 minute, and then would run off and play; stopped at at age of 5 years; since age of 1, mother had noticed that the eyes would occasionally roll up for a second or two, about once or twice a week throughout childhood	14	20

TABLE 6.—*Data in Five Cases—Continued*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
60	19	M	Negative	Negative	At about age of 3, began having momentary attacks in which he staggered and laughed; apparently always conscious; these occurred several times a week and continued to age of 15 or 16 when frequency was probably several times a year; attributed to exertion or excitement	..	18
45	13	F	M., migraine	Profuse menstruation	Since age of 11, occasional spells of laughing and crying with little or no provocation; at that time sleep walking began and during such periods also would make swallowing motions and fuss with bedclothes; two or three times a week; at age of 11, also began wetting the bed for about two months; headaches also since age of 11, with occasional nosebleed	..	13
31	40	F	Negative	"Worm fits" in childhood; past 3 or 4 years attacks of stomach distress with nausea or vomiting; operation on uterus at age of 38	Since age of 26, husband noticed attacks of "erratic spells" in which she would lose her temper over a trifle and be out of sorts for several days; since age of 35, attacks of "transitory bewilderment" lasting several seconds; these now occur once or twice on the day preceding major convulsions	35	38

Comment.—The cases in group 6 bring up the question of the relation between certain disturbances in sleep, outbursts of temper and epilepsy. We have recently shown that infantile convulsions and certain displays of temper, notably head-banging and breath-holding, have "positive correlations."[8]

In case 4, the spells of screaming during sleep, followed by limpness, were probably major convulsions. In cases 4, 24, 60 and 45, the outbursts differ from "ordinary temper" in their suddenness, brevity and apparent lack of cause; disturbances of sleep, pavor nocturnus and somnambulism occurred in cases 4 and 45; the frequency in the group of such recurrent attacks as vomiting spells in cases 4 and 31, infantile convulsions (case 31), nosebleed (case 45) and partial loss of consciousness (case 31)[9] should also be noted.

8. Patrick, Hugh T., and Levy, David M. (footnote 5). Heuyer, J.: Les troubles du sommeil chez l'enfant, J. méd. franç., vol. 15, November, 1926, especially pp. 6-17.

9. The following authors may be referred to:

Vogt: Die Epilepsie im Kindersalter, Berlin, S. Karger, 1910, p. 127. Vogt regards twilight or confusional states or periodic irritable moods in children as aids in the diagnosis of epilepsy.

Morse, John Lovett: Pediatrics, Boston, W. M. Leonard, 1913, p. 597. Among the case histories is described a fit of crying, always ending in a convulsion. There was no spasmophilia. Morse makes a differential diagnosis between "reflex convulsions" and epilepsy.

(Footnote continued on following page)

GROUP 7: ATTACKS OF "DREAMY STATES," LONESOME FEELINGS, QUEER FEELINGS, FRIGHTENED FEELINGS, CHANGES OF CONSCIOUSNESS

TABLE 7.—*Data in Eleven Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
53	6	M	B., epilepsy	Negative	At age of 5, while playing, suddenly ran to mother and said "who's shot" though no sounds were heard; was frightened a few moments and then normal; five or six days later ran to mother as before, unable to talk, "seemed oblivious to surroundings" and in few minutes normal; several other similar attacks during the next month, which were followed by major convulsions	..	5
24	21	M	Negative	Negative	At age of 9 or 10, sudden attacks of "lonesome feelings," which would pass off in 10 to 15 seconds; no loss of consciousness; during attacks all objects would appear blue; at age of 11, these attacks occurred with loss of consciousness and convulsions	..	11
47	42	M	F., recurrent headaches; p.c., epilepsy; m.a., migraine	Negative	At age of 5 or 6, and since, attacks of sudden "homesick feelings" with indescribable dreamy state and feeling of discomfort around lower part of chest and feeling "very sorry"; short duration; several weeks to one a month; no loss of consciousness till last year when also had convulsions	..	41
9	48	F	Nephew insane	Negative	Since childhood, momentary attacks of dreamy states in which she saw past acquaintances or beautiful scenes; probably about once in six months	44	44
31	58	M	M. and d., migraine	Attacks epistaxis	During childhood, sudden "frightened feelings," very transient; these attacks disappeared; at age of 51, onset of attacks at night of strange feeling about nose and throat and peculiar taste "like odor of cat's nose"; at first rather pleasurable, lately disagreeable; about two years ago, first nocturnal convulsion	..	56
49	23	M	F., alcoholic; m.a., hysterical	Delayed walking and talking (at 2 or 3 years)	At age of 7, soon after scarlet fever, began to have attacks of "queer feelings"; very transient, no loss of consciousness, two or three a month with a free interval of from six to twelve months until onset of epileptic attacks at age of 17	17	17
59	16	M	M., migraine	Meningitis with convulsions at age of 14 months; nocturnal enuresis to age of 10	Since age of 11, every other day or so, attacks of "feeling of apprehension" lasting several seconds, until age of 13, when he had sudden rigidity, fixed stare, fingers of the right hand would drum, but could control it, he says; head and eyes would turn to left, and in severe attacks would stagger in circles; no loss of consciousness; frequency about one in four or five days	13	..

Groszmann, M. P. E.: Data and Tests in Study of the Exceptional Child, Brit. J. Child. Dis. **7**:481 (Nov.) 1910. The author states: "sudden attacks of excitement, out-breaks of temper, destructiveness, hitting other children and the like, are clear indications of psychic epilepsy."

Laumonier, J.: La colère et son traitment, Bull. gén. de thérap. **160**:329 (July-Dec.) 1910. Laumonier has observed the frequency of attacks of anger in families of epileptics and the epileptics themselves. He believes there is a strong relation between violent anger and epilepsy. According to Ribot, periods of attacks in epilepsy are those in which "symptoms of anger find expression in the extreme."

TABLE 7.—*Data in Eleven Cases—Continued*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
41	43	F	P.u., melancholia; p.u., epilepsy	Negative	Since age of 15, attacks of "queer feelings" in head and general "nervousness" with agoraphobia; then had no loss of consciousness; later, these attacks were accompanied by general rapid trembling and feeling of weakness; typical grand mal at age of 18	..	18
37	28	F	M., "nervous breakdown"	At age of 2 years convulsions; at age of 13, chorea; four attacks appendicitis	At age of 16, began to have attacks of "lonesome feelings" with precordial oppression and palpitation several times a day; these continued to about age of 18; with present major convulsions also has these attacks	..	22
62	35	M	M. and two m.a., migraine	Recurrent headaches in youth	At age of 18 or 19, attacks of "momentary change of consciousness," a rather pleasant sensation, no loss of consciousness; would continue his work or conversation; about one a month	..	27
56	27	F	M., migraine	Married five years; no pregnancy; menstrual periods irregular	At age of 24, shortly after scarlet fever had "dizzy spell" in which "like a flash" there occurred a sensation of being tired all over; recovered in one or two seconds; at first about once a month; more frequent in past year, when became unconscious several times during these attacks; in past year also had attacks in which she had a strange feeling of being far away and feeling as though hands were large and arms very long and thin; duration a few moments followed by feeling of weakness; increasing frequency to eight in one day; in past three months attacks with feeling of something hanging over her, clears throat and then goes to sleep; at times also in these attacks there are slight movements of hands and feet followed by a flush; no fall until past month when it occurred with unconsciousness and involuntary evacuations	24	27

Comment.—Group 7 consists of a miscellaneous collection of sudden fleeting changes in consciousness, or emotional states, varying from "pleasant and dreamy states" to "frightened feelings." There is great irregularity in the time elapsing before the true epilepsy developed—from three days to over fifty years. In case 34, independent olfactory aural atttacks preceded the epileptic seizures, though they followed transient emotional attacks of childhood. This group is especially significant in that the resemblance to epileptic seizures is close. The momentary and sudden character of these attacks is shown in every case. The patient in case 59 was included in this list as obviously epileptic, though loss of consciousness was not noted. In four of the eleven cases, the attacks occurred finally as part of, or also with, major convulsions (cases 24, 47, 37 and 56). In case 56, an unusual series of "debutante" attacks occurred before the final seizures—dizzy spells, transient emotional attacks, transient changes in somatic sensations and, again, attacks of an emotional type. In this group also appears a frequent complication with other symptoms: visual in cases 24 and 98; discomfort in chest in cases 47 and 37; olfactory in case 34; motor in cases 59, 41 and 56.

GROUP 8: ATTACKS OF INSOMNIA, DROWSINESS, NIGHT TERROR

TABLE 8.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
66	14	F	Negative	Infantile convulsions at age of 9 months; appendectomy at age of 10 years	As a child would suddenly go to mother, say "I'm sick," lie down for a few moments and get up apparently well; frequency not stated; at age of 8 or 9 when standing near the table she told her mother that she "felt bad," then suddenly dropped to her knees and picked herself up; duration only a few seconds; apparently no loss of consciousness; these attacks continued three or four times daily, followed by an interval of six months of freedom from attacks; by the age of 9, these attacks returned with loss of consciousness	9	..
63	35	M	B., insane	Syphilis four years ago; two Wassermann tests, 12 and 4 months ago, negative; physical examination negative	Night terrors in childhood.....	20	12
10	36	F	Negative	Negative	Many attacks of insomnia followed by depression; periods of insomnia once in from one to four months over four days to three or four weeks periods; about one or two years ago began having feeling of "absence or lapse," followed immediately by palpitation; subjective, not noticed by others	..	36

Comment.—Night terrors are symptomatic of many conditions in childhood. The symptoms in this case may be purely accidental. All disturbances of sleep in childhood, however, require thorough examination. Some of them are related to epilepsy (as noted in group 6). The insomnia in case 10 is probably also an unrelated finding. In cases 66 and 10, the early attacks described are suggestive of "petit mal."

GROUP 9: ATTACKS OF SUDDEN GAIT DISTURBANCES, "JERKING OF EXTREMITIES," "SHIVERING"

TABLE 9.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
51	3	M	B. and m.c., epilepsy	Developmental delay	When 2 years of age, awakened "shivering as though with cold" for about half an hour; quieted and went back to sleep though restless; a week later a similar attack, also with no loss of consciousness; two months ago, and since, frequent major convulsions	..	3
18	16	F	M.a., migraine	Walked at age of 3 yrs.; no other developmental delay	At age of 9, while walking with mother would say she had to stop a moment; this would occur suddenly while walking and she was well in a moment; this occurred once every two or three weeks; after about a year, during this act, the mother noticed the mouth would be drawn to one side; then sudden fall and unconsciousness	..	10
28	19	F	M. and b., migraine; one sibling infantile convulsions	Recurrent headaches	At age of 17, first noticed jerking or twitching of extremities, which would sometimes keep up for an hour; at times it interfered with dressing; increased frequency to once daily and occasionally during other times in the day	..	18

Comment.—In case 18, there was probably an independent aural attack that ran for a year before the major convulsion began. Its frequency and brevity are noteworthy. In cases 51 and 28, the attacks are unusual in that they were of long duration. There seems little suggestive of a "forerunner" in them in the account given. We are not informed that they became integrated in the epileptic attack that ensued. In case 51, there is an epileptic family history and also developmental delay, data that at least might have prompted further investigation. It is interesting that in the entire series so few attacks of a motor type are found. It may be due to the fact that occasional "shivering or twitching" attacks are thought not worth mentioning or that the motor attack is less frequently a forerunner.[10] Fletcher refers to the larval epilepsy of Morel; to symptoms preceding epilepsy, "masked" in the form of dizziness, headache, temper outbreaks, loud talking with "characteristic" amnesia; in childhood, petulance without cause, suddenly assuming peculiar attitudes or some purposeless movements of automatic type. He gives no definite data as to cases.

Since writing the foregoing statements, we have seen two epileptic patients with sudden jerks of the arms without loss of consciousness. In one case these jerks occurred at longer or shorter intervals for three years preceding the onset of grand mal attacks. Afterward, they frequently ushered in the generalized seizure. In the other case, they did not precede the onset of convulsions but occurred sometimes as an aura and sometimes entirely without loss of consciousness, with no further symptoms for the time being.

GROUP 10: ATTACKS OF "VISIONS," "DARKNESS," "BUZZING IN EARS"

TABLE 10.—*Data in Three Cases*

Case No.	Age	Sex	Family History	Past History	Recurrent Symptoms Preceding First Epileptic Attack	Age at Onset: Petit Mal	Age at Onset: Grand Mal
43	32	F	Negative	Negative	When 29 years of age, after first child was born, "vision comes over my mind," at first once in several weeks or months, now several in one day; three weeks ago first major epileptic convulsion	..	32
54	37	M	Negative	Negative	At age of 33, two or three attacks of buzzing or roaring in ears "like an electric fan hum" for a few moments; three weeks later, humming appeared increased in intensity; he got up and walked out, when sudden fall and first major convulsion	..	33
44	48	F	M. and s., migraine	Sleep walker and talker since childhood	At age of 46, four or five attacks of drawing feeling in the eyes, sudden darkness for a moment; first epileptic attack six months later and one of previous attacks followed first true seizure	..	46

10. Fletcher, W. B.: Memphis M. Monthly **23**:565 (Nov.) 1903.

Comment.—The preepileptic attacks in cases 43 and 44 continued after the major convulsions began. In case 54, the attack became the aural phase of the complete seizure. That such "incomplete attacks" may follow and alternate with epileptic seizures as in case 44 has been especially indicated by Herpin (previously cited) and frequently observed by us. Visual and auditory types of incomplete attacks occur most frequently in combination with other symptoms, as in groups 1 and 2. It is interesting that the lapse of time between "complete" and "incomplete" attacks is shortest for groups 9 and 10.

SUMMARY AND CONCLUSIONS

In the records of 500 private patients with "essential" epilepsy, sixty-four cases were found in which recurrent attacks, other than migraine or infantile convulsions, preceded the "true" seizure for periods varying from one week to about forty years. A study of these attacks was made in an effort to determine the existence of "forerunners," i.e., preepileptic seizures, and if possible, to enable their recognition and hence treatment at this most favorable time.

The sixty-four cases of various recurrent attacks were classified according to their most characteristic symptoms into ten groups. Such types of recurrent attacks to which, in the course of time, epileptic features were added, or which, without changing in form, became a recognized integral part (chiefly as aura) of the complete epileptic seizure, were considered to be, in all probability, preepileptic or "incomplete attacks of epilepsy" (Herpin). Obviously many attacks showed no special relationship.

In spite of the fact that the original case histories were taken without such a problem in mind and hence were incomplete, such prior symptoms probably not having been elicited in many instances when present, certain cases were found within each group that warrant the belief in the existence of numerous recurrent attacks that are forerunners of epilepsy. Based on the study of their later development into complete epileptic attacks, the "forerunners" are, in general, characterized by their sudden and momentary character and the absence of any uniform or consistently determining cause. Often, and for varying periods of time before epilepsy ensues, they may become increasingly frequent, and may be accompanied or followed by dazed states, drowsiness, marked fatigue or change without apparent loss of consciousness. The more completely they present the foregoing characteristics, the more likely is epilepsy to follow.

The "dizzy spells" in group 1 are compared with similar symptoms in the psychoneuroses, in alcoholism, in various organic diseases of the nervous system and with objective vertigo. Typical of the "preepileptic dizzy spells" are the momentary character, the paucity or lack of

accompanying symptoms, the gradual increase in frequency of attacks, with the added element of confusion, change or loss of consciousness and the absence of physical conditions. Attacks of dizziness or vertigo in other conditions are typically of much longer duration, are definitely related to psychic factors, to toxic or infectious states, or to organic disease, and often present evidence of objective vertigo.

In the momentary dizzy spells, as also in the attacks under group 2 of chiefly momentary abdominal sensations, confusion or dazed states may be added long before attacks with unconsciousness begin. Six of the thirteen recurrent attacks in group 2 later became the aural phase of the epileptic seizure.

Two cases of recurrent "attacks of pallor" in group 3 were suspected of being "preepileptic" in that they were momentary and were followed by sleep or confusion states.

Two of the three sensory attacks in group 4 were followed by drooling, disturbance of speech or change of consciousness, and two became auras of the ensuing epilepsy, the "preepileptic" phase being ten and fifteen years, respectively. Again the attacks were characterized by suddenness and brevity.

Of the three recurrent attacks in group 5, one became an aura, another continued along with major convulsions.

In one of the five cases in group 6, screaming occurred during sleep and was followed by limpness. The outbursts of temper in four cases of this group differ from "ordinary temper" in the suddenness, brevity and apparent lack of cause or motivation; also in their combination with other symptoms such as infantile convulsions, pavor nocturnus, vomiting spells, and in one case, "transient bewilderment."

Of the eleven attacks in group 7, four became clearly integrated with the epileptic seizures. In every case, the attacks are characterized by suddenness and brevity. This group contains various types of sudden change in consciousness and in the emotional state. It appears especially significant.

The attacks in group 8 show progressive brevity and change of consciousness, demonstrating perhaps a relationship between these two factors.

One of the three attacks of sudden disturbance of gait in group 9 existed as an independent aural attack for one year. Of the three "attacks" in group 10, two continued independently after the major convulsions began and the remaining one became an aura.

In each of the ten groups are cases in which the relation to epilepsy is clearly seen. They may be regarded as partial or preepileptic attacks. Their main features are suddenness, brevity, apparent lack of antecedent cause or relationship to physical conditions.

DISCUSSION

DR. H. DOUGLAS SINGER: It may lend some support to the view that these features have a relation to epilepsy to mention a patient seen recently in whose case the reverse held true. A woman, aged 42, began to have epileptic seizures which involved the left side of the body and were accompanied by loss of consciousness; shortly afterward she went into status epilepticus, the fits remaining still limited to the left side. The symptoms suggested some organic disease, but there were no signs of a local nervous involvement and the seizures were not of jacksonian character. After the status ceased she rapidly improved. Since then, although there have been no definite seizures, she has had momentary attacks exactly like some of those that Dr. Patrick has described. She describes them as extreme nervousness and "something seems to flutter in the chest." I have seen her in several of them; her face becomes flushed, but she goes on talking throughout the attack. She has this little sensation many times a day. This probably belongs in the same category as those described.

DR. HASSIN: Dr. Herpin, in a book published in the sixties, described cases such as presented by Dr. Patrick as cases of incomplete epilepsy. Does Dr. Patrick accept a type of so-called genuine epilepsy? If he does, what is the difference between what he calls "forerunners" and Herpin's incomplete epilepsies?

DR. HASSALL: This paper should aid one considerably in making diagnoses in children. I recall two or three cases in children in which I was doubtful as to the diagnosis; in one case, the child would scream and bite himself on the forearm; in another case, the patient would pinch himself on the side of the face. These attacks occurred once a week or once in two weeks, but looked like periodic attacks that might become epileptic. I was of the opinion that they were epileptic, but in view of the prognosis I hesitated to predict that the patients would later show definite convulsive attacks. The remarks of Dr. Patrick should aid considerably in clearing up the diagnosis in many such children.

DR. PATRICK: I thought some of this material was important for pediatricians, and reported about thirty of the cases which related entirely to children to the Chicago Pediatric Society recently. I am certain that many physicians, including pediatricians, frequently do not recognize the nature of some of these "spells." I think pediatricians and internists, in the presence of the atypical, abortive or slight attacks, are prone to refer them to some general nutritive disorder, especially if some general disorder is present. I remember one child, aged about 3½ years, with a condition that I considered to be epilepsy. He was under the care of a good internist, but it was hard to manage his diet. His bowels were ill regulated and he needed general attention, but the fits needed attention too. It took me a year to convince the parents of this fact. As soon as the fits were treated, in addition to the general condition, he became well and has remained so for twenty-one years.

I agree with Dr. Hassin's implied opinion that however slight the attack is, if it is of the character of epilepsy, it is epilepsy, whether the patient has a big fit or a little one. I think the expression of Herpin, "debutante" epilepsy, is misleading. If a young woman is a debutante she is already in society, and a "debutante" attack is real epilepsy. In this connection I will repeat again a remark Hughlings Jackson once made to me, when he said in his modest way, "I do not use the expression 'jacksonian' but if you will allow me to use it this time, I think all fits are jacksonian." That is, all fits start somewhere in the brain. We all know that fits which have an aura sometimes stop with the aura. That may continue for a long time before it develops into complete attacks, but it is epilepsy just the same.

THE SCHIZOPHRENIC SYNDROME AS A PRODUCT OF ACUTE INFECTIOUS DISEASE *

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May schizophrenia result from acute infectious disease; if so, in what manner and with what frequency does this occur, and what is the relation of this psychotic product to the so-called symptomatic psychoses? To these problems the present study is addressed.

No one now doubts the exogenous origin of some cases of the schizophrenic syndrome, cases of what are in every other respect orthodox "dementia praecox"; Bleuler, Jaspers, Kretschmer, Birnbaum and others have advanced this fact beyond dispute. Few writers, however, have been statistically precise. To these, Rosanoff [1] and Strecker [2] are exceptions; the former found somatic exciting causes in twenty-six of 202 cases of schizophrenia, and the latter found that in seventeen of 100 cases there were serious or overwhelming physical disease as precipitants and in seventeen others there were somatic precipitants of doubtful (not insignificant) importance.

There is scarcely any literature regarding the percentage of schizophrenic patients in whom the psychosis was precipitated by acute somatic infections, and such statistics would probably be of little value because of the fluctuations in the prevalence and seriousness of infectious disease. More accessible are the casuistic data relative to the psychiatric products of the various somatic diseases, but these data are not abundant and much of the material is useless because of the irreconcilable discrepancies in terminology and nomenclature.

So far as is pertinent, the literature may be summarized as follows:

1. Schizophrenia, strictly regarded, occurs occasionally (frequently as compared to other types of psychoses) after any of the acute infectious diseases; it sometimes appears during the acute illness, more frequently during the defervescence and occasionally weeks, months or years afterward. Kraepelin thought scarlet and typhoid fevers the most frequent precursors; in the more recent literature, influenza is far in the lead, but this is probably due largely to the enormously greater morbidity rate of influenza, with the consequent greater total quantity of psychiatric data.

2. The schizophrenic syndrome, usually not so labeled, but equivalently described and called dementia, acute confusional psychosis (or

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1. Rosanoff, A. J.: Exciting Causes in Psychiatry, Am. J. Insan. **69**:349, 1912.

2. Strecker, E. A.: The Precipitant Situation in 200 Cases of Mental Disease, Am. J. Psychiat. **4**:503, 1922.

insanity), acute hallucinatory confusion, catatonia, onirical delirium, frenosia sensoria, cataphrenia and delirium schizophrenoides, is frequent following most of the acute somatic diseases, e. g., typhoid fever, scarlet fever, diphtheria, cholera, typhus fever, peritonitis, malaria, recurrent fever and other diseases.

3. Other psychiatric pictures, e. g., the manic-depressive psychoses, appear in some instances after some, perhaps all, of these diseases, but much less frequently.

The most comprehensive recent study is that of Skliar,[3] whose statistics may be summarized as follows:

Typhus Fever: One hundred and nine cases were followed by psychosis, of which only thirty-five were precipitated by the infectious disease; nine of the thirty-five cases resulted in schizophrenia, ten in manic-depressive psychoses and six in hysteria.

Recurrent Fever: Forty-one cases of psychosis occurred, of which nine were precipitated by the infectious disease; four of the nine were cases of schizophrenia, three of manic-depressive psychoses and two of hysteria.

Typhoid Fever: Seven cases were followed by psychosis, of which five were precipitated by typhoid fever; three of these five cases were schizophrenia.

Influenza: In four cases influenza was followed by psychosis, of which two were of the schizophrenic type.

Malaria: In four cases this was followed by psychosis, of which none was a case of schizophrenia.

Cholera: Psychosis occurred in three cases, one of which was of the schizophrenic type.

In many, but not all, of these cases there was an hereditary taint.

REVIEW OF THE LITERATURE

Tuberculosis.—This relationship has been much discussed. Claude and Rose,[4] and Gosline [5] concluded, after a study of seventeen cases of schizophrenia, that the mental and physical pictures are so nearly parallel that one must be taken for the cause of the other. Dide [6] gave a table showing that tuberculosis was found at thirty-four of 202 autopsies

3. Skliar, N.: Psychoses in Infectious Diseases, Especially Typhus and Recurrent Fevers, Monatschr. f. Psychiat. u. Neurol. **2**:21, 1922.

4. Claude, H., and Rose, F.: Etude clinique et anatomique d'une psychose toxi-infectieuse à forme catatonique au type de la démence précoce, Rev. neurol. **16**:1280, 1908.

5. Gosline, H. I.: The Rôle of Tuberculosis in Dementia Praecox, J. Lab. & Clin. Med. **4**:186, 1919.

6. Dide, M.: La démence précoce est un syndrome mentale toxi-infectieux subaigu ou chronique, Rev. neurol. **13**:381, 1905.

(16.83 per cent) in cases of mental diseases other than schizophrenia. Nineteen of these patients died from tuberculosis. Tuberculosis was found at twenty-one of thirty-six autopsies (50.75 per cent) in cases of schizophrenia; fourteen of these patients died of tuberculosis. He believes that the frequency of tuberculosis in schizophrenic patients means that it plays a causal rôle. Dide believes that hebephrenocatatonia is a primary toxi-infectious psychosis. "Paranoia" (meaning thereby Kraepelin's paranoid type of schizophrenia) is only secondarily related to the infection, the infection having entered later. Intestinal toxemia is a primary cause, as is also tuberculosis.

Wolfer [7] calls schizophrenia a "metatuberculosis."

Meningitis.—Lagriffe [8] reported a case of meningitis accompanied by "mental confusion" from both of which complaints the patient recovered; they were followed in seven years, however, by schizophrenia.

Sepsis.—Focal Sepsis: Trepsat evidently believes that gastro-intestinal and hepatorenal intoxications are responsible for the schizophrenic syndrome; the work of Cotton [9] in this country points in the same direction.

General Sepsis: Trepsat [10] quoted Aschaffenburg as reporting that of 132 patients with "puerperal insanity," hebephrenocatatonia developed in fifty-six. Meyer reports fifty-one cases, with an unfavorable outcome in ten; these cases were designated by M. Claus, who cites Meyer, as catatonia. Trepsat discusses a case of dementia of his own in which gastro-intestinal fever played a part.

Syphilis.—The theory of syphilitic schizophrenia persists. Urechia and Rusdea,[11] for example, stated that the symptoms of schizophrenia may be observed in the course of syphilitic disease of the brain, including general paralysis. These schizophrenoid symptoms may be transient or lasting. In one case, the clinical picture was that of schizophrenia through the entire six year course from onset to death. Cases of twenty years' duration have been reported, lumbar puncture or necropsy finally establishing the diagnosis. These authors conclude that catatonia is evidently the result of a certain injury to a certain part of the brain, but the morbid agent causing the injury need not always be the same. Gosline [12] described one case which was definitely syphilitic, another

7. Wolfer: Dementia Praecox Studies, Chicago **3**:141, 1920.

8. Lagriffe, quoted by Padeano, G.: Paris Thesis, 1923, no. 349.

9. Cotton, H. A.: The Defective, Delinquent and Insane; the Relation of Focal Infections to Their Causation, Treatment and Prevention, Princeton, 1921.

10. Trepsat, L.: Troubles physiques dans la démence précoce, hébéphrénocatatonique, Paris Thesis, 1905, no. 419.

11. Urechia, C. L., and Rusdea, N.: Schizophrenoid Cerebral Syphilis, Encéphale, 1921, vol. 16.

12. Gosline, H. I.: Newer Conception of Dementia Praecox Based on Unrecognized Work, J. Lab. & Clin. Med. **2**:691 (July) 1917.

which was alcoholic and possibly syphilitic, and two others, all of which he thought represented instances of schizophrenia produced by the infectious or toxic process. Ballet and Gallais [13] described a patient, aged 21, with a positive Wassermann reaction of the blood, although the cerebrospinal fluid gave a negative reaction; he showed mental confusion simulating schizophrenia from which he recovered at the end of thirty months, when the Wassermann test was faintly positive and Argyll Robertson pupils were still present. Bahr found a positive Wassermann test in 31 per cent of ninety-five schizophrenic patients. Southard and Solomon [14] gave the case histories of four neurosyphilitic patients presenting schizophrenic syndromes. Kraepelin [15] mentioned a schizophrenic form in discussing general paralysis, although he declined to accept the view of Steiner and Poetzl that syphilis could cause schizophrenia. Yet, a few others have contradicted these views on statistical bases, e. g., Wassermann reports (Greene [16]).

Epidemic Encephalitis.—Typical schizophrenic pictures of various types have been described in this disease.

M. Briand believes epidemic encephalitis enters into the etiology of schizophrenia more often than is generally believed. Rogues de Fursac is of the same opinion, and H. Claude, Conos and Kahn are quoted as supporting the view that the syndrome may reappear in the chronic form and that some dementias, evidenced by fleeting ocular symptoms and myoclonic contractions, can be referred back to an epidemic encephalitis.

Babinski and Jargovski report a case of muscular rigidity with a catatonic state, but without other psychic symptoms, following epidemic encephalitis.

Briand and Rouquier mention postencephalitic hebephrenocatatonia; Harmand, pseudodementia praecox; Pierre Kahn, a syndrome of the form of dementia praecox (hebephrenocatatonic and chronic hallucinatory psychosis); Truelle and Petit de Bourges, catatonic syndrome, motor disturbance associated with psychic (hebephrenocatatonic) manifestations. Padeano's conclusions are that cases of pure catatonia are rare, that the pure psychic syndrome (mental confusion, melancholic ideas, hypochondriasis, persecutory states, mania and catatonia) is equally rare, and that the mixture of organic and psychic symptoms is the most frequent.

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13. Ballet, G., and Gallais, A., quoted by Padeano, G.: Paris Thesis, 1923, no. 349.

14. Southard, E. E., and Solomon, H. C.: Neurosyphilis, Boston, W. M. Leonard, 1917, pp. 442-452; also case 59.

15. Kraepelin, E.: Psychiatrie, Leipzig, 1910, vol. 2.

16. Greene, R. A.: Dementia Praecox and Syphilis, Am. J. Psychiat. **1**:309, 1922.

Kinnier Wilson [17] reported two cases in which the patients had encephalitis and cerea flexibilitas; one of them was alternately apathetic and noisily excited; the other had hallucinations, and was denudative and "catatonic." Tilney and Riley [18] included a "cataleptic" type in their clinical classification of cases of epidemic encephalitis; this is illustrated by a patient whose relatives believed she had "gone insane." Sicard and Bollack [19] discussed at length the cataleptic picture in encephalitis.

Influenza.—Influenza is the only acute febrile disease which occurs with sufficient ubiquity and morbidity to make possible any general statistical study of its psychic effects. The epidemic of 1918-1919 was intense, widespread and apparently productive of much mental illness; for these reasons, the relation of schizophrenia to acute somatic infections may well be analyzed on the basis of the postinfluenzal material.

A great variety of postinfluenzal psychotic pictures occur, the influenzal toxin apparently having unusual neurotoxicity. These pictures may be classified into: (1) the more or less simple deliria; (2) the schizophrenic syndrome sometimes called schizophrenoid delirium, sometimes toxic-infectious psychosis and amentia, and (3) other recognized psychotic entities or reaction types, e. g., general paralysis, manic-depressive psychoses and psychoneuroses.

The literature is not in entire agreement concerning the statistical enumerations of the relative frequency of various syndromes and entities. Nearly all authors find the schizophrenic syndrome by far the most frequent, but not all are willing to call it schizophrenia. They agree as to the good prognosis. Nearly all consider also that the schizophrenic syndrome may appear both in predisposed (schizoid) and unpredisposed (syntonic) persons, and similarly in those of good as well as those of bad heredity.

The literature just summarized may be given in some detail, as follows:

Waterman and Folsom [20] studied fifty-one cases of psychosis associated with influenza at the Manhattan State Hospital in 1918 and 1919. Seventeen of twenty-three cases in males were diagnosed as belonging without doubt to well recognized psychiatric groups. Of these, four were schizophrenia, all of the patients being predisposed to this disturbance. Of the twenty-eight cases in females, three were regarded as certain and five as probable schizophrenia.

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17. Wilson, S. A. K.: Epidemic Encephalitis, Lancet **2**:7 (July 6) 1918.

18. Tilney, F., and Riley, H. A.: Epidemic Encephalitis, Neurol. Bull. **2**:106 (March) 1919.

19. Sicard and Bollack: Catatonia in Encephalitis, Bull. et mém. Soc. méd. d. hôp. de Paris **44**:262, 1920.

20. Waterman, Chester, and Folsom, R. P.: Psychoses Associated with Influenza, State Hosp. Quart., Aug., 1919, vol. 4.

Paton [21] remarked the occasional precipitation of schizophrenia by influenza, but ascribed to it only a minor rôle. Gosline [12] reported on histologic observations on the brain and pointed out the similarity of the observations in a case of influenza with delirium and in cases of schizophrenia; he concluded that "certain cases of dementia praecox are due to infectious or toxic processes."

In a study of twenty cases of postinfluenzal psychoses at the Walter Reed Hospital in 1919, Fell [22] reported schizophrenia as the diagnosis in five cases (25 per cent); he also said that "the occurrence of dementia praecox symptoms is not a sure indication of permanency, but such cases run a longer course and recovery is less likely." The same author, in another study,[23] again emphasized the mixture of delirium with schizophrenic symptoms for which he favors the designation "delirium schizophrenoides."

Sandy,[24] in a study of neuropsychiatric cases reported to the office of the Surgeon-General of the army, remarked that from among over 70,000 neuropsychiatric cases only seventy-three could be ascribed to influenza; but of these seventy-three, seven were cases of schizophrenia (as compared with thirty-two cases of the infective-exhaustive type, and four of the manic-depressive type).

Jelliffe [25] discussed in some detail the mechanisms of the production of schizophrenic symptoms in postinfluenzal infections, but did not give any statistics.

Harris [26] studied eighteen cases of postinfluenzal psychosis at the Worcester State Hospital, of which eight were diagnosed schizophrenia. In four of them there was apparently no predisposition to the disturbance.

In a study of the delirium accompanying influenza, Schlessinger [27] described the varieties of delirium observed by him in Geneva, mentioning catatonic states, peculiar automatisms and stereotypies.

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21. Paton, S. L.: Psychiatry, Leipzig, 1910, vol. 2.

22. Fell, E. W.: Postinfluenzal Psychoses, J. A. M. A. **72**:1658 (June) 1919.

23. Fell, E. W.: Psychoses Accompanying Influenza, Boston M. & S. J. **122**: 113, 1920.

24. Sandy, W. C.: The Association of Neuropsychiatric Conditions with Influenza in the Epidemic of 1918, Arch. Neurol. & Psychiat. **4**:171 (Aug.) 1920.

25. Jelliffe, S. E.: Nervous and Mental Disturbances of Influenza, New York M. J. **108**:755 and 807, 1918.

26. Harris, A. F.: Influenza as a Factor in Precipitating Latent Psychoses and Initiating Psychoses with a Brief History of the Disease and Analysis of Cases, Boston M. & S. J. **153**:610, 1919.

27. Schlessinger, A.: Des délires infectieux au cours de la grippe, Rev. méd. de la Suisse Rom. **39**:489 (April) 1919.

Riese [28] described six postinfluenzal cases in detail, including one called "amentia," and two which were probably schizophrenic. Although holding to the usefulness of the amentia concept, he concedes that many cases so-called subsequent to influenza must today be classed as schizophrenia.

In sharp contrast with these observations are such studies as that of Harris and Corcoran [29] at the Brooklyn State Hospital, who did not find any cases of schizophrenia in fifty consecutive cases in which influenza or influenza with pneumonia precipitated a psychosis. Similarly, in an elaborate study of 160 pages, Walther [30] of the University of Berne described sixty cases of postinfluenzal psychoses from the canton of Berne, without anywhere in the book mentioning the words "schizophrenia" or "dementia praecox." The author made much of the old concept of amentia, which he divided into four types, comprising sixteen cases. He seems to have been cut off entirely from the American and English literature.

Bleuler [31] was exceedingly ambiguous in reference to this subject. "Neither the grip nor the war has added to the existence of schizophrenia." Elsewhere (p. 363) he says:

> Like Kraepelin I saw several influenza deliria . . . in which paresthesias were interpreted illusionally. In grip psychoses it is chiefly a question of a schizophrenic sort of dissociation of the mental stream, which appears all the more similar to the schizophrenic because irritations of the nervous system readily give occasion to a kind of physical hallucinations; the affectivity invariably, however, continues to fluctuate. . . . Fever deliria, without a schizoid character . . . also occur at the same time as the infection.

In a printed discussion of the work of Waterman and Folsom, Kirby [32] stated that it seemed improbable in the light of their observations that schizophrenia is precipitated abruptly by influenza, although conceding that peculiar catatonic-like symptoms are frequently observed, and also conceding that "as soon as we get away from the ordinary febrile deliria we come immediately into a very obscure field and must recognize that mixed types occur . . . in very puzzling combinations."

PERSONAL STUDIES

My own study of the problem dealt with approximately 175 cases of acute mental disease admitted to the Boston Psychiatric Hospital in 1918

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28. Riese, Walther: Psychic Disturbances After Spanish Grippe, Neurol. Centralbl. Nov. 1, 1918, vol. 39; abstr. J. Nerv. & Ment. Dis. **56**:115, 1922.

29. Harris, I. G., and Corcoran, D.: Psychoses Following Influenza, State Hosp. Quart. **4**:469 (Aug.) 1919.

30. Walther, F.: Ueber grippepsychosen, Bern, Bircher, 1923, pp. 160.

31. Bleuler, E.: Textbook of Psychiatry, English trans. by Brill, New York, 1924.

32. Kirby, quoted by Waterman, C., and Folsom, R. P. (footnote 20).

and 1919, in which influenza was regarded as having something to do with the outbreak of the mental illness. This series has been reported in whole and in part in previous communications.[33] The data relevant to the present discussion are as follows:

Sixty-seven of the total series were diagnosed "dementia praecox" according to the psychiatric standards of that period, and presented an acute syndrome which was convincingly schizophrenic to an unprejudiced staff. Of fifty patients who were followed up, thirty-five were found apparently to have recovered completely; five were improved, five were unimproved and five were worse. The diagnosis was not always confirmed by subsequent examinations by the staff, the diagnosis being changed (frequently because of the tendency toward recovery) to manic-depressive or toxic-infectious psychoses. Whatever term the nosologic categories ultimately utilized, the acute picture presented the unmistakable schizophrenic stigmas, including intrapsychic ataxia, emotional-ideational splitting, incoherence, stereotypies and other bizarre expressions, and were not conspicuously different from the usual types of schizophrenia.

SUMMARY OF THE MATERIAL ON INFLUENZA

From my observations, and from the literature in general, it would seem that the schizophrenic syndrome after influenza is characterized by three notable features: (*a*) it is relatively the most frequent psychotic disorder produced; (*b*) it occurs with and without predisposition or hereditary taint, and (*c*) in most cases, it terminates in complete recovery, in some cases promptly and in some after many months or even a year or more.

Implications of the Data on Influenza: If one retains the kraepelinian conceptions of schizophrenia, one must think from this that influenza precipitated many cases which only seemed in the acute phase to be schizophrenia but which actually were somatic psychoses or cyclothymic psychoses of strongly schizophrenoid coloring.

For those, including myself, who reject Kraepelin's conception of schizophrenia in favor of the conception of a schizophrenic syndrome of varied and cooperative etiologies, including the toxemia of infections,

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33. Menninger, K. A.: Psychoses Associated with Influenza, J. A. M. A. **72:** 235 (Jan. 25) 1919; Influenza and Neurosyphilis, Arch. Int. Med. **24:**98 (July) 1919; Psychoses Associated with Influenza, Arch. Neurol. & Psychiat. **2:**291 (Sept.) 1919; Influenza Psychoses in Successive Epidemics, ibid. **3:**57 (Jan.) 1920; Influenza and Hypophrenia, J. A. M. A. **75:**1044 (Oct. 16) 1920; Influenza and Epilepsy, Am. J. M. Sc. **161:**784, 1921; Influenza and Melancholy, J. Nerv. & Ment. Dis. **53:**287, 1921; Reversible Schizophrenia, Am. J. Psychiat. **1:**573, 1922; Epidemic Encephalitis, J. Kansas M. Soc. **22:**139, 1922.

representing certain phases of psychic disintegration with varied courses and varied degrees of reversibility, the conclusions are that many cases of true schizophrenia occurred subsequent to influenza, most of which ended in recovery, indicating a benign or reversible process.

IMPLICATIONS OF THE DATA ON INFLUENZA AS RELATING TO THE PSYCHIATRIC THEORY

One may judge from case histories and inferences from the older nosologic designations that these same conclusions and implications apply to the psychiatric results of other acute somatic diseases, although probably to a lesser degree, owing to the alleged greater neurotoxicity of influenza. The differential diagnosis problem centers about the "Amentiafrage," i. e., as to whether there is any intrinsic psychopathologic difference between delirium and schizophrenia, aside from chronicity. Between them, for a long time a borderline group, best described by Meynert as "amentia," was postulated. Subsequently it was given up by most psychiatrists; the kraepelinian school abandoned it because of the doctorine of the specific entity conception of schizophrenia; the French and some Italian psychiatrists abandoned it for precisely the opposite reason, namely, because they placed it with delirium and schizophrenia in a confusional syndrome group. Regis,[34] for example, wrote of the schizophrenic and of the obviously somatogenic pictures that they were essentially similar processes, and in 1909 he asserted that "dementia praecox is essentially a toxic psychosis" and classified it as a species of "mental confusion," a descriptive denominator of the aberrant mental states accompanying or following acute somatic disease. He insisted on the essential inseparability of schizophrenia and "chronic" mental confusion. He circumvented the difficulty of pronounced predisposition in schizophrenia by allowing two forms, the "constitutionelle" and the "accidentelle."

Dupré, Deny, and others of the French school followed essentially the ideas of Régis, but the idea was perhaps most ardently advanced by Dide,[35] who proposed "to give to the different states (of dementia praecox) the name toxic-infectious psychoses, subacute and chronic, primary (hebephrenocatatonic) and secondary (paranoid)." Deny was more conservative, but freely conceded that "it is certain there exist very great analogies between the clinical picture of dementia praecox and the states of confusion, of torpor and dream states which characterize the toxic-infectious psychoses, and the autotoxic origin of that affection is rendered very possible by this fact."

34. Regis, E.: Traité de Psychiatrie, 1909.
35. Dide: Démence Précoce.

LITERATURE PERTAINING TO THE THEORY

Bleuler regarded the schizophrenic syndrome as capable of varied pathogenesis. He conceded the indefiniteness of the definitions, the difficulties of diagnostic differentiation and the probable relationships of even the most typical deliria and schizophrenia. Some of his characteristic passages should be cited:

There remains the relationship between schizophrenia and infectious diseases. Schizophrenia often begins with a febrile disease and in some cases there seems to have been nothing abnormal prior to the febrile illness. This could be a coincidence but one often sees how a fever is followed by some improvement; if it thus influences a psychosis, one must also assume that there is some relationship between the fever and the aggravation of mental symptoms. This may be accomplished by physical or psychic influence. It must further be remembered that many cases, which were formerly placed in the amentia group, really belong to our schizophrenia and that a weak physique, plus a febrile illness constitute the etiology.[36]

Most difficult is the differentiation of schizophrenia from the forms designated acute confusion. A useful diagnostic description of these does not yet exist.

In these forms, with which I may here consider the fever psychoses, I know of absolutely no symptom which may not also occur in schizophrenia; in the foreground stands confusion, often with it hallucinosis. Both are very ambiguous symptoms; and no one has yet described anything characteristic of the confusion and of the hallucinosis of these psychoses. Thus nothing else remains than the diagnosis of schizophrenia in those cases of confusion showing schizophrenic symptoms; but where despite a good examination, schizophrenic symptoms are not to be found, one must accept one of these other confusions. Outspoken catatonic symptoms, with the exception of flexibilitas cerea and especially command-automatism, speak against any such confusion and against kraepelinian amentia. Frank negativism and impulsive verbigeration in such a condition always indicate schizophrenia, even if it is not at once possible to find the schizophrenic disturbances of association and affect.

I may add that we have done well with this method of diagnosis for years, in that it has not been necessary to revise our diagnosis in any case in which the examination justified us in making a diagnosis. And yet one cannot be satisfied with such a negative differentiation. Though one does not find schizophrenic signs in a particular case today, they may yet be seen tomorrow.[37]

Lated he stated:

Many think they are turning against me when they say physical changes lie at the bottom of the group (dementia praecox). I, myself, have expressly emphasized this fact. One must acknowledge that at least the great majority of clinical pictures which are now collected under the name dementia praecox rests on some toxic action or anatomic process which arises independently of psychic influences. That such groups (those arising from psychic causes) exist is yet to be proved, while the principal group in my opinion is certainly caused by organic changes.[38]

36. Bleuler in Aschaffenburg: Handbuch, Leipzig, sect. 4, 1st half, p. 280.

37. Bleuler, E.: Zur Amentia-frage, Centralbl. f. Nervenh. u. Psychiat. **18**:815, 1907.

38. Bleuler: Ztschr. f. d. ges. Neurol. u. Psychiat. **13**:30 and 450, 1915.

This was definitely the view of Ernest Southard,[39] supported by his neuropathologic research observations and his ingenious correlations of these with clinical symptoms, a process which students of epidemic encephalitis syndromes are endeavoring to further. The work of Alzheimer and others of the "brain spot" theory (versus the "mind twist" theory—a figure of Dr. Southard's) need only be mentioned.

Kraepelin, under the title of "infectious imbecility," an expression certainly not generally used by American psychiatrists, describes "a temporary or permanent diminution of general mental ability after illness." Influenza, acute arthritis and, occasionally in children, pertussis bring about the milder forms running for from a few weeks to a month with or without delirium. More severe forms follow typhoid fever, erysipelas, cholera, variola, malaria, tuberculous peritonitis and acute arthritis. They begin with delirium or confusion, depression, delusions of sinning and of persecution, mild hallucinosis, usually complete disorientation and marked amnesia. Silliness, impulsive violence, insomnia and anorexia are frequent. The prognosis is "gradual recovery in a few months in 50 per cent of the cases, the remainder proceeding to permanent imbecility." The impossibility of deciding whether such cases should be regarded as belonging to the hitherto delimited groups of toxic-infectious psychoses, epidemic encephalitis or catatonic dementia praecox is obvious.

Bumke [40] has recently called attention to the similarity of certain types of schizophrenia to some other symptomatic psychoses, not only in symptomatology, but also in the conditions of onset, and that there frequently is no difference between the two except that one results in recovery and the other in dementia. This does not indicate that the two should be separated.

Bumke supports the view that schizophrenic and so-called symptomatic psychoses frequently differ only in outcome, and hence essentially not at all. In summarizing modern psychiatric trends, he points out again that while it has long been recognized that schizophrenia does not always lead to dementia, the question arises as to whether the end-results of schizophrenia are really anything more than a form of unfavorable departure which different mental diseases may take. That catatonic syndromes in the narrower sense are not specific has been known for a long time; also that they are apt to follow any kind of injury, that

39. Southard, E. E.: A Study of the Dementia Praecox Group in the Light of Certain Cases Showing Anomalies of Sclerosis in Particular Brain Regions, Am. J. Insan. July, 1910, vol. 67; On the Topographical Distribution of Cortex Lesions and Anomalies in Dementia Praecox with Some Account of Their Functional Significance, ibid., Jan., 1915, vol. 71.

40. Bumke, O.: Present Trends in Clinical Psychiatry, München. med. Wchnschr. **1**:1595, 1924.

qualitatively similar injuries would cause one brain to have a transitory psychosis and another to have a long-lasting and even incurable defect, and that the picture in both cases would remain the same for a long time. It is conceivable, he thinks, that these things resemble the schizophrenic process. Here also, the course would not depend on this or that disease entity but, as in other pathologic processes, on the organism and the disease-producing causes.

Elsewhere Bumke [41] expressed the belief that the investigations of constitutional difference have led to an underestimation of exogenous factors in schizophrenic syndromes, and that the whole structure of the conception of schizophrenia is crumbling.

Hall and Neyman,[42] basing their studies on fifty cases selected on a basis of a recent onset and a definite clinical syndrome, in which the patients were subjected to a routine physical and mental examination in which all the modern laboratory methods were employed, including examination of the cerebrospinal fluid, the endocrine functions, basal metabolism, sugar tolerance tests, etc., concluded that there were definite toxic complications in some of the cases; that in other cases there were endocrine disturbances; and that the term "dementia praecox" represents not a disease entity, but a clinical syndrome capable of subdivision into groups associated with (1) toxic conditions, (2) endocrine disturbances and (3) psychogenic disturbances.

Hoch [43] wished to differentiate organic reactions, affective reactions and trend reactions, applying this differentiation to delirium and other somatopsychoses. He regarded amentia as a transition state between the simple deliria and frank schizophrenia.

Austregesilo [44] called this syndrome cataphrenia, defining it as a state of mental debility of the dementia type, differing from dementia as ordinarily conceived, however, in that it may retrogress to complete recovery.

Stransky [45] expressed the belief that the "dementia accompanying amentia" is differentiated from that accompanying schizophrenia by the natural expression of affect. Since the schizophrenic alteration of facial expression in mild cases is not in every case recognizable, one cannot make a differential diagnosis by this sign alone. Consideration of etiology helps very little. There are many such confusions without weakened states and without fever; in two cases, Stransky could demonstrate at

41. Bumke, O.: Dementia Praecox, Klin. Wchnschr. **3**:437, 1924.

42. Hall, G. W., and Neyman, C. A.: Studies of Schizophrenic Reactions, Am. Neurol. Assn., Forty-eighth Annual Meeting, May, 1922, Washington, D. C.

43. Hoch, A.: Problem of Toxic Infectious Psychoses, New York State Hosp. Bull., Nov., 1912.

44. Austregesilo, A.: Cataphrenia, Semana méd. **25**:365, 1918.

45. Stransky, quoted by Hoch (footnote 43).

postmortem examination only chronic nephritis. On the other hand, schizophrenia so often becomes manifest on the occasion of febrile illness that this criterion is utterly useless. Much more certain is the anamnesis, but unfortunately only in the direction of a schizophrenia which has already given sufficient indications in the symptomatology.

Bonhoeffer [46] thinks that organic deliria of the type described by Hoch were rarely seen during the period of defervescence, but that the pictures seen then in various types of amentia differed from organic deliria in that the patients were apt to be less accessible, less disoriented, less variable in their level of consciousness, nearly or entirely free from speech defect and more severely and permanently incoherent; that they were apt to manifest more complicated thought content, a wider flight of ideas and other manic symptoms; and also that they were apt to act more like catatonic patients and to show negativism, stereotypies and verbigeration, "so much so that no symptom that occurs in dementia praecox cannot be seen here also . . . and the differential diagnosis may be very difficult . . . or only possible on the ground of etiology and onset or outcome . . . but these cases usually get well." (These, as will be recalled, are almost Bleuler's words.)

Numerous neuropathologists have pointed out that the psychologic changes and histologic observations described in schizophrenia are similar to those found in toxic deliria in cases complicated by severe visceral disease. Of these investigators, Southard [39] is the best known, but Rosanoff,[47] Sioli,[48] Alzheimer and many writers quoted by Gosline [12] could be mentioned.

No one has put the whole question better than has Phillip Coombs Knapp [49] in a paper read before the American Neurological Association twenty years ago, the substance of which is incorporated in the first few and in the last paragraphs, which are worthy of nearly full quotation:

> The history of the differentiation of acute confusional insanity from other forms of mental disease follows the ordinary course. First established as an independent affection by Delasiauve and Westphal, it might fairly have been supposed to have won definite recognition with the appearance of Meynert's masterly essay in 1889 and Chaslin's monograph a few years later, even though English and American writers, always slow at that time in assimilating the psychiatric work done upon the continent, made little mention of it.
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> The subsequent history of confusional insanity, however, has been peculiar. With a number of writers *amentia*, the term suggested by Meynert, was sub-

46. Bonhoeffer: The Symptomatic Psychoses, in Aschaffenburg: Handbuch, Leipzig, 1915, vol. 3.

47. Rosanoff: New York State Hosp. Bull. **2**:200, 1914.

48. Sioli: Centralbl. f. Nervenh. u. Psychiat., 1909, vol. 32.

49. Knapp, P. C.: Confusional Insanity and Dementia Praecox, J. Nerv. & Ment. Dis. **35**:609, 1908.

stituted for confusional insanity, but the development of Kraepelin's doctrine has forced amentia decidedly into the background and established dementia praecox as the chief mental disease. Amentia, according to Kraepelin, occurs in only one-half of 1 per cent of admissions to his clinic, while dementia praecox occurs in about 15 per cent and forms the great bulk of the permanent chronic inmates of the asylums. Stransky reports cases of amentia as a rarity and Jahrmarker believes that many cases of this rare disease are really dementia praecox or maniacal-depressive insanity. There has been a tendency, however, to include amentia with the toxic and infectious psychoses and to admit some connection if not an actual identity of the affections.

In the differentiation between the two affections, Kraepelin, as is well known, stated that in dementia praecox the onset is gradual and there is not a previous history of exhausting influences. Among the characteristic symptoms are negativism, verbigeration, mutism, stereotyped attitudes and catatonic states. The patient is not influenced by emotions, and his attention is defective, but he has good perception and orientation. He has a fair memory for recent events, understands his environment, has correct ideas of time and recognizes persons. Hallucinations and delusions are less frequent. In amentia, on the other hand, consciousness and memory are more impaired, perception and orientation are much affected, the patient has no knowledge of persons or of recent events and he is often emotional and has hallucinations and delusions. Negativism, verbigeration and stereotyped attitudes are rare. Amentia is of sudden onset, and often follows some exhaustion. Recovery is not uncommon, while in dementia praecox the tendency is to mental deterioration and recovery is rare and apt to be incomplete or followed by a recurrence of the disease with increasing dementia.

Many of the symptoms which Kraepelin attributes to dementia praecox, however, were described by Meynert as characteristic of amentia. The confusion of amentia, for example, is regarded as due to a disturbance of association, the projection system being unaffected. Perception is, therefore, not disturbed, but when the process advances further the projection system also becomes involved, and a state of stupor develops in which perception is also affected. Confusion and stupor, with Meynert, are thus different states of the disease, the disturbance of perception marking a greater involvement of the brain. Kraepelin, however, assumes that the disturbance of perception is one of several symptoms which serve to differentiate amentia from dementia praecox. There can be no doubt that the cases reported by Meynert and his description of amentia correspond very closely to the cases and descriptions given by Kraepelin and his followers of dementia praecox. The distinction between the two is admittedly difficult at times (Paton). It is therefore not surprising that Bianchi frankly admits that amentia, acute dementia, dementia praecox catatonia, stupor and mental confusion are merely syndromes representing certain phases of a complex psychosis, to which he gives the name of sensory phrenosis, or that Regis and many other French writers regard dementia praecox simply as a more advanced stage of acute confusion. . . .

The fact that a term is inappropriate or etymologically incorrect is not a sufficient reason for discarding it, if, like hysteria, it has the sanction of long usage. Dementia praecox has not that sanction, and, what is still worse, it is a term prejudicial from the start. It emphasizes the feature of dementia as the inevitable outcome of the disease, which to ordinary minds, in spite of the term "acute curable dementia," only too often connotes an incurable terminal state. The teaching of Kraepelin emphasizes the element of mental deterioration if not of actual dementia, which is not an inevitable result even if we accept the extreme doctrines of the Heidelberg school. Bianchi's term of sensory phrenosis is not

open to this objection, and, if we accept with him the probable identity of confusional insanity (amentia) and dementia praecox, we can extend a larger hope to the patient and his friends by recognizing that complete recovery is often possible and that the patient is not inevitably doomed to "dementia praecox."

In brief, the manifestations of certain kinds of deliria and certain kinds of schizophrenia look exactly alike and these conditions are differentiated only by the onset and the termination, a differentiation which in this stage of knowledge is begging the question. This business of diagnosis by outcome instead of by psychologic analysis is an illusory self-deception resulting logically enough from the psychiatric fundamentalism accompanying the introduction of Kraepelin's useful but acknowledged premature groupings to a practical and suggestible American medical profession. It has required two decades for an attitude of pluralism in psychiatric diagnosis, such as that of the French, to make perceptible alterations in our technic in spite of the insistence of such leaders as Adolf Meyer, with his "reaction types," Ernest Southard with his syndrome and major group conceptions, and Jelliffe and White with their emphasis on analysis.

After all, the delimination and designation of the syndrome type is a matter of descriptive partitioning which does not of itself contribute to one's understanding of the patient or the disease process. Much more important is an analysis of the psychic architecture of the particular case and the kinds of damage done to it by certain accidents (e. g., somatic infections) and its reactions thereto.

That in some cases this damage is a stripping-off of superficial elaborations of consciousness or a breaking of surface tension relationships, in such a way as to reveal an underlying skeleton of the configuration known as "schizophrenic" is a theory not difficult to apply to the known facts, and supported by much of the clinical data. The particular kind of psychotic picture revealed by the toxic attack on the encephalon and its consciousness-fabrications probably depends on the kind of mental substructure preexisting, to speak in static terms, or on the type of habitual conflict solution, to speak in dynamic terms. That these preexisting substructures may be correlated with certain characterologic aspects known as "temperament," or with certain anatomic aspects known as *"Körperbau"* is without the province of this discussion, except so far as in future studies they may appear to be correlated with features of the clinical picture revealed by the toxic disintegration.

Representing the analytic point of view in the study of the psychic products of infection, Jelliffe,[25] in a combined descriptive and analytic study of postinfluenzal conditions, says of the psychotic conditions:

By almost insensible gradations, mild or profound depressed states develop on a basis of the toxic condition plus a greater individual unconscious conflict. The flight into the psychosis may become an overcompensatory one in those by no

means rare cases, in which suicide is affected or attempted. Less severe depressions are the rule and are very frequent. . . . At times the depression may be accompanied by delusional ideas. These are not specific. They have no relation to the influenza per se but are the symbolized products of the individual's own conditioned reflexes or complexes, using a physiological (Bechterew, Pavlow) or a psychoanalytic term (Freud, Jung). They tell of the patient's conflicts which existed long before the influenza came along, but which by reason of what for lack of a better concept we call the "reduction in resistance" or "lowering of the psychological level" because of the toxemia and the attending worries, financial or in the love life, permit the conflict to break through under various camouflaged forms.

Hollos and Ferenczi,[50] after an illuminating exposition of the psychic significance and interpretation of certain symptoms and trends in cases of general paralysis, added that "of course, one should seek to explain in a similar manner the non-paretic cases of anoia (amentia) and the symptoms of most toxic deliria . . . Through these patterns of the individual soul the way would be pointed out for the explanation of psychical tendencies toward unification hitherto unexplained, even of the basic facts of thought association."

CONCLUSIONS

Studies reported by me and by others justify the following conclusions relative to the schizophrenic syndrome and infectious diseases:

Infectious disease, not to mention other exogenous agents, in certain persons breaks the integrative fabric of consciousness and releases a psychologic regression of various degrees and types. These regressive pictures include all of the recognized "reaction types," but apparently most frequently the delirious and the schizophrenic. The syndromes formerly designated "dementia praecox," "toxic-infectious psychosis," "amentia" and "confusional psychosis," are all included, the differentiation being in many cases neither possible nor useful. The particular type of psychotic picture revealed in a particular case by a toxic attack on the encephalon probably depends on the kind of mental substructure preexisting, and not demonstrably on the kind of toxin (or infection). Evidences of the nature of this substructure may or may not be previously apparent in the ordinary descriptive observation of the patient; similarly, the hereditary record may or may not contain outspoken evidences of psychopathy. The schizophrenic types of regressions are relatively frequent, but, although ordinarily ominously regarded, they are, when of this somatogenic precipitation, usually reversible; i. e., the splitting (or stripping or breaking of surface tension relationships, or whatever may be the best figure of speech) tends to be benign rather than malignant.

50. Hollos, S., and Ferenczi, S.: Psychoanalysis and the Psychic Disorder of General Paresis, p. 48.

DISCUSSION

The following questions submitted to Dr. Menninger before the Commission, together with the answers to them, are here reported verbatim.

DR. WHITE: I shall repeat a question which I asked this morning and which apparently was misunderstood. Here are thirty-five of fifty patients who get well, and I am wondering whether the cross-section of the psychosis, when it is in full bloom, would not show the presence of certain constructive, conative tendencies. I should like to know whether you have discovered any evidences of rehabilitating, reconstituting factors at work in the direction of recovery, and if so, what they are.

DR. MENNINGER: I do not know what they are. I do not even know whether they are there. I infer that they must be, and that it would be interesting and valuable to know what they are. Further analysis of the clinical material, some of which was recorded stenographically as produced by the patients, may provide a basis for conclusions on this important point.

DR. KIRBY: I should like to ask whether in Dr. Menninger's series it was possible to distinguish any predominating clinical types. It would be important to know whether the usual paranoid, catatonic or hebephrenic clinical pictures were represented or were his cases essentially all deliria which presented certain features which he thought indicated a relationship to the schizophrenic reaction type?

DR. MENNINGER: We were not very much interested in the kraepelinian type at the time and did not always classify our cases according to them. I have only an impressionistic recollection as to how they would be tabulated. I think the excited types of catatonic reaction were the most frequent. (Reference to the case histories indicates the correctness of this impression—of thirty-three cases in which a typing was attempted, fourteen were listed as catatonic, eight as hebephrenic and eleven as paranoid. Some of the latter were labeled "paranoid or hebephrenic.")

DR. BASSOE: Did I understand that you meant to include under schizophrenia, the types that we used to call confusional insanity and amentia, or if not, what is the relative proportion of cases to which these old terms would apply?

DR. MENNINGER: I think that it is impossible to contradict Bleuler who says that a useful distinction between those pictures and the schizophrenia picture does not exist. It is of course impossible to say what these would have been called ten or fifteen years ago. I have been of the impression, from reading, that the same pictures of "acute confusional psychoses" that occurred after influenza in 1889-1892 would have been called acute schizophrenia by us. We were often aware that the somatogenic factors were important and of course, we saw many cases in which we thought them chiefly responsible, and diagnosed such cases according to the current nomenclature for somatogenic psychoses ("toxic-infectious psychosis," etc.). Those that we diagnosed as schizophrenia, however, possessed definitely and abundantly the earmarks, as it were, of orthodox schizophrenia.

DR. JELLIFFE: Dr. Menninger has very nicely delimited a problem, in so far as he has spoken only of possible relationships following such types of acute infectious disease which of themselves are more or less limited. He has spoken of typhoid fever, measles, scarlet fever, influenza, etc., those types of infectious disease which, by reason of the transitory nature of the stress put on the organism, might in a sense be excluded, as he has more or less excluded them, as occa-

sioning factors. Now I should like to ask him if he were to consider some of the more chronic infectious types of disease, what would the nature of his response be?

Thus, for instance, shall we say, tuberculosis? Would he say a word about the anomalous situations that arise in syphilis and the pictures that look like schizophrenia? Might he say a word about the as yet unrecognized so-called focal infections, and of course leave out the subject of encephalitis, which I wish to talk about.

DR. MENNINGER: Tuberculosis, syphilis, focal infections and encephalitis are dealt with in the body of my presentation but were omitted from the abstract as presented to the association. It is my personal conviction that these chronic infections are of even more practical importance in the precipitation of psychotic picture, including the schizophrenic syndrome, than is influenza. They are somewhat less dramatic, however, and because of their continued prevalence are somewhat less accessible to a statistical study of the type undertaken by us with influenza. Some writers have felt very definitely that all the chronic infections mentioned by Dr. Jelliffe are frequently responsible for the calling forth of the schizophrenic syndrome. Of course, we all know that they frequently, in fact usually, occur without severe psychopathologic accompaniments, and it is likely that we should consider the existence of a conflict between the degree to which "somatic compliance" (Freud) affords a gratification for a libidinous tension and the degree to which the life adjustment already engineered by the cerebrum is impaired by an injury from these exogenous toxins. Concerning these intricate problems, no one is better fitted to speak than Dr. Jelliffe.

DR. ADOLF MEYER: I should like to ask a question which in years past was occasionally raised by critics of my dynamogenetic conception. In your experience, how frequent are those cases that present a definitely destructive development, and to what extent were you able to convince yourself that a constitutional study and a previous history of the case had been made, so that one would be able to say that the condition was definitely a deterioration produced by the infectious disease itself? Is there in the deterioration that is produced by the infectious processes, adequate evidence that we might be dealing with fever damage, or things of that sort, or do we have to admit that perhaps the literature in that direction is, and will be, thoroughly deficient, until the importance and difficulty of the constitutional problem is fully realized by the investigators?

DR. MENNINGER: The degree of visibility of the underlying substructure before being exposed by the scraping off process, or what you may call it, varied considerably. In some instances, it was conspicuous that a case was (shall I say) predisposed; that it took only a little pull on the trigger to fire the gun. In other cases, however, there was no apparent predisposition and no hereditary taint; and while there is no way of saying that more investigations might not have found it, certainly the routine investigations did not find it. This was similarly reported by a number of authors, some of whom were not sympathetic with our point of view that the syndrome was a frequent one.

However, Dr. Meyer, I certainly should not want to give the impression of being unitarian enough to suppose that any one thing has any one cause. I am pluralistic enough to insist that there could be no one cause for schizophrenia. Influenza or other somatic infection is not a cause, but it may be one of the factors involved in the débâcle. I think I said seven years ago that influenza caused psychosis. I have grown older since and I hope, wiser. I have certainly changed my mind.

EFFECT OF AGE ON VIBRATORY SENSIBILITY*

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CONTENTS

The results of this study—diminution or loss of the sensation in the lower extremities of a large percentage of persons in the involutional period of life—are deemed worthy of record, because it is during this period that changes in vibratory sensibility assume considerable importance for diagnosis; if such an alteration is found in normal persons, it indicates the need for wariness in arriving at a diagnosis based on alterations in this form of sensation.

REVIEW OF THE LITERATURE

In a review of the literature, no study of a large number of persons from this standpoint was found. Vibratory sensibility has been tested in normal persons by Rumpf,[1] Treitel,[2] Williamson,[3] Symms,[4] Wood,[5]

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1. Rumpf: Ueber einen Fall von Syringomyelie nebst Beitragen zur Untersuchung der Sensibilität, Neurol. Centralbl. **8**:185, 1889.

2. Treitel: Ueber das Vibrationsgefühl der Haut, Arch. f. Psychiat. u. Nervenh. **29**:633, 1897.

3. Williamson, R. T.: Vibrating Sensations in Affections of the Nervous System and in Diabetes, Lancet **1**:855, 905; Vibrating Sensation in Diseases of the Nervous System, Brit. M. J. **2**:25, 1907.

4. Symms, J. L. M.: A Method of Estimating Vibratory Sensations, Lancet **1**:217, 1918.

5. Wood, E. J.: Further Studies of Quantitative Variations in Vibration Sensation, Tr. A. Am. Phys. **36**:368, 1921; The Quantitative Estimation of Vibration Sensation, Guy's Hosp. Rep. **71**:78, 1921.

Ahrens,[6] Egger,[7] Rydel and Seiffer,[8] and Piercey;[9] only the last three authors discuss the influence of age. Egger stated that this sensibility is greater in children and adolescents and diminishes with increasing years, although a number of persons aged 60, 70 and 80 and one over 100 retained their acuteness of perception. Rydel and Seiffer[10] agreed with this statement. Piercey found this sensibility absent over the sacrum in six persons over 65 years of age.

AUTHOR'S EXPERIMENTS

Varieties of Patients Studied.—The one hundred and seven patients studied were in the convalescent and neurologic wards of the Philadelphia General Hospital and the Infirmary for Nervous Diseases. They comprised three groups: (1) those without signs of organic disease of the nervous system—seventy-two cases (table 1 contains five cases—four of chorea and one of pseudopertrophic muscular dystrophy—that are exceptions to this condition, but all observers agree that vibratory sensibility is unaffected in these conditions); (2) postencephalitic and idiopathic parkinsonism—twenty-one cases, and (3) hemiplegia—fourteen cases. The diagnosis noted for each of the nonneurologic patients is that of the acute stage of the illness that necessitated hospitalization. At the time of examination, the acute period had passed and the patients were convalescent. The Wassermann reaction of the blood was negative in every case. Sense of position and of touch was present to the ordinary clinical tests in every case except in certain hemiplegic patients. Examination of vibratory sensibility by the tuning fork is more delicate than the routine clinical tests for the other modalities, so that the use of finer methods might have disclosed alterations analogous to those of vibration.

Technic of Examination.—Vibratory sensibility should be examined both qualitatively and quantitatively, and although this report is based on the latter method, both were used. The quantitative investigation is liable to a greater degree of error than the qualitative. The fork inadvertently may be struck a harder blow at one time than at another, and as a result, the actual duration of its vibration may vary. This difficulty

6. Ahrens, R. S.: A Study of the Vibratory Sensation, Arch. Neurol. & Psychiat. **14**:793 (June) 1925.

7. Egger, M.: De la sensibilité osseuse, J. de physiol. et pathol. générale **1**: 511, 1899.

8. Rydel, A., and Seiffer, W.: Untersuchungen über das Vibrationsgefühl oder die sogenannten "Knochensensibilität" (Pallesthesie), Arch. f. Psychiat. u. Nervenh. **37**:488, 1903.

9. Piercey, H. D.: The Quantitative Measurement of Vibratory Sensation, Ohio State M. J. **19**:572, 1923.

10. Rydel, A., and Seiffer, W.: Ueber Knochensensibilität, Neurol. Centralbl. **32**:329, 1903.

has been overcome to some extent by the use of the Gradenigo type of fork. It was not available for this study, but the ordinary fork was believed to have some advantages, because it is the type usually employed in routine neurologic examinations. This fork was 16.5 cm. long, with a base 4 by 5 mm. square and with a vibratory rate of 128 a second.

The examination was conducted in the following manner: The same force of blow being used each time, the fork was struck and the base placed in contact with the styloid process of the ulna. The patient was asked to describe what he felt. If his description did not indicate a distinct perception of the vibration, he was tested with the nonvibrating fork and asked if there was any difference between the two contacts. If he did not perceive any, he was not examined further. If he gave a clear description, the fork was struck again, and he was asked to state the instant the sensation ceased. Then the prongs were touched to stop the vibration, and if he did not reply instantly, the examination was discontinued. If his reply was simultaneous with the cessation of vibration, the fork was struck again and the length of time the vibration was felt was estimated with a stopwatch. Five such examinations were made on each of the following bony points: styloid process of the ulna, styloid process of the radius, olecranon process, internal malleolus, external malleolus, tibia and patella. If there was a considerable discrepancy in the results obtained from any one point, ten trials were made at that point. The results presented are the averages of at least five trials for each point tested. In order that the element of fatigue might be excluded as much as possible, two successive examinations were not made at one place.

At intervals, the fork was stopped mechanically to determine whether the patient was attending, the promptness of his reply on these occasions serving as a check. In conducting the examination, care was taken to exclude disturbing influences in the environment, to prevent fatigue on the part of the patient before, and the development of ennui during, the testing.

Before discussing the results, it is advisable to point out certain sources of error that are present in this study. Though the same person used the same fork on every patient, there was no way of making sure that the force imparted to the tuning fork was the same on each occasion. The best indication that the variation was slight is the fact that many patients showed not more than one second's difference in their responses from any one bony point. The fork is light, and its vibration would not be felt so well as that of some of the larger and heavier instruments; a patient might not perceive the vibration with this fork who would be sensitive to another. This does not detract from the results, however, for if the vibration of this instrument was not felt, sensibility was diminished, although its loss could not be inferred. The intelligence of the patients was not high; among the older ones, arteriosclerotic cerebral changes may have operated to make the responses less sure. These patients, however, responded instantly each time the fork was stopped mechanically, even though their eyes were closed and they could not see the movement made. One has a right to infer, therefore,

a normally low threshold and ordinary discrimination. A scrutiny of the results proves that the factors mentioned do not introduce such a large element of inaccuracy as might be expected, particularly as this is not intended for an exact physiologic study but rather as a clinical estimate.

There is considerable difference between the time intervals recorded in this series for any point and the results of other observers. A similar discrepancy is found, however, between the results of the other observers. This variation is due to differences in tuning forks and methods of testing. It must be understood distinctly that the figures reported here have only a relative and not an actual value; they are not to be compared with the figures of any previous observer and should not be used as a standard of comparison by any future investigator. They can be compared only with another series of observations made by the same observer using the same fork.

It should be noted that examination of the patella is unsatisfactory. If the part is not pressed firmly against the underlying joint surfaces, the patient often will not feel a vibration. At other times, he may feel the vibration distinctly over one part of the patella and not at all over another part. Little reliance can be placed, therefore, on the results obtained from this part of the test, and though the results obtained therefrom are included in the tables, they should be considered in the light of these remarks.

Comment on Results.—Tables 1 to 7 present the results from the non-neurologic cases, arranged in decades from the second to the eighth. A quantitative examination of vibration is impracticable in the first decade, because it is difficult for a young child to indicate accurately when the sensation ceases. Undoubtedly it is present from an early age. The youngest person tested was a child of 18 months. When the non-vibrating tuning fork was placed in contact with the bony points, he looked interested; but when the vibrating fork was used, he burst into laughter as soon as the contact was made, probably indicating a true perception.

A study of tables 1 to 7 and 10 and 11 shows the following results: Vibratory stimuli are perceived best by adolescents. During the first fifty years, there is only a slight difference in the average duration of perception on stimulation over the styloid processes of the ulna and radius, the olecranon process, the tibia and the patella. This slight difference is probably a statistical error due to the wide variation between the minimum and maximum readings for each age group and the small number of cases included in each series. However, decade by decade, there is a decrease in the duration from the malleoli, and this decrease seems large enough to be real and not artificial. In the sixth, seventh

TABLE 1.—*Quantitative Estimation of Vibratory Sensation in the Second Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
1. L. P.	9	Normal	5.5	5.4	6.2	12.6	12.0	9.2	6.1	8.3	7.0	6.0	10.6	12.6	8.8	7.8
2. F .P.	10	Normal	9.8	11.2	7.4	13.2	10.0	6.2	4.4	12.6	15.8	7.8	7.6	10.0	5.2	4.8
3. B. F.	10	Normal	9.5	8.7	8.3	7.3	6.6	7.2	5.6	10.6	10.0	9.4	5.8	8.0	6.5	5.0
4. H. F.	10	Chorea	9.4	13.8	8.4	10.6	10.0	11.4	7.0	8.8	10.4	13.2	10.8	8.0	10.2	9.6
5. J. M.	11	Subacute nephritis	5.0	6.0	3.6	3.2	4.8	4.4	3.6	7.4	5.0	3.4	3.2	5.2	4.4	4.6
6. P. S.	11	Chorea	10.0	6.8	4.4	5.8	6.0	6.0	4.4	9.2	10.8	4.2	5.6	7.8	6.2	4.4
7. H. R.	13	Progressive musc. dystrophy	8.8	9.6	8.2	8.6	....	5.6	4.2	10.6	10.8	8.6	7.8	....	4.4	5.6
8. H. Re.	13	Tubercular right knee	12.2	13.6	5.0	12.1	12.0	....	4.8	12.8	16.2	5.6	9.2	11.0	....	4.4
9. C. D.	15	Pneumonia	13.0	12.0	10.4	7.3	7.1	5.6	3.2	13.6	12.4	10.2	7.0	7.8	4.6	4.2
10. B. B.	15	Chorea	6.6	7.4	5.4	5.4	6.3	4.8	4.2	7.8	7.6	5.2	7.4	6.6	6.0	5.0
11. E. W.	15	Chorea	12.3	9.8	8.8	8.2	8.6	7.2	7.6	18.6	18.0	9.4	8.4	7.2	8.6	6.6
12. W. D.	16	Normal	10.3	9.3	5.6	6.3	7.0	5.8	5.0	8.6	7.3	4.6	7.3	6.3	6.0	4.6
Average			9.3	9.4	6.8	8.3	8.2	6.6	5.0	10.7	10.9	7.3	7.5	8.2	6.4	5.5
Combined averages of right and left sides			10.0	10.1	7.0	7.9	8.2	6.5	5.2							

TABLE 2.—*Quantitative Estimation of Vibratory Sensation in the Third Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
13. W. K.	20	Normal	10.4	10.4	....	8.0	9.2	7.0	2.6	10.2	10.0	....	7.0	7.4	5.0	6.2
14. J. L.	21	Normal	6.2	6.2	4.8	4.2	3.0	3.8	3.2	5.2	4.8	4.4	4.8	3.8	3.6	3.6
15. M. D.	21	Tonsillitis	13.0	13.0	9.2	14.8	16.8	9.8	5.8	16.8	16.2	9.4	16.4	14.0	11.0	6.0
16. D. L.	23	Tonsillitis	9.0	6.2	6.4	5.6	6.0	6.2	5.0	7.0	5.8	6.0	5.8	6.6	6.6	7.2
17. H. L.	24	Pneumonia	6.5	6.6	3.1	4.6	6.6	5.8	4.1	7.0	4.5	6.5	5.1	4.8	5.6	3.0
18. M. Du.	24	Normal	11.6	9.0	6.1	8.1	6.2	8.2	3.2	6.5	8.4	5.3	6.0	5.3	5.1	2.8
19. T. C.	26	Bronchitis	10.8	8.0	7.6	7.0	9.2	5.4	5.6	8.4	7.4	6.4	7.8	9.3	5.2	5.0
20. J. G.	27	Arthritis	7.6	8.4	6.2	5.0	4.4	4.6	2.2	5.4	5.0	4.4	3.4	4.8	4.2	2.4
21. R. W.	29	Influenza	11.6	12.2	8.2	8.6	7.8	7.6	6.2	10.6	11.0	11.8	7.2	8.4	5.6	4.6
22. R. C.	29	Influenza	7.6	7.4	6.6	7.1	5.5	6.4	5.4	8.5	9.0	6.6	6.0	6.4	5.8	5.0
Average			9.4	8.7	6.4	7.3	7.4	6.5	4.3	8.5	8.2	6.7	6.9	7.0	5.7	4.5
Combined averages of right and left sides			8.9	8.4	6.5	7.1	7.2	6.1	4.4							

TABLE 3.—*Quantitative Estimation of Vibratory Sensation in the Fourth Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
23. R. M.	30	Nephritis	6.2	5.1	7.8	4.0	3.4	3.2	2.8	6.4	6.0	4.6	3.2	3.0	3.2	3.0
24. H. C.	31	Gastric ulcer	7.4	6.0	4.6	8.2	7.4	7.2	7.2	7.6	7.5	5.8	6.8	8.4	7.2	6.8
25. M. P.	32	Normal	9.2	9.8	9.6	12.4	13.2	8.8	6.2	9.8	11.8	9.4	11.5	11.2	9.4	6.2
26. G. B.	32	Pulmonary tuberculosis	4.2	4.2	3.2	2.6	3.0	3.0	1.8	3.6	4.0	3.4	3.0	2.8	2.8	2.1
27. G. H.	34	Normal	9.0	8.7	....	7.5	7.2	9.5	6.7	8.7	11.2	....	5.2	6.8	8.0	7.5
28. E. C.	34	Normal	....	....	....	5.7	5.5	8.4	3.8	....	....	....	9.5	7.6	6.7	4.5
29. J. F.	36	Chronic arthritis	7.0	8.7	7.6	5.4	7.6	5.6	3.8	6.5	7.0	5.4	6.0	5.6	5.0	4.6
30. J. M.	36	Pulmonary tuberculosis	11.2	8.6	10.0	9.1	7.2	5.0	5.2	11.2	13.0	8.1	8.6	10.2	8.2	5.6
31. T. F.	37	Chronic myocarditis	14.1	11.3	9.5	8.6	7.4	10.8	5.4	10.6	11.0	9.2	9.3	7.6	8.6	6.8
32. G. W.	39	Bronchitis	6.6	6.6	4.8	0.2	1.2	1.7	2.2	4.8	4.6	5.8	0.6	2.8	0.0	0.0
33. L. R.	39	Chronic myocarditis	9.4	8.4	6.1	5.2	4.4	4.2	3.3	9.8	9.6	5.8	7.4	7.8	5.0	3.8
34. H. W.	39	Peritonitis	8.2	8.6	7.0	5.0	5.2	7.6	6.2	7.5	6.4	7.0	6.8	7.2	5.6	6.2
Average			8.4	7.8	7.0	6.1	6.0	6.2	4.5	7.8	8.3	6.4	6.4	6.7	5.8	4.7
Combined averages of right and left sides			8.1	8.0	6.7	6.2	6.3	6.0	4.6							

TABLE 4.—*Quantitative Estimation of Vibratory Sensation in the Fifth Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
35. J. M.	40	Asthma	7.4	8.2	8.4	1.5	0.0	3.0	3.6	7.4	9.4	4.8	1.6	1.8	1.4	4.8
36. F. G.	40	Arthritis	8.2	8.0	6.0	3.0	0.0	0.0	2.3	9.5	8.6	5.5	0.0	4.6	0.0	0.0
37. J. C.	42	Chronic myocarditis	10.0	10.0	5.4	6.0	8.1	9.6	5.6	10.0	9.8	7.8	6.8	6.2	8.8	9.4
38. J. B.	42	Tonsillitis	11.6	12.1	8.0	8.2	5.8	8.0	7.0	11.4	9.2	9.6	6.4	6.4	5.2	5.6
39. M. O.	42	Acute rheumatic fever	16.6	10.1	12.0	8.5	8.6	8.8	5.4	11.8	10.8	9.6	8.8	8.4	10.0	6.6
40. G. K.	43	Intestinal influenza	11.6	10.2	11.2	5.8	5.8	6.0	4.4	8.6	8.8	8.6	9.4	8.4	7.4	5.6
41. G. H.	44	Pulmonary tuberculosis	4.4	4.6	4.4	2.8	3.0	3.2	3.4	4.6	5.0	5.0	3.4	2.8	3.8	4.0
42. E. N.	45	Acute rheumatic fever	10.4	8.8	6.2	6.4	5.0	4.8	....	8.8	10.6	6.4	3.6	7.3	4.8	2.8
43. J. P.	46	Chronic myocarditis	7.7	7.7	4.5	3.8	3.4	3.8	5.8	8.1	7.6	5.1	5.6	6.8	3.6	5.2
44. M. R.	46	Bronchitis	8.7	6.2	7.4	9.1	5.6	3.6	0.0	5.3	9.0	9.0	5.8	3.4	5.0	4.6
45. H. F.	47	Chronic arthritis	9.6	8.0	7.8	4.4	4.4	6.0	5.1	9.0	8.6	7.5	5.8	6.4	7.0	6.2
Average			9.6	8.5	7.3	5.4	4.5	5.1	4.2	8.5	8.8	7.1	5.2	5.6	5.1	4.9
Combined averages of right and left sides			9.0	8.6	7.2	5.3	5.0	5.1	4.5							

TABLE 5.—*Quantitative Estimation of Vibratory Sensation in the Sixth Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
46. F. B.	50	Chronic myocarditis	5.2	5.4	3.6	2.4	2.8	0.8	0.0	4.4	5.0	3.2	3.6	3.6	3.0	2.6
47. H. T.	50	Alcoholism	8.0	9.8	8.6	4.0	4.1	5.8	6.0	10.8	10.4	8.6	6.2	7.0	4.6	5.6
48. G. H.	51	Bronchitis	4.8	8.4	6.8	4.6	5.6	5.6	3.8	5.6	5.8	3.6	5.7	6.8	4.2	0.7
49. H. H.	52	Influenza	9.8	10.4	9.4	5.6	6.0	7.0	7.0	8.6	10.2	9.0	5.4	5.6	5.4	5.0
50. P. O.	52	Bronchitis	3.6	3.4	4.0	0.0	0.0	0.8	0.0	3.2	4.2	2.4	0.0	0.0	0.8	0.0
51. F. D.	53	Mitral stenosis	7.4	6.6	8.2	0.0	2.8	0.8	0.0	7.6	6.0	8.4	0.0	0.0	0.0	0.0
52. P. E.	55	Chronic myocarditis	2.0	3.6	0.0	0.0	1.1	0.0	0.0	6.0	4.2	6.0	0.0	0.0	0.0	0.0
53. G. S.	55	Enlarged prostate	....	....	....	5.7	6.0	5.5	4.0	....	....	....	3.5	5.0	4.5	3.7
54. W. J.	56	Cardiac decompensation	5.5	7.0	4.6	2.8	2.0	1.5	5.0	6.4	6.4	4.8	2.6	0.3	2.8	3.0
55. W. L.	57	Cardiac decompensation	7.6	6.6	6.4	2.0	1.1	3.0	5.0	7.6	7.8	8.4	0.0	3.8	2.6	3.8
56. H. D.	59	Auricular fibrillation	3.6	4.0	3.6	2.4	2.4	1.8	2.0	4.6	3.4	4.4	1.8	3.0	3.2	2.2
Average			5.7	6.5	5.5	2.6	3.0	2.9	2.9	6.4	6.3	5.8	2.6	3.1	2.6	2.2
Combined averages of right and left sides			6.0	6.4	5.6	2.6	3.0	2.7	2.5							

TABLE 6.—*Quantitative Estimation of Vibratory Sensation in the Seventh Decade*

Case	Age	Diagnosis	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
57. J. K.	62	Chronic myocarditis	4.8	5.2	3.0	3.4	3.6	3.8	3.6	4.4	3.4	3.6	2.8	3.4	2.8	3.2
58. T. H.	63	Chronic myocarditis	12.8	12.6	7.6	2.8	3.0	2.1	2.0	3.8	4.8	6.0	3.6	2.6	2.0	0.0
59. T. B.	63	Chronic myocarditis	6.8	8.3	6.4	6.8	5.2	5.4	7.6	8.2	7.6	6.4	5.8	6.0	5.0	6.8
60. A. B.	64	Eczema	....	....	....	3.8	4.0	3.7	5.0	....	....	....	2.2	3.2	3.2	3.5
61. T. N.	65	Arthritis	8.2	8.2	6.3	0.0	0.0	0.0	2.2	6.8	3.8	8.2	0.0	0.0	2.2	2.2
62. C. N.	65	Chronic myocarditis	8.3	6.5	5.6	1.6	1.2	2.1	0.0	6.3	9.0	3.2	1.0	0.0	0.6	0.0
63. F. R.	66	Chronic myocarditis	6.0	6.4	5.0	0.5	0.0	0.0	0.0	7.1	6.7	7.1	0.0	0.0	3.2	1.4
64. J. B.	67	Chronic myocarditis	3.8	3.8	4.3	1.8	2.0	2.2	0.0	4.8	4.6	3.3	2.8	3.0	2.2	0.0
65. J. M.	67	Arthritis	12.0	13.6	10.1	4.0	4.2	3.2	0.0	10.5	10.8	8.8	5.0	2.2	3.8	....
66. W. W.	68	Chronic myocarditis	7.4	4.8	6.0	0.0	0.0	0.0	0.0	5.6	6.6	6.0	0.0	0.0	0.5	0.0
67. E. W.	68	Chronic myocarditis	2.8	2.2	2.8	3.2	2.2	3.4	2.8	4.8	4.2	3.0	2.4	2.2	2.2	2.2
68. A. B.	69	Enlarged prostate	....	....	....	3.7	3.7	4.7	3.2	....	....	....	4.0	3.0	6.7	3.2
69. J. L.	69	Infected finger	7.5	5.8	5.2	4.0	0.0	1.8	2.0	4.4	4.6	3.6	2.6	2.0	2.0	1.6
Average			7.3	7.0	5.6	2.7	2.2	2.4	2.1	6.0	6.0	5.3	2.4	2.1	2.8	2.0
Combined averages of right and left sides			6.6	6.5	5.4	2.5	2.1	2.6	2.0							

and eighth decades there is a more definite decrease over all the bony points, but particularly over the malleoli, tibia and patella. There is no question that this is an actual decrease, because the decrease in the results obtained on the lower extremities in the first and last three age groups was found to lie outside the limit of probable error. Furthermore, table 11 shows that the number of cases in which vibratory sensibility was absent in the lower extremities increases in direct ratio with the age of the patient.

Table 8 shows that a similar decrease in relation to age is found in the results obtained from cases with parkinsonism. As a rule, however,

TABLE 7.—*Quantitative Estimation of Vibratory Sensation in Persons over 70 Years of Age*

Case 70, C. B., aged 74, chronic myocarditis, generalized arteriosclerosis, chronic diffuse nephritis			
Styloid process, left ulna	4.0	Styloid process, right ulna	6.0
Styloid process, left radius	6.0	Styloid process, right radius	5.8
Left olecranon process	7.4	Right olecranon process	7.0
Left internal malleolus	Not felt	Right internal malleolus	Not felt
Left external malleolus	Not felt	Right external malleolus	Not felt
Left tibia	Not felt	Right tibia	Not felt
Left patella	Not felt	Right patella	Not felt
Case 71, H. H., aged 77, generalized arteriosclerosis, endarteritis obliterans, former amputation of right leg			
Styloid process, left ulna	2.4	Styloid process, right ulna	4.2
Styloid process, left radius	3.6	Styloid process, right radius	3.6
Left olecranon process	2.8	Right olecranon process	3.4
Left internal malleolus	Not felt		
Left external malleolus	Not felt		
Left tibia	Not felt		
Left patella	Not felt		
Sacrum	Not felt		
Case 72, A. B., aged 91, spinal arteriosclerosis, weakness of legs, touch, pin prick, heat, cold, and position sensations normal in the lower extremities			
Styloid process, left ulna	4.0	Styloid process, right ulna	2.2
Styloid process, left radius	2.8	Styloid process, right radius	2.2
Left olecranon process	3.2	Right olecranon process	2.0
Left internal malleolus	Not felt	Right internal malleolus	Not felt
Left external malleolus	Not felt	Right external malleolus	Not felt
Left tibia	Not felt	Right tibia	Not felt
Left patella	Not felt	Right patella	Not felt

the patients with postencephalitic paralysis agitans gave lower readings than normal persons of analogous ages. The one striking exception to this is case 78. This patient was the most active of the group. Rigidity even to the point of helplessness was a prominent symptom in all the others. Because of this, it was thought that the rigidity itself might produce local conditions in the limbs which might interfere with the reception of the stimuli or the transmission of the impulse, and it was to determine this that the series of hemiplegia patients with contractures was examined.

From table 9 it will be seen that certain cases show a slight decrease in the duration on the hemiplegic as compared with the normal side, but the fact that this decrease is not found in all cases and that it is most

TABLE 8.—*Quantitative Estimation of Vibratory Sensation in Parkinsonism*

Case	Age	Left Ulna	Left Radius	Left Olecranon	Left Internal Malleolus	Left External Malleolus	Left Tibia	Left Patella	Right Ulna	Right Radius	Right Olecranon	Right Internal Malleolus	Right External Malleolus	Right Tibia	Right Patella
A. Postencephalitic Parkinsonism															
73. C. R.	15	4.8	5.2	4.4	4.5	4.0	3.2	2.0	5.0	6.2	3.4	3.5	4.0	3.2	2.7
74. S. S.	16	7.1	7.8	4.7	6.2	6.2	5.8	2.8	8.8	10.6	6.0	6.6	6.2	5.2	3.0
75. M. A.	17	8.0	6.2	4.2	6.6	3.8	6.4	4.4	6.2	5.4	2.5	6.4	4.7	7.0	4.4
76. J. F.	21	7.0	7.4	4.6	5.8	6.2	6.0	3.6	9.6	10.1	6.4	7.0	5.4	5.6	2.0
77. S. T.	21	6.5	9.2	5.8	3.0	4.2	4.4	3.3	5.7	8.2	7.2	4.8	4.6	3.2	0.8
78. A. B.	22	11.1	11.8	7.4	16.3	10.6	18.4	18.2	10.6	13.2	8.4	17.6	16.2	17.8	12.6
79. H. F.	26	4.8	4.2	3.8	3.0	4.6	4.0	3.8	5.4	5.4	3.8	2.8	4.6	4.2	3.1
80. J. J.	44	5.7	6.5	5.0	5.6	4.1	4.3	0.0	5.0	6.2	4.3	5.6	6.3	3.1	0.0
81. M. M.	46	6.3	8.4	3.6	2.8	3.3	2.2	0.0	5.3	8.2	4.0	3.2	5.2	3.2	0.0
B. Idiopathic Parkinsonism															
82. A. W.	51	9.2	11.2	....	8.4	7.4	5.1	4.7	11.2	11.0	....	5.5	6.4	9.1	6.8
83. C. B.	53	2.0	2.4	3.7	4.2	3.2	1.6	2.2	3.2	3.2	2.8	4.4	5.6	2.2	1.9
84. B. S.	54	8.3	9.3	4.8	0.0	0.8	1.3	0.0	4.0	5.5	6.1	0.0	0.8	2.8	0.4
85. J. C.	55	8.2	10.0	....	0.0	3.7	3.0	3.7	8.2	8.5	....	4.2	0.0	4.0	2.7
86. G. M.	58	6.0	5.0	3.6	3.2	3.6	3.2	3.4	5.2	4.6	3.8	3.0	2.8	3.8	3.6
87. T. D.	60	p	p	p	0.0	0.0	0.0	0.0	p	p	p	0.0	0.0	0.0	0.0
88. P. L.	63	4.7	5.0	....	0.0	0.0	0.0	0.0	7.0	5.6	....	0.0	0.0	0.0	0.0
89. M. N.	65	9.2	9.0	....	0.0	0.0	0.0	1.6	14.2	16.4	....	4.8	1.5	1.6	5.5
90. W. L.	65	9.2	9.0	....	0.5	0.0	4.5	1.0	9.2	7.5	....	6.0	6.7	8.0	6.0
91. J. L.	67	6.5	5.7	....	0.5	0.0	0.0	0.0	6.2	6.2	....	0.0	0.0	3.2	0.0
92. S. G.	75	9.0	8.2	....	2.8	3.6	4.2	3.8	8.8	8.0	....	2.7	0.0	6.5	5.2
93. G. T.	78	5.2	7.8	....	0.0	0.0	3.2	3.2	6.2	6.7	....	3.0	3.0	2.7	2.5

TABLE 9.—*Quantitative Estimation of Vibratory Sensation in Hemiplegia*

			Hemiplegic Side							Normal Side						
Case	Age	Side of Paralysis	Ulna	Radius	Olecranon	Internal Malleolus	External Malleolus	Tibia	Patella	Ulna	Radius	Olecranon	Internal Malleolus	External Malleolus	Tibia	Patella
94. A. L.	32	Left	6.8	6.6	5.8	4.4	4.4	3.6	4.6	9.4	10.2	8.6	6.0	8.4	7.2	4.4
95. B. M.	42	Left	3.5	3.1	2.4	0.0	2.6	1.4	3.2	3.6	5.4	3.0	2.6	4.0	3.4	2.4
96. C. M.	50	Left	4.0	4.0	2.8	1.6	1.6	1.4	2.4	6.4	5.0	3.0	0.0	0.0	2.4	0.0
97. D. W.	54	Right	15.4	17.6	13.1	12.9	13.5	13.0	14.6	13.3	13.9	14.3	13.7	13.4	14.5	15.7
98. E. F.	55	Left	2.2	2.8	....	2.2	1.4	2.2	....	3.6	3.2	....	2.4	3.4	4.4	....
99. F. D.	60	Left	3.8	4.4	3.4	0.0	0.0	0.0	0.0	3.0	5.6	3.4	0.0	0.0	0.0	0.0
100. G. B.	60	Right	4.7	3.6	4.6	3.4	3.2	2.6	0.0	3.8	3.6	3.4	3.2	2.8	3.2	2.8
101. H. L.	60	Left	4.6	4.0	3.0	0.0	0.0	0.0	0.0	8.0	6.4	5.8	2.8	1.2	3.6	2.4
102. I. M.	66	Left	5.6	5.2	2.6	1.0	0.8	0.0	0.0	6.0	5.6	3.4	1.4	1.2	2.0	1.2
103. J. D.	67	Left	1.6	2.2	....	0.0	0.0	0.0	0.0	5.4	5.6	....	3.6	3.2	3.0	1.6
104. K. L.	70	Right	5.7	6.5	....	1.5	3.5	1.7	....	8.0	6.0	....	3.5	3.5	1.7	....
105. L. K.	75	Left	9.4	7.4	7.6	8.3	0.0	0.0	0.0	5.4	7.0	6.3	13.0	0.0	0.0	0.0
106. M. H.	78	Left	12.6	9.6	8.8	0.0	0.0	0.0	0.0	9.2	4.6	0.0	0.0	0.0	0.0	0.0
107. N. T.	79	Left	4.6	4.4	....	0.0	0.0	0.0	0.0	4.2	6.4	....	0.0	0.0	0.0	0.6

marked in case 103, one of left hemiplegia, hemianesthesia and hemianopia, indicates that it is due to involvement of the thalamocortical radiations rather than to a local condition in the extremities. Some such sensory involvement, in either the thalamus or the subthalamic region, seems probably the cause of the decrease in encephalitis. The cases of hemiplegia show a similar decrease in relation to age.

TRANSMISSION OF VIBRATORY SENSIBILITY AND CAUSE OF ITS LOSS

Nature and Path of Transmission of Vibratory Sensibility.—Such a striking alteration of sensibility as occurs in persons during the involutional period of life needs some definite explanation. Before discussing the character and location of the pathologic change, it is necessary to

TABLE 10.—*Combined Average of Right and Left Sides*

Decade	Ulna	Radius	Olecranon	Internal Malleolus	External Malleolus	Tibia	Patella
Second.....	10.0	10.1	7.0	7.9	8.2	6.5	5.2
Third.....	8.9	8.4	6.5	7.1	7.2	6.1	4.4
Fourth.....	8.1	8.0	6.7	6.2	6.3	6.0	4.6
Fifth.....	9.0	8.6	7.2	5.3	5.0	5.1	4.5
Sixth.....	6.0	6.4	5.6	2.6	3.0	2.7	2.5
Seventh.....	6.6	6.5	5.4	2.5	2.1	2.6	2.0

TABLE 11.—*Number of Cases Showing Absence of Vibratory Sensation*

	Decade					
	Second	Third	Fourth	Fifth	Sixth	Seventh
Excluding patella.....	0	0	1	2	4	5
Including patella.....	0	0	1	3	5	8

consider briefly the nature of the sensation and the conduction pathways of vibratory sensibility. Although there are many conflicting theories as to its nature—these theories have been summarized well by Katz[11] in a recent paper—it seems more in accord with the known facts to consider it a specific variety of sensation. The end-organs that subserve it are not known, but the work of Frank[12] proves that the impulses ascend to the dorsal roots in the motor nerves. Most authorities agree that from there they ascend to the dorsal column nuclei in the ipsilateral posterior columns. (It is difficult to understand from Frank's article how he reaches the conclusion that they are conveyed in the lateral

11. Katz, D.: Ueber die Natur des Vibrationssinns, München. med. Wchnschr. **70**:706, 1923.

12. Frank, G.: Die Störungen des Vibrationsgefühls bei der traumatischen Verletzung der peripheren Nervenstamme, Arch. f. Psychiat. u. Nervenh. **62**:627, 1920-1921.

columns.) From the dorsal column nuclei, the fibers decussate in the fillet and pass upward with that strand of white matter to the contralateral thalamus and cortex.

LOCATION OF THE PATHOLOGIC LEGION

Somewhere in this long pathway, the conduction of the vibratory impulse tends to be interrupted or meets with interference during the latter half of life. Cortical or subcortical lesions would have to be bilateral to account for the bilateral distribution of the sensory change, and furthermore, such lesions seldom cause loss of sensation.

Local conditions in the extremities, such as edema, will produce diminution of the sensibility; such conditions, however, were not present in any of the cases. Diseases of the arteries, with consequent nutritional disturbances of the end-organs or nerves, might interfere with the conduction of the impulses, but in only one instance was this observed —the patient in case 71 suffered from endarteritis obliterans. With this exception, it was possible to obtain good pulsation in the dorsalis pedis and popliteal arteries in all the patients. Disease of the peripheral nerves must involve the motor bundles to produce vibratory loss, and the signs of peripheral motor disturbance would be plainly evident. Such was not the case. A lesion of the dorsal roots would show disturbances of other sensations, and these were always normal. As the loss occurs in older persons, the influence of alcohol must be considered, but a number who had lost vibratory sensibility in the legs denied its use, and no difference was found in the results when patients who admitted the use of alcohol were compared with those who had never indulged.

It seems probable that the lesion responsible for involutional alteration in vibratory sensibility is situated in the spinal cord and involves the fibers from the lumbar enlargement almost exclusively. The exact location of the tract that conducts vibratory impulses from the legs is unknown, except that it passes upward in the columns of Goll. According to Tilney and Riley,[13] the fibers of this column are arranged in laminae, those entering the lowest part of the cord being most medial, those entering the upper portions of the lumbar enlargement being more lateral.

Vascular Supply of the Spinal Cord.—Williamson,[14] and Whitaker,[15] from whose articles the illustration is drawn, stated that the peripheral

13. Tilney, F., and Riley, H. A.: The Form and Functions of the Central Nervous System, New York, Paul B. Hoeber, 1921.

14. Williamson, R. T.: On the Relation of Diseases of the Spinal Cord to the Distribution and Lesions of the Spinal Blood Vessels, London, H. K. Lewis, 1895.

15. Whitaker, J. R.: Anatomy of the Brain and Spinal Cord, Edinburgh, E. & S. Livingstone, 1911.

margins of the posterior columns are supplied by the peripheral arteries, branches of the anastomosed anterior and posterior spinal arteries. The posterior median artery, a branch of the posterior spinal, supplies the area adjacent to the posterior median fissure. In the upper part of the cord, a small vessel, the intrafunicular artery, penetrates into the paramedian fissure to supply the contiguous margins of the columns of Goll and Burdach, but in the dorsal and lumbar regions this vessel is absent. The central and lateral portions of the column of Goll receive their blood supply from minute terminal branches of the anterior median artery, supplying the central gray matter, from branches of the posterior spinal artery, supplying the posterior horn, and from the terminations of the peripheral and posterior median vessels. As all the vessels of the cord are terminal, this means that this region of the column, i. e., the central and lateral portions, is poorly supplied with blood.

According to Williamson, the lower part of the spinal cord has not as efficient a blood supply as the upper portion, and he notes that Moxon drew attention to the fact that the spinal arteries are the longest vessels in the body, and that the reinforcing vessels have to pass upward in the lower part of the cord, sometimes for a considerable distance. Carrington,[16] working under Moxon's direction, injected the femoral arteries in seven subjects. Though the point of injection was closer to the lower than to the upper part of the cord, he found that the anterior spinal arteries filled from above downward, and in no instance were the reinforcing vessels to the lower part of the cord injected.

Clinical observation agrees with the experimental evidence that the lower portions of the spinal cord have an inefficient vascular supply at best, and this is particularly true of the thoracic region. Both Lewandowsky[17] and Russell[18] called attention to the proportionately greater frequency of transverse myelitis in this region (in fact, the former says it occurs five times as frequently there as in the rest of the cord), and they attribute this frequency to the anatomic arrangement of the vessels.

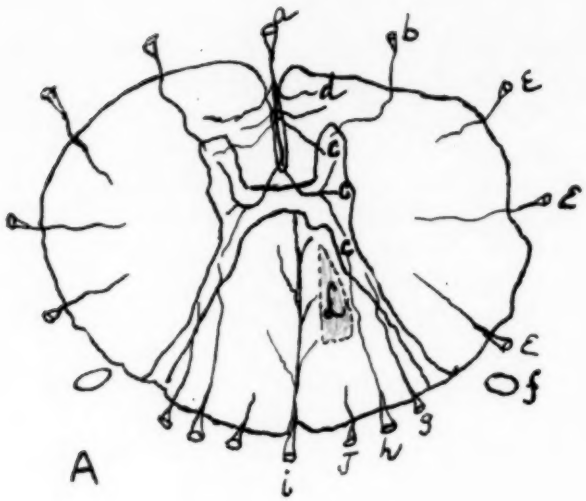
Spinal Arteriosclerosis the Probable Cause of Vibratory Loss.—Williamson found that in cases of paralysis agitans well marked vascular and perivascular changes were found in the spinal cord—thickening of the vessel walls, perivascular and diffuse interstitial sclerosis; Redlich[19]

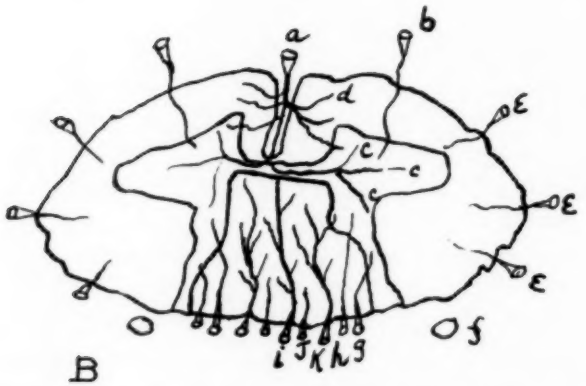
16. Carrington, quoted by Williamson (footnote 14).

17. Lewandowsky, M.: Handbuch der Neurologie, Spezielle Neurologie I, Berlin, Julius Springer, 1911.

18. Russell, C. K., in White, W. A., and Jelliffe, S. E.: Modern Treatment of Nervous and Mental Diseases, Philadelphia, Lea & Febiger, vol. 2, 1913.

19. Redlich, quoted by Williamson (footnote 14).





Cross-section of the spinal cord, showing the arterial supply: *A*, at level of eighth thoracic segment; *B*, at level of eighth cervical segment. *a* indicates the anterior median artery, a branch of the anterior spinal; *b*, anterior radicular artery, a branch of the anterior spinal supplying the anterior portion of the ventral horn; *c*, central arteries, terminal branches of the anterior median, supplying the central gray matter and the middle and ventral horns; *d*, peripheral arteries, branches of the anterior median, supplying the ventral white column; *e*, peripheral arteries, branches from the anastomosis between the anterior and posterior spinal arteries, supplying the lateral white column; *f*, posterior spinal artery; *g*, posterior radicular artery, a branch of the posterior spinal, supplying the dorsal horn; *h*, posterior commissural artery, a branch of the posterior spinal, supplying the base of the dorsal horn; *i*, posterior median artery, a branch of the posterior spinal, supplying the adjacent margins of the posterior columns; *j*, peripheral arteries, branches of the posterior spinal, supplying the periphery of the posterior columns; *k*, intrafunicular artery, a branch of the posterior spinal, supplying the contiguous margins of the columns of Goll and Burdach in the upper dorsal and cervical regions of the spinal cord—it is not present in the lower thoracic or lumbar regions; *l*, the region in the posterior columns where the fibers conveying discriminative sensory impulses, and particularly vibratory sensation, pass upward in the thoracic and lumbar regions of the spinal cord.

pointed out a similar change in the cords of elderly people, though in these the change was not so marked, and the perivascular sclerosis was absent.

During the involutional period, the arterial system is prone to sclerotic changes. The majority of the older persons examined in this study showed some degree of generalized arteriosclerosis. Such an arterial condition would result in a decreased blood supply to the spinal cord and particularly to the thoracic region, where the circulatory system is least efficient. The central and lateral portions of the column of Goll, poorly supplied at best, would bear the brunt of the loss, and it is in this location that the fibers carrying the impulses of position, vibration and other types of posterior column sensibility from the lower limbs pursue their upward course. As the fibers carrying these impulses from the upper limbs enter the cord at a higher level, vibratory sensibility is not disturbed in the upper limbs. This does not explain why the fibers that conduct position and other modalities of posterior column sensibility seem to be spared while those which conduct vibration are affected. The latter modality has no obvious or necessary bearing on the needs of civilized man and is rarely experienced in a pure form; it might be expected that its conduction pathways, seldom exercised, would disintegrate under an attack which the more used and important modalities survive.

Two cases seem to support the theory that arteriosclerosis of the spinal cord is the factor that produces this loss of vibratory sensibility. Case 71 is one of generalized arteriosclerosis and endarteritis obliterans. In this patient, though the pulsation in the dorsalis pedis artery was lost, that in the popliteal vessels remained.

The deficient blood supply of the distal part of the leg might account for the loss of vibratory sensibility over the malleoli, but would hardly be sufficient to produce the loss over the tibia and patella. Furthermore, the sensibility was absent over the sacrum, and the absence in this location would point to an intramedullary rather than to a peripheral disturbance of the conduction pathways. Case 72 is one of spinal arteriosclerosis, and the vibratory is the only type of sensibility affected.

Piercey has theorized that arteriosclerosis of the vessels of the spinal cord explains the decrease and loss of vibratory sensibility in the involutional period of life, and the results of this study are in agreement with this theory. The sensory loss in paralysis agitans is greater than in normal persons because of the greater arterial involvement. Certain persons throughout life have a lower threshold for vibration than others; these retain the sensibility after they reach 50 years of age, though it is diminished. Those who have a higher threshold are more liable to lose the sensibility in the lower extremities after this age is attained.

SUMMARY AND CONCLUSIONS

Vibratory sensibility was tested in seventy-two persons between the ages of 10 and 90 years, who did not show any signs of organic disease of the nervous system. It was found that adolescents perceived the vibrations best. Decade by decade, there was a slight decrease in the sensibility over the lower extremities, and this decrease became striking after the age of 50 years. Many of these older persons had lost vibratory sensibility for this region. A similar decrease in relation to age was found in twenty-one cases of parkinsonism and fourteen cases of hemiplegia.

The most probable location for the pathologic changes underlying this decrease is the posterior columns of the spinal cord. The lesion is probably vascular. The blood supply to the central and lateral portions of the column of Goll in the thoracic region is inefficient; any general vascular disease would affect this region promptly and severely. It seems likely that the fibers carrying vibratory impulse from the legs pass upward in this location, and their function suffers as a result of arteriosclerotic changes that occur in the involutional period of life. Other modalities of posterior column sensibility in these cases seem unimpaired by the ordinary clinical tests. These tests are not as delicate as those used in examining vibration. Application of more delicate methods of testing the sense of position might show an analogous impairment in these modalities.

My studies have led to the following conclusions:

1. The ability to perceive vibratory stimuli from the lower extremities becomes impaired in most persons after the fifth decade. The degree of impairment increases with age.

2. This impairment is a result of diminished blood supply to the central and lateral portions of the columns of Goll, in the thoracic region of the spinal cord, as a consequence of the generalized arteriosclerosis that occurs in the later decades of life.

SO-CALLED "BRAIN PURPURA" OR "HEMORRHAGIC ENCEPHALITIS"

A CLINICOPATHOLOGIC STUDY *

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In various toxic-infectious conditions a type of brain lesion has been described to which has been given the names "brain purpura," "hemorrhagic encephalitis," and "perivascular hemorrhages"; none of these titles gives an adequate idea of the pathologic nature of the disease, though each contains some element of truth. The nature of the process, the nomenclature, the type of cell involved in the pathologic reaction and even the type of lesion which should be included in this group are sufficiently ill defined to make a survey of the field both desirable and useful.

In 1903, Rosenfeld [1] described a pathologic process in the brain to which he gave the name "hemorrhagic encephalitis." This condition had apparently been overlooked up to this time. His article was followed, in 1905, by a more thorough investigation by Schmidt,[2] who first used the term "brain purpura." Schmidt preferred the latter term, though the lesion so designated was similar in all respects to that described by Rosenfeld. He not only studied the occurrence and incidence of the lesions but attempted to trace their development and formation. In 1913, Oeller [3] contributed an elaborate paper in which he attempted to trace the relation of certain small areas of cerebral hemorrhage to "hemorrhagic encephalitis" and attacked the term introduced by Rosenfeld. Since these descriptions there have been several contributions that deal mainly with the occurrence of these areas of "hemorrhagic encephalitis," "brain purpura" or "perivascular hemorrhages" in various diseases. The type of lesion described by Schmidt and Oeller differs sufficiently from other lesions found in the brain to

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1. Rosenfeld, M.: Zur Casuistik der acuten hämorrhagischen Encephalitis, Deutsche Ztschr. f. Nervenh. **24**:415, 1903.

2. Schmidt, M. B.: Ueber Gehirnpurpura und hämorrhagische Encephalitis, Beitr. z. path. Anat. u. z. allg. Pathol., supplement **7**:419, 1905.

3. Oeller, H.: Pathologisch-anatomisch Studien zur Frage der Entstehung und Heilung von Hirnblutungen und über ihre Stellung zur hämorrhagischen Encephalitis, Deutsche Ztschr. f. Nervenh. **47-48**:504, 1913.

constitute a separate and distinct group, but the development of these lesions is still sufficiently obscure to require investigation. It is essential to know the exact characteristics of the lesions and to use a term to describe them which will leave no doubt as to their definition. With this in view, I have reviewed ten cases with the object of studying the life cycle of these areas.

REPORT OF CASES

CASE 1.—*Acute bronchopneumonia in a child, aged 2. Hemorrhagic encephalitis.*

History.—A colored child, aged 2, who entered the Children's Hospital on the service of Dr. Le Boutillier, had been born at full term after a normal pregnancy without the use of intruments. Development was normal until the age of about 10 months when it became apparent that the head was large. The child had never walked or crept. She had spoken only a few words. Four months before admission she had a severe attack of pneumonia and since had had frequent colds which were always accompanied by swelling of the face and legs.

Physical Examination.—The child was sick and drowsy, with a temperature of 99 F. and a pulse rate of 140. The head was large and was oval in shape. The eyelids were edematous. The lungs showed bronchitis. There were marked enlargement of the liver and slight edema of the legs and back. During the course of a spinal puncture, the heart suddenly stopped and failed to respond to stimulation. The course had been progressively downward, however, and the child was moribund when the spinal puncture was done. The urine showed a heavy trace of albumin.

General Pathologic Examination.—The lungs showed an acute bronchopneumonia, chronic bronchitis, fibrous pleurisy and pleural effusion. The heart showed moderate left-sided dilatation and hypertrophy, with toxic degeneration of the myocardium. The spleen showed a follicular hyperplasia. Central necrosis was found in the liver. The intestines were the seat of a subacute enteritis, and the colon, of a gangrenous colitis.

Gross Examination of the Brain.—The brain weighed 1,100 Gm. Slight edema was present. A frontal section showed slight ventricular dilatation, most marked in the third ventricle. Petechial hemorrhages were noted in the white matter of the brain, and a few were present in the basal ganglia.

Microscopic Examination.—A section of the frontal cortex showed several fairly large areas or foci, entirely within the white matter of the brain, which were distinctly pathologic. None were seen in the cortex. In the center of the focus was a small capillary. In some foci the endothelium of the capillary appeared normal, while in others it was markedly swollen and seemed to obliterate the lumen of the vessel almost completely. Around the vessel was a layer of irregularly arranged cells. Some of these cells were degenerated; others were in a good state of preservation. The nuclei of these cells were large and vesicular, contained nucleoli, and were for the most part crescentic in shape; some, however, were oval and round. The chromatin network was most evident just under the nuclear membrane, while in the center of the nucleus it was only slightly evident. Some nuclei were pyknotic. Around this area of cells was an area that was homogeneous except that it seemed spongy in appearance; it was practically devoid of cells. A few cells were present, but they were poorly preserved (figs. 7 and 8). A similar focus elsewhere in the frontal area showed the same general picture, except that the process seemed to be much more recent; practically all the cells were polymorphonuclear and were arranged in several layers around the

vessels. In this focus the endothelium of the central capillary was much swollen. There was also a homogeneous area here, but it was not as marked as when the cellular infiltration was composed of mononuclear elements. A few areas in the brain were almost entirely homogeneous, and contained only a few scattered and degenerated cells. Thrombi were not seen in the vessels.

CASE 2.—*Acute rheumatic fever and lobar pneumonia in a man, aged 32, with hemorrhagic encephalitis.*

History.—A white man, aged 32, entered the Philadelphia General Hospital on the service of Dr. Schnabel, complaining of rheumatism. Five weeks before

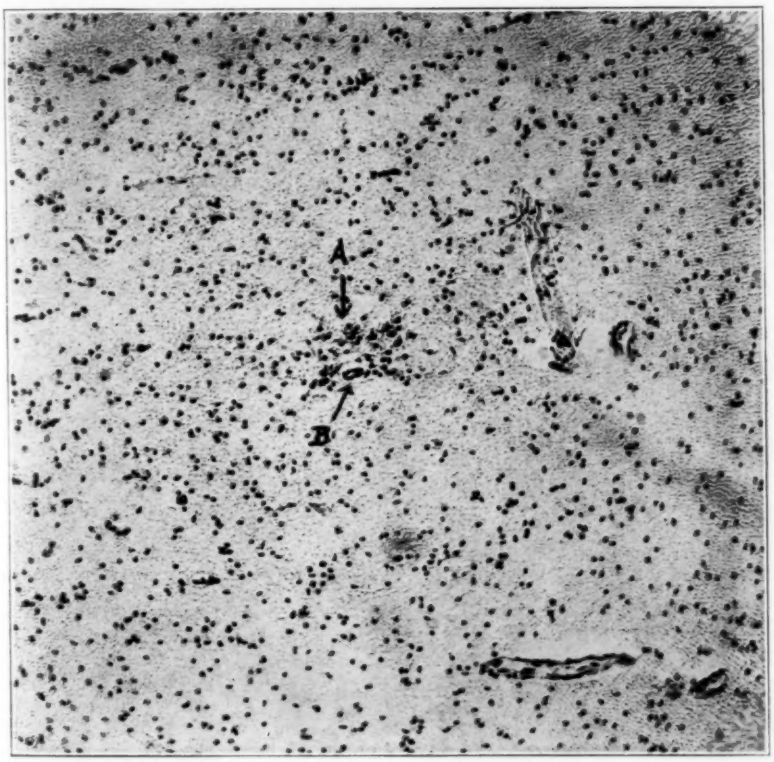

Fig. 1.—An early focus, showing the collection of cells (*A*) around a small central vessel (*B*). Toluidine blue strain.

entrance he began to cough and had pain in the right side of the chest with fever. The pain migrated to the right knee, then to the left knee, and finally to the right index finger. The joints were red and swollen. There was a history of gonorrhea from seven to eight years before admission to the hospital.

Physical Examination.—The heart was definitely enlarged, with a precordial shock and a soft systolic murmur which was heard vaguely in the axilla. The right index finger, left knee and left ankle were swollen and tender. Laboratory examinations showed 14,000 white blood cells, a negative blood Wassermann reaction, and a sterile blood culture. The spinal fluid was entirely normal.

Clinical Diagnosis and Course.—The condition was diagnosed as acute rheumatic fever, bilateral lobar pneumonia, mitral valvulitis and septicemia. After thirteen days in the hospital, the patient died.

General Pathologic Examination.—Myocardial degeneration and cloudy swelling of the heart, lobar pneumonia, edema and passive congestion of the lungs and acute splenic tumor were found. The kidneys were the seat of a glomerular nephritis; the liver showed passive congestion and cloudy swelling.

Brain: The brain weighed 1,370 Gm.; it was somewhat congested. The convolutions were slightly shrunken, the pia thin and transparent, and the vessels

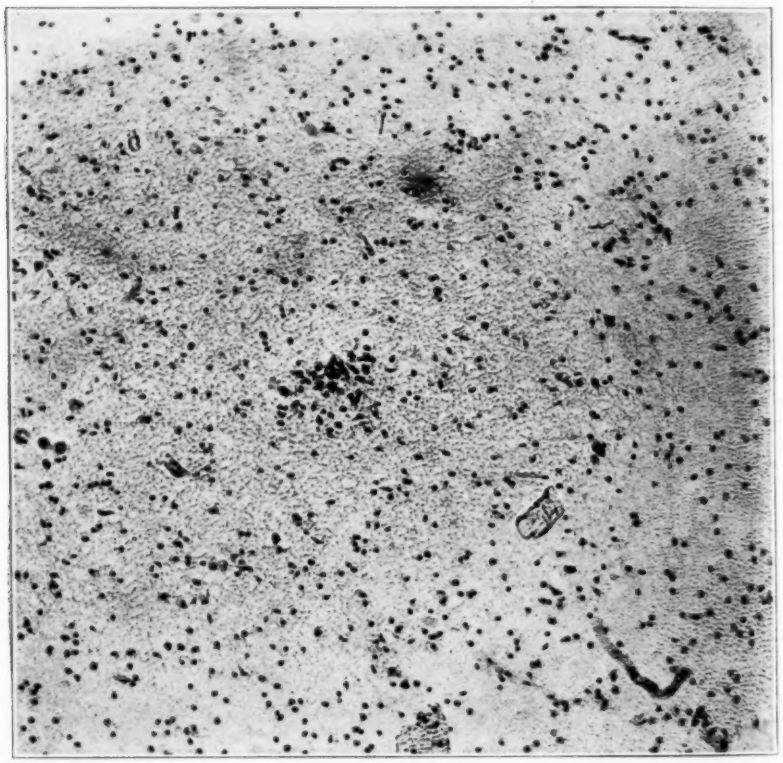

Fig. 2.—A focus similar to that in figure 1.

thin walled and collapsed. A frontal section revealed a normal ventricular system and normal anatomic markings. Here and there throughout the brain were small pinpoint, brownish discolorations confined entirely to the white matter; they numbered from three to five in each cut surface. Only one such area was seen in the corpus callosum. "Hemorrhages" were not found in the basal ganglia. The gross diagnosis was hemorrhagic encephalitis.

Microscopic Examination.—Numerous foci were seen in the white matter of the frontal and occipital cortex. These areas were similar in all respects to many described in other cases. In the occipital cortex were many areas of cell groupings around a vessel, without, however, any homegeneity of these areas (figs. 1 and 2). Most of the nuclei were small and round; relatively few were oval or

crescentic and fairly large. A few areas showed necrotic centers close to the vessel, with many pyknotic and degenerated nuclei. The center of such an area was a large necrotic mass. Outside this necrotic center was a homogeneous structure containing cells which were fairly well preserved. Many cells here were also pyknotic, with round vesicular globules in the cytoplasm. The cell processes in some instances within these areas were distinctly visible for long

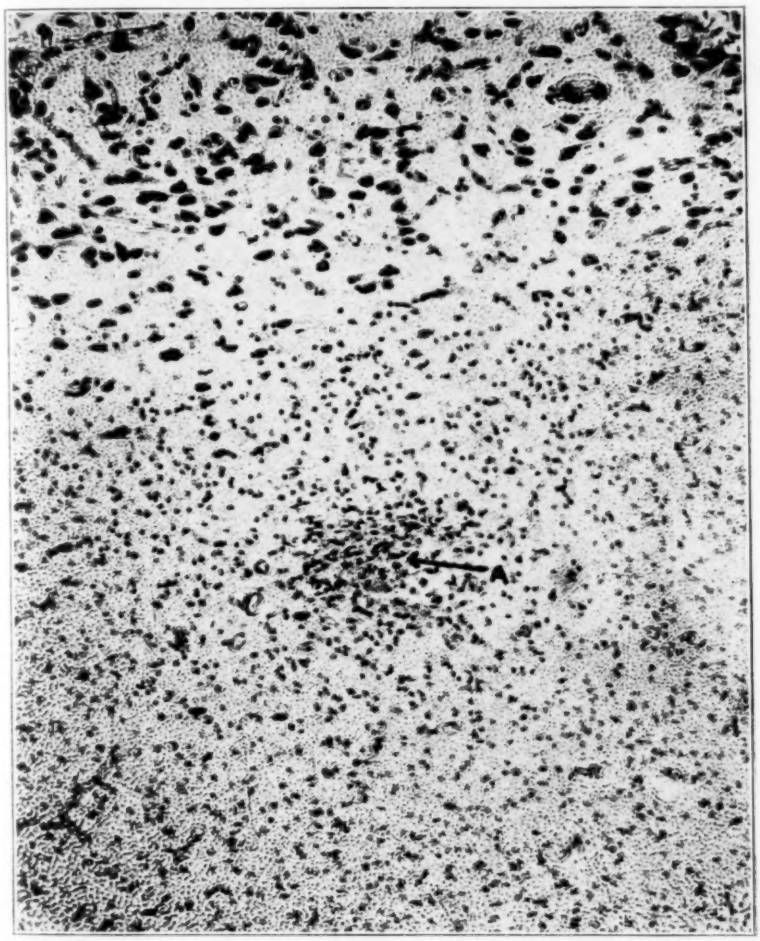

Fig. 3.—A more advanced focus showing a larger collection of cells and also beginning necrosis in the central portion of the focus (*A*). This focus lies just below the cortex.

distances and looked like the processes of glia cells. The endothelium of the capillaries appeared swollen, in some cases so greatly as almost to obilterate the lumen. In a few places the perivascular spaces of Virchow-Robin were dilated.

Cajal gold sublimate staining showed no increase in the astrocytes within or around the foci. In a few places there appeared to be a single wall of these cells

around the focus; this was interpreted as due to a pushing aside of the astrocytes by the process in these areas (figs. 12 and 13). In a few early foci astrocytes could be seen within the focus, and also on the edge of the focus, in a fairly well preserved or degenerated state, sending long finger-like processes into the focal area. An increase was not seen in the astrocytic neuroglia, however, and I interpret these manifestations as due to involvement of the astrocytes within the brain tissue in the focus of softening rather than to any active rôle which they play in the process.

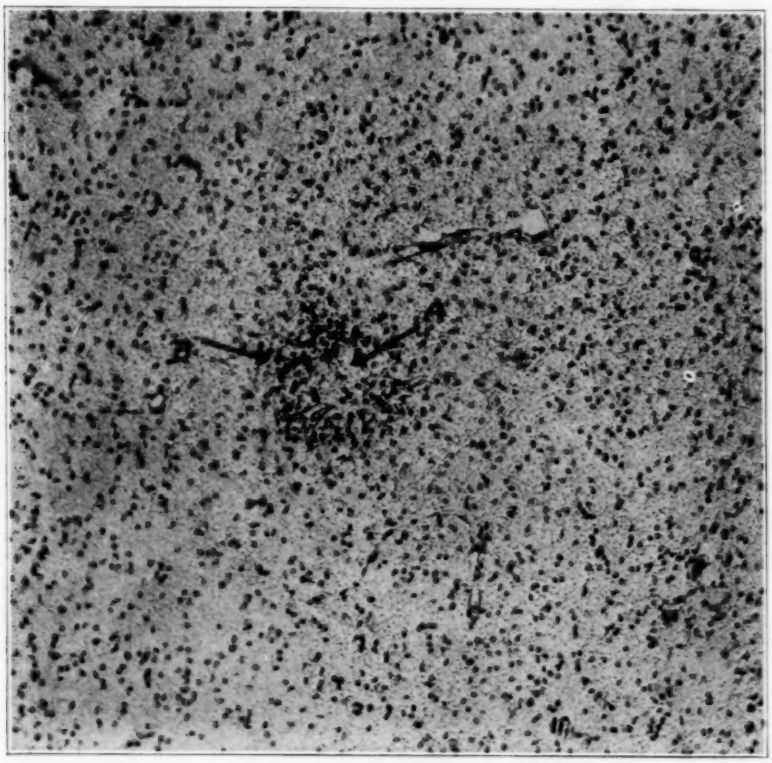

Fig. 4.—A still more advanced focus showing the necrotic center (*A*), and the palisade-like arrangement of cells around it (*B*).

Hortega's first variant of Achucarro's stain showed definite manifestations in several of these foci. In one area the focus was seen to lie at the end of a small vessel. In the center of this focus was a small capillary vessel, the cells of which were narrow and densely stained. Arranged in a radial fashion around this small capillary were cells with large oval nuclei which stained lightly and in which the silver was deposited in small droplets. These were numerous and all of one type. They appeared to be oligodendroglia cells.

CASE 3.—*Bronchopneumonia in a child, aged 3. Hemorrhagic encephalitis.*

History.—A white boy, aged 3 years, whose birth had been normal, was admitted to the service of Dr. Graham at the Jefferson Hospital, with the com-

plaints that for six months he had vomited after every meal, had been unable to take solid food and was extremely nervous. He had never talked or been able to sit up.

Physical Examination.—The child appeared sick, with eyes moving constantly from side to side, twitching of the eyelids and tongue, and with the mouth opening and closing about three times a minute. The eyes showed a lateral nystagmus. The pupillary reactions were normal. The lungs presented râles. The heart was normal. The knee jerks were absent. A Babinski sign was present bilaterally. After four days in the hospital, the patient died.

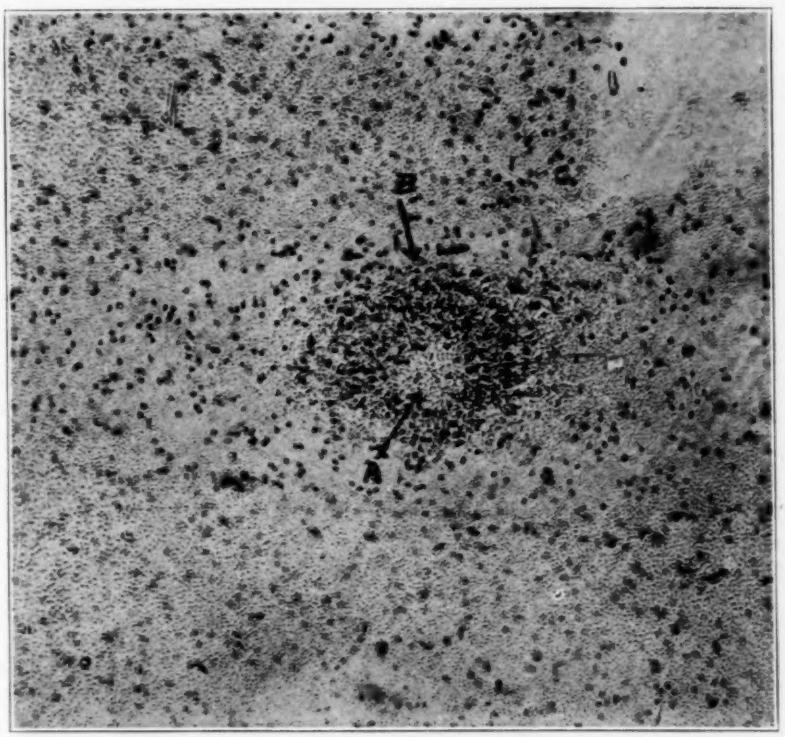

Fig. 5.—Here the focus is more definitely delimited than in figure 4. The necrotic center at *A* is easily seen, as well as the large collection of cells around it (*B*).

General Pathologic Examination.—The outstanding feature was bilateral bronchopneumonia. The other organs were not remarkable.

The brain appeared large for a child, aged 3. The convolutions were flattened. The vessels at the base appeared normal. A few superficial points of hemorrage were seen over the occipital pole. A mild internal hydrocephalus was present.

Microscopic Examination.—In the hippocampus were several areas of varying size containing collections of cells of the mononuclear type. Some areas were arranged around vessels, but just as many were not perivascular. In this region also were numerous small hemorrhages immediately around the vessels and in the

brain tissue. The structure of the foci was characteristic: a central capillary; around it a hemogeneous area; outside of this a more or less dense wall of mononuclear cells. In the areas in which the vessel was visible, the endothelium appeared markedly swollen and sometimes almost obliterated the capillary lumen.

CASE 4.—*Secondary anemia with cerebral hemorrhage and hemorrhagic encephalitis.*

History.—A colored boy entered the Philadelphia General Hospital on the service of Dr. Husik about five weeks after he had fallen and struck his mouth, which produced much bleeding. About five days later, he had nose bleed which

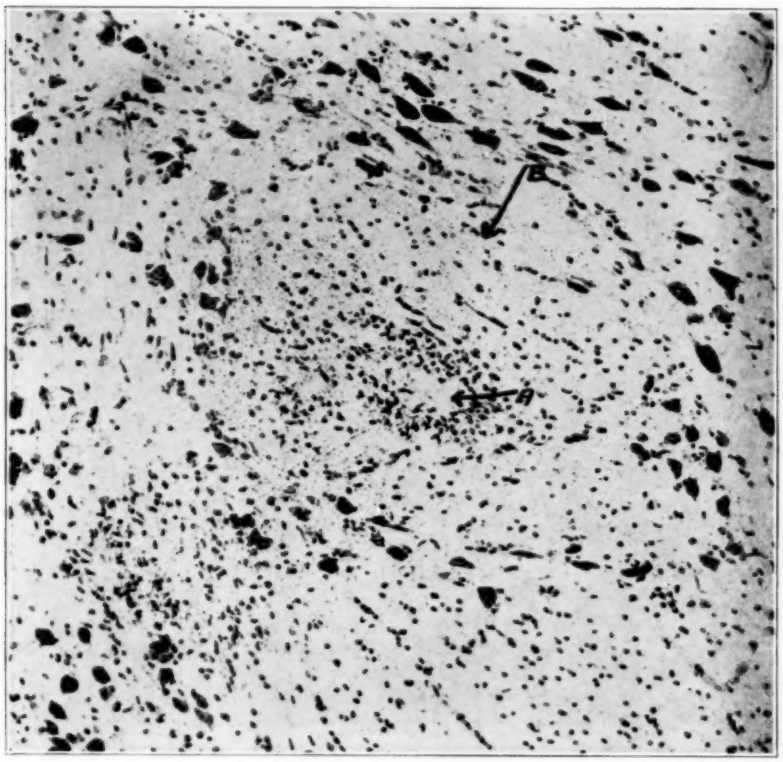

Fig. 6.—One of the foci under higher power, with central necrosis (*A*), and beginning necrosis at the periphery (*B*). This focus is in the pons.

lasted more than six hours. Since then, he had had similar hemorrhages every other day lasting about two hours. A week before entrance, he felt sick at the stomach and had pain in the top of the head. Two days before entrance, he went to bed because of these symptoms. He became drowsy and weak. He had another nasal hemorrhage the day before entrance, and following this became comatose. In this condition, he was admitted to the hospital. He had had varicella, mumps and double pneumonia in 1922.

Physical Examination.—The patient was stuporous and appeared decidedly ill. The heart showed a hemic murmur over the base; there was no enlargement. The lungs were normal. There were two small ulcers on the gums of the lower

jaw. The left pupil did not react to light, but the right reacted well. The reflexes were absent or diminished. Plantar stroking evoked a questionable Babinski sign in both feet. There was a positive Oppenheim sign bilaterally. Ankle clonus was not present. The neck was definitely rigid and there was a bilateral Kernig sign. The hemoglobin was too low to be measured. The red blood cells numbered 3,100,000 and the white blood cells 16,000. The spinal fluid showed no cells, a negative Wassermann reaction, and a colloidal gold curve of 4433321000. The patient became steadily worse and died of cardiac failure and pulmonary edema two days after entrance to the hospital.

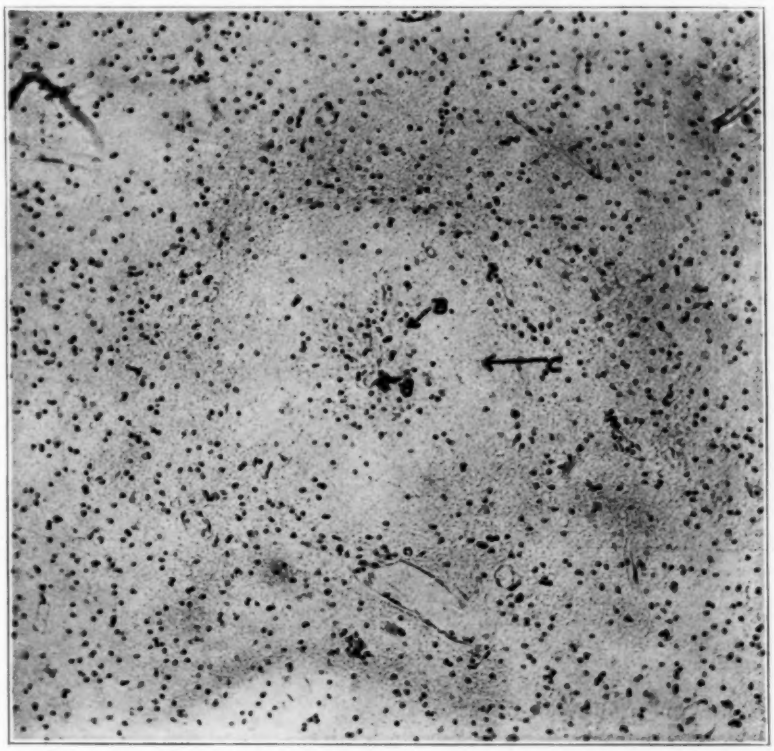

Fig. 7.—A large, fully developed focus with central vessel (*A*) surrounded by a few scattered cells (*B*) and an almost homogeneous periphery (*C*). This is the granuloma of Dürck. Toluidine blue strain.

General Pathologic Examination.—Chronic ulcerative tuberculosis and chronic fibrous pleurisy were found in the lungs. The spleen showed a conglomerate tuberculosis. In the heart there was cloudy swelling, while the kidneys and liver were the seats of chronic passive congestion and cloudy swelling.

Gross Brain: The brain seemed of normal size. The left frontal lobe was larger than the right, and was invaginated into the right frontal lobe across the mesial plane. Both frontal lobes were edematous. In the left frontal lobe was a hemorrhage which shelled out readily, leaving a cavity measuring 6 by 4 by 4 cm. The cavity extended from the anterior portion of Broca's area to within 3 cm. of the left frontal pole. Over the area of hemorrhage the pia-arachnoid

was infiltrated with blood. Another large hemorrhage was present at the lateral margin of the left temporo-occipital lobe, at a point where these two lobes meet. The vessels at the base of the brain were thin walled, collapsed, and without plaques. Vertical section of the brain revealed many small hemorrhages in the brain, especially in the motor and sensory areas. There was also a small hemorrhage in the splenium of the corpus callosum.

Microscopic Examination.—Sections of the frontal and occipital cortex showed relatively few small areas of hemorrhage. In the cortex and white matter in one area there was marked congestion of the smaller vessels. The red cells were almost entirely within the vessels, but in a few areas they had wandered outside

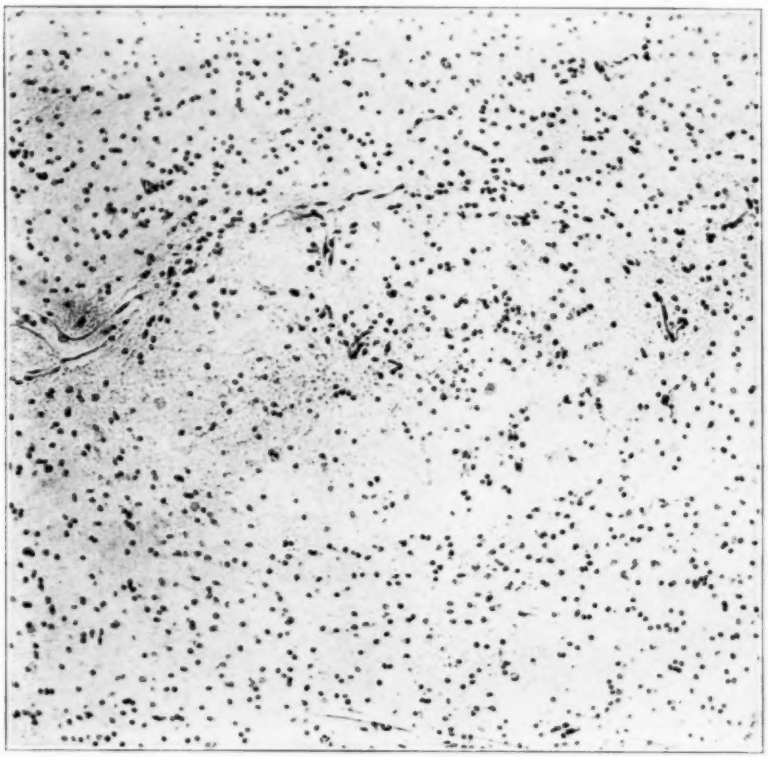

Fig. 8.—A similar focus. This is larger than in the preceding figure.

the vessel walls. In such areas the reaction around the vessels was slight. In one or two places were slight cellular reactions composed of glia cells. In one area in the white matter was a fairly large focus, the center of which was hemogeneous (fig. 4). Surrounding this were numerous cells, chiefly of the mononuclear type with crescentic or oval vesicular nuclei and well-defined nucleoli, with poorly defined cytoplasm. Some of the cells were polymorphonuclear, but these were few in number. The cells on the whole were well preserved.

CASE 5.—*Primary aplastic anemia with brain purpura, in a man, aged 33.*

History.—A white man, aged 33, admitted to the service of Dr. Joseph Sailer at the Philadelphia General Hospital in December, 1926, had been well until about

one year before entrance when he noticed the onset of dizziness. Three weeks before entrance this became much worse, and he became so short of breath that he could not walk more than a few steps without resting. He had been growing paler for three or four weeks. Four days before entrance he began to have pain on swallowing and coughed up a little blood-flecked sputum. He also had slight pain on talking.

Physical Examination.—The patient was pale and sallow; the lips and conjunctival and buccal mucosa were white. The heart was normal. The lungs were the seat of pneumonia. The blood pressure was: systolic, 110; diastolic, 65. The red blood cells at first were 1,180,000, and fell a week later to 900,000 and then

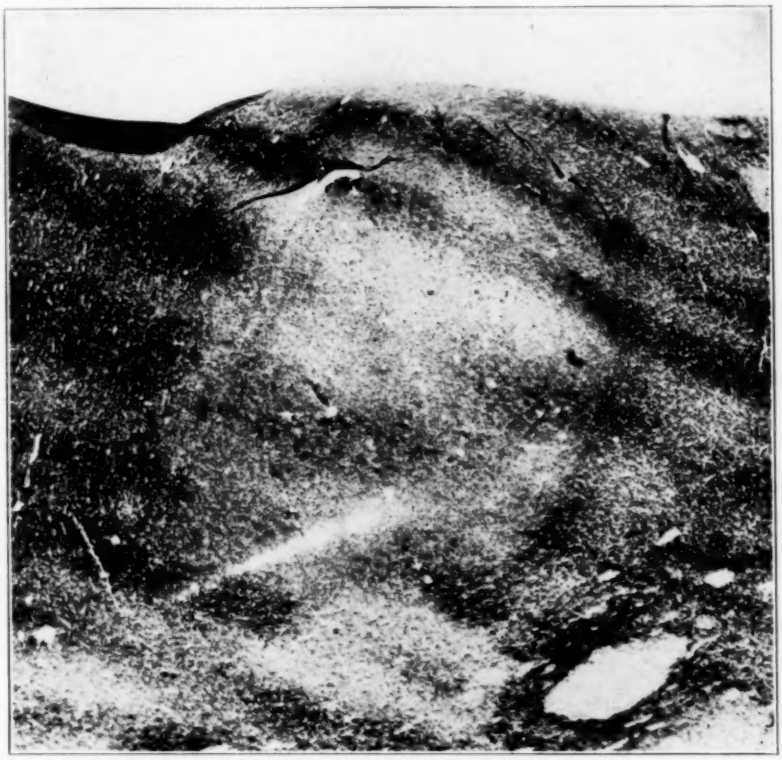

Fig. 9.—A low power photograph showing the size which some foci may attain. Silver carbonate stain of Hortega.

to 700,000. The white blood cells numbered 3,800 and 3,100. The hemoglobin content was 5.7 and later 2.6 per cent. There were 86 per cent lymphocytes among the white cells. Poikilocytosis, anisocytosis and polychromatophilia were present. A few nucleated red cells were present. The van den Bergh test showed a delayed icterus index of —4. The blood Wassermann reaction was negative. The patient became rapidly weaker and died about ten days after entrance.

General Pathologic Examination.—The picture was that of pernicious anemia. The spleen showed the changes of pernicious anemia. The liver showed hemo-

siderosis, and there was hyperplasia of the bone marrow. Early atherosclerosis of the aorta and lobular pneumonia were present.

The brain weighed 1,580 Gm. The consistency was good; the pia-arachnoid was normal and the vessels at the base were white, collapsed, and had thin walls. The convolutions were moderately broadened. The outstanding feature of the brain was the marked pallor—it seemed almost entirely avascular.

Microscopic Examination.—In the white matter of the occipital cortex were a few small foci. The center of such a focus was homogeneous, with a spongy or lacelike structure. Within this area were a few remnants of degenerated cells.

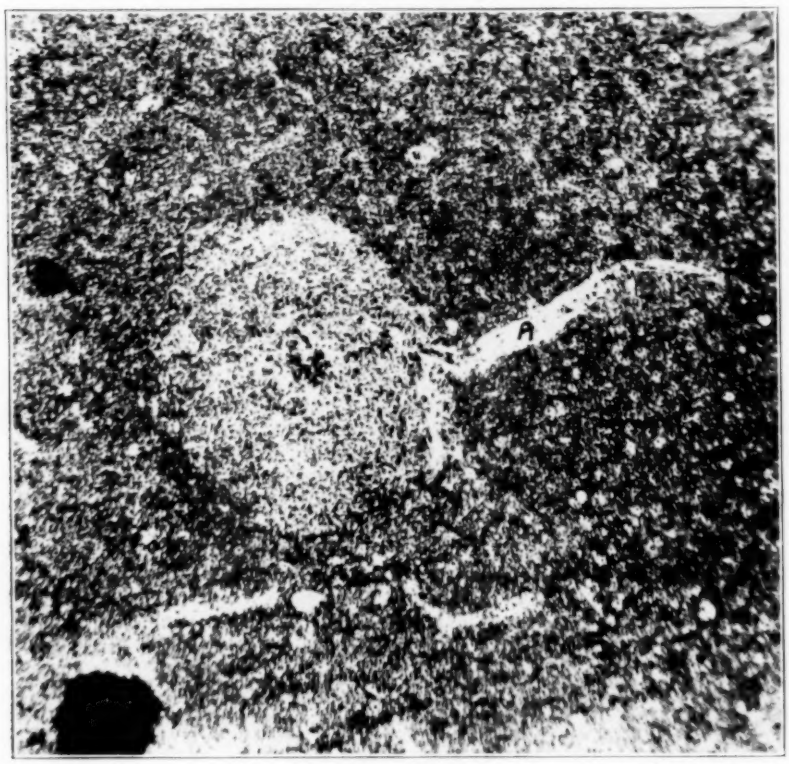

Fig. 10.—A similar focus. The clear relation of the focus to the vessel (*A*) should be noted.

Around the homogeneous focus was a collar of cells. Some of these cells were pyknotic and degenerated, but most of them were well preserved. The nuclei were oval or round with a well stained nucleolus and a light staining chromatin network. The cell substance was granular. Among the cells was much cellular débris. Many of the cell nuclei were elongated, darkly stained and poorly preserved. These foci seemed early and contained more cellular reaction than necrotic material (figs. 5 and 6).

In the frontal area several foci were scattered through the white matter. Usually they were seen immediately below the cortex. One such area had the characteristic blood vessel in the center. Around this was a collar of cells about

six or seven layers deep. The nuclei in this area were well preserved, with round, oval or crescentic shapes. Some of the cells were parallel with the vessel and some at right angles to it. The cytoplasm was granular and not well defined. There were a few pyknotic nuclei in the focus. Deeper in the white matter was a focus similar to those seen in the occipital area with a homogeneous center around which was grouped a collar of poorly preserved cells.

In the basis pontis were several foci. These did not involve the pontile nuclei, but were chiefly within the white matter. One such focus was oval, with a homogeneous center, around which was arranged a collar of cells of the type

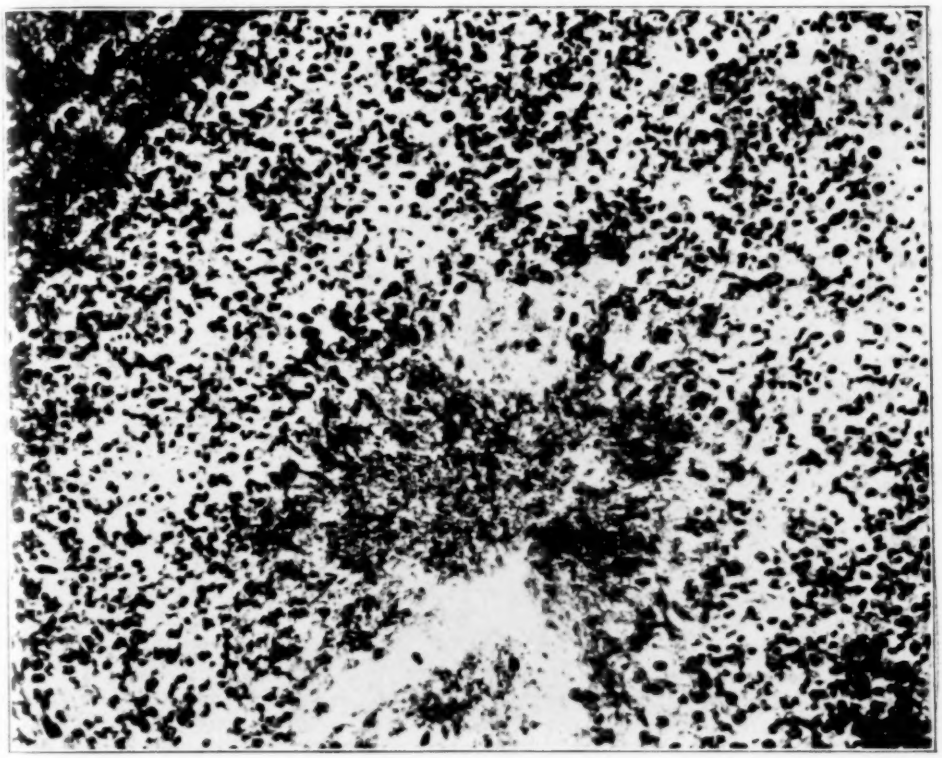

Fig. 11.—A high power photograph of the edge of a focus showing the abundance of oligodendroglia cells. Silver carbonate stain of Hortega.

described within the cerebrum. Many of these nuclei were pyknotic. There were many of these foci in the pons, some of which showed more marked evidences of disintegration than others.

The endothelium of the vessels in several of these foci was tremendously swollen. In some instances this was so great as practically to occlude the vessel.

Glia: Cajal's gold sublimate stain did not show a collection of astrocytes in the foci. With Hortega's fourth variant of Achucarro's stain there was, in these foci, a collection of cells which were impregnanted with silver (figs. 10 and 11). Several of these foci were studied in the corpus callosum. The homogeneous area showed a few cells impregnated and considerable granular débris.

The area surrounding the homogeneous center showed a ring of heavily stained cells, several layers thick. These formed a thick wall around the homogeneous area. They had small round nuclei for the most part. Most of these impregnated heavily and were well preserved; others were granular and broken up. The focus of degeneration was not sharply walled off from the surrounding brain tissue. The latter was irregularly invaded by the process. Hortega's first variant showed similar manifestations. The cells were oligodendroglia.

CASE 6.—*Acute nephritis and endocarditis with uremia in a man, aged 23. Brain purpura.*

History.—A white man, aged 23, entered the Philadelphia General Hospital on the service of Dr. J. Sailer, complaing that he had not been feeling well for two or three months. He had an occasional hacking cough and an occasional attack of vertigo. Two days before entrance he had nose bleed, which lasted one and a half hours. He felt chilly and nervous and went to bed. The day of entrance he was found breathing heavily and with blood-caked lips. He had a convulsion during which he shook all over but did not bite the tongue. Polyuria seemed to be present.

Physical Examination.—The patient was semicomatose. The head was described as microcephalic. The lungs and heart were normal. The blood pressure was: systolic, 170; diastolic, 90. The extremities were rigid. The reflexes were all hyperactive; there was bilateral ankle clonus and Babinski sign. Ophthalmoscopic examination showed slight edema of the retina in both eyes. The blood sugar varied between 115 and 207 mg. per hundred cubic centimeters, and the blood urea nitrogen was between 100 and 250 mg. The spinal fluid was normal. The carbon dioxide combining power was 12. The patient became more comatose, developed marked acidosis and died two days after entrance.

General Pathologic Examination.—Acute mitral endocarditis and cloudy swelling of the heart, bilateral bronchopneumonia and bilateral hydronephrosis and pyelonephritis were found.

Brain: The brain weighed 1,450 Gm. The occipital lobes were small, while the frontal lobes were strikingly developed. The brain was almost rotund in shape; the consistency was normal. The pia-arachnoid was normal in appearance. The vessels at the base were small and collapsed. Vertical sections of the brain showed a moderate general edema. Scattered throughout the brain were pinpoint red hemorrhages. These were also present in the pons, and were found entirely in the white matter; none were seen in the cerebral cortex. The gray matter of the putamen contained a few small hemorrhages. They were scattered diffusely in the white matter of the brain; they were small, the size of a pinpoint, and usually discrete. Some were confluent and measured from 1 to 2 mm. in diameter. Others were even larger, from 4 to 5 mm., and were surrounded by a yellowish green area. The hemorrhages in the majority of cases were just below the cortex, but there was no uniformity in this regard, some lying deep in the white matter.

Thrombi were not found in any of the large veins or sinuses.

Microscopic Examination.—Numerous foci were found in the white matter of the brain. These seemed to be of various ages. One such small focus was seen around a vessel in longitudinal section. The cell nuclei were well preserved, but the cytoplasm was broken up and disintegrated. The nuclei were large, vesicular, oval, round or crescentic in shape, with most of the chromatin arranged peripherally. The vessel was not occluded, and a homogeneous area was not present in this focus. There were many areas similar to that described. Some

of the areas were larger, and some were more definitely related to vessels than others. In some areas a central vessel was not seen. The caudate and putamen did not show such areas. The age of the foci varied. Some showed only cellular collections around a vessel, such as the focus described; others showed a homogeneous area immediately around the vessel with the cells grouped just outside this homogeneous area. The endothelium of the vessels was swollen in many foci, and in one the process seemed to be proliferative with two or three layers of cells.

Hortega's fourth variant showed a collection of glia cells in the foci. The cells impregnated heavily with silver. The nuclei were round and fairly small. The gold sublimate method of Cajal did not show an increase of astrocytic neuroglia in these areas. Around some could be seen a single layer of astrocytes which seemed to form a wall around the focus, but there was no proliferation of these cells. A few astrocytes could be found within the homogeneous areas. In these areas many of the astrocytes had lost their identity. They were elongated, and the nuclei were thin and pyknotic. In one case a wall of astrocytes, about three cell layers thick, was found around a focus. In addition, astrocytes were found within the foci, and in one particular focus the processes from these cells could be seen stretching throughout the area as if an attempt at organization.

CASE 7.—*Cerebral thrombosis with softening and with petechial hemorrhages in the brain of a woman, aged 65.*

History.—A white woman, aged 65, entered the Philadelphia General Hospital on the service of Dr. J. McConnell in July, 1924, complaining that for three weeks before entrance she had been unable to use the right leg. This appeared first as a difficulty in placing the leg in walking, and was followed later by complete disuse. The right arm was less affected. One week after the onset, she became incontinent of urine. She gradually regained use of the right arm, but not of the right leg. The day of entrance to the hospital she became suddenly unconscious and lost the use of the right arm. The past history was unimportant except that she had had headache and vertigo for the previous three years.

Physical Examination.—The eyes deviated to the left; there were slow nystagmus, flattening of the right side of the face, and inability to use the right arm and leg. The reflexes were absent in the right arm and leg, but present on the left; there was a Babinski sign on the right. The urine showed a cloud of albumin with hyaline and granular casts. The blood urea nitrogen was 60 mg. per hundred cubic centimeters. The spinal fluid contained 90 cells, 82 of which were polymorphonuclears, and an increase of globulin.

General Pathologic Examination.—The aorta showed arteriosclerosis. The kidneys were the seat of arteriosclerosis and a chronic diffuse nephritis. The liver, lungs and spleen showed chronic passive congestion.

Brain: The brain was small and weighed 1,120 Gm. The pia-arachnoid showed thickening over the frontal and parietal areas. Under the pia in the left frontal area hemorrhage was present. The left frontoparietal area was definitely softer than the rest of the brain and was the seat of necrotic softening. Vertical section of the brain showed petechial hemorrhages in the frontal area, in the parietal region, and in the basal ganglia and island of Reil. These occurred in addition to the softening. The vessels at the base were decidedly sclerotic, tortuous and thickened.

Microscopic Examination.—In the white matter were numerous foci of various types and apparently at different stages of development. Some were diffuse collections of cells without definite arrangement or boundary. They were

scattered in small foci throughout the white matter, and gathered usually around a small vessel; some, however, did not show a definite relation to the vessels. The cells in these small foci were almost entirely mononuclear with large oval or crescentic nuclei of the type described in other areas. In these small foci, there were no homogeneous areas such as were present in the larger lesions. Other foci in this case were arranged definitely around a small capillary as a center. The endothelial cells were often swollen. Surrounding the vessel were polymorphonuclear and mononuclear elements, with the latter type predominating. In a few places the vessels were plugged with polymorphonuclear cells, a few of which appeared to be penetrating the vessel wall. The foci as a whole varied in size and shaded off gradually into the surrounding brain substance. Homogeneous foci were not seen, and homogeneous areas within the foci described were rare.

Case 8.—*Chronic nephritis and arteriosclerosis with hemorrhagic encephalitis.*

History.—A white man was admitted to the service of Dr. Lowenburg at the Philadelphia General Hospital in January, 1927, while unconscious. In October, 1926, he had had a cough and a "cold in the chest." In December, 1926, he had to go to bed because of weakness, but the cough had disappeared. He had been in bed for five weeks before entrance. In January, 1927, on the day of entrance to the hospital, he became somnolent and drowsy and had to be awakened often. He became delirious and for this reason was admitted. He had had typhoid fever at 16, and pneumonia three times. He was subject to frequent attacks of tonsillitis.

Physical Examination.—Breathing was labored with deep, prolonged expirations. He was sensitive to external stimuli. He had an internal strabismus of the right eye, and the right pupil was slightly smaller than the left. The lungs showed many moist crepitant râles. The heart was enlarged to the left. The blood pressure was: systolic, 150; diastolic, 50. The reflexes were generally increased. The urine showed a heavy trace of albumin with many leukocytes. The Wassermann reaction of the blood was negative. The blood urea nitrogen was 90 mg. per hundred cubic centimeters. The spinal fluid was under greatly increased pressure and was bloody. The patient died of cardiac failure after three days in the hospital.

General Pathologic Examination.—There was an ulcerative and vegetative endocarditis of the aortic valve, with chronic vegetations of the mitral valve; there was also a septic myocarditis. The lungs showed a lobar pneumonia in the red stage. An acute follicular splenitis and an acute hemorrhagic nephritis was present. There was marked cloudy swelling in the liver, and degenerative changes in the pancreas and suprarenal glands.

Brain: The brain weighed 1,400 Gm.; its size, shape and consistency were normal. The pia-arachnoid did not show any abnormalities. The vessels at the base were thin walled, bluish and collapsed. There was no evidence of sclerosis. Section of the brain frontally showed punctate hemorrhagic spots dotting the entire substance of the cerebrum, cerebellum and pons. The thalami and lenticular nuclei also contained many small punctate hemorrhages.

Microscopic Examination.—In the white matter of the frontal region were numerous small foci. In the center of these foci a small capillary was usually seen. The endothelial lining of some of these capillaries was much swollen and in one or two instances almost occluded the vessel. Around the vessel were cells arranged in a radial fashion. In some instances the cells were many layers deep; in others they consisted of only one or two layers. The nuclei of the cells nearest

the central vessel were oval and light, and contained little chromatin; they were large and seemed to have a long, threadlike cytoplasm. The cells on the outer edge, away from the vessel, were round and dark, and did not show cytoplasm.

The gold sublimate method of Cajal did not show an increase in the astrocytic neuroglia in these areas. Scharlach R stains did not show an increase of fat within or around the foci nor cells which contained fat around these areas.

CASE 9.—*Meningovascular syphilis and right cerebral thrombosis in a man, aged 48. Hemorrhagic encephalitis.*

History.—A colored man, aged 48, entered the Philadelphia General Hospital on the service of Dr. C. W. Burr, with a history that five weeks before entrance he had had a "stroke."

Physical Examination.—The heart was large; râles were present in both sides of the chest; the liver dulness was enlarged. The pupils were stiff to light. There was left hemiplegia with weakness of the left side of the face. The reflexes on the left side were all hyperactive. There was ankle clonus and a Babinski sign on the left. The Wassermann reaction of the blood was weakly positive. The spinal fluid showed: 27 cells; slightly increased globulin content; 4 plus Wassermann reaction, and a colloidal gold curve of 3444221000. The clinical diagnosis was: cerebrospinal syphilis, right cerebral thrombosis, chronic myocarditis.

General Pathologic Examination.—The heart showed adhesive and calcified pericarditis with extreme myocardial degeneration. There was a chronic glomerular nephritis with arteriosclerosis and cloudy swelling. The liver showed passive congestion and fatty infiltration, and the lungs showed edema, passive congestion and small areas of bronchopneumonia.

Brain: The brain weighed 1,450 Gm. The pia-arachnoid over the convexity was slightly misty, while in the interpeduncular space it was moderately thickened and milky in appearance. There was slight cortical atrophy. At the frontal poles, especially, the convolutions were shrunken. The carotid arteries were tortuous, thickened and contained a few plaques. Section of the brain frontally showed almost complete softening of the basal ganglia on the left side. Cavitation was not present. In section more posteriorly, the softening involved the right internal capsule.

There were numerous fresh hemorrhages in the gray and white matter, especially in the occipital area. They were also present in the thalamus, putamen, pallidum and pons. Here they appeared as discrete hemorrhages varying in size from that of a pinpoint to from 1 to 3 mm. in diameter. In the hemispheres they were confluent and streaky in character, and invaded the cortex. They were not discrete, but gave a streaky, blotchy appearance to the brain. Thrombi were not seen in any of the large veins or sinuses.

Microscopic Examination.—The areas in this case were distributed chiefly in the white matter; some, however, were seen in the cortex. They were practically all cellular collections around a vessel and did not show homogeneity. The nuclear and cell characteristics were the same as those described in other cases.

Cajal's gold sublimate stain showed a condition similar to that in cases 2 and 5. The same was true of Hortega's first and fourth variants.

CASE 10.—*Arteriosclerosis, nephritis and uremia, with perivascular hemorrhages in the brain in a man, aged 69.*

History.—A white man, aged 69, entered the Philadelphia General Hospital in September, 1925, on the service of Dr. Robertson. For the past ten or twelve years he had had alternating periods of diarrhea and constipation, the former last-

ing for a week or more and the latter for a few days. During the week before entrance the diarrhea had been more severe than ever, the patient having from fifteen to twenty-five stools a day. For the past three or four years he had had difficulty in passing water, and occasionally he had had to be catheterized. He had had gonorrhea six or eight times. Since he was 3 years of age, he had had weakness of the right arm and right side of the face.

Physical Examination.—The head was rotated slightly to the right. The pupils were equal, but reacted sluggishly to light. The right side of the face was definitely smoother than the left. The heart and lungs were normal. There was weakness of the right arm and leg and a positive Babinski sign on the right side. The urine was normal except for the presence of hyaline casts. The blood urea nitrogen was 90 mg. per hundred cubic centimeters. The patient died in uremic coma after six days in the hospital.

General Pathologic Examination.—The aorta was atheromatous; the heart showed hypertrophy and dilatation, myocardial fibrosis and arteriosclerosis. The lungs showed bronchopneumonia. The kidneys were arteriosclerotic. The bladder showed a chronic suppurative cystitis.

Brain: The brain was fairly soft and showed marked injection of the cortex. Marked arteriosclerosis was present.

Microscopic Examination.—A few foci similar to those already described were seen. These were small areas in the white matter arranged around a central vessel, which were filled with cells with large vesicular nuclei and surrounded by similar cells.

SUMMARY OF FOCI

Gross Characteristics of the Foci.—The foci that have been described, the formation and evolution of which will be traced later, have a characteristic appearance when seen grossly. They have also a fairly uniform distribution. In the gross specimen these foci appear as small discolorations the size of a pinpoint scattered throughout the brain substance. They are small, varying from 1 to 2 mm. in diameter, but may coalesce to form areas as large as 4 or 5 mm. The latter are much less frequent than the small foci. These small discolored areas are usually bright red and cannot be removed by wiping. Their usual locus is in the white matter of the centrum ovale, and they are scattered unevenly through this region, at times showing a predilection for the territory at about the junction of gray and white matter. Schmidt [2] spoke of them as small areas of softening spread throughout the brain and cord like the plaques in multiple sclerosis. They may be many or few; in the former instance, they give the appearance of purpuric spots scattered throughout the brain substance. Oeller [3] spoke of them as "flea-bite like hemorrhages," and Dietrich used the same term in describing them.

While they are found mainly in the centrum ovale they have been seen in other parts of the brain. Dürck [4] found that they had a pre-

4. Dürck, H.: Die pathologische Anatomie der Malaria, München. med. Wchnschr. **68**:33 (Jan. 14) 1921.

dilection for the corpus callosum and internal capsule. In three of my cases there were many such foci in the corpus callosum. They occur also in the gray matter of the brain, but are infrequent. When found in the gray matter they are most abundant in the basal regions, especially in the thalamus. One of the patients in my series had many foci in the pons, while several had foci in the basal ganglia. In none were areas found in the cortex or cerebellum. Dürck [4] described them in the cerebral cortex and in the nucleus dentatus of the cerebellum in patients with malaria, and Herzog [5] made the surprising statement, which is not verified by other investigators, that they are most frequent in the gray matter, in the medulla and in the floor of the fourth ventricle. He found them also in the hypophysis and in the second and eighth cranial nerves. He studied these foci in typhus fever, and it may be true that in this disease the foci have a predilection for the gray substance of the brain. Langbein and Oeller [6] reported their occurrence in the corpora quadrigemina. Schröder [7] never found these foci in the cortex and cerebellum. This was true in my series of ten cases. From the reports of others there can be no doubt that they are found in the cerebral cortex, but they are much less common there than in the white matter, where they occur in the centrum ovale, in the corpus callosum and in the internal capsule.

Occurrence.—The foci have been reported in a surprisingly large number of conditions and serve to indicate how universal is their presence in certain disease states. Toxic conditions of various sorts are responsible for their presence. Dietrich [8] reported them in phosgene poisoning, carbon monoxide poisoning, grip, croupous pneumonia, typhus fever, encephalitis and following trauma cerebri. Hahn and Fahr [9] and others have found them in deaths following the administration of arsphenamine; here they are usually widespread. Gröndahl [10] found them in the experimental production of fat emboli. Schröder [7] and

5. Herzog, G.: Zur Pathologie des Fleckfiebers, Centralbl. f. Allg. Path. u. path. Anat. **39**:97 (Feb. 28) 1918.

6. Langbein, R., and Oeller, H.: Klinisch-pathologischer Beitrag zur Frage der akuter hämorrhagischen Encephalitis, Deutsche Ztschr. f. Nervenh. **45**:58, 1912.

7. Schröder, P.: Groszhirnveränderungen bei perniziöser Anämie, Monatschr. f. Psychiat. u. Neurol. **35**:543, 1914.

8. Dietrich, A.: The Origin of Perivascular Hemorrhages in the Brain, Ztschr. f. d. ges. Neurol. u. Psychiat. **68**:351, 1921; Pathologisch-anatomische Beobachtungen über Influenza im Felde, München. med. Wchnschr. **65**:928, 1918.

9. Hahn, R., and Fahr, T.: Zur Frage der Salvarsanschädigung, München. med. Wchnschr. **67**:1222 (Oct. 22) 1920.

10. Gröndahl, A.: Untersuchungen über Fettembolie, Centralbl. f. Chir., 1911, vol. 34.

Wohlwill [11] reported their occurrence in persons with pernicious anemia in whom they occur characteristically in the brain.

Infections of various sorts may produce them. They are frequent in persons with the meningitides and meningo-encephalitides. Oeller [3] described them in cases of cerebrospinal meningitis and tuberculous meningitis. Schmidt [2] found them in bronchopneumonia, erythema multiforme and psoriasis; Dürck,[4] in thirty cases of malaria, and Herzog [5] reported these foci in twelve cases of typhus fever. They occur also secondarily to circulatory disturbances in the brain, as described in five cases by Oeller.[3] Spielmeyer [12] described them in old cases of scurvy. In my series of ten cases the foci occurred in bronchopneumonia (two cases), chronic nephritis (two cases, in one of which the patient died in uremia), acute rheumatic fever, pernicious anemia, acute mitral endocarditis, secondary anemia with cerebral hemorrhage, cerebral thrombosis with softening and meningovascular syphilis with cerebral thrombosis and softening.

The occurrence of the foci can be divided into two classes, depending on the method of their production: (1) primary, and (2) secondary. In the primary type they occur as the direct result of some toxin or infection such as gas poisoning, meningitis, pneumonia, typhus fever or pernicious anemia. In the secondary type the foci occur as a result of some circulatory disturbance in the brain, a hemorrhage or a thrombosis, and they are usually seen in the immediate vicinity of these disturbances.

Microscopic Features.—The foci found in the brain under the varied conditions detailed have been thoroughly studied; their characteristics are a matter of comparative unanimity among all authors. In the center of the focus is usually a capillary or a precapillary vessel. This is not constant because the section may be so cut as to avoid the central vessel. As a rule, however, the vessel can be seen within the focus. The endothelium of the vessel usually shows swelling or complete destruction with pyknosis or loss of nuclei. In some instances the swelling is so great as completely to obliterate the lumen of the capillary. Often the lumen contains a fibrin clot or a thrombus, but while this is emphasized by many authors it was not a common occurrence in my series.

Immediately next to the central vessel is an area of necrotic tissue which may be small or relatively large. The tissue in this necrotic center is completely destroyed, but sometimes a few cells may be found

11. Wohlwill, F.: Zum Kapitel der pathologisch-anatomischen Veränderungen des Gehirns und Rückenmarkes bei perniziöser Anämie und verwandten Affektionen, Deutsche Ztschr. f. Nervenh. **68-69**:438, 1921.

12. Spielmeyer, W.: Histopathologie des Nervensystems, Berlin, S. Karger, 1922, p. 389.

remaining and these are definitely diseased. Beyond this necrotic center and continuous with it is what Spielmeyer describes as a "palisade-like" arrangement of glia cells. These cells are intact and completely surround the necrotic area. They are many layers deep and form a distinct wall around the necrotic center of the foci. Beyond the collar of glia cells there may or may not be an outer area of hemorrhage. In most of my cases these areas of hemorrhage or "Ringblutungen" were not present, but they have been particularly emphasized by all German writers except

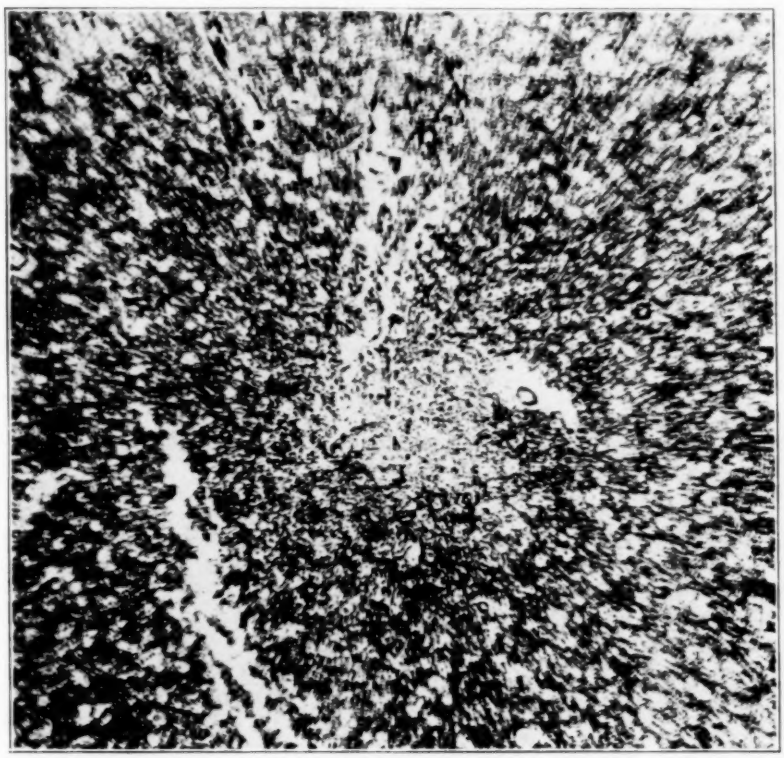

Fig. 12.—Cajal gold sublimate stain showing the failure of the fibrous neuroglia to take part in the process.

Spielmeyer. This palisade-like arrangement of cells is seen only in moderately advanced foci. Later, the foci become entirely homogeneous with a central vessel surrounded by a small area of necrosis, beyond which is a more or less distinct ring of cells which are in various stages of degeneration; outside these is a widespread area of coagulation necrosis. These foci, seen in figures 7 and 8, are the granulomas of Dürck, and are, in my estimation, the end-result of the process to be described. Spielmeyer [12] stated that the structure of these foci is always

the same, regardless of the nature of the noxious agent. This is true of my ten cases and also of the foci described in the numerous disease states by the authors cited.

Certain points concerning the foci are still unsettled. One of these is the nature of the cells which surround the central necrotic area. Schmidt [2] believed that these cells arise in part from the vessel wall, from the perithelium of the capillaries and the endothelium of the lymph spaces, and in part from the neuroglia. He thought that they probably

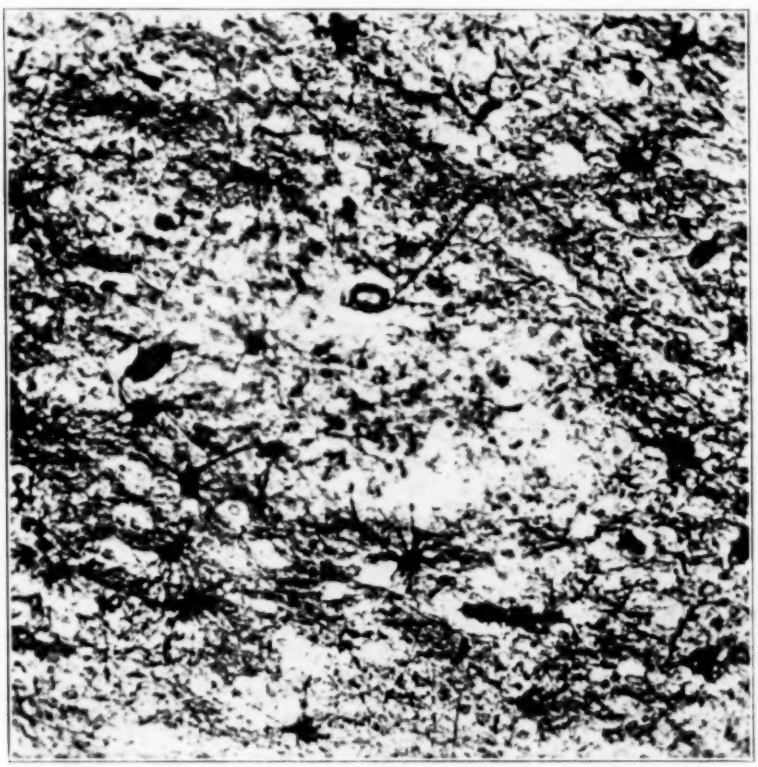

Fig. 13.—A high power photograph of figure 14. The astrocytes send processes into the focus, but do not penetrate into it.

are neuroglia cells because they lie at some distance from the vessels. Schröder,[7] too, believed that the cells are neuroglial in origin, and Spielmeyer [12] was of the same opinion. But while it seems to be accepted that these cells are neuroglial in origin, no attempt has been made to identify the exact type of neuroglia. By the use of differential stains in the ten cases of my series, it has been possible to identify the specific type of neuroglia in the areas described. They are oligodendroglia cells which are stained by the silver carbonate

method of del Rio-Hortega, and are shown in figure 13. No other type of neuroglia is concerned in the process. The cells are exclusively oligodendroglia. The gold sublimate stain of Cajal does not show fibrous neuroglia within the foci, but some are present immediately outside these areas and in a few instances could be seen to form a single wall of cells immediately surrounding the focus.

Stains for microglia did not show evidence of proliferation of this type of cell within the foci. Fat stains did not show fat within the

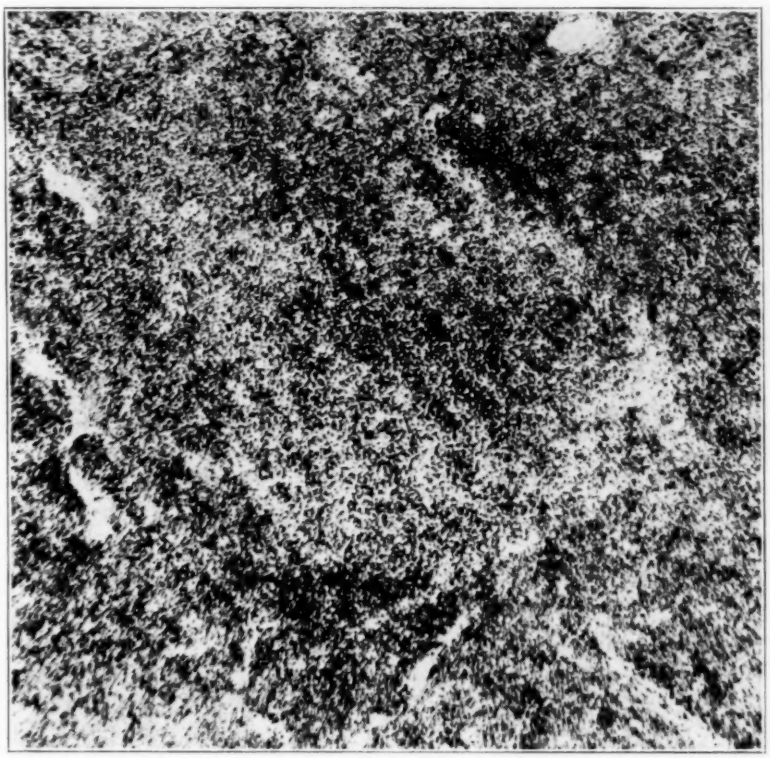

Fig. 14.—A low power photograph showing the oligodendroglia within a focus. Silver carbonate stain of Hortega.

cells in the foci, and osmic acid stains were likewise entirely negative. It was therefore possible to conclude that the cells which surround the necrotic center of the foci are neuroglia cells and that the specific type of neuroglia present is the oligodendroglia of del Rio-Hortega.

The presence of red blood cells in these foci has likewise been a matter of some controversy. The erythrocytes are usually found at the periphery of the focus and are not numerous in most instances. Schmidt [2] was impressed with the presence of erythrocytes in these areas,

and it was for this reason that he gave the term hemorrhagic encephalitis to the condition. Oeller [3] and Dietrich [8] also emphasized the presence of red cells. Spielmeyer,[12] on the other hand, declared that for him there can be no doubt that the foci are independent of the hemorrhages; the proof of this is found in the occurrence of these areas without hemorrhages. Wohlwill, too, declares that these areas may occur without hemorrhage. In my cases hemorrhage was apparently of little importance in the foci for in most instances hemorrhages were not seen

Fig. 15.—A similar focus. Those cells present within the focus are oligodendroglia. Silver carbonate stain of Hortega.

in relation to these areas, despite the fact that, grossly, the lesions appeared discolored. For my cases, therefore, I concluded that the occurrence of red blood cells in the foci was not constant and therefore not of great importance. The presence of the red cells in the areas is usually explained by diapedesis through the walls of the injured capillary or precapillary vessel. This has been widely accepted and probably explains the situation in most instances.

The occurrence of thrombi in the central vessels is still another moot point. The central precapillary or capillary vessel shows constant

changes. The endothelium is swollen or destroyed, and the vessel is often occluded by the swollen endothelium. Oeller,[3] Schmidt,[2] Dietrich [8] and others consider the occurrence of thrombi in the vessels of great importance, but in my cases these were extremely infrequent and probably of little importance.

Development of the Foci.—Most of the efforts of earlier investigators were directed toward the identification and description of the foci. Few were concerned with the attempt to trace the evolution of the foci from their earliest forms to their mature state. My cases have shown such varied stages in the evolution of the foci that it has been possible to draw some conclusions with regard to their formation.

Two possibilities are outstanding: (1) As a result of injury to the vessels and occlusion of the small capillaries there may develop an area of coagulation necrosis immediately surrounding the vessel. Such an area is seen in figures 4 and 5. Following this there may occur an invasion of this area of necrosis, which, however, seems to remain incomplete, so that the invading cells, the oligodendroglia, never penetrate into the innermost portions of the area of coagulation necrosis, that is, into the area immediately surrounding the vessel. Cells continue to rally to the invaded area, however, and eventually form the "palisade-like" arrangement of neuroglia cells which are seen in figures 4 and 5. (2) As a result of injury to the endothelium of the capillary vessels by a toxic or infectious process, neuroglia cells are collected about the vessel, as is seen in figures 1 and 2. Many cells gather about the area, and as the blood supply is cut off through the occlusion of the vessel by the swollen endothelium, or possibly by a thrombus, the central cells in the area become destroyed and there follows the central necrosis seen in the various illustrations. The outer layers of glia cells, however, remain intact. As the process extends, the necrosis spreads to include the cells on the edge of the focus, with the result that eventually there develops a complete area of coagulation necrosis, as is seen in figures 7 and 8. This necrosis is never absolutely complete. There are always cells to be seen in the central parts of the foci and also in the periphery, but these are all in some stage of degeneration, most of them in severe stages of necrosis. It is difficult to explain why there is an area of necrosis immediately surrounding the vessel while a short distance away are cells which are not entirely destroyed. My explanation is that the necrosis immediately surrounding the vessel is due to local injury from the toxic or infectious process, while the coagulation necrosis at the periphery is due to occlusion of the blood supply from the central vessel.

Of the two possibilities, it seems to me that the second conforms more closely to the facts, since it is known that occlusion of a vessel

can produce such areas of coagulation necrosis. Spielmeyer [12] believed that the important factor is a central necrosis as a result of injury to the vessels either by a toxin or by infection.

Other explanations have been offered in attempting to explain the origin of these foci. These are chiefly speculative, however, and are not based on careful microscopic study. Oeller [3] explained the occurrence of the foci by a damming back of blood as a result of venous thrombosis. In many of his cases a thrombosis of a large vein or sinus was present, but careful search in my cases failed to reveal any such condition. Others, while admitting Oeller's hypothesis, failed to corroborate his observations. Schmidt believed that the origin of the focus is a perivascular hemorrhage which is the result of diapedesis of red blood cells following injury to the vessel or circulatory stasis. Hemorrhages are so inconstant, however, that it seems hardly fair to attribute to these the cause for the occurrence of the foci. Gröndahl, in an experimental study of fat emboli, came to the conclusion that there first occurred a fat embolus and then injury and necrosis of the vascular endothelium, followed by seepage of red cells through the vessel wall. Dietrich favors a combination of local injury to the vessel and circulatory stasis, with hemorrhage around the vessel as a result. To me, the fallacy of these explanations lies in the fact that they presuppose that hemorrhage is the basis of the foci and, having asserted this, leave the matter in suspense. They do not attempt to study the evolution of these foci from the perivascular hemorrhage.

TERMINOLOGY

If the type of disorder described is to be clear, it seems to require a term that will adequately describe the condition. "Hemorrhagic encephalitis" is a poor term because: (1) hemorrhage is not an important part of the process, and (2) the process is not inflammatory, as the term encephalitis would imply. "Brain purpura," too, is inadequate because the process is not a purpura, but merely resembles a purpuric rash when seen in gross sections of the brain. I suggest the term "medullary perivascular necroses." This is at least explanatory of the condition, though it does not cover all the facts. At least it indicates that the foci are multiple, that they occur around vessels, that they are necroses and that they occur for the most part in the white matter.

There are two common pathologic conditions to which the condition herein described bears a close resemblance: multiple sclerosis and multiple areas of softening. There are many points of resemblance. Most of the lesions are within the white matter of the brain, though they may occur within the gray substance, just as in multiple sclerosis and in the multiple areas of softening seen in arteriosclerosis of the

small cerebral vessels. As occurs in these conditions, also, the foci are scattered irregularly throughout the brain substance but have a definite relation to the vascular supply of the brain. Brouwer believed that multiple sclerosis is caused by a noxious agent which is conducted along the blood vessels to the central nervous system, because the smaller "sclerotic spots correspond in extent with the territories of the blood vessels." It is the close relationship of the foci with the blood vessels in all these conditions which is the most striking and the most important characteristic of the condition.

CHANGES IN THE BRAIN IN PYEMIA AND IN SEPTICEMIA *

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The central nervous system is frequently affected in pyemia and in septicemia. Since these morbid conditions have been studied mainly clinically, a study of the pathologic changes in the central nervous system in these diseases may prove of interest. With this in view, two cases were studied: one of acute hematogenous infection (*Staphylococcus pyogenes-aureus*) and another of unknown etiology.

REPORT OF CASES

CASE 1.—*History.*—A white girl, aged 8, admitted to Cook County Hospital (Dr. McNally's service) on March 30, 1925, complained of pain and swelling of the right ankle of about one week's duration. There was no history of any previous illness.

Examination.—The patient was poorly nourished and appeared desperately ill. The temperature was 103 F., the pulse rate 140 and the respiration rate 30. The scalp was normal. The pupils were regular and reacted normally to light and in accommodation. The scleras were slightly jaundiced, and the conjunctivae showed minute petechial hemorrhages. The lips were covered with herpes. The left ear drum was reddened and hyperemic and showed evidence of an old infection. The throat was slightly reddened, and the tonsils were hypertrophied. The neck was not rigid, but petechiae were present on the right side, and "pulsation on the left side." The cervical lymph glands were palpable. The lungs were normal. The apex beat of the heart was visible in the fourth and fifth interspaces in the nipple line; the left border extended to the left and downward. A systolic murmur was heard to the left for a short distance on the axillary line. The liver was felt three fingerbreadths below the costal margin. The spleen was not palpable. There were no masses and no tenderness in the abdomen. Pathologic reflexes were not present. The right ankle was swollen and markedly tender. The skin in this region was a dull red, and there were two swollen areas with definite fluctuation. The white blood count was 38,000. Blood culture showed *Staphylococcus pyogenes-aureus.*

The clinical diagnosis was malignant endocarditis, chronic otitis media and acute osteomyelitis of the right tibia.

Course and Treatment.—The swelling was incised bilaterally, with evacuation of foul-smelling, grayish pus; the left ear drum was punctured. The temperature ranged from 101 to 104 F., the pulse rate from 128 to 150 and the respiration rate from 30 to 60. Numerous petechial spots appeared over the lower part of the abdomen and the thighs. The patient soon became stuporous, lapsed into unconsciousness and died on April 2, 1925.

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* Submitted for publication, March 7, 1928.

* From the Division of Neuropathology (Dr. Hassin) of the pathology laboratories of the Research and Educational Hospitals of the University of Illinois and the State Psychopathic Institute.

Necropsy (Dr. Harry Singer).—Anatomic Diagnosis: The anatomic diagnosis was chronic suppurative otitis media (left); purulent metaphysitis of the distal end of the right tibia with extensive panostitis; interfascial abscesses of the right lower leg; miliary embolic abscesses of the lungs, liver and kidneys; multiple anemic infarcts of the spleen, kidneys and brain; multiple diffuse submucous, subserous and subcutaneous petechial hemorrhages; recent surgical incision of the left tympanic membrane; bilateral fibrinous pleuritis; moderate superficial lymphadenopathy, and superficial crusted excoriation of the face.

Macroscopic Appearance of the Brain: The configuration and convolutions of the brain were practically normal. The pia was transparent, not thickened nor adherent, except over the right parieto-occipital area, which was markedly hemorrhagic. The base of the right frontal lobe showed a slight hemorrhagic subpial

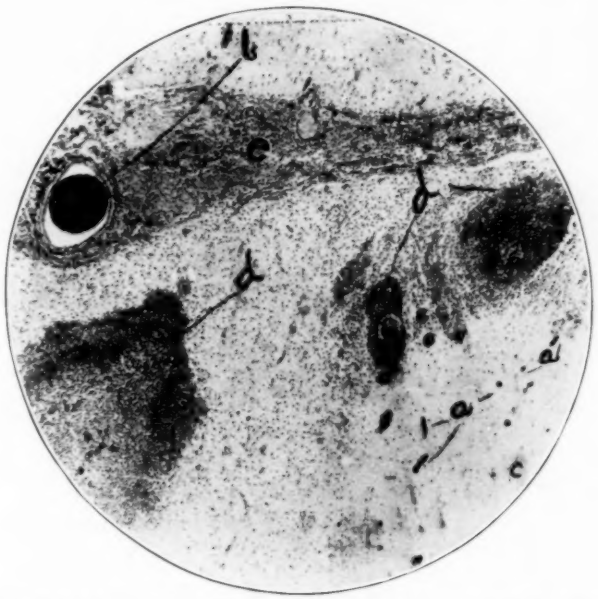

Fig. 1.—Occipital lobe: *a*, bacterial emboli; *b*, pial vessel with bacterial embolus; *c*, area of necrosis; *d*, miliary abscesses; *e*, pia; toluidine blue stain; low power magnification.

focus. The white and gray substances were sharply defined. The ventricles were normal. Numerous petechial spots were present, especially in the region of the basal ganglia; no signs of softening or hemorrhage were found. In the right hemisphere of the cerebellum, there was a hemorrhagic area the size of a dime; it involved the gray matter and extended to the white substance. The pons and medulla were normal.

Microscopic Examination: Sections from various portions of the brain revealed a number of changes, of which the most striking were (1) multiple emboli, many of which contained miliary abscesses, and (2) nodules. The emboli were made up of bacteria, and were especially numerous in the occipital lobe, plugging the capillaries and larger vessels (fig. 1 *a*). A similar but larger embolus was present in the adjacent pia (fig. 1 *b*). Morphologically, the micro-organisms resembled staphylococci and, as a rule, were massed in clusters. In the optic

thalamus a few of the smaller vessels were filled with isolated clusters of cocci, some of which were enclosed within phagocytes, completely filling their cytoplasm (fig. 2). Masses of micro-organisms were also scattered freely in the brain substance (occipital lobe, optic thalamus, caudate nucleus) and were usually mixed with red blood cells, blood pigment granules and polymorphonuclear leukocytes.

The brain substance, especially in the immediate area of the capillaries obstructed by the cocci, was more or less necrotic and covered by scattered nuclear fragments, pyknotic nuclei and poorly stained ganglion cells which showed little if any reactive phenomena (fig. 1 *c*). In contrast, areas around larger embolic vessels exhibited foci that much resembled miliary abscesses (fig. 1 *d*). The infiltrations in some instances were so dense that they almost obliterated the vascular lumen.

Scattered among the polymorphonuclear leukocytes were some ill defined cell bodies. Their nuclei varied in shape; some were oval, round or vesicular; others were irregular, elongated or distorted and pyknotic. Their cytoplasm often exhibited vacuoles, many of which contained polymorphonuclear leukocytes and

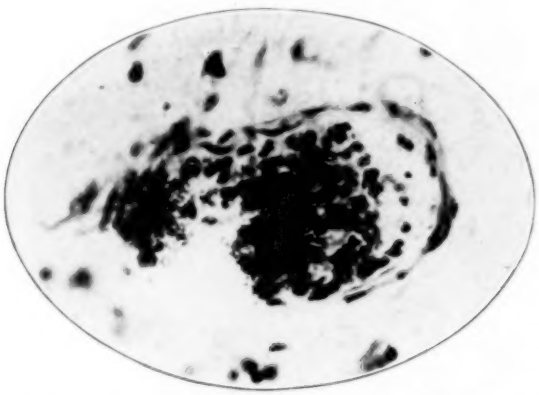

Fig. 2.—Optic thalamus; a small vessel filled with clusters of staphylococci free and within phagocytes; toluidine blue stain.

cocci. They may be looked on as macrophages, some of which contained blood pigment granules, while some areas contained markedly hemorrhagic foci. These were usually round and varied in size, containing red blood corpuscles, a few polymorphonuclear cells, macrophages laden with blood pigment granules and some reticulated cells which were irregular in shape and somewhat resembled gitter cells.

There were numerous nodules in the cortical and subcortical layers of the frontal, parietal and occipital lobes, pons and basal ganglia. They were round, oval or irregular (figs. 3 and 4). The cells comprising the nodules were for the most part glia elements. As a rule, they formed compact cell conglomerations with multiform vesicular nuclei, usually rich in chromatin granules. Some nodules were less compact. The cells through their cytoplasmic processes appeared fused or blended, forming a syncitium (so-called "Gliarasen" of Nissl). Other nodules varied in their cellular content, for the most part consisting of both glia and hematogenous elements, mainly polymorphonuclear leukocytes.

Such nodules invariably harbored a great number of micro-organisms. Frequently, clusters of cocci were seen at the margins of the nodules or at some

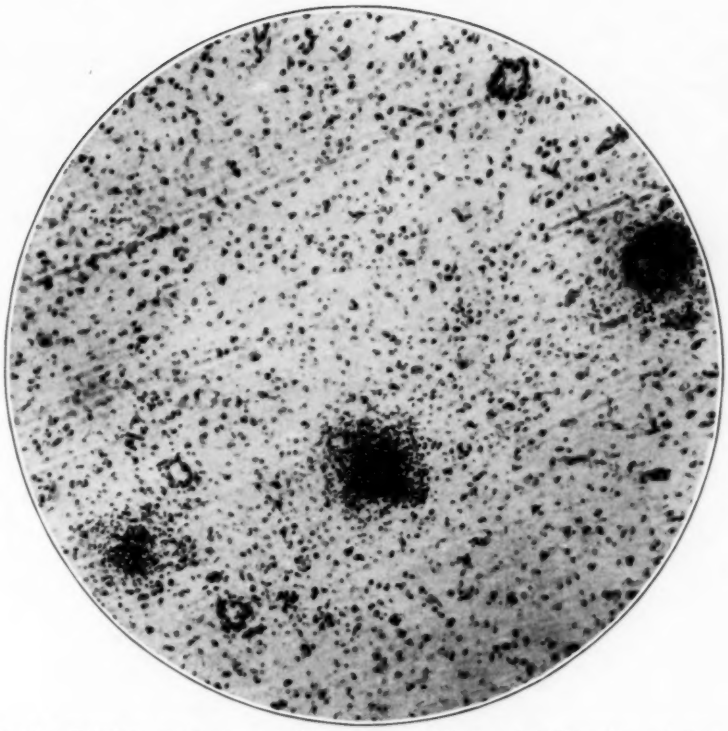

Fig. 3.—Caudate nucleus, showing three nodules and infiltration of the vessel walls; toluidine blue stain.

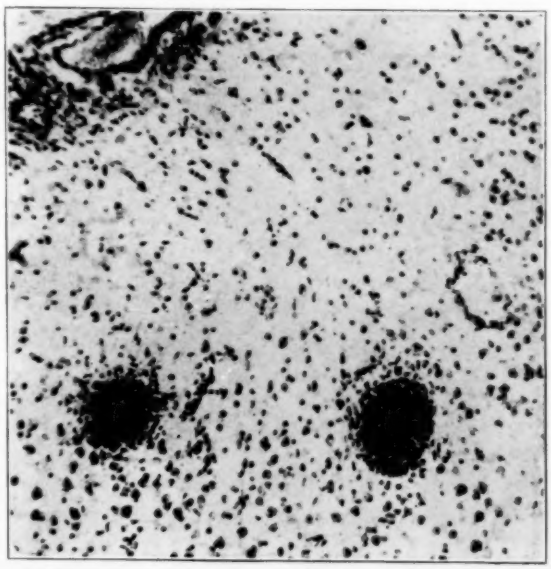

Fig. 4.—Parietal lobe showing nodules; toluidine blue stain.

distance from them, mainly among glia cells, and they were also enclosed within the cells themselves—glia phagocytes (fig. 5). These were numerous and often exhibited mitotic figures. The cells were rich in cytoplasm and irregular in shape. Others appeared rodlike, with long branching processes and sausage-shaped nuclei, resembling microglia or Hortega cells. Ganglion cells were often present among the glia elements, the whole forming a new focus or merging with the adjacent nodule. The stroma appeared rarefied but was generally edematous, especially in the vicinity of the nodules. The nearby capillaries and smaller vessels were hyperemic, hypertrophied and infiltrated; their endothelium was swollen and proliferated, exhibiting an occasional mitotic figure. Not infrequently, cocci were seen in the capillary wall, within its endothelium, and were present even in the nearby glia cells. In the ganglion cells, they were exceptionally rare. A few polymorphonuclear leukocytes were invariably found scattered in the areas

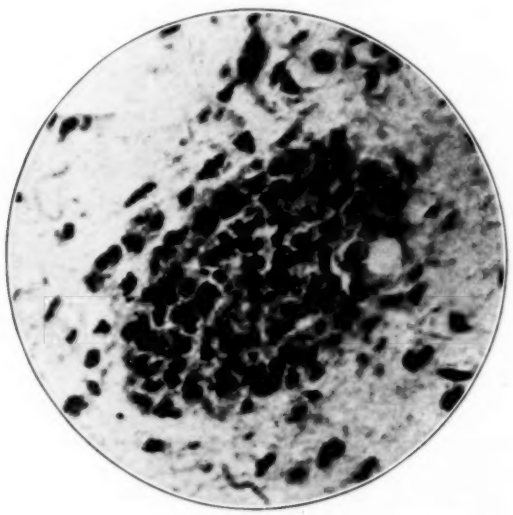

Fig. 5.—Caudate nucleus nodule composed of glia phagocytes containing staphylococci; toluidine blue stain.

described, while in rare instances small nodules were seen around small blood vessels.

Besides large and small nodules throughout the various layers of the cortex and white substance there were scattered clusters of glia nuclei, rod cells as well as cytoplasmic glia cells.

The large as well as the small ganglion cells showed various degenerative changes, such as neuronophagia and chromatolysis. The large cells often appeared vacuolated, and some were even totally devoid of Nissl bodies. In scarlet red specimens, they were more or less filled with fat. Some were much swollen or necrosed and invaded by glia cells (neuronophagia); the nuclei were displaced, pale or balloon-shaped. Such changed cells somewhat resembled macrophages, especially around the periphery of the nodules.

Many of the larger blood vessels were distended and hyperemic. The walls of the smaller vessels were hyperplastic and infiltrated with mononuclear and polymorphonuclear leukocytes and occasional gitter cells, and were bordered by

rows of glia cells (glia wall). Plasma cells were exceedingly rare, but mast cells were common. The capillaries were prominent and many were in the process of new formation (budding). Mitotic figures were often present in the endothelial cells, which, as mentioned, were markedly proliferated (fig. 6).

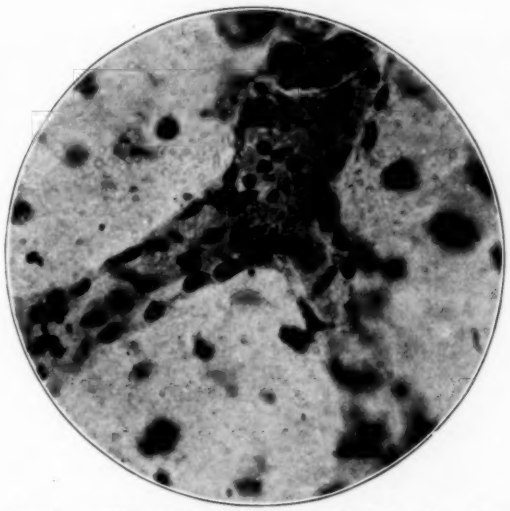

Fig. 6.—A proliferated capillary as described in the text.

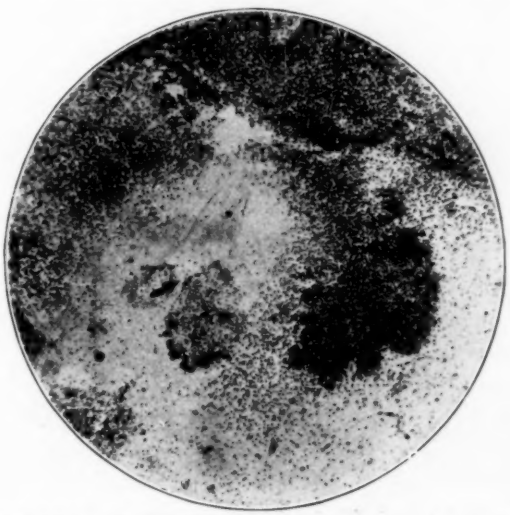

Fig. 7.—Occipital lobe. Invasion of the subpial layer of cortex by polymorphonuclear leukocytes; toluidine blue stain.

The pia-arachnoid throughout the cortex and base of the brain was more or less distended and infiltrated, especially in the regions of the pons, the motor area and the occipital lobe (fig. 1 *c*). Around the latter, the infiltrative elements were mostly polymorphonuclear leukocytes, erythrocytes and macrophages. Some areas appeared hemorrhagic and contained numerous macrophages packed with blood

pigment granules. In others (over the motor cortex and pons), the pial meshes contained fewer erythrocytes, but many polyblasts, fibroblasts, clusters of mesothelial cells, gitter cells and numerous macrophages. At some places (occipital lobe), polymorphonuclear leukocytes invaded the subpial layer, almost obliterating the demarcation between the cerebral substance and the pia (fig. 7). The subpial

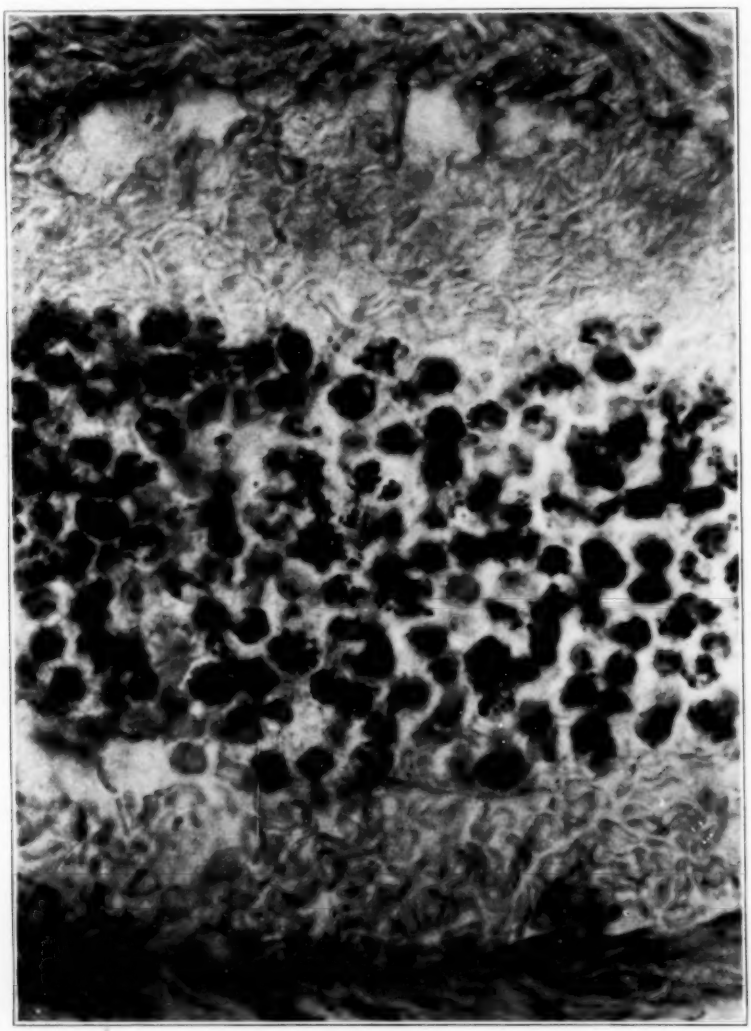

Fig. 8.—Pial vessel filled with phagocytes and staphylococci.

layer contained numerous cytoplasmic glia cells, gitter cells and macrophages which were intermingled with the polymorphonuclear cells. Micro-organisms either were scattered in the form of clusters or were enclosed within macrophages and the pial meshes.

The pial vessels were hyperemic, and, like those of the parenchyma of the brain, were proliferated and infiltrated with polymorphonuclear leukocytes and

lymphocytes. Some vessels contained hyaline thrombi. One vessel, as shown in figure 1 *b*, was plugged by a bacterial embolus, while in another (motor area) the lumen of the vessel was filled with leukocytes, and their cytoplasm was packed with micro-organisms (fig. 8).

The stroma of the choroid plexus was hyperplastic and distended, partly by hemorrhage and partly by leukocytic infiltrations. Many blood pigment granules were lying free or within macrophages. The blood vessels were congested; some were infiltrated. Many of the tuft cells were swollen, vacuolated and resembled gitter cells or macrophages. Some of the latter contained blood pigment and were surrounded by clusters of cocci and polymorphonuclear leukocytes forming small foci (fig. 9). A few amyloid bodies were scattered in the stroma.

Fig. 9.—Choroid plexus; *a*, foci of polymorphonuclear leukocytes, lymphocytes, macrophages and staphylococci.

Summary and Comment.—The changes described may be summed up as mainly inflammatory with marked infiltrative and hyperplastic phenomena in the pia-arachnoid, choroid plexus and glia; degenerative changes in contrast, though present, were rather insignificant. The changes were invariably associated with the presence of the *Staphylococcus pyogenes-aureus*, which evidently was responsible for the reactive phenomena in the mesodermal and glia tissues. The mesodermal reactions were represented by polymorphonuclear cells, proliferation of the endothelial and adventitial cells and new formation of the capillaries.

More significant was the glia reaction, which was represented by granulomas and nodules. The latter were probably a manifestation of, or a reaction against, a local infection, just as in trichinosis,[1] in which the nodules, as in the case reported by Hassin and me, invariably contained embryos of *Trichina* (*Trichinella*). Foci or nodules have also been described in other pyemic states. Kimmelstiel[2] found them in *Streptococcus viridans* infection, but without micro-organisms in the glia nodules as in the case here recorded. He found them, however, in mixed nodules which consisted of hematogenous and glia elements. Nodules were also described by Lemke[3] and Flater[4] in subacute bacterial endocarditis. They were present as small conglomerations of cells around and within the blood vessels, some of which contained bacterial emboli. No mention has been made of the condition of the glia or ganglion cells.

Abscess-like nodules were described by Schob[5] in general paralysis. They were associated with necrosis, contained spirochetes and exhibited marked reactive phenomena on the part of the blood vessels and glia tissue. Jakob[6] sees in them a close resemblance to lesions found in infectious diseases such as poliomyelitis and intoxications. On the other hand, Southard and Keene,[7] who were the first to describe staphylococcus infection of the brain, did not mention nodules. "The typical picture," they state, "is of a central colony of staphylococci in and near a vessel surrounded by zones of polynuclear leukocytes, large phagocytes and blood. Dying nerve cells are sometimes included in the lesion. The neuroglia cells are slightly active about some of the lesions."

Besides the changes caused by the micro-organisms in the case here recorded, many changes might have been the result of intoxication. For example, Parker[8] was able to isolate an exotoxin from certain strains of staphylococci. When injected into animals, it caused, within twenty-

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8. Parker, Julia T.: The Production of an Exotoxin by Certain Strains of Staphylococci, J. Exper. Med. **40**:761, 1924.

four hours, edema and infiltration with polymorphonuclear and large mononuclear cells. This was followed by marked inflammation, beginning necrosis, pyknosis and nuclear fragmentation of the cells. It is possible that the other changes found in my case, such as edema of the brain tissues, necrosis and hemorrhages were also the result of a toxic action. As a matter of fact, cases of acute sepsis are not uncommon in which pathogenic micro-organisms are difficult to demonstrate or cannot be found. In such cases the etiologic factor is undoubtedly a toxemia; that is to say, it is to be found not so much in the micro-organisms themselves as in the toxins elaborated by them. This evidently was true in case 2.

CASE 2.—*History.*—A married woman, aged 29, an American, who was admitted to Cook County Hospital (service of Dr. Tice) on Nov. 20, 1924, in a stuporous condition, two weeks previously had had four teeth extracted. This was followed by swelling of the face. Several days later, she developed severe chills, profuse sweats, a temperature of 105 F. and numbness and pains, especially in the upper extremities. Two days later, she became stuporous and the sphincters became paralyzed. Previously, she had had rheumatism at the ages of 6 and 18, and influenza in 1918.

Examination.—The patient was well nourished and in a state of somnolence from which she could easily be aroused. The eyes showed nystagmoid movements; the conjunctivae were injected; the pupils were round, regular and alternately contracted and dilated. The lips showed sordes and were extremely dry. The teeth showed many old cavities, and many teeth were missing. The cheeks were flushed; the expression was apathetic. The neck was not rigid. The heart tones were indistinct and were not accompanied by murmurs; the pulse rate was rapid; no thrills or arrhythmias were detected. Roughened breath sounds were heard over the bases of both lungs. The liver was palpable two fingerbreadths below the margin of the ribs. The spleen was palpable. The reflexes were all present; the Babinski sign was absent; Kernig's sign was suggestive. The spinal fluid was clear; its pressure was not increased; it contained 14 cells per cubic millimeter; the Ross Jones, Pandy and Wassermann tests were negative.

Examination of the blood showed 10,900 white cells, of which 55 per cent were polymorphonuclears, 26 per cent eosinophils, 17 per cent small and large lymphocytes, 1 per cent transitionals and 1 per cent basophils. The hemoglobin content was 50 per cent. The urine was acid; the specific gravity was 1.025; it showed a trace of albumin, a few red and white cells and granular casts.

Course.—On Nov. 24, 1924, a clinical note by Dr. Tice stated: "The patient is semicomatose; there are paresis of the right side of the face and paralysis of the right arm, with a moderate degree of spasticity. The lower extremities are not involved."

On Nov. 26, 1924, 20 cc. of spinal fluid was removed by spinal puncture; the fluid was clear and under distinctly increased pressure; it contained 18 cells per cubic millimeter; the Wassermann test was negative.

On Nov. 26, 1924, the temperature was 104 F.; the pulse rate was 80 and the respiration rate 30.

On Nov. 29, 1924, Dr. Hassin made the following note: "The patient is comatose; the eyes and head are turned to the right; painful stimuli are not perceived. The pupils are dilated; the eyes show nystagmoid movements; the right palpebral fissure is much smaller than the left. The reflexes are all absent. The

patient seems to be paralyzed on the right side, but the left leg also appears to be paralyzed; the neck is not rigid. The Brudzinski sign is indefinite. Probable diagnosis: meningo-encephalitis of unknown origin."

The Widal test proved negative for typhoid and paratyphoid A and B. The patient died on Nov. 29, 1924.

Partial Necropsy (Dr. Rappaport).—A brief abstract of the observations were: The heart valves and endocardium were normal; one large infarct was present in the spleen; smears from this organ revealed diphtheroid bacilli. The brain showed minute areas of softening and some thickening of the pia. Only one half of the brain was obtained for microscopic study.

Microscopic Examination.—The sections revealed, under low power magnification, many irregularly shaped foci, some of which consisted of dense masses of cells that often formed nodules. Such areas were especially numerous in the internal capsule and in the parietal lobe. In the former, the foci contained

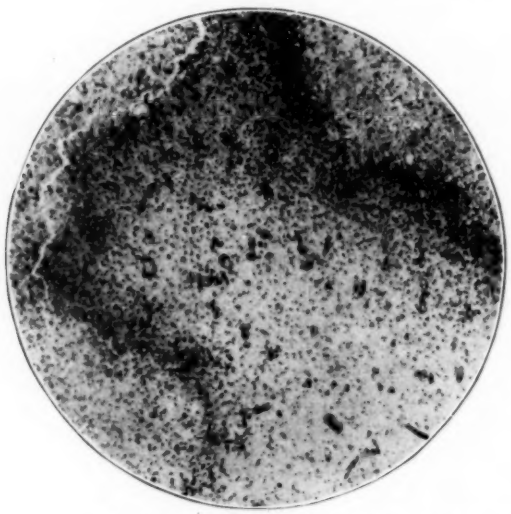

Fig. 10.—Parietal lobe showing foci of softening described in the text; toluidine blue stain; low power magnification.

masses of gitter cells gathered around the blood vessels. In the parietal lobe they were less numerous, were also mainly around the vessels but also were irregularly scattered and enveloped by a dense wall of cell bodies, for the most part glia cells (fig. 10). The latter were more or less rich in cytoplasm, while many had the features of fat granule (gitter) cells. Mitotic figures were frequently encountered. Among the gitter cells were also present many glia nuclei, rod cells and cytoplasmic glia cells. In sections stained with the method of Alzheimer-Mann, the glia cells showed a generous amount of cytoplasm and dominated the field to such an extent that the nerve fibers were difficult to discern. The nerve fibers generally showed mild changes; in some the axons and myelin were slightly tumefied, while some nerve fibers appeared entirely normal. Some were crowded with so-called glia nuclei, which usually were scattered and often showed as so-called swollen oligodendroglia. The blood vessels were mostly empty; a few were congested, and some larger vessels appeared to be thrombosed. The vessel walls usually showed marked signs of proliferation of the adventitia and the

endothelium, in which mitotic figures were occasionally seen. The larger vessels occasionally exhibited a mild infiltration with lymphocytes, polymorphonuclear leukocytes and especially gitter cells.

The other type of foci, as mentioned, resembled granulomas, which, however, differed from true nodules in the presence of many newly formed capillaries. Such "granulomas" evidently were also foci of softening but in the process of healing. The cells of the nodules were partly of glia but were mostly mesodermal in the form of elongated cell bodies (fibroblasts). They were found largely near the capillaries in a stroma which was edematous and markedly reticulated. The contiguous ganglion cells were greatly degenerated with phenomena of satellitosis and neuronophagia. Clusters of glia nuclei, rod cells and cytoplasmic glia cells were usually intermingled with the degenerated ganglion cells. A few of the foci appeared hemorrhagic, for they contained a considerable number of red blood cells mixed with various cellular elements and newly formed capillaries. In addition, in these foci were gitter cells and macrophages filled with granules of blood pigment. Additional changes were found in the ganglion cells remote from the areas of softening in the form of chromatolysis, satellitosis and neuronophagia. The cortex and subcortical areas exhibited many congested capillaries with prominent endothelium. Occasionally, mild perivascular infiltration with lymphocytes and an occasional mast cell were encountered in some of the larger vessels.

The pia was hyperplastic and contained many fibroblasts, macrophages, gitter cells, large lymphocytes and a few polymorphonuclear leukocytes. The blood vessels were congested. There were no changes in the choroid plexus. Many of the tuft cells contained blood pigment granules.

Summary and Comment.—The pathologic process in this case may be summed up as multiple degenerative foci of softening, with marked reactive glial and less marked mesodermal reactive phenomena; vascular changes were not marked; the areas of softening in no way depended on the condition of the blood vessels.

This case differed from case 1 in the presence of signs of "healing" phenomena, in the form of numerous fibroblasts, masses of glia cells around the foci, mild signs of recent thrombosis in a few of the blood vessels and the better preservation of the parenchyma. In contrast to the previous case, no enclosures of micro-organisms within hematogenous elements, the endothelium or adventitial cells were found. In short, the reactive phenomena in these two cases differed. In case 1, they were in the form of foci of infiltration, diffuse and focal. They were caused by the direct invasion of the parenchyma by the micro-organisms and gave the clinical picture of pyemia. In case 2, the reactive phenomena were in the form of multiple foci of softening. They were the result of the invasion of the parenchyma, not by micro-organisms, but by their toxins, which produced a condition of septicemia. The pathologic observations in case 2 much resembled what Hassin and Bassoe [9] described as multiple degenerative softening, in which numerous foci of degeneration of the nerve tissue were scattered throughout the central nervous system with-

9. Hassin, G. B., and Bassoe, Peter: Multiple Degenerative Softening Versus Multiple Sclerosis, Arch. Neurol. and Psychiat. **7**:613 (May) 1922.

out any relationship to the blood supply. In their case, a man, aged 28, with a history of severe phlegmon of a finger, acute tonsillitis, catarrhal conjunctivitis and carious teeth, developed a severe headache, vertigo, failing vision and retention of urine. The neurologic symptoms were: unequal, sluggish pupils; slight rigidity of the neck; inconstant reflexes which varied from hour to hour; slight facial paralysis; strabismus, and nystagmus. The spinal fluid was normal; the Wassermann reaction was negative. The course was acute and afebrile, except for terminal hyperpyrexia. Death occurred seven weeks after the onset. The pathologic observations were practically the same as in my case: multiple foci of degeneration, mainly in the midbrain, medulla and to a less extent in the nucleus caudatus; definite widespread gitter cell infiltration of the blood vessels, especially of the capillaries in the midbrain, basal ganglia and medulla; absence of inflammatory phenomena and of secondary cord degeneration; lipoids in the subarachnoid space and the choroid plexus, and, in addition, diffuse degeneration of the cortex, basal ganglia and cervical cord. The two cases also confirm the view advocated by Hassin that infiltrative phenomena as seen in case 1 denote the presence of an active virus in the form of a micro-organism, while non-microbic or toxic factors do not cause infiltrative, but what have been called by Bonfiglio productive, phenomena so well seen in lead encephalitis.[10]

CONCLUSIONS

1. Pyemic changes in the brain show mainly as acute inflammatory conditions such as are seen in early stages of inflammation of the central nervous system.

2. The inflammation may also be local in the form of multiple foci or nodules.

3. The nodules are focal reactions to the presence of a microbic agent.

4. The septicemic changes in the brain in contrast show not as foci of inflammations but as patches or foci of softening.

5. These foci are degenerative, that is to say, they are independent of the vascular conditions and are due merely to the action of toxins.

6. Being multiple, the soft patches may be contrasted, as shown by Hassin and Bassoe, with the hard patches observed in multiple sclerosis.

7. The central nerve changes occurring in septicemia may be designated, by the name used by Hassin and Bassoe, as multiple degenerative softening.

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10. Hassin, G. B.: The Contrast Between the Brain Lesions Produced by Lead and Other Inorganic Poisons and Those Caused by Epidemic Encephalitis, Arch. Neurol. & Psychiat. **6**:268 (Sept.) 1921.

ATYPICAL NEURALGIA, SO CALLED

A CRITICAL ANALYSIS OF ONE HUNDRED AND FORTY-THREE CASES *

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In the Neurosurgical Clinic of the University Hospital my co-workers and I have had an unusual opportunity for the investigation and treatment of major trigeminal neuralgia, having on our records some 1,200 odd cases. This wealth of material has afforded us an intimate knowledge of the characteristic features of the disease, as well as of the many variations from the normal chain of symptoms. Aside from the cases of true trigeminal neuralgia, we have, in addition, records of 245 examples of what, for want of a better term, we have called atypical neuralgias. As a class, the victims of these irregular or atypical types of neuralgia are a pathetic lot. They often date their discomforts back many years, and they insist that the pain is unbearable and difficult of description; yet they seldom show any evidence of the intense suffering of which they complain.

We have been absolutely nonplussed in our attempts to account for the origin of the pain phenomena or to provide a remedy of any kind. Not infrequently, we have referred patients to psychiatric specialists and have been told that the pain is "psychogenic" in origin. It would, in a way, be a great comfort at least to know the origin of the pain, that is if the psychiatric specialists are correct in their observations. Whether the pain is psychogenic in origin or not, there is at least one case in our series, and one of the most distressing, in which the patient wrote in answer to our follow-up inquiry that she had been entirely cured by Christian science. Would that Christian science could cure them all! It would give a clue, at least, to many things one ought not to do in the efforts to relieve, if it is true that there is not, as we are inclined to believe, an organic basis for the pain. At all events, our observations prove conclusively that no remedy applied directly to any branch or division of the trigeminal system is in the least helpful; that no operation dealing with structures within the pain territory, especially the teeth and the sinuses, will give the patient the slightest relief. We might go a step further and say without fear of contradiction that any of the physical remedies not only do not relieve, but often make matters worse. Every time the effort is made to give relief by physical means, the threshold of the patients' endurance to pain is lowered and the pain becomes less bearable. This sequence of events seems to us not unlike the experience

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* From the Neuro-Surgical Division, University of Pennsylvania Hospital.

* Read at a Meeting of the Philadelphia Neurological Society, April 22, 1927.

of patients with vague abdominal pains at one time attributed to bands and adhesions, and movable and displaced organs. After one or more abdominal procedures for corrective purposes, these patients, like those with atypical neuralgia in whom attempts at treatment have been made, were pushed a little farther down the ladder of health.

At one time an attempt was made to find a relationship between the sympathetic system and the pain phenomena. In some of the atypical neuralgias there are associated phenomena of sympathetic origin, such as hyperemia, lacrimation and transitory edemas. With little more justification than these, one of us resected the superior cervical sympathetic ganglion in ten cases with invariable failure.[1] Likewise, cocainization of the sphenopalatine ganglion is no longer considered effective. Could the pain be of central origin? In organic lesions, such as tumor of the brain, if the tumor should be in the thalamic region there may be pain referred to the arm or the leg on the contralateral side. But the absence

TABLE 1.—*Numbers of Operations of Different Types.*

Type	Number
Injection of alcohol in branches of the trigeminal nerve	64
Cocainization and injection of the sphenopalatine ganglion	50
Extraction of teeth	48
Sinuses	48
Supra-orbital and infra-orbital nerve avulsions	24
Nasal operations	15
Cervical sympathectomy	12
Stripping of the peri-arterial (carotid) plexus	10
Subtotal section of sensory root of trigeminal nerve	11
Mastoid operations	5
Pelvic operations	5

of any other focal symptom, even though the pain may be of many years' duration, would seem to be sufficient to negate this hypothetic conclusion.

So we acknowledge an impasse and in the hopes of finding some clue to the origin and nature of these atypical cases, we have subjected the 143 histories of this series to a critical analysis.

ANALYSIS OF CASE RECORDS

Table 1 gives in detail the number of operations and the types performed. Many of the patients had numerous operations, some had only a few and others had none. In a few instances they were free from pain for a few days, perhaps a week or so, but in the vast majority of cases the pain became worse. No matter what course of therapy was pursued, the ultimate results were the same—dismal failure.

From the number of injections and operations performed on the trigeminal branches, it is evident that there must be a number of

1. Frazier, C. H.: Unsuccessful Attempt to Relieve Atypical Neuralgia by Operation on the Cervical Sympathetic, Philadelphia Neurological Society, April 22, 1927.

instances in which there was a reasonable doubt as to whether the diagnosis was typical or atypical neuralgia.

A great number of the patients had an associated neurosis accompanying the pain. Whether this neurosis was due to the peristent pain, or preceded the pain, is the debatable question. Obviously, a continuous pain of such severity as these patients complained of might greatly disturb the stability of the nervous system. In fact, in some instances the pain was so distressing and so annoying the patients threatened suicide; many became drug addicts, and others became psychopathic.

TABLE 2.—*Age from Onset of Symptoms*

Age	Cases
10	15
20	29
30	34
40	27
50	16
60	9
70	0
Unknown	13
Total	143

TABLE 3.—*Incidence According to Sex*

Sex	No. of Cases
Male	35
Female	108
Total	143

TABLE 4.—*Side Involved*

Side	No. of Cases
Right	51
Left	46
Both	46
Total	143

The following observations were made as to the relationship between the onset of pain and the age of the patient: A few cases were observed in the first decade; the condition was more frequent in the second, third and fourth decades (63 per cent), and greatly decreased in the fifth and sixth decades (17 per cent). It may thus be concluded that this disease is more prevalent in middle life.

Table 3 demonstrates definitely that the females greatly predominated over the males, there being approximately three times as many women as men.

In contradistinction to trigeminal neuralgia, the pain in one third of the cases was bilateral, and in the other two thirds the right and left sides were equally involved.

We have acknowledged our ignorance as to the etiology of this disease, but we present in tabular form (table 5) certain events that were coincident with the onset of pain. Of these, the relative frequency of the extraction of teeth is striking (15 per cent). The teeth were not extracted for the relief of pain, but immediately after extraction pain ensued. In all these cases pain was referred to the jaw at the site of extraction and continued there throughout the course of the disease, although at times it spread to other areas. However, in the majority of cases (65 per cent), the patient could not recall any event as an etiologic factor.

In studying the distribution and location of pain, we are indeed confronted with a complicated situation. It is exceedingly diversified. It involves many areas about the face and spreads in different directions; but complicated and diversified as it is, we may, from the distribution, classify this series into ten definite groups. In table 6 these groups are

TABLE 5.—*Coincidental Events*

Events	No. of Cases
Teeth extracted	22
Accidents	
(a) War wounds	4
(b) Automobile	2
(c) Railroad	2
(d) Struck on head	1
Diseases	
(a) Influenza	7
(b) Colds	4
(c) Gastro-intestinal disorder	1
Operations	5
Worries	5
Pregnancy	1

designated from A to A_9. In the majority of cases, after the location of the pain was once fixed in the patient's mind, there was little variation no matter how many months or years may have elapsed. Occasionally, however, cases were encountered which, at the onset of the disease, might belong to one group, but as time progressed would enter another. These cases, however, were the exception rather than the rule. One of the outstanding features of these atypical neuralgias is the extraordinary constancy of the distribution of pain throughout the course of the disease. Table 6 gives the classification in condensed form, and the case histories which will be presented have been chosen as illustrative of their respective groups.

GROUP A.—In this group are fifteen cases in which the pain involved a specific single zone. The pain did not radiate, but remained stationary. It did not spread in any way characteristic of other groups.

GROUP A_1.—In this group of fourteen cases, the pain took a circular route and covered an extensive area. It began in the lower jaw, and then extended to the upper jaw, to the malar region and to the nose, and

then either over the eye, in the eye or under the eye; to the frontal region and to the temporal or parietal region; in some behind, in others in front of the ear, and in others directly through the ear; continuing to the occipital or suboccipital region, to the neck, down the shoulder and into the arm. This group represents the widest distribution, and the remaining groups include only certain of the constituent zones.

TABLE 6.—*Distribution of Pain Throughout Course of Disease*

	LOCATION																				
A.	Individual areas																				15
		1. Lower jaw, upper jaw, inside of mouth 2. Eye, supra-orbital 3. Cheek, suboccipital																8 4 3			
A_1	Lower jaw to	upper jaw malar region nose	to	over eye in eye under eye	to	frontal area temporal area parietal area	to	behind ear front of ear through ear	to	occipital region suboccipital region neck shoulder arm											14
	A_2	Upper jaw malar region nose	to	over eye in eye under eye	to	frontal area temporal area parietal area	to	behind ear front of ear through ear	to	occipital region suboccipital region neck shoulder arm											35
			A_3	Over eye in eye under eye	to	frontal area temporal area parietal area	to	behind ear front of ear through ear	to	occipital region suboccipital region neck shoulder arm											24
					A_4	frontal area temporal area parietal area	to	behind ear front of ear through ear	to	occipital region suboccipital region neck shoulder arm											7
A_5	Lower jaw to	upper jaw	malar region, nose		eye	ear	temporal area, neck														19
	A_6	Upper jaw to	malar region, nose		eye	ear	temporal area, neck														16
				A_7	eye to	ear	temporal frontal area														6
						A_8	temporal frontal parietal area														6
							A_9	Body paresthesia plus A_1													1
																			Total		143

GROUP A_2.—In this group of thirty-five cases, instead of beginning in the lower jaw the pain commenced in the upper jaw, the malar region or the nose, and then completed the arc.

GROUP A_3.—This group consists of twenty-four cases; the pain began over the eye, in the eye or under the eye, and then completed the arc.

GROUP A_4.—This group consists of seven cases; the pain began in the frontal region, temporal region and parietal region to complete the arc.

GROUP A_5.—In this group and the following, the pain did not complete the arc, but began in either one part of the face or the other and radiated to definite areas. There were nineteen cases in which the pain began in the lower jaw and radiated to the upper jaw, the malar region, the nose, the temporal region or the neck.

GROUP A_6.—This group consists of sixteen cases; the pain began in the upper jaw and radiated to the malar region, the nose, the eye, the temporal region or the neck.

GROUP A_7.—There were six cases in which the pain began in the nose and radiated to the malar region, the temporal region or the frontal region.

GROUP A_8.—This group consists of six cases, in which the pain began in the temporal region and radiated to the parietal region.

GROUP A_9.—In this, the only case of this group, the pain made the complete circuit as in group A_1, and, in addition, there was generalized body paresthesia.

GROUP A

Individual areas.

CASE 1.—E. H., a woman, aged 42, was admitted to the neurosurgical service of the University Hospital, Nov. 7, 1923, complaining of pain in the upper and lower jaw. The family and previous histories were essentially unimportant except for measles, mumps, pertussis and diphtheria in childhood. The general physical and neurologic examination gave negative results.

Neuralgia.—Previous to three years before admission to the hospital the patient was perfectly well. At that time, without any known cause, she developed a continuous pulling, gnawing pain in the right side of the upper and lower jaws and teeth posteriorly; this pain had been practically continuous, with only occasional intervals of freedom of from one to two hours' duration. The pain was deep in the jaw. It was aggravated by talking, draughts, fatigue, worry and climbing stairs; it was worse in the winter. It was relieved by morphine, heroin, codeine, and swallowing; during the summer months the pain was not so annoying. The patient was inclined to worry; she had occasional fainting spells, and often a sense of edema of the right side of the face when the pain was most severe. She had had ten teeth extracted; other attempts at treatment included electricity, chiropractic, Christian science, violet ray and the removal of a bone from the nose. In all, she had visited about sixty dentists. Following the original pain, which started in the upper jaw, she had two teeth removed; the result of this extraction was an increase of pain and an involvement of the lower jaw. She had been unable to get relief in any manner.

GROUP A_1

Lower jaw to upper jaw and malar region, to under eye, over eye and in eye, to frontal temporal and parietal regions, to behind ear, front of ear and through ear, to occipital region, suboccipital region, neck and shoulder.

CASE 2.—A. M., a woman, aged 44, was admitted to the neurosurgical service of the University Hospital, June 24, 1925, complaining of pain in the right side of the head. The family and previous histories were essentially unimportant. Physical and neurologic examination gave negative results.

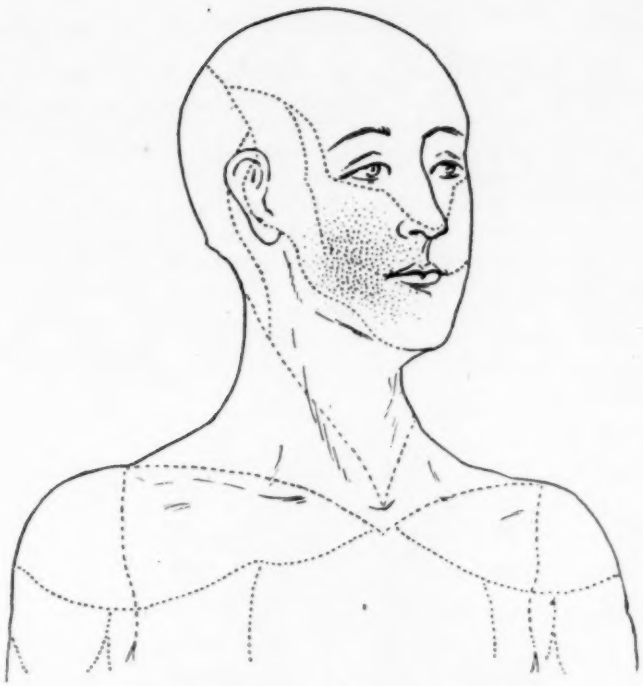


Fig. 1.—Distribution of pain in group A.

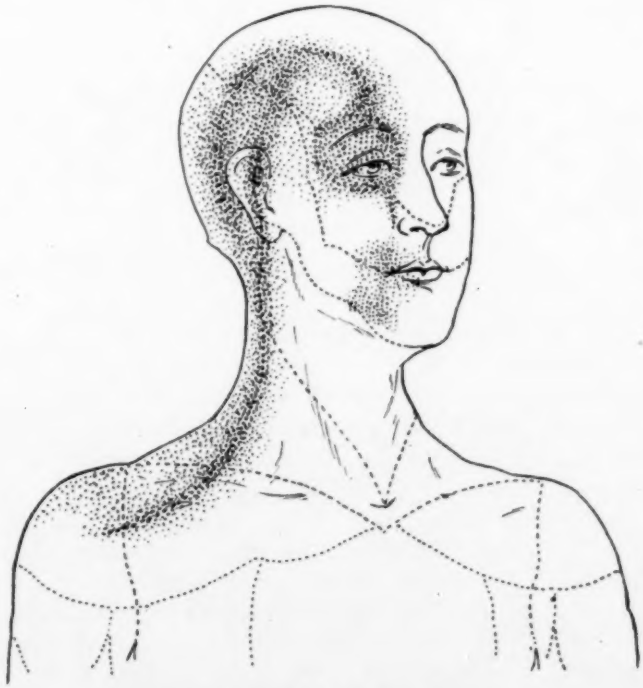


Fig. 2.—Distribution of pain in group A_1.

Neuralgia.—Seventeen years before admission to the hospital, while she was alighting from a street car, the motorman started the car too soon, and the patient was wrenched. She was not unconscious or injured in any way. Since then she had had pain deep in the eye like a ball of fire, and aching neuralgic pains all over the front teeth and radiating upward to the frontal region and backward to the occipital region, into the ear and then down the shoulder. Frequently, this pain was of a shooting character, but more frequently it was a deep-seated ache. She was never entirely free from pain, but she had more severe attacks occurring once a month and lasting from two to five days. Following these attacks of severer nature she had a slight discharge from the right ear; the eye closed, and was red and lacrimated. Nothing relieved this pain. It was accentuated by crying, unpleasant experiences, worry or fatigue.

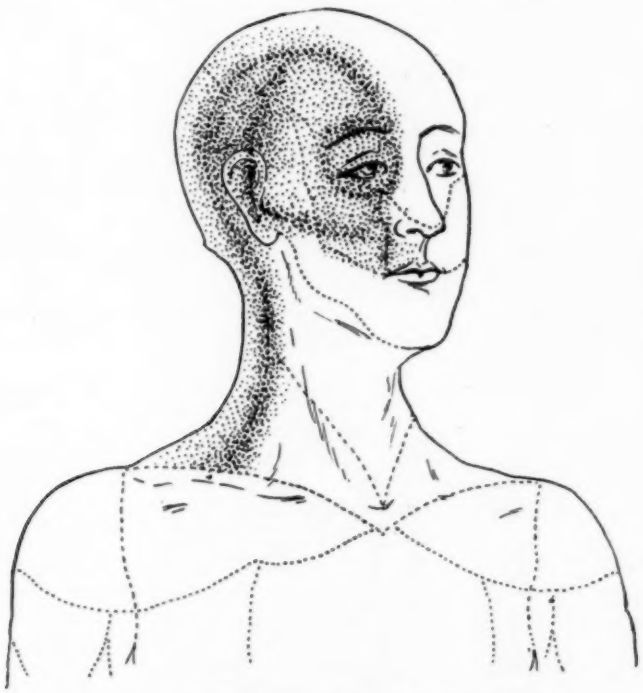


Fig. 3.—Distribution of pain in group A_2.

GROUP A_2

Upper jaw and malar region to under eye, over eye and in eye, to frontal, temporal and parietal regions, in ear and back of ear, to occipital and suboccipital regions and neck.

CASE 3.—E. G., a woman, aged 38, was admitted to the neurosurgical service of the University Hospital, Sept. 28, 1925, complaining of pain on both sides of the face. The family history was not significant. The patient had used morphine for two and a half years. A general physical examination gave negative results. A neurologic examination revealed sluggish pupils, but was otherwise normal. A roentgenogram of the ethmoid showed clouding.

Neuralgia.—The patient had had pain for three years. It was constant, but every week, for a period of two or three days, the patient had more severe attacks of an aching, shooting character; during the remissions it was more of a dull ache. When the attacks were severe, they were followed by nausea and vomiting. The pain was deep seated and did not always carry the same area of distribution. It was deep in the orbit and extended back of the ear, up into the temporal region and often down into the neck; sometimes it started in the upper jaw or cheek and extended through the eye, the temporal region, back of the ear or in the ear, and then down into the neck. She had had two attacks on the left side. During the severe attacks, scalding tears appeared in the eyes. Following the attacks, she had a "funny, heavy feeling in the head." She had had operations performed on the sinuses, she had had five injections of alcohol and many teeth

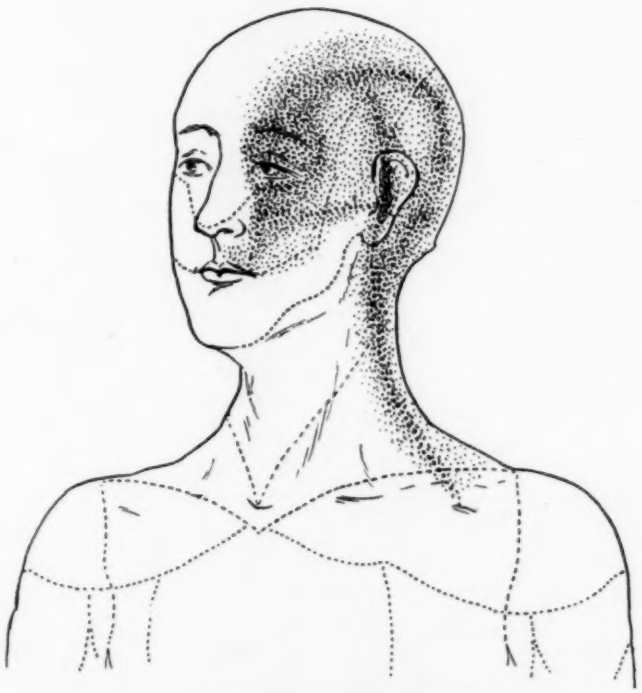


Fig. 4.—Distribution of pain in group A_2.

extracted without relief of pain. The pain was aggravated by heat and exposure to cold air in the winter would bring on an attack; it was worse during the menstrual periods; the pain was frequently relieved by the application of ice.

GROUP A_3

Under eye, in eye, over eye, to frontal, temporal and parietal regions, through ear to occipital and suboccipital regions and neck.

CASE 4.—D. F., a woman, aged 41, was admitted to the neurosurgical service of the University Hospital, Feb. 20, 1923, complaining of pain in the left side of the face. The family history was unimportant. The patient had had measles in childhood. Physical and neurologic examinations gave negative results.

Neuralgia.—Six years before admission to the hospital, without any apparent cause, the patient developed a shooting, boring pain in the left side of the face. It started under the eye and extended deep into the eye and over the supra-orbital region; frequently it passed over the frontal region, deep into the ear or behind the ear and then down into the suboccipital region, neck and arm. She was never entirely free from pain, and had severe attacks every three or four months, lasting from two to three weeks. This pain was aggravated by heat, talking, swallowing, eating, fatigue, contact, coughing, sneezing and the menstrual periods, also by sudden changes of position. Nothing relieved it; it was increasing in severity and she had had one tooth extracted without relief. These severe attacks were associated with flushing of the left side of the face and profuse lacrimation.

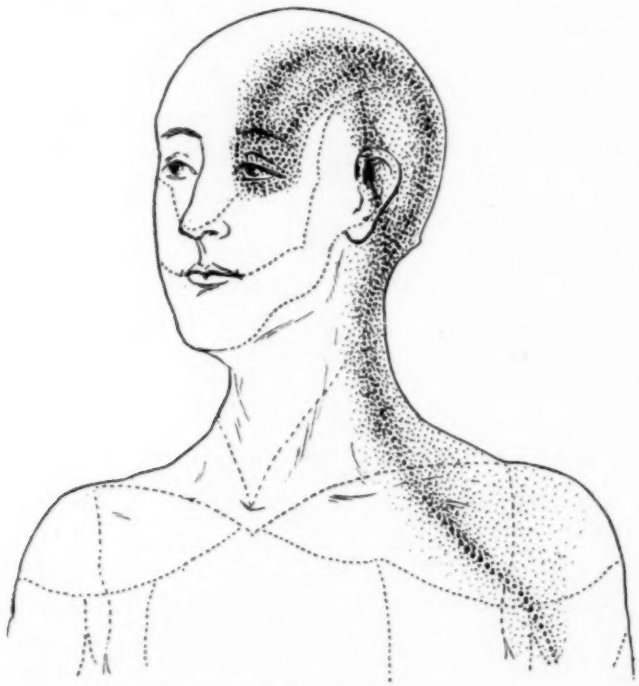


Fig. 5.—Distribution of pain in Group A_3.

She received temporary relief from cocainization of the sphenopalatine ganglion and also by an injection. The pain returned three months later, and she was free from pain for another three months following the use of a patent medicine.

GROUP A_4

Frontal region, to behind ear, to occipital region, to suboccipital region.

CASE 5.—M. L., a man, aged 24, was admitted to the neurosurgical service of the University Hospital, April 10, 1922, complaining of pain on the right and left sides of the head. The family history was unimportant. The patient was a war veteran and had been struck in the face by shrapnel.

Neuralgia.—Since discharge from the army, he had had dull and aching pain, which was practically constant from 11 a. m. until bed time. This pain began

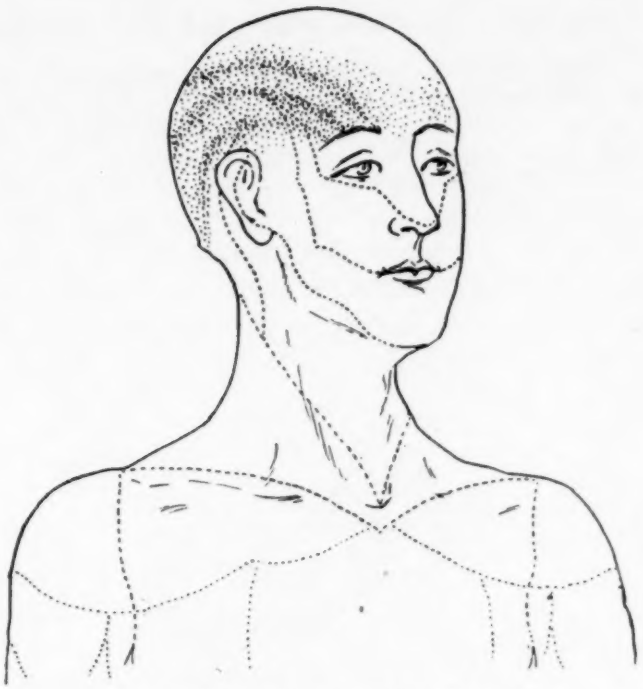


Fig. 6.—Distribution of pain in group A_4.

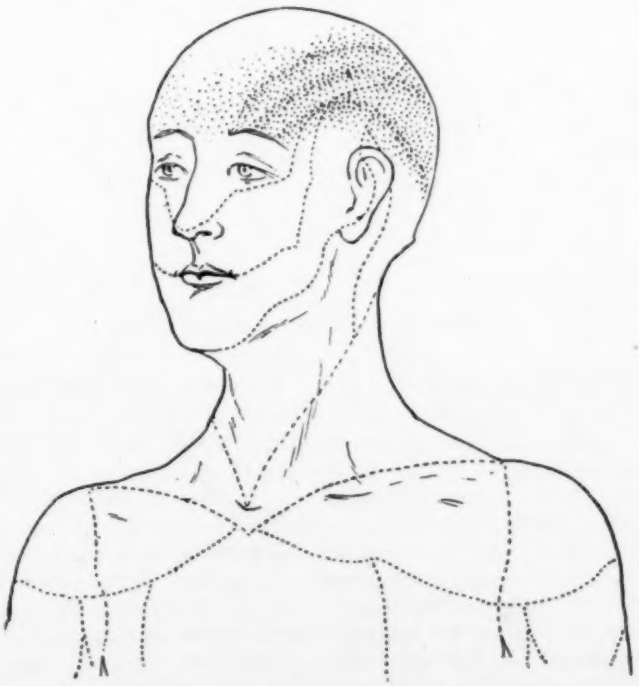


Fig. 7.—Distribution of pain in group A_4.

in the supra-orbital or frontal region, extended over the vertex to the occipital region and was of greater severity on the right side than on the left. The attacks were worse when he was tired. They were relieved somewhat by going outdoors and by rest. The patient had had medicines of various types; teeth were extracted; electricity, osteopathy, violet ray and avulsion of the supra-orbital nerve were tried without relief.

GROUP A_5

Lower jaw to upper jaw, malar region, nose, eye, ear, temporal region or neck.

CASE 6.—C. P., a woman, aged 42, was admitted to the neurosurgical service of the University Hospital, July 9, 1923, complaining of pain in the right

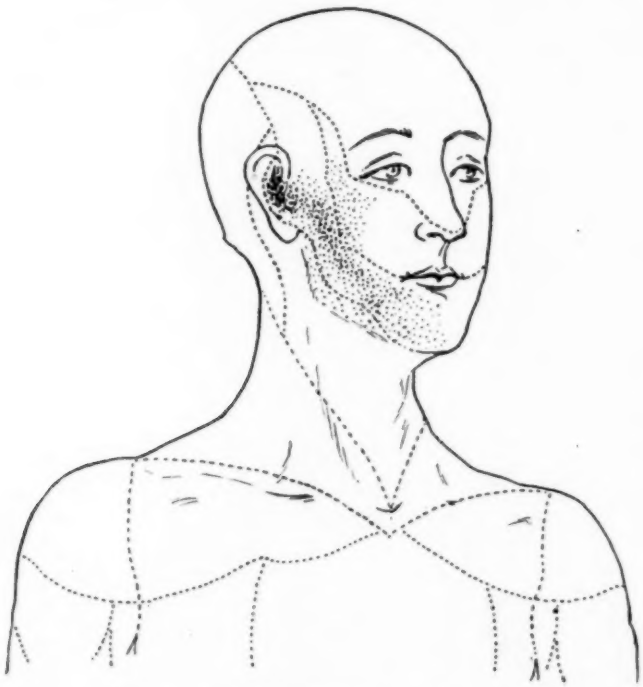


Fig. 8.—Distribution of pain in group A_5.

side of the face. The family and previous histories were without significance. Physical and neurologic examinations gave negative results.

Neuralgia.—The onset occurred twelve years before admission to the hospital, without apparent cause. The pain was steady, nagging, tearing, stinging and excruciating; she was never free from it; she could not find a word to describe it. It was situated in the lower teeth and jaw, both front and back and radiated up to the ear, deep inside the ear and to the malar region. There were periods when she had accentuations of pain; these were mainly in the evening. It was aggravated by talking, eating, fatigue, brushing the teeth and noise. It was relieved somewhat by the use of hot water bottles and by morphine. She took from 75 to 100 (4.87 to 6.5 Gm.) grains of acetylsalicylic acid a day. She had tried electricity, osteopathy, chiropractic, Christian science and the roentgen ray

and had her teeth extracted. She had had the phenopalatine ganglion cocainized; the superficial branches of the trigeminal were cut on four occasions, and injections of alcohol were given. The pain continued.

GROUP A_6

Upper jaw to malar region, nose, eye, ear, temporal region or neck.

CASE 7.—H. W., a woman, aged 33, was admitted to the neurosurgical service of the University Hospital, Jan. 9, 1924, complaining of pain in the left side of the face. The family and previous histories were unimportant. A physical examination gave negative results. Neurologic examination revealed the left pupil larger than the right.

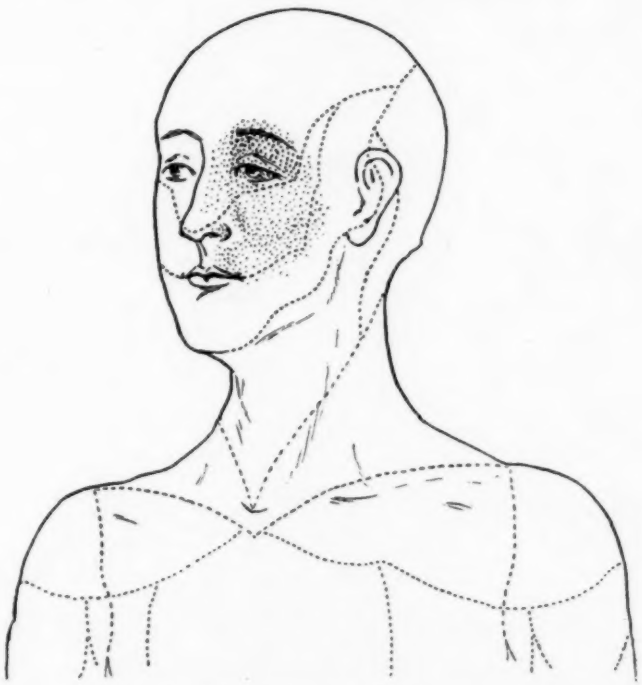


Fig. 9.—Distribution of pain in group A_6.

Neuralgia.—Four years before admission to the hospital, two days after the extraction of an upper left molar tooth, the patient began to have a dull, aching pain over the left malar region. The pain was constant and radiated to the left cheek, left side of the nose and around the left eye. It was described as a "funny" pain. There were times as she breathed when it seemed as if the cold air came from the antrum and passed down into the lip and teeth. At other times it seemed as if all the teeth were in and all aching. The pain was sharp when she had a "cold"; it seemed like a "thousand needles radiating" from the ala of the nose; at times it was like a "jumping toothache." At times there were acute exacerbations lasting one hour or so, when the left cheek felt as if it were being tied in a knot. These severe attacks would occur daily and often were associated with flushing and edema of the face. The pain was aggravated

by fatigue, hot and cold food or drink and vibration. It was relieved somewhat by heat and rest; phenobarbital, morphine, scopolamine and cactine made sleep possible, but did not relieve the pain. She had had the teeth extracted; a left antrum operation which relieved her for a short time; a submucous nasal resection; drainage of the ethmoid and sphenoid sinuses; a tonsillectomy; a turbinectomy; an injection of alcohol and sphenopalatine cocainization, all without relief.

GROUP A_7

Eye, to ear, temporal region, frontal region and parietal region.

CASE 8.—A. B., a woman, aged 34, was admitted to the neurosurgical service of University Hospital, Sept. 17, 1924, complaining of pain in the right side of the head. The family history was without importance. The patient had had diph-

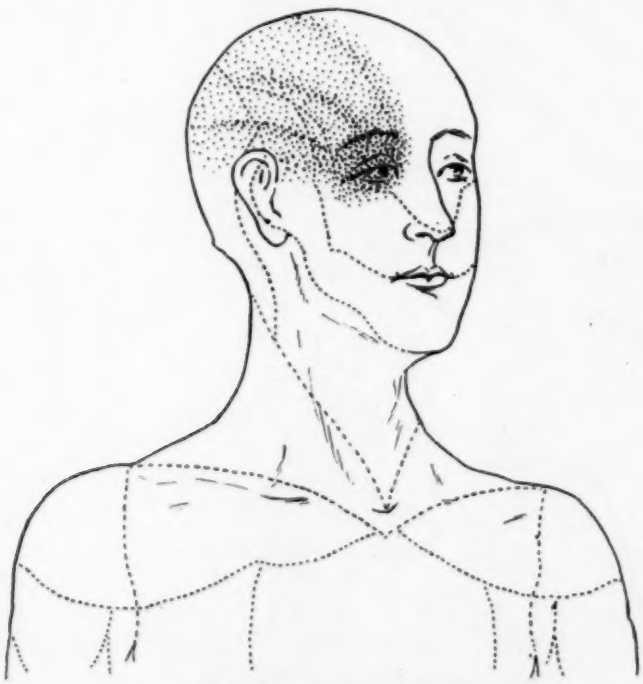


Fig. 10.—Distribution of pain in group A_7.

theria at the age of 4; scarlet fever at the age of 9; a hysterectomy at the age of 26, and two secondary operations for pelvic pain. Three years before admission to the hospital a pulmonary hemorrhage occurred, and tubercle bacilli were found in the sputum. A general physical examination revealed: slight enlargement of the posterior cervical glands; a slight scar over the right orbit due to an injury; evidence of infiltration of both apexes, but no evidence of activity, and numerous hard nodules in the lower part of the abdomen, without pain, tenderness or distention. Neurologic examination gave negative results.

Neuralgia.—Since the age of 10, the patient had had attacks of pain in the right side of the face, of a throbbing and shooting character, starting in and deep behind the eye socket and radiating to the frontal, temporal and parietal regions.

These attacks occurred once or twice a week, and were usually accompanied by vomiting; they were of such severity that the patient had to go to bed. Recently, they had become much worse, occurred daily and were constant; the patient improved during the day only after the administration of morphine. Pressure occasionally relieved the pain; stooping exaggerated it, and lying flat relieved it. The sphenopalatine ganglion had been cocainized without relief; in fact, this exaggerated the pain. The patient appeared to be addicted to the use of morphine.

GROUP A_8

Temporal, frontal and parietal regions.

CASE 9.—R. S., a man, aged 32, was admitted to the neurosurgical service of the University Hospital, Jan. 7, 1925, complaining of pain in the temporal and parietal

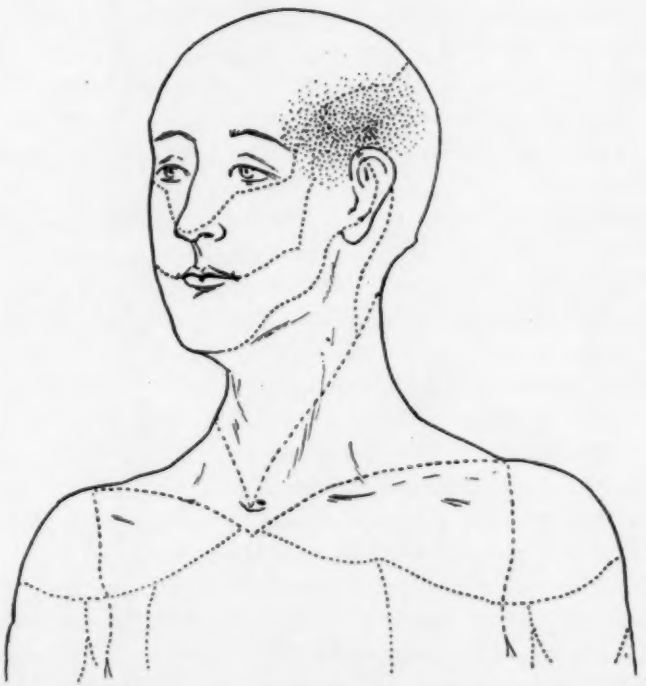


Fig. 11.—Distribution of pain in group A_8.

region on the left side. The family and previous histories were unimportant. General physical and neurologic examination gave negative results, except for slight exophthalmos of the left eye.

Neuralgia.—Fourteen years before admission to the hospital, two days after a turbinectomy on the left side, pain started in the left upper temporal region, and later involved the left anterior parietal region; it was severe, aching and steady. Since the onset, it had recurred every six to nine months and lasted for a period of six weeks. During the six weeks' period, he had an attack of pain each day lasting about one hour, and then with a sensation of deep pressure it disappeared rather suddenly. During the interim he was entirely free from pain. With each

severe attack he had marked lacrimation of the left eye, followed by congestion of the conjunctiva. Occasionally he had salivation. The pain could be controlled to some extent by reading or talking, or by holding a piece of ice in the mouth. It was not relieved by morphine, ½ grain (0.032 Gm.). He had had teeth extracted, chiropractic treatment, violet-ray treatment and cocainization of the sphenopalatine ganglion, without relief.

COMMENT

Analysis of the type of pain of which these patients complained demonstrated an extraordinary number of descriptive adjectives (table 7). In the total number of 143 cases, sixty-four different adjectives were used to describe the pain. A single adjective was not always used; frequently there were several. This suggests that the patient had extreme difficulty in describing the character of the pain; in some cases the patient was wholly at a loss for a descriptive adjective. There was one outstanding characteristic, however, in which all concurred—the pain was not superficial; it was not referred to the surface like that of trigeminal neuralgia; it was deep seated, in the tissues, in the bone or in the eye ball.

To us this is one of the most valuable signs in the differential diagnosis between typical and atypical neuralgia. It is a matter of common knowledge that in tic douloureux the pain is in the main referred to the terminal distribution of the division affected, the lips, the tip of the nose, the teeth in the alveolus, the eyelids, etc. This is in striking contrast to the sense of deep-seatedness of the pain in the atypical neuralgia. Not only is the point important in differential diagnosis, but it at once stimulates speculation as to its significance. What is the interpretation, if there is any, of the striking difference? We confess that our imagination has suggested none that would seem to have any bearing, either as to the origin or the nature of these pain syndromes.

From a glance at table 7 one is struck not only, as already suggested, with the multiplicity of descriptive terms, but with the predominance of terms that are not at all common to the phraseology of tic douloureux. To make this more apparent, the tic douloureux terms have been set up in italics. As will be seen, a large majority of these terms belong conclusively to atypical neuralgia. This is one commentary on table 7. Another is the type of pain. One is in the habit of recognizing various types of sensation as thermal, pain, tactile and pressure. Those of tic douloureux invariably imply thermal sensation and a sense of sharp, cutting or stabbing pain; those of atypical neuralgia seem freequently to imply pressure sensations, as throbbing, gripping, pulling, bursting and the like. One is led to speculate as to the significance of these conspicuous distinctions, and at once the question of what part the facial nerve, to which is attributed the sense of pressure, may play.

The pain of tic douloureux is essentially paroxysmal with intervals of complete relief. The pain of atypical neuralgia is essentially persistent and continuous, with periods of days in which there are severe exacerbations. During the first two or three hours of these aggravated periods,

TABLE 7.—*Type of Pain*

Sensation *	No. of Cases
1. Dull aching	52
2. *Burning*	26
3. Throbbing	20
4. *Shooting*	16
5. *Sharp*	14
6. Boring	11
7. Drawing	9
8. Pulling	8
9. Sense of pressure	7
10. *Hot Iron*	6
11. Gnawing	5
12. Soreness	5
13. Toothache	5
14. *Knifelike*	4
15. *Pricking*	4
16. Beating	3
17. *Needle-like*	3
18. Gripping	3
19. Bugs creeping	3
20. *Electricity*	3
21. *Tingling*	2
22. *Lightning*	2
23. Bursting	2
24. Nagging	2
25. *Stinging*	2
26. *Smarting*	2
27. Itching	2
28. *Tearing*	2

* Thirty-six additional descriptive adjectives: twitching, severe, jumpy, like a bruise, crawling, saw-cutting face, something in jaw, unbearable, a mass of fire, pins and needles, stiffness, like menthol, wearing, pounding, surging, buzzing like a mosquito, crushing, vibrating, excruciating, log on top of head, full feeling, grabbing, like a hard knot, deep in eye, eye ball bursting, eye pushed through head, drawing out of eye, ball of fire in eye, eye feels like electricity.

Descriptive adjectives	64
Total cases	143

the pain gradually increases until the height is reached, after which the intensity slowly subsides, until at the end of the third day or so, the chronic phase is resumed.

There are many variations from this rather typical history. There may be an interim of from three to nine months. A few cases showed a remission as long as from two to three years. During these remissions and these interims, the patients were entirely free from pain. Even though there were remissions, the patient often had a continuous feeling of oppression or aching in the region of the pain zone, though not of such severity and intensity as during the exacerbation.

None of the patients included in this survey was relieved by any therapeutic measures. In a few the pain was eased by the administration of coal tar products, or the common alkaloids, such as codeine and morphine (table 8).

Mention may be made in passing of the common use of opiates in the atypical neuralgia as another means of differentiation from tic

TABLE 8.—*Agents for Easing Pain*

Agent	No. of Cases
Acetylsalicylic acid	12
Heat	9
Morphine	9
Cold	4
Codein	3
Lying down	2
Pressure	2
Massage	1
Epinephrin hydrochloride spray	1
Smoking	1
Chewing paraffin	1

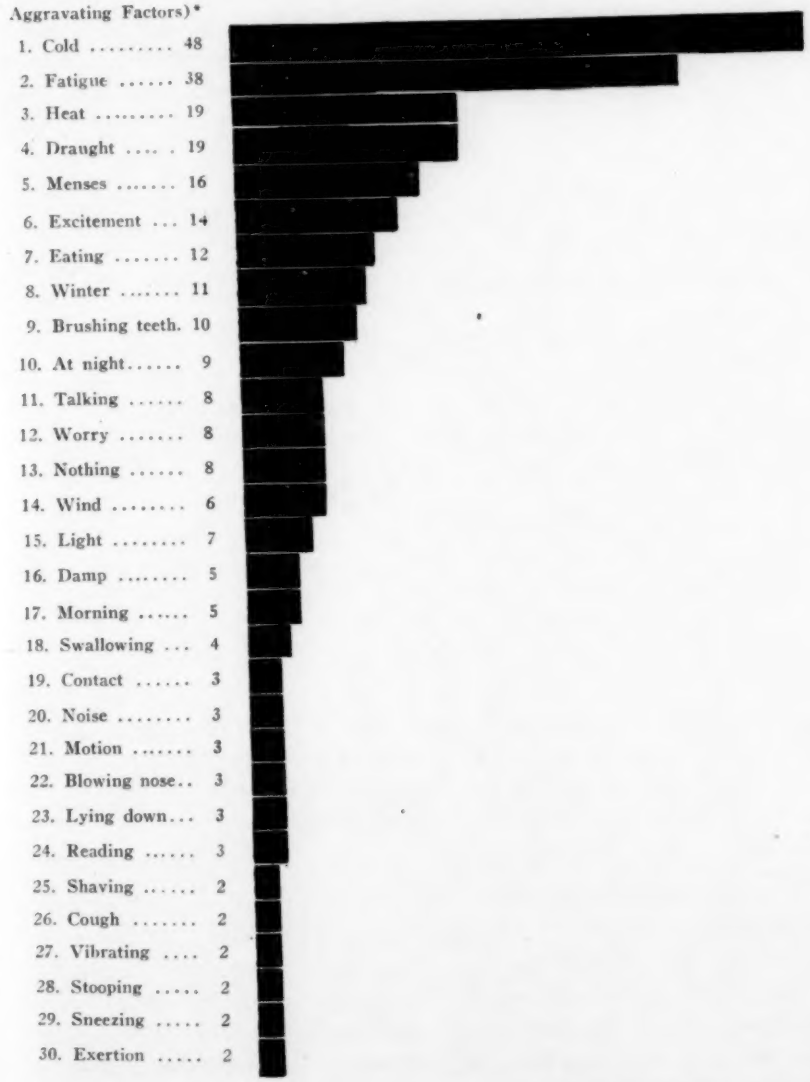
douloureux. If one should ever be in doubt as to whether he is or is not confronted with a case of true tic douloureux, he can with easy assurance base his diagnosis on this simple circumstance. The patient with true tic douloureux is never a drug addict. He not only does not crave opium or its derivatives, but flatly refuses them.

The factors aggravating the pain may be divided into general—changes of temperature, changes of climate, menses, fatigue, etc.—and local—brushing the teeth, washing the face, eating, light, blowing the nose, etc. (table 9). Pain was aggravated in forty-eight cases by cold; in thirty-eight by fatigue; in nineteen by heat. In eight cases the pain was not affected in any manner by extraneous factors—it just appeared in its natural cycle and was not aggravated by any factor.

In the entire group of 143 cases, the patients complained of 268 factors that aggravated the pain. Usually there was more than one such factor. Of the total of 268, there were only fifty-six focal factors, such as swallowing, contact, blowing the nose, shaving, etc. The mere recording of these local factors that aggravate pain might at once arouse in

the mind of the critical person a doubt as to the accuracy of diagnosis. Swallowing, blowing the nose, shaving, etc., are just the stimuli which excite the paroxysms in tic douloureux. The criticism, therefore, is natural, but the opportunity for an intensive study and the

TABLE 9.—*Factors Aggravating Pain*



* Nine additional factors aggravating pain: Annoyance, care, crying, anger, washing, yawning, constipation, shock, sticking out tongue.

Factors aggravating pain..... 39
Total cases 143

failure to relieve the pain by injections of alcohol established the diagnosis beyond a peradventure of doubt, whenever there might have been any. An explanation of these points of similarity might be found in the fact that the subjects of atypical neuralgia are susceptible to suggestion, and often may answer "yes" to direct questions as to what aggravates the pain.

TABLE 10.—*Focal Factors Versus General Factors Aggravating Pain*

Total factors aggravating pain	268
General factors aggravating pain	212
Focal factors aggravating pain	56
Total cases	143

TABLE 11.—*Ratio of Pain to Sympathetic Phenomena*

Pain alone	65
Pain plus sympathetic phenomena	78
Total cases	143

TABLE 12.—*Associated Sympathetic Phenomena*

Eye disturbance		60
(a) Lacrimation	33	
(b) Edema	25	
(c) Unequal pupils	13	
(d) Corneal injection	11	
(e) Enophthalmos	1	
Salivation		5
Nasal discharge		11
Flushing of face		18
Aural discharge		2
Nausea and vomiting		24
Perspiration		3

TABLE 13.—*Relation of Nasal Pain to Nasal Discharge*

Total cases of nasal pain	55
Cases with nasal discharge	11
Cases of pain in other areas with nasal discharge	0
Cases uninvolved	44

In conjunction with expression of pain, many patients had associated sympathetic phenomena. Of the entire 143 cases, sixty-five had pain alone, and seventy-six had sympathetic phenomena (table 11). Sympathetic phenomena, usually occurring with the more severe attacks, were more frequent when pain involved the eye. Of the sixty cases in which pain was referred to the eye, lacrimation was the most common sympathetic sign (table 12).

Rarely were there any sympathetic phenomena without pain in the same area. A group of comparative tables (tables 13, 14, 15 and 16) were constructed to show this relationship of the region of pain to the

region of sympathetic phenomena. Of fifty-five patients in whom the nose was involved, eleven had rhinorrhea; of fifty-six patients in whom the malar region was involved, ten had malar flushing; of ninety-seven patients in whom the eye was involved, fifty-one had sympathetic disturbances in the orbit; in thirty-three patients with complaints of pain

TABLE 14.—*Relation of Malar Pain to Malar Flushing*

Total cases of pain in malar region	56
Cases with malar flushing	18
Cases of pain in other areas with malar flushing	0
Cases uninvolved	38

TABLE 15.—*Relation of Eye Pain to Eye Involvement*

Total cases of pain in eye	97
Cases with eye involvement	51
Cases of pain in other areas of eye involvement	9
Cases uninvolved	46

TABLE 16.—*Relation of Ear Pain to Ear Involvement*

Total cases of aural pain	33
Cases with ear discharge	2
Cases with pain in other areas with aural discharge	0
Total cases uninvolved	31

TABLE 17.—*Relation of Pain in Lower Jaw, Upper Jaw and Inside of Mouth to Etiology, Factors Aggravating Symptoms and Sympathetic Phenomena*

Aggravated by eating, talking, swallowing	20				
Unaffected by eating, talking or swallowing	76				
Involving other areas	0				
Total cases involving areas	96				
		Cases involving inside of mouth	37		
					Unaffected
				Etiology of pulling teeth	22	15
				Aggravated by brushing teeth	10	28
				Salivation	5	32

in the auditory canal, only three gave evidence of increased activity of the ceruminal glands. Thus, not only was the orbit most frequently the seat of pain, but there were, proportionate to other pain zones, more instances of sympathetic disturbance.

It is not altogether surprising that there should be sympathetic phenomena in the territory of the trigeminal nerve. This is readily

explained by reference to the many contacts of the trigeminal nerve and sympathetic ganglia and plexuses: the carotid, ciliary, otic and sphenopalatine. It was the frequent association of sympathetic phenomena and pain that suggested the sympathetic system as the origin of the pain in the atypical neuralgia. As stated earlier in this discussion, however, we have had to abandon this position as untenable.

Of the thirty-seven patients in whom pain was referred to the lower jaw, the upper jaw and the inside of the mouth, thus, in the majority an apparent etiologic factor in twenty-two was the onset of pain coincident with the extraction of teeth. Of the twenty-two patients, in ten the pain was aggravated by brushing the teeth, and five patients complained of salivation. In the ninety-six cases involving the upper and lower jaw, and the inside of the mouth, in twenty of the patients the pain was aggravated by talking, eating and swallowing; in seventy-six, it was not aggravated by these factors (table 17).

CONCLUSIONS

Among the outstanding features of this analysis are several that show clearly the distinction between the major neuralgias and these atypical forms.

1. The charts graphically represent the location, distribution and radiation of pain; the pain does not follow the direction of the several divisions or branches of the trigeminal nerve, but jumps across anatomic boundaries and extends often beyond the trigeminal zone into the neck and arm.

2. The character of pain suggests disturbance of the sense of pressure.

3. The pain is usually continuous, with exacerbations and occasional remissions.

4. The pain is deep-seated rather than superficial.

5. Sympathetic phenomena are frequently associated with the pain.

6. The disease is more common in women than in men; not a few of the patients are addicted to the use of drugs.

7. There is no etiologic factor common to the majority. Only one factor, the extraction of teeth, was common to any considerable proportion (15 per cent).

8. Drugs, extractions of teeth, drainage of sinuses, tubinectomies, injections of alcohol, the roentgen ray, sympathectomies and all the forms of treatment advocated by cults have been tried and have failed.

THE SYMPTOMATOLOGY OF TUMORS OF THE FRONTAL LOBE

BASED ON A SERIES OF TWENTY-TWO CASES *

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CONTENTS

The difficulty of localization presented by several cases of tumors of the frontal [1] lobe led to a critical review of the cases personally observed and of those from the records of the Neurological Clinic of the Hospital of the University of Pennsylvania, in an attempt: (1) to determine the features characteristic or suggestive of the development of tumors in this region; (2) to evaluate the importance of the various symptoms previously reported as of localizing value; (3) to consider the value of laboratory studies and other diagnostic procedures; (4) to estimate the diagnostic value of the mental state in the patients. The material of this series includes three cases personally studied and nineteen cases selected from the records of the Neurosurgical Clinic. Only those cases were selected which seemed predominantly to involve the frontal lobe and which encroached on adjacent regions only in the late stages, if at all. All the growths were verified by operation or necropsy; ten were gliomas, eleven were endotheliomas and one was a sarcoma. The right lobe was involved in nine cases and the left in eight; five midline endotheliomas affected both lobes, but one lobe to a greater degree than the other.

The frontal lobes have been the subject of much study for many years. A voluminous literature has accumulated dealing with the

* Submitted for publication, Nov. 29, 1927.

* From the Neurosurgical Service of Dr. Charles H. Frazier of the Hospital of the University of Pennsylvania.

* Read at a meeting of the Philadelphia Neurological Society, January, 1928.

1. Frontal is used to designate the anterior two thirds of the frontal lobe, i. e., anterior to the motor cortex.

physiology of this portion of the brain, and numerous clinical signs, considered of definite diagnostic value, have been reported. However, that the diagnosis of frontal lobe tumors is still a matter of great difficulty is proved by the comparatively large size of the neoplasms found at operation or necropsy in this series, and the large size of most tumors of the frontal lobe reported in the literature.

HISTORICAL

The mind, or soul, was ascribed by the ancients to reside in various organs of the body. During recent centuries, this faculty has been considered intimately connected with the brain, but the portion of the brain directly concerned has been a matter of doubt. Bennett,[2] in 1837, while discussing intelligence, quoted several cases of injury of the frontal lobe in which he considered the mental faculties unimpaired, and for this reason he doubted that this area could be the center of the mind or intellect. The work of Hughlings Jackson[3] and Ferrier[4] added new impetus to the study of the subject; yet these two able men arrived at entirely opposite conclusions. Jackson considered the prefrontal lobes the seat of the higher psychic functions, while Ferrier failed to find evidence to support such a theory, and considered the higher psychic manifestations merely evidence of a higher degree of complexity or evolution of various sensory and motor areas. E. Müller[5] supported this view, as also did Schuster.[6] Phelps,[7] on the contrary, not only was an ardent supporter of prefrontal localization for the psychic functions but attempted to fix such a center exclusively in the left prefrontal lobe. Burr[8] also considered the prefrontal lobes intimately concerned with the psychic functions, and papers of Mills and Weisenburg[9] and Mills[10] carried similar conclusions. Von Monakow[11] did not consider that the psychic centers were specifically located in the prefrontal lobes, while

2. Bennett, J.: Physiology and Pathology of the Brain, Edinburgh, John Carpae & Son, 1837.

3. Jackson, Hughlings: Evolution and Dissolution of the Nervous System, Brit. M. J. **4**:591, 660 and 703, 1884.

4. Ferrier, David: Functions of the Brain, ed. 2, New York, G. P. Putnam's Sons, 1886.

5. Müller, E.: Allg. Ztschr. f. Psychiat. **59**:830, 1902.

6. Schuster, P.: Psychische Störungen bei Hirntumoren. Stuttgart, Ferdinand Enke, 1902.

7. Phelps, C.: Localization of Mental Faculties, Am. J. M. Sc. **123**:563 (April and May) 1902.

8. Burr, C.: Frontal Lobes and Mental Functions, Phila. M. J. **11**:217, 1903.

9. Mills, C. K., and Weisenburg, T. H.: Localization of the Higher Psychic Functions, J. A. M. A. **46**:337 (Feb. 3) 1906.

10. Mills, C. K.: Proc. Phila. Co. M. Soc. **25**:191, 1904.

11. Von Monakow: Ergebn. d. Physiol., 1904, vol. 3.

Bianchi [12] thought that his experimental work clearly showed that the frontal lobes contained the psychic centers. Ruckert,[13] Pfeifer,[14] Serog,[15] Petrina [16] and Newmark [17] reported tumors of the frontal lobe in which comparative or complete absence of mental disturbance led them to question the relationship of the frontal lobes to psychic functions. Gaspero [18] found the psychic disturbances in tumors of the brain to be most frequent in the various areas in the order mentioned: corpus callosum, frontal lobes, occipital, temporal, parietal, cerebellum, pituitary and brain stem. Brodmann, as late as 1912, concluded that the functions of the frontal lobes were practically unknown. Feuchtwanger,[19] in his recent monograph, did not find any evidence to support the theory that the higher psychic functions were localized in the frontal lobes, although he believed that this region might be concerned with active memory, volition and feeling tone. Donath [20] and Moersch [21] were of the opinion that psychic functions are largely dependent on integrity of the frontal lobe. Reports of Nuñez [22] and Zeigelroth [23] indicated similar views, while Nonne [24] commented on the absence of mental disturbance in a neoplasm of the frontal lobe of apparently long duration.

Modern textbooks generally teach that the frontal lobes are intimately concerned with the psychic functions, and many state that the early appearance and marked degree of mental disturbance is a characteristic sign of tumors of the frontal lobe. Kennedy [25] called attention to the development of retrobulbar neuritis on the side of the tumor, with concomitant choked disk on the opposite side as a characteristic sign of frequent occurrence. Newmark [17] considered unilateral disturbance or loss of sense of smell and visual acuity as important diagnostic signs, while Gaspero,[18] Oppenheim and others considered moria (joking) as of

12. Bianchi, L.: Mechanism of the Brain and Function of the Frontal Lobes, Edinburgh, E. & S. Livingstone, 1922.
13. Ruckert, A.: Eine Stirnhirntumorcyst, Berl. klin. Wchnschr. **27**:1298, 1909.
14. Pfeifer, B.: Psychische Störungen bei Hirntumoren, Arch. f. Psychiat. **47**:558, 1910.
15. Serog, M.: Allg. Ztschr. f. Psychiat. **68**:583, 1911.
16. Petrina: Prag. med. Wchnschr. **18**:217, 1912.
17. Newmark, L.: California State J. Med. **9**:11, 1913.
18. Gaspero, H.: Mitth. d. Ver. Aerzte in Steiermark **50**:217, 1913.
19. Feuchtwanger, E.: Monographien a. d. Gesamtgebieted Neurologie u. Psychiat., Berlin, Julius Springer, 1923, vol. 38.
20. Donath, J.: J. Nerv. & Ment. Dis. **61**:113 (Feb.) 1925.
21. Moersch, F.: Am. J. Psychiat. **4**:705 (April) 1925.
22. Nuñez, P.: Encéphale, **21**:37 (Jan.) 1926.
23. Zeigelroth, L.: Arch. f. Psychiat. **77**:829, 1926.
24. Nonne, M.: Med. Klin. **23**:1 (Jan. 7) 1927.
25. Kennedy, Foster: Am. J. M. Sc. **142**:355, 1911.

definite significance. Bruns,[26] Oppenheim,[27] Tilney,[28] Gordon [29] and others reported cases of tumors of the frontal lobe in which ataxia was so marked as to resemble cerebellar lesions, and Bostroem [30] commented on the development of ataxia of the trunk and fixed attitudes. Lechelle [31] reported two cases in which somnolence formed the early and predominant symptom, and Nuñez [22] noted deviation of the eyes to the side of the lesion, or paralysis of movements of the head and feet to the side opposite to the lesion. He also considered unilateral loss of smell and unilateral choked disk as important signs. Nonne [24] called attention to the value of x-ray studies and ventriculography, while Schuster,[32] Stiefler,[33] Adie and Critchley [34] and others added forced grasping and groping to the signs of involvement of the frontal lobe. The most recent publications on the subject, especially in regard to the rôle of the psychic states, continue to show wide divergence of opinion. Pussepp [35] considered that psychic disorders were the most striking features in the symptomatology of tumors of the frontal lobe. In Sachs' experience, rather vague but appreciable change in personality formed the most constant and significant indication of involvement of the frontal lobe.[36] Ikutaro,[37] on the other hand, stated that psychic manifestations were not an important factor in his series of cases, and he considered that whatever mental symptoms did occur could be explained on the basis of increased intracranial pressure.

SYMPTOMATOLOGY

The search for signs common to and suggestive of involvement of the frontal lobe led to a statistical study of the subjective and objective symptoms observed from the onset of the illness to the time of admission to the hospital. The observations are summarized in table 1.

Incidence.—In this group of twenty-two cases, fifteen of the patients were male and seven were female; however, the number is too small to lend any significance to this unequal ratio. In age the patients varied from 7 to 62 years, but the young and the aged seemed relatively immune in comparison to the middle-aged.

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26. Bruns, L.: Deutsche med. Wchnschr. **18**:138, 1892.
27. Oppenheim, H.: Arch. f. Psychiat. **21**:22, 1889-1890.
28. Tilney, F.: J. Nerv. & Ment. Dis., October, 1916.
29. Gordon, A.: J. Nerv. & Ment. Dis. **47**:261, 1917.
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31. Lechelle, Alajouanine and Thevenard: Bull. et mém. Soc. méd. d. hôp. de Paris **49**:1347 (Oct.) 1925.
32. Schuster, Ztschr. f. d. ges. Neurol. u. Psychiat. **83**:586, 1923.
33. Stiefler, G.: Deutsche Ztschr. f. Nervenh. **89**:161, 1926.
34. Adie, W., and Critchley, M.: Brain **50**:142, 1927.
35. Pussepp, L.: Folia Neuropathologia Estoniana **6**:150, 1926.
36. Sachs, E.: Brain **50**:474, 1927.
37. Ikutaro, T.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **29**:280, 1927.

Onset and Progression.—The onset of illness in many instances was abrupt, and the course rapid and severe.

CASE 7.—A woman, aged 31, who was admitted to the hospital in March, 1923, had been well until one month prior to that time, when severe headaches and projectile vomiting suddenly developed; these were soon followed by rapid failure of vision in the right eye. Two months after the onset of symptoms a large endothelioma, 10 by 6 by 5 cm., was removed (fig. 1). The tumor originated from the anterior extremity of the falx and extended backward, displacing both frontal lobes but involving the right to a greater degree than the left.

CASE 20.—A man, aged 29, admitted to the hospital in January, 1927, had been well until two months before admission, when severe headaches and vomiting appeared. At the time of admission, he was able to give a good account of his illness, he appreciated his condition, and his mental responses, while slow, were

TABLE 1.—*Symptomatology of Tumors of the Frontal Lobe as Noted Prior to Hospitalization*

Age, Years	No. of Cases
1 to 10	1
11 to 20	1
21 to 30	4
31 to 40	9
41 to 50	5
51 to 60	2

Duration	No. of Cases
1 to 3 months	5
3 to 6 months	3
6 to 12 months	5
1 to 4 years	7
4 to 6 years	2

Initial Symptom	No. of Cases
Headache and vomiting	7
Headache alone	4
Convulsions	4
Headache and failing vision	3
Failing vision	2
General fatigue	2
Lump on forehead	1

Headache	No. of Cases
Present	21
General	11
Localized	11
Localized at site of lesion	2
Absent	1

Vomiting	No. of Cases
Present	13
Severe	4
Absent	9

Vision	No. of Cases
Failing	17
Bilateral	12
Unilateral	5
No disturbance	5

Convulsions	No. of Cases
Present	9
Generalized	6
Jacksonian	3
Absent	13

Weakness	No. of Cases
Localized	5
General	4
Absent	13

Aphasia	No. of Cases
Transitory	9
Absent	13

Mental State	No. of Cases
Marked disturbance, early	2
Moderate disturbance, early	3
Slight disturbance, early	3
Slight disturbance, late	6
No disturbance	8

accurate. During the ten day period that preceded his death, definite mental symptoms appeared; he became irritable, confused and forgetful, and expressed and reacted to hallucinations and delusions of persecution. Necropsy revealed a large glioma of the right frontal lobe, with slight involvement of the left lobe and corpus callosum (fig. 2).

The time that elapsed between the onset of illness and admission to the hospital was less than three months in five cases, less than six in eight and less than a year in thirteen. In other instances the onset was insidious and the progression slow.

CASE 15.—A man, aged 46, admitted to the hospital in May, 1926, first noted headaches and impaired vision in 1924. The headaches persisted; the following year he grew weak, and later he became drowsy, forgetful and slow in action. When admitted to the hospital he was disoriented, apathetic and confused. Necropsy, two weeks later, revealed a large glioma of the left frontal lobe (fig. 3).

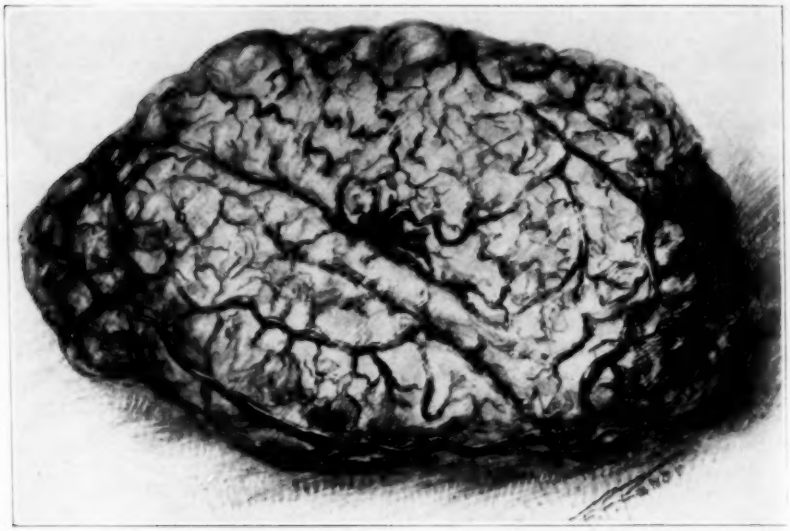

Fig. 1.—Endothelioma, 10 by 6 by 5 cm., weighing 190 Gm., which originated from the falx and displaced both frontal lobes, the right more than the left. The symptoms were entirely of pressure nature (headache, vomiting and failing vision in the right eye), and appeared only two months prior to operation. Examination revealed: bilateral impairment of smell; vision of right eye, finger perception at 6 inches (15 cm.); of left eye, 6/36; papilledema, 4.5 diopters on the right and 2.5 on the left. The mental state was considered normal.

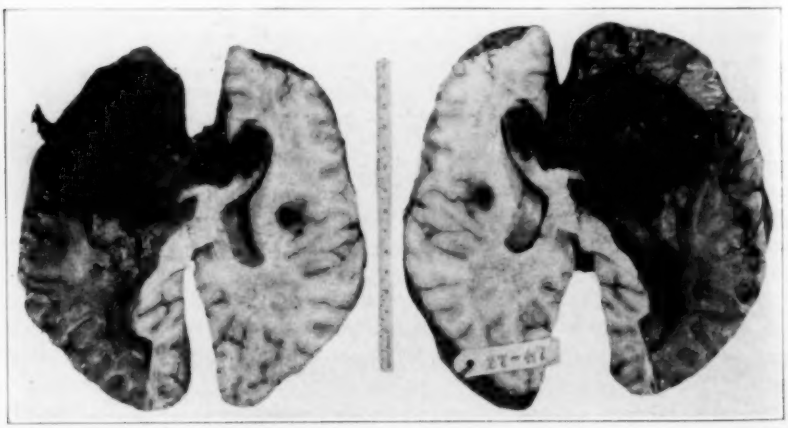

Fig. 2.—Glioma. The patient was well until two months before death. The initial symptoms were of pressure nature (headache and vomiting). Mental changes (irritability and difficulty in thinking) were first noted three weeks prior to death and rapidly progressed to a definite psychic disturbance.

In seven cases, the history of illness extended over periods of from one to four years, while in two instances the symptoms dated back from four to six years.

Headache.—Headache was the first indication of illness in fourteen patients and only one person remained entirely free from this symptom. The pain in the head was fairly well localized in eleven patients, but in only two instances did

Fig. 3.—Glioma of left frontal lobe. Pressure symptoms appeared two years prior to hospitalization; mental changes were noted one year later. At the time of admission to the hospital, the mental symptoms were definite, but the neurologic signs were bilateral, and ventriculography was of great value in localizing the lesion. Ventriculograms are shown in figure 5.

the localization correspond to the site of the lesion. In the other ten patients, the headache was general. Vomiting, which accompanied attacks of headache, occurred in thirteen patients, but in only four was it persistent and severe; it was entirely absent in nine.

Visual Disturbance.—Failing vision was the complaint that followed headache in frequency, being encountered in seventeen of the twenty-two histories. Five patients gave a definite history of marked visual failure in one eye, before impairment of the other eye was noted. Five patients failed to note any change of visual acuity.

Convulsions.—Convulsions were not uncommon, being prominent symptoms in the histories of nine patients. The seizures were general in nature in six cases and formed the initial or an early symptom in four instances. Two of these patients were treated for some time as patients with idiopathic epilepsy. Jacksonian convulsions were late developments in three cases. Generalized weakness was noted in four patients, while in five a slowly progressive monoparesis or hemiparesis was observed. Several of the patients were described as clumsy, but whether this akwardness was the result of weakness or a manifestation of ataxia could not be determined.

Disturbance of Speech.—The development of aphasic symptoms was also difficult to determine, but this apparently occurred in nine patients who were said to have had difficulty in expressing themselves, or used words incorrectly. In most instances the disorder of speech was a transient disturbance.

Mental Signs.—Accurate determination of the mental state of the patients during the period preceding hospitalization is impossible, as the discriminative ability of the patients' associates was a most variable factor, and subtle changes may have developed unobserved. In eight histories it was stated that the informants considered that the mental ability and personality of the sufferers had not undergone any change. A slight degree of mental impairment, indicated by mild confusion and slowness in thinking, appeared just prior to admission in six patients. From mild to moderate psychic changes were recognized early in the illness in six patients, but in only two instances did marked mental decline and personality change constitute early and prominent symptoms.

Comment.—The onset and progression of symptoms in tumors of the frontal lobe show nothing characteristic, the usual picture being that of general pressure. Unilateral failure of vision is suggestive, other cases of retrobulbar neuritis being excluded, as is also the development of mental symptoms, but it would seem that mental disturbance, sufficient in degree to be appreciated by a layman, is not of common or early occurrence.

NEUROLOGIC SIGNS

Examination at the time of admission to the hospital and at various intervals during residence in the hospital resulted in the following observations:

Disturbance of Smell.—Anosmia, bilateral, was found in four patients, while six showed a bilateral impairment of this sense. Not in any case could a unilateral loss of smell be determined; only two patients showed a unilateral impairment. Smell was bilaterally acute in nine cases. In the cases in which this sense was designated as impaired, the ability to detect odors remained, but the acuity and discriminative ability were definitely dulled.

Vision.—One patient was completely blind. Bilateral and equal impairment of vision was found in ten patients, while eight showed bilateral but unequal impairment. In five of these patients, the visual loss was chiefly on one side. The lesions

in all the cases were basal endotheliomas, and in each instance the lesion was on the same side as the eye most severely affected, or in midline lesions in which both lobes were displaced the side of greatest involvement corresponded to the side of poorest vision. In cases in which the difference in visual acuity was only slight, this relationship was not found. Three such instances were noted, and in these the lesion was on the side of poorest vision once, and on the opposite side twice.

Papilledema.—Choked disk was reported in seventeen of twenty patients, and the degree of the swelling varied from 2 to 6 diopters. In ten patients, the papilledema was equal on the two sides, while in seven the swelling was greater on one side than on the other. A consistent relationship did not exist between the side of the lesion and the side of greatest swelling. In four instances, the lesion was found on the same side, and in three cases it was found on the opposite side. This would seem to support Parker's conclusion [38] that the difference in the degree

TABLE 2.—*Neurologic Signs in Tumors of the Frontal Lobe*

Smell	No. of Cases
Bilateral loss	4
Bilateral impairment	6
Unilateral impairment	2
No disturbance	9

Vision	No. of Cases
Blind, bilateral	1
Impaired, bilateral	18
Impaired, equal	10
Impaired, unequal	8
No disturbance	2

Papilledema	No. of Cases
Present	17
Bilateral, equal	10
Bilateral, equal	7
Highest on tumor side	4
Lowest on tumor side	3
No swelling	3

Visual Fields	No. of Cases
Concentric contraction	7
Fields full	3

Exophthalmos	No. of Cases
Present	8
Unilateral on side of lesion	6
Bilateral, slight and equal	2

Motor Weakness	No. of Cases
Facial, unilateral	10
Extremity, unilateral	8
General	3
Absent	11

Coordination	No. of Cases
Ataxia, slight and on weak side	5
Ataxia, slight and general	2
Tremor, bilateral	2
Tremor, on tumor side	2
Tremor, on opposite side	1

Disturbance of Speech	No. of Cases
Present, variable	6
No disturbance	16

of choked disk is dependent on the variation of the intra-ocular pressure, and indicates that this observation is not of any value in determining the side of the lesion.

It is of interest to note that the phenomenon of homolateral primary optic atrophy with concomitant papilledema on the contralateral side was not reported. This condition, described by Gowers and Kennedy, might be expected in cases of basal lesions, yet in the five basal endotheliomas included in this group the papilledema was bilateral, and in four instances the degree of swelling was greater on the homolateral than on the contralateral side. In case 7, previously referred to, the patient developed headaches, vomiting and rapidly failing vision in one eye one month before admission to the hospital. Examination revealed a swelling of 4.5 diopters in the right eye, and vision reduced to finger perception at 6 inches (15 cm.), with a swelling of 2.5 diopters and 6/36 vision in the left eye. The tumor was almost entirely on the right side. A determination of the visual field could not be made in many patients, but the usual observation was a concentric contraction of various degrees.

38. Parker, W. R.: Mechanism of Papilledema, Arch. Neurol. & Psychiat. **14**:31 (July) 1925.

Exophthalmos.—In eight of the twenty-two patients, exophthalmos was noted: slight in all instances, unilateral in six and bilateral in two. In every case of unilateral exophthalmos, the protruded eye corresponded to the side of the lesion. This is in accordance with the observation of Flateau,[39] Rosenblath[40] and Weisenburg[41] that in cases of tumor of the brain with unilateral exophthalmos the lesion is on the side of the affected eye, or in cases of bilateral but unequal exophthalmos the lesion is on the side of greatest protrusion.

Motor Disturbance.—Motor involvement was in every instance a late development; the degree of weakness was slight, and in several patients it occurred while they were under observation in the hospital. In such cases this development proved of greatest value, as illustrated by the following case:

Case 17.—A man, aged 27, entered the hospital in November, 1926, because of headaches and failing vision. He had felt well until two months previously, when occipital headaches developed and increased in severity, and vision began to fail. Mental changes had not been observed by his associates, and on admission to the hospital he was alert, emotionally stable and cooperative, and intellectual powers, memory and judgment were well within normal limits. Focal signs were not found. Smell was bilaterally acute; vision was 6/15 in the right eye and 6/22 in the left eye; the visual fields were concentrically contracted, and both disks were swollen 6 diopters. The spinal fluid pressure was 32 mm. of mercury; serologic tests and x-ray studies of the skull gave negative results. Two weeks later, a slight weakness and incoordination of the left upper extremity developed, and at operation an endothelioma, 5 by 5 by 4.5 cm., was found displacing the right frontal lobe and encroaching on the motor cortex. The sudden onset, rapid failure of vision and high degree of papilledema, in the absence of focal signs, at first cast suspicion on a lesion producing internal hydrocephalus, and only the appearance of the motor weakness gave a clue to the localization of the neoplasm.

Lower facial weakness was found in ten patients, while a monoparesis or a hemiparesis, with corresponding reflex changes, was demonstrable in eight. The tendon reflexes were bilaterally increased in six instances, probably as the result of basal pressure.

Disturbance of Coordination.—The consideration of ataxia in connection with tumors of the frontal lobe is of particular interest because of the frequency with which cerebellar symptoms have been reported in cases of involvement of the frontal lobe. These symptoms are considered due to functional disturbance of the frontopontocerebellar tract, a function that is not yet clearly understood. Incoordination, usually slight in degree, was noted in only seven patients of this group. The disturbance was limited to the paretic side in five instances, and in two cases it was general. A slight tremor was evident during the examinations of five patients, bilateral in two, limited to the same side as the lesion in two and limited to the opposite side in one. A definite relationship could not be found between these disturbances of coordination and the size, location and type of tumor.

Vestibular Reactions.—Vestibular examinations were made in seven cases, and the reactions in all instances indicated an increase of intracranial pressure and cortical irritability. The usual interpretation was that of a lesion in the region

39. Flateau, G.: Deutsches Arch. f. klin. Med. **77**:433, 1902.

40. Rosenblath: Deutsche Ztschr. f. Nervenh. **21**:335, 1906.

41. Weisenburg, T. H.: Exophthalmos in Brain Tumor, J. A. M. A. **55**:1957 (Dec. 3) 1910.

of the brain stem, and the posterior fossa was correctly excluded in all cases. However, involvement of the frontal lobe was not determined, and the brain stem interpretation at times complicated the diagnosis by lending support to other evidence suggestive of pituitary involvement.

LABORATORY AND DIAGNOSTIC MEASURES

Spinal Fluid.—The intracranial tension, estimated by the pressure of the spinal fluid, showed wide variation. The highest pressure recorded was 50 mm. of mercury, while pressures between 30 and 40 mm. were found in eleven patients. Five showed pressures from 20 to 30 mm., and the tension in five others was below 12 mm. The degree of papilledema was roughly proportional to the height of the pressure of the spinal fluid except in cases of subsiding choked disk with atrophy.

Metabolic Rate.—Basal metabolism tests were made on eight patients; two showed increased rates, + 6 and + 26, while six gave subnormal rates of from — 8 to — 34. Guillain, Leroche and Alajouanine[42] found the basal metabolism consistently reduced in cases of tumor of the brain, and considered this the effect of abnormal intracranial pressure on the general nutrition by way of the central nervous system. The metabolic rate apparently does not give any clue as to the location of the lesion, and in cases in which the pituitary region is suggested it may be misleading, as a lowered rate is usually interpreted as suggestive of pituitary involvement.

X-Ray Examination.—X-ray pictures of the skull showed a diagnostic and localizing area of bone thickening in two cases of endothelioma and in a third case a localizing atrophy of the lesser wing of the sphenoid. Atrophy of the dorsum sellae was seen in four cases, and the pituitary fossa was slightly enlarged in three. A child, aged 9, showed general convolutional atrophy. X-ray studies in ten cases gave normal results.

Ventricular Estimation and Ventriculography.—Ventricular studies proved of utmost value in those cases in which there was a question as to the actual existence of a lesion or doubt as to the laterality of the neoplasm. In two cases, the affected side was correctly determined by means of ventricular estimation, and the worth of this procedure has recently been emphasized by Grant.[43] Ventriculography proved of even greater diagnostic importance, localizing the lesion beyond a doubt as the following examples illustrated. In case 13, the patient had complained of headaches and slowly failing vision for a long period. Focal signs were absent, but the history of the recent development of transitory disturbance of speech and occasional "shaking attacks" of the right arm and leg suggested a left-sided lesion. Ventriculograms showed both ventricles displaced to the left, the right smaller than the left, diagnostic of a right-sided lesion, in this instance a gliomatous cyst (fig. 4). Again, in case 6, pain in the right eye was the only focal symptom. Headaches and vomiting were severe; the pressure of the spinal fluid was 40 mm. of mercury; smell was bilaterally acute; mental changes had not been noted, and sensory or motor disturbances could not be determined. Ventriculograms in this case showed displacement of both ventricles to the left, with deformity of the right ventricle, diagnostic of a lesion of the right frontal lobe.

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42. Guillain, Leroche and Alajouanine: Compt rend. Soc. de biol. **92**:574 (March) 1925.

43. Grant, F.: Tr. Phila. Neurol. Soc., Arch. Neurol. & Psychiat. **19**:192 (Jan.) 1928.

In case 15, all neurologic signs were bilateral, but the ventriculogram clearly showed the side primarily involved (fig. 5).

Comment.—This survey shows that the neurologic signs produced by tumors of the frontal lobe are the result of: (*a*) local pressure on adjacent structures, and (*b*) general increase of intracranial pressure. Of these signs, only the former are of diagnostic value. Disturbance of the sense of smell, failure of vision, especially unilateral or predominantly on one side, unilateral exophthalmos, the gradual development of a central type of motor weakness and aphasic disturbances are the most

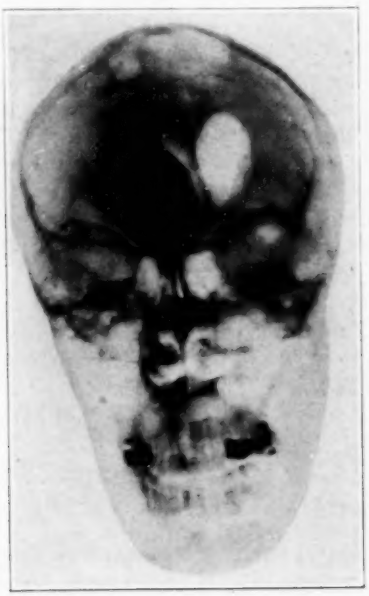

Fig. 4.—Ventricular deformity and displacement produced by a gliomatous cyst in the right frontal lobe. Pressure symptoms (headache and failing vision) had been present for four years. Dulness and transient disturbance of speech developed during the year preceding admission. Focal signs were absent, but a lesion of the left frontal lobe was suggested. The ventriculogram definitely localized the lesion.

constant and important symptoms. Disturbances of coordination were encountered so infrequently and were so vague that they seemed of questionable value. Neither deviation of the eyes nor forced grasping and groping were observed in any of the patients. While the forced grasping was not specifically sought in many of the patients, the stimulation used in the frequent sensory tests should have produced such a response, if obtainable, and in the few I examined evidence of such reaction was not elicited. When found, the occurrence of unilateral optic

atrophy with concomitant papilledema of the opposite disk is undoubtedly of great diagnostic value, but this condition was not reported in any of these cases, and the frequency of such development, as an early sign, is made questionable when it is realized that 37 per cent of the patients were examined at intervals of from one to six months after the onset of illness, and 60 per cent of them were seen within a year. Somnolence, while of frequent occurrence, was in every instance a late development, apparently dependent on the increased intracranial pressure. This subject was recently studied by McKendree and Feinier,[44] and their conclusion that somnolence is not of localizing value in cases of tumor of the brain is in accord with the results in this series.

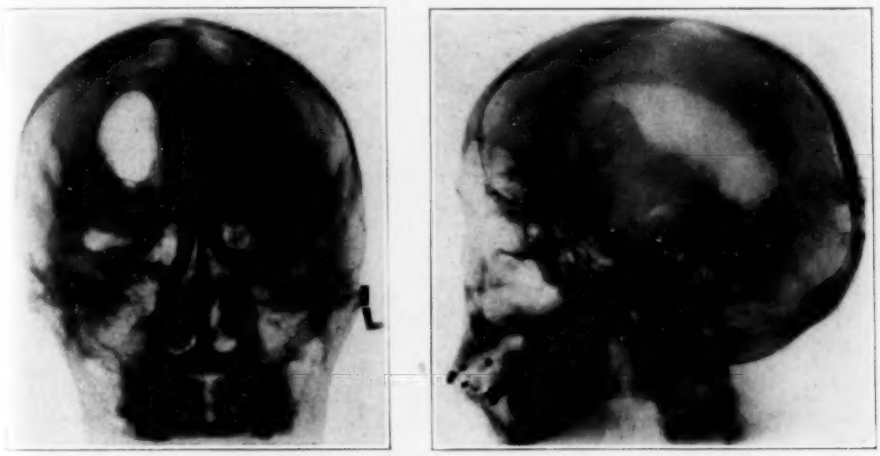

Fig. 5.—Bilateral and equal disturbance of smell and vision were the only focal signs in this case, and the laterality of the lesion was in doubt. The ventriculogram clearly showed the side involved (fig. 3).

MENTAL SYMPTOMS

Gradual change in personality, failing interest, dulling of affect, defects of memory, attention and concentration, impaired judgment and blunting of social and moral sense may be said to constitute the psychic disturbances considered by many as a characteristic frontal lobe syndrome. Psychic disturbance that developed early and progressed rapidly to this state occurred in only two patients. Early and definite, but more moderate, mental symptoms were noted in three patients, and in the late stage of illness these persons were disoriented, showed gross judgment defects, and were emotionally unstable or apathetic. In five cases, mild

44. McKendree, C., and Feinier, L.: Somnolence; Its Occurrence and Significance in Cerebral Neoplasms, Arch. Neurol. & Psychiat. **17**:44 (Jan.) 1927.

but appreciable psychic changes were observed early in the illness, and in these the course of the mental disturbance was slowly progressive. Mental symptoms of a mild nature developed late, just prior to admission to the hospital in six patients, while six were considered free from psychic disturbance both prior to and during residence in the hospital.

It is probable that every tumor of the brain exerts some influence on the psychic qualities of the patient, although the change may be so slight as to go unrecognized. It is also probable that the nature of the mental reaction is a reflection of the psychic stability of the patient and is dependent on the personality make-up rather than on the degree of involvement of a certain area of the brain. This view is supported by the fact that in every instance symptoms of a pressure nature preceded any psychic disturbance, yet the neoplasm in this area must have attained fair size to have produced the increased pressure. The rapid relief of mental symptoms, so frequently observed following the drainage of a gliomatous cyst, also suggests that this in such cases is a purely mechanical effect and that the brain tissue involved remains functionless. Again, if the psychic manifestations were primarily dependent on the location and extent of involvement of the brain, it would be expected that tumors in the same location, of the same type and of approximately the same size and duration of symptoms would produce similar psychic disturbances. That this is not the case is clearly shown by the following examples:

Case 4.—A man, aged 43, was in the hospital on several occasions during 1922 and 1923. He had been a cashier in a bank and an average husband and citizen previous to the illness. A few months prior to his first admission to the hospital, headaches, blurring of vision and irritability were noted; confusion soon developed and progressed to such degree that he had to give up work. During the course of a year, a marked change in personality occurred; paranoid trends developed; he grew profane, emotional and mentally dull; he showed poor judgment; social sense deteriorated, and he became most careless of appearance and manners. The mental picture was so suggestive of paresis that antisyphilitic treatment was given for a time in spite of negative reaction in the serologic tests. Operation, and later necropsy, showed a large cystic glioma of the right frontal lobe.

Case 9.—A man, aged 31, admitted to the hospital in April, 1923, had been well until four years previously, when the development of pain and failing vision in the left eye was soon followed by general convulsions. A Wassermann test of the blood gave a positive reaction at that time; a syphilitic etiology was assumed, and he was treated for syphilis and epilepsy. During the four-year period, change in mental ability or personality had not been noted; he had continued at work, and at the time of admission to the hospital he was fully oriented, alert, cooperative, neat and emotionally stable. Operation revealed a large glioma of the left frontal lobe.

Case 11.—A man, aged 35, admitted to the hospital in April, 1925, was reported to have had good habits and business ability. The illness, of three years' duration, began with general convulsions, which were followed by failing vision in the left

eye; he was treated for epilepsy. A marked change in personality gradually developed; he became fault-finding, turned against members of his family and showed emotional instability, memory defects, poor business judgment and deterioration of moral standards. When seen in the hospital, he was irritable, childish in his reactions, unable to appreciate his condition, confused and blunted. Operation disclosed a large midline endothelioma, originating from the falx and involving the left lobe to a greater extent than the right. The tumor, 5.5 by 5 by 4.5 cm., is shown in figure 6.

Fig. 6.—Endothelioma, 5.5 by 5 by 4.5 cm., originated from the anterior portion of the falx and displacing the left frontal lobe, and, to a slighter degree the right. Illness, of three years' duration, began with generalized convulsions and failing vision in the left eye. Mental symptoms appeared early and resulted in a definite change in personality. Examination revealed bilateral anosmia; bilateral choked disk, greatest in the left eye; only light perception in the left eye, and vision impaired in the right eye.

This history should be compared with that in case 12.

Case 12.—A man, aged 42, admitted to the hospital in June, 1925, had been well until one year prior to that time when blurring of vision, especially in the

right eye, was noted. This was the only symptom, aside from headache, and it progressed to almost blindness. Change in personality, of moral standards or mental acuity had not been observed, and on admission to the hospital the patient was alert, fully oriented and emotionally stable; he did not show any defects of memory and his judgment seemed well within normal limits. Operation in this instance also revealed a large midline endothelioma, 6.5 by 6.5 by 5 cm., originating from the falx and displacing chiefly the right lobe.

If psychic disturbance is the result of functional impairment of a definite area of the brain, it is extremely difficult to account for the marked variation in the

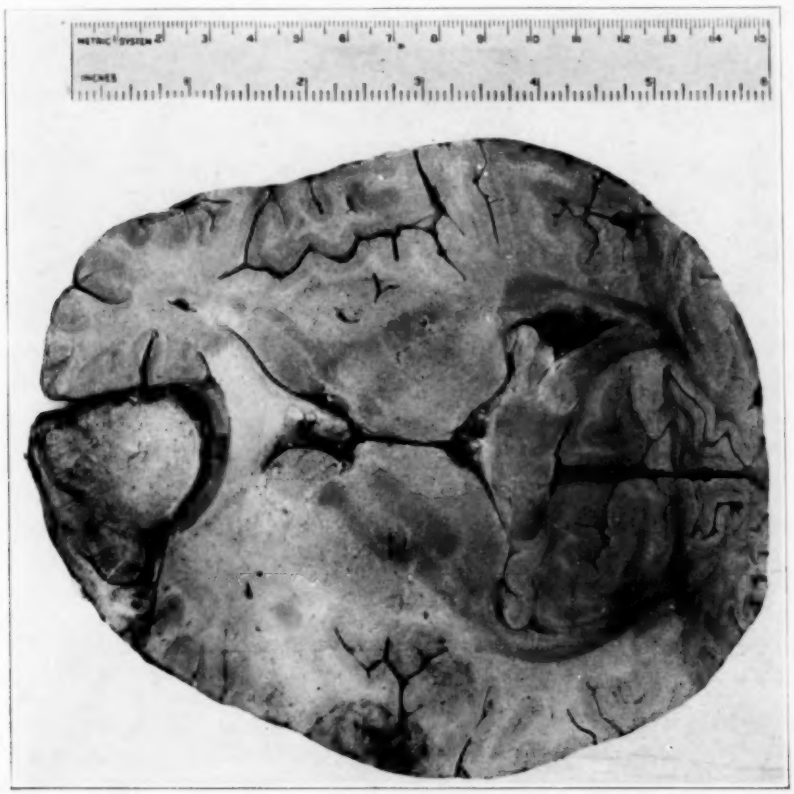

Fig. 7.—The illness began with headaches and occasional vomiting one year before admission. Two months before admission, vision began to fail rapidly, especially in the right eye. The mental state was considered normal. Polyuria, polydipsia, enlarged sella and a basal metabolic rate of —27 led to a diagnosis of a pituitary lesion. The tumor was an endothelioma.

symptomatology produced by these tumors, so similar in type location, size and duration.

A characteristic type of mental symptoms was not found in this series. Jocosity, stressed by many writers, was neither a common nor a prominent manifestation, and it was noted in only four cases. In none

of these was it as marked as that recently observed in a patient with a tumor of the parietotemporal lobe. Another patient, with a glioma of the cerebral peduncle, had a history of change in personality, mental decline and moral deterioration even more striking than those of the patients in cases 4 and 11. A third patient, in whom a small tumor of the anterior portion of the third ventricle occluded both foramina of Monroe, producing an internal hydrocephalus and pressure phenomena, showed rapid intellectual decline, confusion, defects in memory, difficulty in expression and periods of apathy—in short, the entire mental syndrome usually attributed to the frontal lobes.

It would seem, from this study, that psychic disturbance is not by any means diagnostic of involvement of the frontal lobe, nor is the early appearance and marked degree of mental change a characteristic symptom of tumors of the frontal lobes, and the absence of such history or observations should not weigh too heavily in the diagnostic exclusion of a neoplasm of the frontal lobe.

COMMENT

The nature of the onset of symptoms, in many of the patients, is a matter of interest. A neoplasm growing in the anterior portion of the cranium would be expected to produce at first mild, and then slowly increasing, signs of intracranial pressure. In nearly 25 per cent of the patients, the symptoms appeared with startling suddenness and severity. Such a history, together with the prominent degree of papilledema that was usually found, suggests a lesion in the posterior fossa or a supratentorial lesion in the vicinity of the ventricular system which produced an internal hydrocephalus.

What is the mechanism by which such a sudden manifestation of symptoms is produced? Some of the tumors in these cases were gliomas, about which any assumption concerning the rate of growth would be hazardous, but a greater number were endotheliomas, a type of relatively slow growth. In case 7, in which a large endothelioma, 10 by 6 by 5 cm., was removed, the symptoms had appeared suddenly, only two months before operation. This case and similar cases indicate that the sudden onset of severe symptoms is not always the result of a rapidly growing tumor. A possible explanation is that a neoplasm in the frontal area, not causing any interference with the ventricular fluid passageways, may develop to considerable size without producing appreciable alteration of the intracranial pressure, because of the compensatory activity of the mechanism of spinal fluid absorption. Such a mechanism can be maintained only so long as the fluid pathways to the pacchionian bodies remain open, and Fay [45] recently indicated that these lie chiefly over the frontal

45. Fay, T.: Proc. Phila. Psychiat. Soc. Am. J. Psychiat., in press.

cortex. A slowly growing tumor, then, may not produce any disturbance of the pressure until it has reached such dimensions that, either by direct pressure, or indirectly through the outward displacement of brain tissue, sudden partial or complete obliteration of the narrow subarachnoid channels is produced, and the rapid rise of intracranial pressure results in the abrupt onset of symptoms.

Are the higher psychic functions localized in the frontal or, more specifically, in the prefrontal lobes? This subject has been only briefly considered and the results submitted cannot be regarded as conclusive. It is also questionable whether cases of tumors are suitable for a study of the pathologic physiology of the frontal lobes, as neoplasms not only cause a local disturbance of function but, by the indirect production of pressure, probably alter the functional capacity of remote portions of the cerebrum; Weisenburg [46] recently stated that "intelligence is the result of activity of the entire brain." While the evidence gathered from this study cannot be said to disprove the theory of localization of the higher psychic functions in the frontal lobes it certainly lends but little support to such a theory. On the contrary, the extreme differences in the clinical pictures produced by similar lesions, the recognition of the influence of relief of pressure on psychic disturbance and the appreciation of the mental symptoms produced by neoplasms in other portions of the brain make the acceptance of such a theory most difficult.

The consideration of neurosyphilis in relation to the symptoms of tumor of the brain is also of interest. It is noteworthy that neither the Wassermann nor the colloidal gold reactions of the spinal fluid, in any of these cases, gave any indication of neurosyphilis. In spite of this, several patients whose blood had also given negative reactions had been subjected to antisyphilitic treatment for an extended period, because of mental symptoms. One man, who had complained of unilateral failing vision, was found to have a high degree of papilledema. The Wassermann reaction in his blood was positive, and he was kept on antisyphilitic treatment, presumably on the assumption of a syphilitic etiology for the visual disturbance and choked disk, despite the fact that treatment failed to give beneficial results, and the visual disturbance progressed to complete blindness. Early and careful testing of the sense of smell would probably have given a valuable clue as to the nature and location of the lesion long before vision had been irreparably damaged. The serologic observations in this group indicate that much reliance may be placed on the Wassermann reaction in the spinal fluid in the exclusion of neurosyphilis. Other illnesses did not greatly complicate the picture. Rapid and unilateral failure of vision appeared in one patient during the course

46. Weisenburg, T. H.: Are the Higher Psychic Functions Localized in the Frontal Lobes? Arch. Neurol. & Psychiat. **18**:640 (Feb.) 1927.

of a severe attack of influenza and was considered due to retrobulbar neuritis, secondary to disease of the sinuses. Here, again, early testing of the olfactory sense would undoubtedly have shown a disturbance of smell.

All the patients presenting a marked degree of visual disturbance, either unilateral or bilateral, showed a corresponding disturbance of the sense of smell, which indicates that the olfactory bulbs are as susceptible to injury by pressure as are the optic nerves. Of the five patients in whom there was definite history of unilateral failure of vision, all showed, on examination, bilateral impairment or loss of smell. This observation was recently stressed by Cushing [47] in his Macewen lecture, in which the meningiomas of the olfactory groove were excellently discussed, and to which the following progression of symptoms is attributed: (1) unilateral loss of smell; (2) homolateral failure of vision due to direct pressure atrophy; (3) complete anosmia, by involvement of the opposite olfactory bulb, due to the growth of the tumor; (4) increased intracranial pressure from the same cause, with consequent papilledema of the opposite optic nerve; (5) mental symptoms due to compression and deformity of the frontal lobes. When the neoplasm originates from the region of the ethmoidal plate, and growth is primarily backward, such a succession is undoubtedly produced, but it would seem that many basal endotheliomas take origin from the anterior portion of the falx and grow upward almost as rapidly as backward. In such instances, and five such cases were found in this series, the neoplasm has attained such size by the time that direct pressure is exerted on the optic nerve that pressure symptoms precede or accompany the visual disturbance, and a bilateral papilledema is produced.

SUMMARY

A study of the development of illness revealed that in every case the first symptoms were those resulting from increased intracranial pressure (headache, vomiting and failing vision). Of the developmental symptoms, psychic disturbances (noted in eight patients) and unilateral failure of vision (present in five patients) seemed most suggestive of involvement of the frontal lobe. In many instances the onset was most abrupt and the progression rapid. This was true of the endothelial lesions as well as of the gliomas and, in cases of endotheliomas, it was considered as evidence that tumors in the frontal region could attain remarkable size without producing appreciable symptoms until after the intracranial tension had been definitely disturbed.

An analysis of the neurologic signs presented during the course of residence at the hospital showed disturbance of smell, impairment of

47. Cushing, H.: Macewen Lecture, 1927, Glasgow, Jackson, Wylie & Co.

vision, unilateral exophthalmos and central type of motor weakness to be the most constant and significant symptoms. The disturbance of smell was usually bilateral, as was also the visual impairment, except in cases of basal endotheliomas in which the visual disturbance was largely unilateral. Visual fields, when altered, showed concentric contraction. Papilledema, nearly always present, varied from 2 to 6 diopters; when it was unequal in degree, relationship to the side of the lesion could not be established. In not a single instance was the phenomenon of homolateral primary optic atrophy with concomitant contralateral papilledema reported. Slight unilateral exophthalmos, found in six patients, corresponded in each instance to the side of the lesion. Ataxic symptoms were not constant and, when present, were more general and less prominent than those produced by cerebellar lesions. Motor weakness, in each instance a late development, was contralateral in the lower part of the face in ten patients, while a monoparesis or a hemiparesis was present in eight.

Of the special examinations, ventriculography and ventricular estimation proved of greatest value. Vestibular studies, when made, correctly excluded the posterior fossa but failed to localize the lesion. The x-ray showed localizing and diagnostic areas of changes in the bone in three cases, and was of positive value in half the cases. Basal metabolism tests usually revealed a lowered rate and were not of localizing value. Intracranial tension, determined by spinal fluid pressure, frequently ranged from 30 to 50 mm. of mercury. Serologic tests of the spinal fluid were negative for evidence of neurosyphilis in every case.

Mental symptoms had been observed fairly early in the course of the illness in eight patients but in only two was this the feature of the case. Psychic disturbance developed later, just prior to or after admission to the hospital, in eight others, while the mental state of six was considered normal throughout. The frontal lobe is considered of great importance in the maintenance of psychic normality, but it is believed that psychic disturbances depend more on the personality make-up of the person and on impairment of the functional capacity of the brain as a whole than on involvement of a given portion of the brain (frontal pole). This opinion is based on the following observations: 1. In every instance the initial symptoms noted were those of general pressure. 2. Drainage of gliomatous cysts, in several instances, was followed by a rapid disappearance of mental symptoms. 3. Lesions similar in type, size, location and duration of symptoms presented most divergent mental pictures. Other cases are briefly cited in which mental symptoms were prominent, but in which the lesions did not involve the frontal lobe. It is believed that, in cases of tumor of the brain the presence of mental symptoms is not by any means diagnostic of involvement of the frontal lobe, nor

is the absence of psychic disturbances of an appreciable nature good evidence of integrity of the frontal lobe, and that the relationship between mental symptoms and the frontal lobe has, in a diagnostic sense, been overemphasized.

CONCLUSIONS

1. Unilateral failure of vision and psychic disturbance are the developmental symptoms most suggestive of tumors of the frontal lobe. These signs are not of frequent occurrence.

2. Psychic disturbance, of an appreciable degree, may be entirely absent in neoplasms of the frontal lobe.

3. Psychic disturbances are dependent to a greater degree on the personality make-up of the person than on the size, character and location of the tumor. The mental state of the patients is an index of their psychic stability.

4. The frontal lobe is, neurologically, a silent area. The initial neurologic signs are those resulting from increased intracranial pressure and involvement of adjacent structures—motor, visual and olfactory.

5. Disturbance of smell and vision, especially when unilateral, unilateral exophthalmos, central motor weakness and aphasic disturbances are the most constant and suggestive neurologic evidence.

6. Ventriculography and ventricular estimation are diagnostic measures of great value.

THROMBOSIS OF A SUPERIOR CEREBRAL VEIN

CLINICAL AND PATHOLOGIC STUDY OF A CASE *

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Thrombosis of a superior cerebral vein without involvement of the superior longitudinal sinus rarely occurs. The syndromes presented from involvement of the rolandic vein in a previously recorded case and in my patient were so similar as to define an apparently new symptom-complex. Differential diagnosis must be made between cerebral venous thrombosis, superior longitudinal sinus thrombosis and tumor of the brain.

REPORT OF CASE

History.—L. W., a white man, aged 76, a stationary engineer, entered the Philadelphia Hospital in February, 1927, with a clinical diagnosis of right hemiplegia. The family history was essentially unimportant. He had used alcohol and tobacco moderately, had had the usual diseases of childhood, pneumonia several years before and a "poisoned foot" about three months prior to admission. Two weeks before entrance into the hospital, he awakened in the morning as usual, but found himself unable to stand. There was no history of unconsciousness or convulsions, but he did complain of feeling dull. There was no complaint before the onset of symptoms and no disturbance of sleep the previous night. After the attack, the right leg was paralyzed and the right arm was weak. It was stated that there was no facial palsy, no disturbance in speech and no loss of sphincter control. The arm gradually regained most of its strength and the leg became stronger, but he was unable to walk on it. He complained of occasional shooting pains in the right leg.

Examination.—The left pupil was larger than the right; there was a slight arcus senilis and some congestion of the conjunctivae. The tonsils were slightly enlarged and congested. The teeth were in fair condition. Hearing was moderately impaired but equal on the two sides. The heart muscle tones were poor, and the blood pressure was 92 systolic and 70 diastolic.

Neurologic Examination.—Incoordination and loss of power on the right side were obvious. There was a questionable right facial palsy of central type, with slight tremor of the tongue and hands. The biceps jerk was increased on the right and decreased on the left; the triceps was also increased on the right but was normal on the left. The knee jerk was more active on the right, but the achilles reflexes were equal. The abdominal reflex was absent on the right and

* Submitted for publication, Nov. 16, 1927.
* Read before the Philadelphia Neurological Society, October, 1927.
* Presented through the courtesy of Dr. M. A. Burns and Dr. N. W. Winkelman.

diminished on the left. The cremasteric reflex was absent on the right but normal on the left. There was no Babinski sign and no patellar or ankle clonus. There was some astereognosis in the right hand without loss of tactile, pain or temperature sensibility.

The Wassermann reaction of the blood was negative and the blood chemistry was normal. On one occasion, leukocytes and albumin were found in the urine.

Course.—The patient was improving gradually, but one and one-half months after admission he developed signs of bilateral bronchopneumonia and died three days later.

Postmortem Examination.—At autopsy, a large thrombosis of the left rolandic vein was found. All the veins of the midpart of the convex surface of

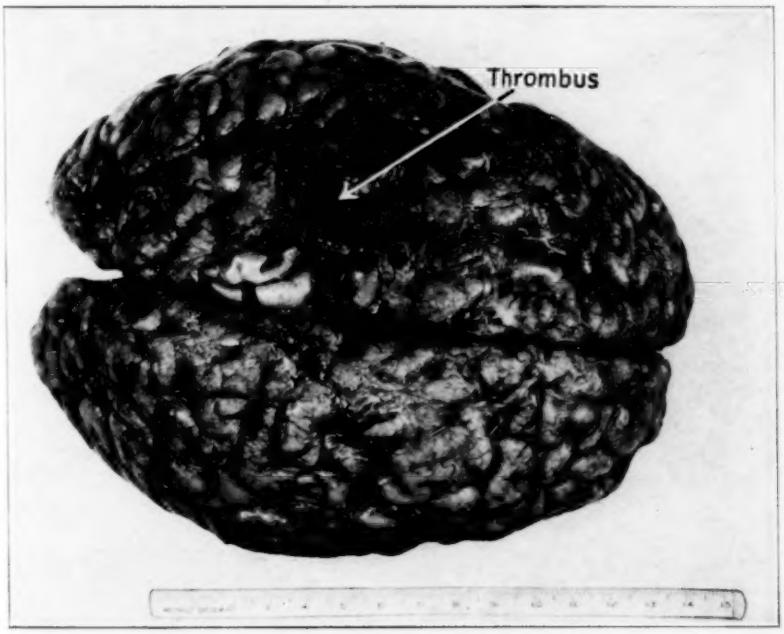

Fig. 1.—Superior surface of the brain showing the thrombus.

the left hemisphere were so dilated as to present the appearance of actual varicosities. The thrombus was about 1 cm. in diameter and 4 cm. in length; it was hard and could easily be rolled under the finger. It did not extend into the superior longitudinal sinus. The vessels at the base were slightly tortuous, and there was a moderate degree of arteriosclerosis of the fibrous type. Arteriosclerotic plaques were not seen.

On horizontal section through the midpart of the genu and splenium of the corpus callosum and the midpart of the thalamus, the brain appeared normal except for dilatation of all the veins of the left hemisphere. A section at the level of the superior surface of the corpus callosum revealed the presence of a moderately large, sharply defined, honeycombed mass of blood vessels, the largest of which was 2 cm. in diameter. The walls of the vessels showed a moderate degree of calcification. The tumor mass was roughly oval and measured 3 by

4 by 3 cm. in its greatest diameters. It was located immediately underneath the large thrombosed vein already described. It involved the area of the centrum ovale through which the fibers from the precentral and postcentral convolutions pass. It did not extend far enough downward to involve the fibers of the internal capsule.

Microscopically, the tumor was found to be made up of a plexiform mass of blood vessels which were for the most part rather thin-walled. The vessel walls showed evidence of degenerative changes in the marked calcium deposits noted throughout. No minute hemorrhages, such as have been described following thrombosis of the vein of Galen, were found. There was some increase in glia formation in the zone immediately around the tumor. It was a typical plexiform hemangioma.

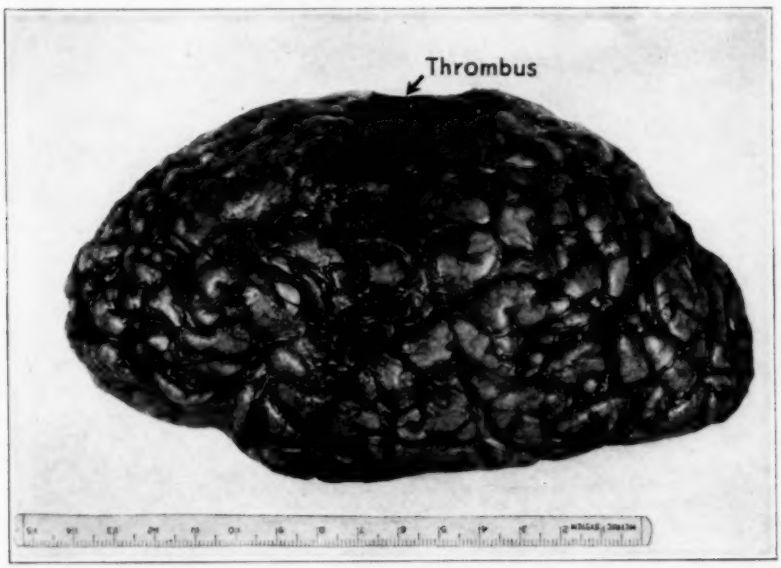

Fig. 2.—Lateral surface of the involved hemisphere, showing the thrombus and the marked dilatation of the veins.

COMMENT

The only similar case that I have been able to find after a careful search of the literature is that of Dowman,[1] who reported a case of thrombosis of the right rolandic vein. He stated that he believed that there was no other recorded case of this kind.

The patient was a white man, aged 37, who complained of dizziness and of numbness in the left hand which extended to involve the left arm, left side of the face, and to some extent, the left leg. This numbness was persistent and was associated with headaches which were more severe in the right parietal region.

1. Dowman, C. E.: Thrombosis of the Rolandic Vein, Arch. Neurol. & Psychiat. **15**:110 (Jan.) 1926.

Physical and laboratory examinations gave essentially negative results. The following neurologic signs were noted: the right pupil larger than the left, weakness in the left hand and arm, sluggish left abdominal reflexes, exaggerated left tendon reflexes and some disturbance in sensation without gross loss. At operation, he found that the right rolandic vein was large, bluish and hard, with a marked distention of the adjacent veins.

Dowman also reported a case in which similar symptoms were noted after ligation of the rolandic vein in the course of a transcortical approach to the third ventricle.

There is a striking similarity of the observations in these two cases. In both there was dilatation of the pupil on the side of the lesion. In

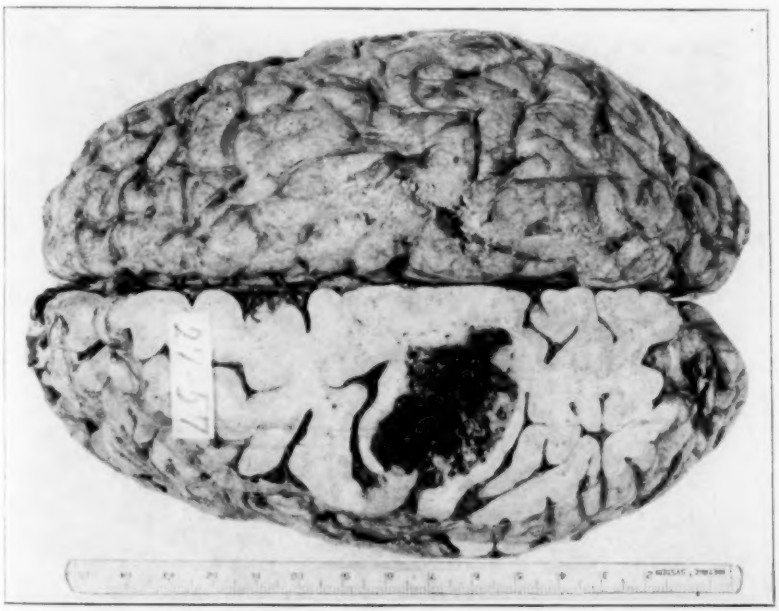

Fig. 3.—Involved hemisphere cut at the level of the hemangioma.

one case there was loss of the abdominal and cremasteric reflexes and increase of the tendon reflexes on the affected side; in the other, the abdominal reflex was sluggish. There was no Babinski sign and no patellar or ankle clonus in either case. There was astereognosis in both cases, but no loss of tactile, pain or temperature sense on gross tests.

Thrombosis of the sinuses occurs mainly at the two extremes of life and is usually the result of one of two causes. It is not uncommon after some infection, either by an associated pyemia or septicemia or by extension from an infected focus. On the other hand, it may develop as a result of changes in the blood vessel wall and lowered blood pressure.

The apparent rarity of this condition makes the case one of extreme interest. Lannois [2] described a similar syndrome in cases which he designated thrombophlebitis of the superior longitudinal sinus, but he does not cite any case in which the thrombosis was limited to one of the superior cerebral veins. It is possible that there is some association between the presence of the hemangioma and the development of the thrombosis, since the two conditions were on the same side, but I do not believe that there is any proof of such a possibility. The blood vessel mass was separated from the surface of the brain by a small amount of cortex.

CONCLUSIONS

1. Thrombosis of a superior cerebral vein without involvement of the superior longitudinal sinus is rare.

2. The case previously reported is similar to that described here.

3. The association between the thrombosis and the hemangioma is problematic.

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2. Lannois, M.: L'hémiplégie ascendante dans la thrombo-phlébite du sinus longitudinal superieur, Acta oto-laryng. **25**:199, 1927.

THE TOBEY-QUECKENSTEDT TEST IN THE LOCALIZATION OF TUMORS OF THE CEREBELLOPONTILE ANGLE *

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This study of the changes in the spinal fluid pressure in cerebellar tumors was suggested by the work of Tobey and Ayer [1] in which they demonstrated that, in lateral sinus thrombosis, compression of the jugular vein on the side of the lesion does not produce a rise in intracranial pressure as measured by a spinal manometer, but that compression of the opposite jugular vein produces almost as great a rise as does bilateral compression. It occurred to me that tumors of the cerebellopontile angle, situated as they are, close to the lateral sinus and jugular foramen, must, in the large majority of cases, cause compression of the sinus on the homolateral side. If such compression is present, it should be capable of demonstration by the Tobey-Queckenstedt test. It was determined, therefore, to apply this test in suitable cases of cerebellar tumor. The tracings were obtained by connecting an indwelling lumbar puncture needle with a recording tambour which in turn writes on a moving drum. As a matter of precaution, the test should not be applied until just before the operation is to be performed.

REPORT OF CASES

CASE 1.—The history in this case was slightly confusing, suggesting the possibility of an encephalitis. It was found, however, that the lumen of the left lateral sinus was completely obliterated, as demonstrated by the Tobey-Queckenstedt test. Operation was performed, and an endothelioma of the left cerebellopontile angle was found (chart 1).

From the tracing in chart 1 it will be seen that the initial pressure was moderately increased —25 cm. of water. The rise in pressure on coughing and straining was normal. Feeble pulse waves were present; respiratory waves were absent. The patient was lying on the right side. With bilateral compression of the jugular vein for ten seconds, the pressure rose from 26 to 58 cm. of water. With compression of the right jugular vein alone, the pressure rose from 26 to 50 cm. of water in ten seconds. With compression of the left jugular vein for ten seconds, practically no rise in pressure occurred. This lack of response was attributed to obliteration of the lumen of the lateral sinus by pressure of the tumor.

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* Submitted for publication, April 14, 1928.

* Read at a meeting of the Philadelphia Neurological Society, Jan 27, 1928.

1. Tobey, G. L., Jr., and Ayer, J. B.: Dynamic Studies in the Cerebrospinal Fluid in the Differential Diagnosis of Lateral Sinus Thrombosis, Arch. Otolaryn. **2**:50 (July) 1925.

Case 2.—The patient was suspected of having a tumor of the cerebellopontile angle on the right side. Subsequent events showed that a tumor was not present (chart 2).

The excursions in this case are not so large as is usual in the average normal person. The initial pressure was 12 cm. of water. The responses on straining and coughing were normal. Pulse waves were present; respiratory waves were practically absent. With bilateral compression of the jugular vein, the pressure rose from 12.5 to 21 cm. of water and promptly fell on release of the pressure. On compression of the left jugular vein, there was a rise of only 2 cm. in ten

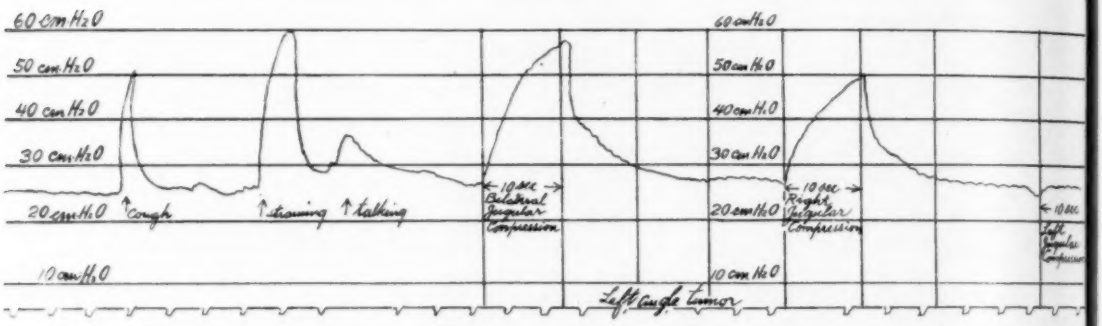

Chart 1 (case 1).—Tracing of the changes in the cerebrospinal fluid pressure in a patient with an endothelioma of the left cerebellopontile angle.

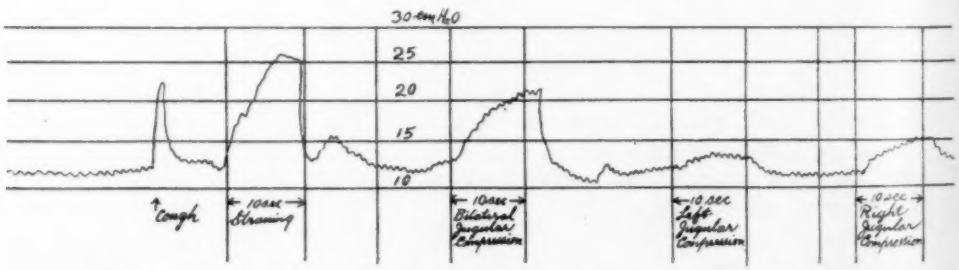

Chart 2 (case 2).—Tracing of the changes in the cerebrospinal fluid pressure in a normal person who was suspected of having a tumor of the cerebellopontile angle.

seconds. On compression of the right jugular vein, there was a rise in pressure of 4 cm. of water. These smaller rises in pressure on compression of the jugular vein are not unusual in normal persons. As a matter of fact, in some patients with a normally low spinal pressure there will not be any response even on bilateral compression of the vein. The responses may be obtained, however, in these cases if the initial pressure is elevated slightly by the introduction of a few cubic centimeters of physiologic sodium chloride solution into the spinal sac. This fact has been mentioned by Tobey and Ayer.[1] As a rule, one expects comparatively

larger excursions with compression of the jugular vein when the initial pressure is elevated.

Case 3.—The patient had bilateral acoustic tumors. The left one was removed about six months prior to making the tracing shown in chart 3. The patient was readmitted for removal of the tumor on the right side. The initial pressure in this case was about 36 cm. of water. The pulse and respiratory waves were well marked. With bilateral compression of the jugular vein over a period of ten seconds, the pressure rose to 50 cm. of water and on release fell promptly to 39 cm. With compression of the right jugular vein, the tumor being on the right side, the pressure rose to 43 cm. of water but was not maintained during the ten seconds that the compression was applied. On release it fell promptly to 36 cm. The difference on the two sides is not greater than one might expect

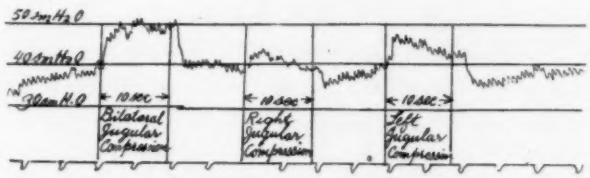

Chart 3 (case 3).—Tracing of the changes in the cerebrospinal fluid pressure in a patient with bilateral acoustic tumors.

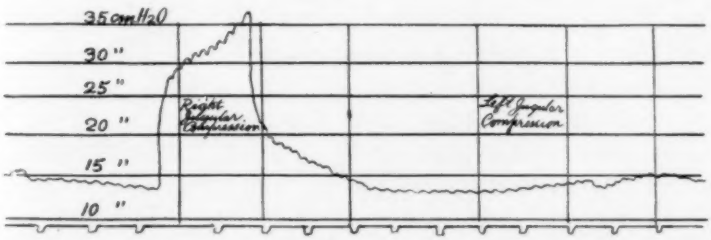

Chart 4 (case 4).—Tracing of the changes in the cerebrospinal fluid pressure in a patient whose symptoms were suggestive of a tumor of the left cerebellopontile angle.

under normal circumstances, but the fact that it favors the side on which the tumor is found is worthy of consideration. The small excursions with compression of the jugular vein in this case may be ascribed to the elasticity at the site of the former suboccipital decompression.

Case 4.—The patient had a history and symptoms suggestive of a tumor of the left cerebellopontile angle (chart 4). The results of the Tobey-Queckenstedt test seemed to bear this out. The initial pressure was 14 cm. of water, and the pulse waves were fairly well marked. The patient was lying flat on his back. On compression of the right jugular vein, the pressure rose to 36 cm. of water. On compression of the left jugular vein, there was not any rise in the spinal fluid pressure. With bilateral compression, the pressure rose to 42 cm. The latter curve is not included in the illustration.

At operation a true angle tumor was not found, but a glioma of the left cerebellar hemisphere was present in the region of the angle.

Case 5.—The patient had a large tumor of the left cerebellopontile angle and a beginning foraminal hernia (chart 5). These two conditions were demonstrated at operation. The initial pressure was 36 cm. of water. Straining in this case elicited a quick response. This was followed at the cessation of the act by a precipitate drop to 5 cm. below the initial pressure, and from this point the pressure slowly rose to the initial pressure. In an attempt to explain this unusual response it would seem fair to presume that it was the result of a partial subarachnoid block at the level of the foramen magnum. The act of straining apparently caused a greater engorgement in the spinal veins than it did in the cerebral veins. The engorgement of the spinal veins displaced fluid from the spinal sac past the partial obstruction into the intracranial cavity. When the act of straining ceased, the current of cerebrospinal fluid was reversed, causing the hernia to jam in the foramen magnum. This resulted in the precipitate drop

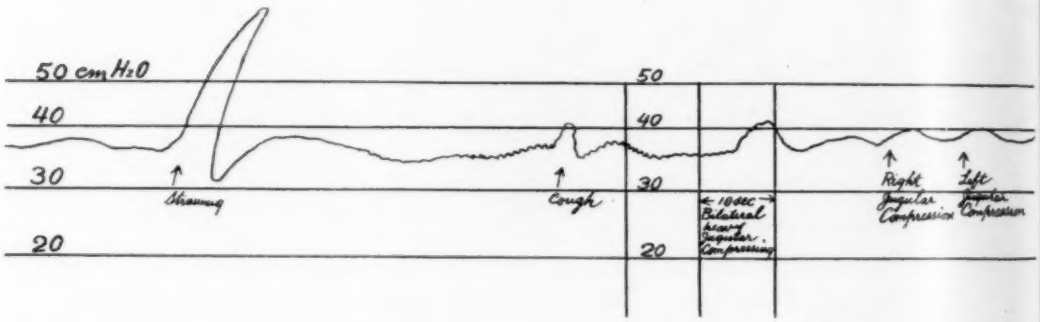

Chart 5 (case 5).—Curve showing changes in the spinal fluid pressure in a patient with a large tumor of the left cerebellopontile angle and a beginning foraminal hernia.

in intraspinal pressure as shown. The pressure then slowly returned to the initial reading as the fluid circulated past the partial obstruction. Additional evidence of a subarachnoid block in this case is shown by the response to compression of the jugular vein. As may be seen, the responses were delayed and small. When blockage to this degree is present, it vitiates the results of the Tobey-Queckenstedt test.

SUMMARY

Four cases of tumors of the cerebellopontile angle are presented with kymographic tracings of the changes in the cerebrospinal fluid pressure during the application of the Tobey-Queckenstedt test. In three of the cases there was partial or complete obliteration of the lateral sinus on the side of the tumor, as demonstrated by the test. In the fourth case the presence of a foraminal hernia interfered with the interpretation of the results.

BODY ACIDITY AS RELATED TO EMOTIONAL EXCITABILITY *

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The material on which this report is based is derived from an experimental investigation which has been in progress for two years. The purpose and plan of the study, together with certain of the earlier detailed results, have been described elsewhere.[1] The present article presents several trends which have become increasingly evident as the work has progressed and which seem, in the light of the accumulated evidence, to be beyond a possibility of being due to chance.

Emotional traits present far greater obstacles to adequate study and measurement than do the intellectual characteristics of a person. Tests of intelligence are now in wide use. In addition to their strictly clinical value as aids to diagnosis and prognosis, experimental work with psychometric tests has led to considerable insight into the nature of intelligence and the hereditary, developmental and environmental factors involved in it. Intelligence, however, is dealt with relatively easily by the psychologic methods of testing, which require that the test set up a standard situation such that the subject's behavior in this situation may be accepted as a sample of his general behavior. Situations requiring intelligent responses may be readily set up and standardized. Not so with other traits of personality, especially those which are called emotional, as the conditions are so complicated and the problem of standardization so difficult that the various efforts to evolve tests have not been entirely successful. The inherent difficulties of the strictly psychologic methods led to the notion that a biologic approach to the problem might be fruitful, and gave rise to the present biochemical study in which I have investigated the correlations between a number of biochemical determinations and certain traits of personality.

The detailed procedure employed has been reported in another connection.[1] I have, in general, obtained parallel biochemical determinations and personality ratings on several groups of subjects and have correlated the results. The chemical determinations included, among others,

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* Submitted for publication, March 6, 1928.

* Read at the Fifth Annual Meeting of the American Orthopsychiatric Association, New York, Feb. 25, 1928.

* From the Institute for Juvenile Research, Chicago, Herman M. Adler, M.D., Director, series C, no. 139.

1. Rich, G. J.: A Biochemical Approach to the Study of Personality, J. Abnorm. Psychol., July, 1928, vol. 23.

the hydrogen ion concentration of the saliva, the acidity of the urine, the alkali reserve of the blood, the creatinine content of the blood and the creatinine excretion in the urine. The subjects consisted of undergraduate students who were rated by fraternity brothers, graduate students rated by fellow workers, and children examined at the Institute for Juvenile Research who were rated by the four workers who saw each child in the clinic. Ratings have been obtained throughout the work on good nature, aggressiveness and emotional excitability, but definite results have been obtained only in connection with two of these: excitability and aggressiveness.

The earlier part of the study, with university students as subjects, showed a positive correlation between the p_H of the saliva and the emotional excitability of the individual. In one group of thirty-nine persons, the p_H was $+0.28$ and in the other, composed of eighteen persons, it was $+0.45$. In recent months I have evolved a simplified procedure, using the quinhydrone electrode, which can be used with children, and at the present time I have data from 134 subjects of the institute with a correlation of $+0.25$. This coefficient has remained relatively constant for some time, differing by only 1 per cent from that obtained in the first sixty-five cases. These three values may be summed up in an average correlation of $+0.30$ in the entire 191 cases; this is over six times its own probable error. There is thus a probability so high as to be almost a certainty that, should the determinations be repeated, similar results would be obtained. A positive correlation here indicates that the least excitable persons tend to have the most acid saliva, while those who are more excitable tend toward neutrality or even alkalinity of the saliva.

A further verification of the relationship between body acidity and emotional excitability comes from the urinary determinations. Working with twenty-four hour samples of urine, which I was able to obtain only from the students, I found correlations of -0.25 and -0.26, between ratings of excitability and the acid content of the urine as measured by direct titration, in the two groups of thirty-nine and eighteen persons, respectively. It is noteworthy that these two coefficients are of practically the same size as those obtained from the salivary determinations. They are of opposite sign merely because p_H decreases instead of increasing as a liquid becomes more acid and is, therefore, a negative measure of acidity. It thus appears that less excitable persons tend to have a more acid urine as well as a more acid saliva than those who are rated as excitable. If these two fluids can be taken as adequate samples of the reaction of the entire body, it would seem that there is a definite negative correlation between bodily acidity and emotional excitability. So far as my measurements go this is beyond the possi-

bility of a chance effect, but the human organism is so complex that one must be cautious in extending such observations to other parts of the body.

The negative correlation between excitability and the acidity of the body does not, however, rest solely on the data which have just been presented. Further evidence has already been accumulated in a number of studies which have been in the literature for some time. Starr,[2] working with types of stammerers, was able to differentiate a lethargic type with a distinctly acid saliva (p_H below 6.6) and an excitable type with a neutral or alkaline saliva (p_H above 6.9). Expressed in terms of correlation, he found a negative relationship between the acidity of saliva and excitability. Similarly, Ludlum[3] brought forward some clinical evidence for two types of acute insanity: one the excited type, with alkaline saliva and alternatingly acid and alkaline urine, perspiration and feces; the other the confused type, with a generally acid diathesis. Both of these observations were made on the relatively large variations found in abnormal conditions and were made by contrasting two extreme types. In this experiment, on the other hand, I have taken my subjects at random, running through the range of normality from one end to the other, and have found by the correlation method exactly the same tendencies in more nearly normal persons.

In this connection a word must be said regarding the ketogenic diets which are being used in the treatment of epilepsy. A review of this subject would be out of place here, but it must be noted that the ketosis produced by starvation or by a diet high in fat is a predominance of keto-acids and, therefore, also an acidosis. It has already been shown that a high body acidity is accompanied, at least in the emotional sphere, by a decreased tendency to respond to stimuli. It is, perhaps, not going too far afield to suppose that the emotionally less excitable subjects also tend to have a generally low nervous excitability. In the epileptic person, on the other hand, there is a nervous mechanism underlying the seizure which may be fairly easily stimulated. Under acid conditions one would expect, from the data quoted, that this mechanism should be less readily excited and that the seizures would become less frequent; it is exactly this condition which is produced by the ketogenic diet. Whether

2. Starr, H. E.: Studies of Human Mixed Saliva, II, J. Biol. Chem. **54**:55 (Sept.) 1922; The Hydrogen Ion Concentration of Mixed Saliva Considered as an Index of Fatigue and of Emotional Expression, and Applied to the Metabolic Etiology of Stammering, Am. J. Psychol. **38**:394, 1922; Physiological Chemistry in the Service of Psychology, as Illustrated by Determination of Alveolar Carbon Dioxide Tension, and the Hemoglobin Content of the Blood, Correlated with Clinical Diagnoses, Psychol. Bull. **24**:186, 1927.

3. Ludlum, S. de W.: Physiologic Psychiatry, M. Clin. N. Amer. **2**:895, 1918.

the result is due to the more general effect of the increased acidity and decreased alkali reserve is not evident. Unless the specific action of the keto-acids can be demonstrated, the effect of the ketogenic diets offers additional verification of the relationship which I am showing.

Since acidity correlates with emotional excitability, it might be expected that any element in the chemistry of the body which varies concomitantly with the acidity would show a similar correlation. Exactly this situation occurs in the case of creatinine. There is a marked parallelism between the excretion of acid in the urine and the excretion of creatinine per kilogram of body weight (creatinine coefficient), both between different persons and between the same person under different conditions.[4] Now, the creatinine coefficient of the urine correlates —0.24 and —0.23 for the two groups of students with emotional excitability. In the case of the creatinine of the blood, a correlation of —0.21 was obtained on 154 subjects. Here, again, two observations verify one another. The more excitable persons, it would seem, tend to produce less creatinine than do those who are rated as being less excitable. The more excitable persons, therefore, show a lower output of creatinine in proportion to the amount of metabolizing tissue, and, since the creatinine must be carried into the circulation as a preliminary to elimination, a lower creatinine content of the blood occurs. It is not possible at this time to state whether the variations in creatinine are dependent on those in acidity, or vice versa, as the concomitance of these two factors is itself a new observation.

The alkali reserve of the blood, the most common clinical measure of the reaction of the body, does not come into direct consideration because it does not show any tendency to vary concomitantly with emotional excitability. On the other hand the alkali reserve of the blood, as well as the amino-acids of the urine as measured by formaldehyde titration, correlate negatively with ratings of aggressiveness. These two determinations, both concerned with the acid-base mechanism of the body, cannot be directly related to each other from the chemical point of view. They do, however, show somewhat of the complexity of the situation. For one finds two separate but related types of behavior, both features of general activity of the nervous system, correlating with different aspects of the acid-base balance of the body.

The relationships considered have been described as tendencies for the chemical determinations and personality traits to vary together. More than this cannot be said. The two factors, one a characteristic of behavior and the other a feature of body chemistry, necessarily show, with correlations of only 0.25 or 0.30, many instances which do

4. Rich, G. J.: A Relationship Between Phosphorus, Creatinine and Acidity in Urinary Excretion, Proc. Soc. Exper. Biol. & Med. **25**:307, 1928.

not fit into the scheme. Yet such a situation is to be expected. Human traits are, at best, complex concepts (they can hardly be called entities) which represent certain outstanding features of behavior. It is now fairly generally recognized, except by extremists of one school or the other, that human activity is built on a double foundation of inherited bodily organization and environmental influence. A man's emotional excitability depends, on the the one hand, on the readiness with which his mechanisms of emotional response are stimulated and the intensity with which they respond. Those who rated for me were unable to observe these basic characteristics. They noted only the responses of the persons to a certain more or less limited number of situations. In the case of children at the institute clinic, the number of such situations was definitely restricted, although more or less constant and standard. Some of them were situations to which definite emotional responses had been conditioned, while in others a process of negative conditioning was effective in inhibiting reactions under the circumstances. This sort of difference in behavior, which is due to environment and training and not to any constitutional bodily mechanism, can hardly be expected to vary concomitantly with biochemical determinations. Only the tendency to give emotional responses is the factor inherent in bodily, especially neural, organization. On this factor there is built by the processes of learning the behavior which can be concretely observed and rated.

While the part played by the constitutional factors in personality sets the upper limit for correlations between behavior traits and body chemistry, it is by no means evident that the correlations of from 0.25 to 0.30, which have been obtained in this study, represent this limit. The whole investigation has necessarily had to proceed by a method of trial and error, and to be extensive rather than intensive. A number of factors, such as diet, exercise and water intake have not been controllable under the conditions of experimentation. The criteria of behavior are far from ideal. Rating scales are at best a makeshift. Yet it is doubtful if any of the tests other than those of intelligence, which are now available, are of sufficient validity to justify their use in this type of investigation.

It would be premature to theorize at this time on the mechanisms underlying the relationships which have been presented here, yet a few pertinent observations are inescapable. One would naturally expect that any correlations found would be with chemical substances concerned in the metabolism of nervous tissue. Such is not the case however. The acid produced by nervous activity is too small in amount to affect general bodily reaction, but that produced by the muscles is sufficient to give a noticeable effect. Moreover, creatinine is a product of the metabolism of muscles, not of nerve tissue. It may be that one is wrong in considering behavior as dependent on the activity of the nervous

system and that it would be more correct to speak of the neuromuscular system as a whole. There is, however, another interpretation. It is well known that in conditions of high acidity or high creatinine content of the blood the activity of the nervous system is reduced to a minimum and eventually to zero, that is, in the comas of uremia and acidosis. This fact points to the possibility that the products of metabolism in other tissues may act as internal secretions chronically to stimulate or depress the nervous system. Whether or not either of these explanations is of any value can only be determined by further experimentation.

It is, after all, not the explanation which is important here, but the fact that there is a definite though low negative correlation between emotional excitability and bodily acidity. The data on the reaction of the saliva have already accumulated to the point where it is beyond the possibility of being a chance observation. The determinations on urine support this belief. Finally the work of such other investigators as Starr and Ludlum is in complete agreement, as are also the effects of ketogenic diets in epilepsy. My next step is planned to test whether or not changes in the reaction of the body, acidification or alkalinization, have any effect on emotional reactions. Since one would then be working with the same persons, and therefore with a more or less constant past environmental influence on each person, definite confirmation of my observations is to be looked for, together with indications for their practical utilization.

Clinical and Occasional Notes

REPORT OF A CASE OF PERIODIC SOMNOLENCE WITH MAJOR OPERATION UNDER HYPNOSIS*

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The differential diagnosis of periodic somnolence is still difficult, in spite of recent advances in the study of epidemic encephalitis, tumor of the brain, pituitary disturbances, narcolepsy and hysteria. Hypnosis may be a valuable aid in the study of these cases.

REPORT OF A CASE

Clinical History.—M. M., aged 23, an even tempered, pleasant woman was admitted to the neurologic service of Dr. George W. Hall, St. Lukes Hospital, on Dec. 23, 1926, with a complaint of "sleeping spells." The patient dated the onset from an attack of what probably was an acute left peripheral facial paralysis (the left eye could not be closed, the right side of the face was drawn up and the sense of taste was impaired) which occurred in October, 1920, and persisted for three months, leaving as a sequel occasional ticlike movements and shooting pains of the left side of the face. The first sleeping spell took place in November following a visit to a dentist, when she slept for six hours.

It was learned later that the patient had given birth to an illegitimate son in August, 1920. The father refused to marry her and ran away. In November, she married a man whom she did not love so as to get a name for the child. After marriage she found that this man was unscrupulous and a drunkard. The first sleeping spell occurred in the first month of marriage. The husband at no time supported her, and later ran away, stealing a sum of money from her father. The father continually objected to supporting her and the child, especially when he remarried. This history was secured in September, 1927, under hypnosis.

The Attacks.—After the onset, attacks of somnolence reappeared about once a month for about two years, when they gradually decreased in frequency until two years before admission; then they no longer appeared for a year and a half. At the end of this time, a pelvic operation was performed. This was followed immediately by a return of the attacks, which were now characterized by greater frequency and longer duration. The average frequency noted while the patient was in St. Luke's Hospital was from three to five attacks a week with occasional periods of freedom for about a week at a time. The longest remission was from Feb. 21 to April 27, 1927, during which the patient was under observation at the outpatient department and had no complaints other than frequent severe dizzy spells and headaches. This remission was terminated by an attack lasting forty hours, which had its onset in the rest-room of the outpatient department immediately after the performance of tests of vestibular function. The average duration was from five to forty hours; the longest attack, four days, was observed while the patient was at Cook County Hospital in November, 1926. The patient took no

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* From the Neurological Service of St. Lukes Hospital, Chicago.

food during the attacks, and there is no record of the passage of urine or feces at these times.

The attacks have occurred at opportune and at inopportune moments. At times, the patient is forewarned by an increasing sense of drowsiness which she cannot fight off; she therefore goes to bed. At other times, the attacks have occurred without sufficient warning. She has fallen asleep on a chair many times; on one occasion she was found asleep on the floor that she had been scrubbing; twice she fell asleep on the street, and was brought to Cook County Hospital as an emergency case. One attack followed a few minutes after a kidnaping episode in which she and a girl companion eluded the kidnapers. Emotion is reported to have been the inciting agent in two attacks, both of which followed heated arguments with her father. Laughter has never brought on an attack. Since admission into the hospital, the patient has had attacks repeatedly while up and about in the ward, frequently falling down and severely injuring herself. She has had attacks while at stool, when she has fallen off the bowl to the floor; on one occasion, she was found asleep in the bath tub with all but her head submerged, and apparently was prevented from drowning by the timely arrival of the nurse. On a few occasions, she has presented somnambulistic tendencies during the attacks; on one such occasion, while walking down a flight of stairs, she tripped and stumbled down the entire flight; she was later found asleep in a position which looked as if she were standing on her head at the bottom of the stairs. At this time, she suffered a severe abrasion and contusion of the hip. On this as on similar occasions, she was carried to bed and remained asleep until awakening occurred spontaneously several hours later.

Additional Symptoms.—Headaches and dizzy spells have been experienced in the past two years. At first they seemed to have no relation to the attacks of sleep, but later preceded them, though not invariably. Insomnia for a week or two followed by a period of restful nights has been noted for many years. Soporifics have been required during the greater part of the hospital residence, although, curiously enough, the nights following sleeping attacks during the day were particularly free from restlessness.

The previous medical history reveals little of importance except that she had influenza in 1925 and metrorrhagia for four years; the latter led to a pelvic operation in June, 1926, since which time menstruation has been scanty, and there have been frequent severe cramplike pains in the lower part of the abdomen and attacks of vomiting.

Physical Examination.—No important observations were made other than tenderness in the left lower quadrant of the abdomen and a tender mass in the left fornix.

Neurologic Examination: When the patient was awake bilateral weakness of the orbicularis oculi, inability to wrinkle the forehead, overhanging eyebrows which made the eyes appear to be half closed and a rather marked fixation nystagmus were seen. Corneal, conjunctival and pharyngeal reflexes were present and the hysterogenic points were not tender. Objective sensory examination gave negative results. All tendon reflexes were normal, with the exception of a positive Oppenheim sign which could be demonstrated, though not invariably, in the right leg. There were no masked face, cogwheel rigidity, slow motion or tremor other than an occasional flickering of the left eyelid. The eyegrounds and fields were normal. Vestibular examination by Dr. Cavanaugh revealed no spontaneous nystagmus, no spontaneous past pointing, negative Romberg sign, normal caloric and turning tests and a normal Babinski-Weill phenomenon.[1]

1. Poston, R. J.: Vestibular or Labyrinthian Epidemic Encephalitis, Brain **49**:482, 1926.

Examination During the Sleeping State: Superficially the patient appeared like one in a normal sleep. Careful observation, however, demonstrated distinct abnormalities. The entire body musculature was flail and flaccid except on a few occasions when contractures of the left leg prevented complete extension. The eyelids were closed and the greater part of the time presented an incessant tremor; retraction of the eyelids usually met with considerable resistance, much greater than would be expected from an examination of these muscles during the waking state. When the pupils were exposed to light, they darted conjugately into one or the other corner of the palpebral fissure as if trying to hide behind the folds of the eyelids. The jaws were always firmly clenched and could not be opened even with considerable force. A positive jerk of the jaw was elicited. The tendon reflexes were greatly increased over the normal state and the abdominal reflexes were variable, usually diminished or not obtained. A positive Oppenheim sign was consistently present on the right side; there were no other pathologic reflexes. Dermographia, difficult to demonstrate during the waking state, was easily obtained. Apparently, complete anesthesia to pain or other stimuli was present. When the patient was first admitted to the hospital, she could be awakened for a few moments by supra-orbital pressure; after a few weeks in the hospital, the attacks became so deep that it was impossible to awaken her even with strong stimuli such as slapping, pinching, sticking with pins, etc. At times, persistent prodding with painful stimuli, more particularly tickling the nose with a feather or talking to her in a joking way would cause her to roll over and bury her face in a pillow. On two such occasions a faint smile was seen to pass over her lips. At other times, when the patient was not disturbed, she fell off the bed and injured herself while thus rolling about during an attack. The pulse rate during attacks is between 60 and 70; in one attack it was observed, at half hour intervals, to be between 48 and 50 for eight hours. Respiration is slow, slightly deeper than normal, and is rhythmic.

Laboratory Studies.—The Wassermann tests of the blood and spinal fluid were negative. The spinal fluid was clear and contained no cells, and the globulin tests were negative. The colloidal gold test did not show reaction in any tube. The basal metabolic rate taken while the patient was awake read + 4.5 per cent on February 10 and + 27.5 per cent on May 5; when taken with the patient asleep, it read — 11.6 per cent on February 9, and — 14.6 per cent on May 7, a difference of 16 per cent in the first and of 42 per cent in the second instances. Blood chemistry studies made during sleep and while the patient was awake did not show appreciable differences or any deviation from the normal. The blood sugar tolerance was within normal limits, the four readings varying between 101 and 116 mg. of sugar per hundred cubic centimeters; the sugar present in the urine was normal, none of the specimens examined showing any sugar. Twenty-four hour specimens of urine averaged 1,200 cc. in volume. Electrocardiograms showed a normal mechanism both when the patient was asleep and when she was awake, with a slower rate in the former states. A roentgenographic study by Dr. E. S. Jenkinson revealed "nothing abnormal in the sella or clinoid processes and no evidence of tumor of the brain. The internal table of the frontal bone is somewhat irregular and there is some evidence of increased intracranial pressure in this region."

Course.—While the patient was in the hospital, there was a gradual progression with an increase in the frequency and intensity of the attacks. Treatment with typhoid-paratyphoid injections, on the supposition that the condition was a postencephalitic sequel, was without appreciable results. At times the patient slept through the entire chill and fever (from 103 to 104 F.) reaction. Treatment with pituitary extract hypodermically and later by mouth was without apparent effect.

On June 1, following an attack in which the patient fell on the floor, clonic movements of the anterior thigh muscles of the right leg suddenly developed. These consisted of a to and fro, pseudorythmic tremor of varied amplitude, sometimes so slight as to be barely perceptible and at other times so violent as to shake the entire body and even the bed. It was maintained for periods of a few minutes to five or six hours. It appeared and disappeared spontaneously while the patient was both asleep and awake, even persisting, though of less amplitude, when the patient walked. This tremor could be controlled to some extent by hyoscine in doses of 1/150 grain (0.0004 Gm.) given hypodermically twice daily. Two months after its onset, the left leg became involved but the disturbance was a type of kicking movement in which the entire musculature was used; on other rarer occasions both arms joined in the seizure with a clonic flexion movement of the forearms. These more generalized movements were observed only during attacks of sleep and were of much shorter duration.

Hypnotic Studies.—On October 10, Dr. John Favill suggested a diagnosis of hysteria. This led to a study by means of hypnosis. The patient was told that she was to be hypnotized and that when the state of artificial sleep had been induced she would exhibit all the phenomena of a typical attack; it was further suggested that she would obey my commands alone and would be awakened at my command and only then. Using the simple formula, "sleep," "sleep more deeply," the patient soon passed into a state not unlike that in previous attacks. The entire musculature was relaxed and flaccid; the eyes were closed and presented the usual incessant tremor; the eyeballs rotated to the right or left corners of the palpebral fissure when the lids were retracted. This retraction met with no resistance. There was complete anesthesia to all external stimuli; the most aggressive attempts by others present to awaken her made not the slightest impression. However, at the suggestion "you are now sensitive to pain," she responded in the normal reflex manner to painful stimuli, and this phenomenon persisted until the suggestion "you feel no pain" was given. When she was given the command: "Tremor of the right leg, start!" the tremor previously noted during spontaneous attacks was immediately instituted; it had every characteristic of the other and on command became so violent as to shake the bed. On further commands, clonic movements of the left leg and of the arms, similar to those previously described, were instituted. All these movements stopped abruptly at the command to cease. The patient awoke promptly on command, rubbed her eyes and acknowledged complete amnesia for the period of induced sleep.

The patient was hypnotized on four other occasions: once for the purpose of a minor operation, removal of an ingrown toe-nail, which was performed without the slightest resistance or indication of pain on the part of the patient; once for the purpose of a demonstration at a staff meeting, and a third time for a major operation, a laparotomy for the relief of intra-abdominal adhesions due to the previous pelvic operation. The indications for the operation were persistent cramp-like pains and attacks of vomiting. The patient readily agreed to hypnotism as an anesthetic when told that she would thus avoid the nauseating effects of a general anesthetic which had so distressed her at a previous operation.

Operation Under Hypnosis (by Dr. Harold O. Jones).—The operation was performed on November 1, at St. Luke's Hospital. The patient was not given narcotics and was brought into the amphitheater awake. She was put into a hypnotic sleep in fifteen minutes, and the operation proceeded in the usual manner. A midline incision, about 7 inches long, was made in the lower part of the abdomen. Local anesthetic was not used. The patient was put in the Trendelenberg position, and adhesions between the large bowel and the site of the former operation were

isolated, ligated and cut. As the small bowel was squeezed, the patient vomited a little, but gave no indication of being aware of what she was doing. When the peritoneum was cut, audible moans were heard, but the patient gave no evidence of conscious perception of pain, such as clenching the hand, gritting the teeth, resistance or any muscular movement. She was completely relaxed during the entire period of the operation, about an hour, and at no time was there any straining or even a suggestion of resistance. The pulse rate, taken every five minutes, showed a variation between 68 and 72. The systolic blood pressure, taken at ten minute intervals, varied between 128 and 132. Following the operation, the patient was taken to her room and awakened by a simple command. She smiled broadly, and asked if the operation had been performed. When told that it was all over, she said that she had not felt any pain and that she felt entirely comfortable. She indicated this by picking up a newspaper and reading leisurely for the succeeding hour. She ate lunch without ill effects an hour later. The postoperative convalescence was free from untoward effects, and at no time was nausea or vomiting experienced.

Final Hypnosis.—On November 7, the patient developed another sleeping attack, the first since the use of hypnotism; at that time I was unable to establish rapport, the attack terminating spontanously in the usual manner. On November 11, the patient was again hypnotized for the purpose of treatment, and strong suggestions were made with a view to preventing the recurrence of sleeping attacks. No clonic movements have been observed since the first use of hypnosis, when suggestions concerning the spontaneity of these were made. Treatment is being continued.

Diagnosis.—The differential diagnosis is confined to chronic conditions in which somnolence is the predominating symptom. The diagnosis of idiopathic narcolepsy, as described by Adie,[2] can be dismissed because of: the duration of the attacks, the fact that the patient could not be awakened, and the absence of those "curious attacks on emotion in which the muscles relax suddenly so that the victim sinks to the ground conscious but unable to move." Narcolepsy, a postencephalitic syndrome, is more difficult to rule out. This diagnosis is suggested by the onset with a peripheral facial palsy and the subsequent attacks of clonic movements. The absence of the usual postencephalitic symptoms does not rule out this diagnosis, as shown in cases reported by Adie,[2] Stiefler[3] and others. These cases also usually present attacks of loss of muscle tone (Adie, Stiefler, Symonds,[4] Spiller), but a patient of Dr. George W. Hall, whom I had an opportunity to study, did not show this interesting symptom. Stiefler's patient had attacks of sleep while standing, sitting, eating, walking or working, and injured himself repeatedly at these times. Tumor of the brain occasionally presents a symptom-complex dominated by periodic hypersomnia,[5] and although this possibility is suggested by the rather flimsy evidence offered by the X-ray and the presence of the positive right Oppenheim reflex, the long duration of the disease without development of other focal symptoms or change in the ocular fundi seems to rule out this diagnosis. Disease of the pituitary body is improbable in view of the negative X-ray pictures of the sella and clinoid processes, the negative laboratory

2. Adie, W. T.: Idiopathic Narcolepsy, Brain **69**:257, 1926.

3. Stiefler, G.: Narcolepsy After Encephalitis, Wien. klin. Wchnschr. **37**: 1044, 1924.

4. Symonds, C. P.: Narcolepsy as a Symptom of Encephalitis, Lancet **2**:1214, 1926.

5. Feiner, L.: Somnolence, Its Occurrence and Significance in Neoplasms, Arch. Neurol. & Psychiat. **17**:44 (Jan.) 1927.

observations and the absence of bone changes or abnormalities of fat deposition. A postconcussion syndrome, always to be considered in the presence of epileptoid or hysterioid seizures, especially when associated with attacks of dizziness, can be dismissed because of the absence of a history of injury of the head and the late appearance of the dizzy spells. Epileptic equivalent, no doubt a good name for this condition, has little to support it clinically.

Perhaps the most plausible diagnosis is hysterical somnolence; this diagnosis would stand on firm ground were it not for the fact that the patient has repeatedly and severely injured herself during attacks. This fact, together with information revealed in the study under hypnosis, more particularly the close resemblance between the attacks of sleep and the induced states, leads me to believe that this case is one of autohypnosis. Angell[6] said: "Autohypnosis is apparently a bona fide state resembling hypnosis in many particulars, but brought on by the independent personal effort of the subject without the help of the hypnotizer. . . . If the aim be to overcome insomnia, the subject may repeat to himself many times over 'I am getting drowsy. I am going to sleep.'" Bramwell[7] suggested an explanation of my failure to establish rapport during a spontaneous attack. He writes: "Self-hypnosis was used to secure relief from insomnia and for dental operations (teeth extraction). During self-hypnosis the subjects were either in rapport with every one or only with certain individuals, according to the suggestions they made to themselves beforehand." In my case, there is no record of any such voluntary induction, but the long history of insomnia, which certainly must have become more severe during the crises referred to in the patient's personal history, may have resulted in an unpremeditated autohypnotism which later became a habit.

If this diagnosis is accepted, it is easy to explain the close resemblance between the hypnotic state and the attacks of sleep. As for the myoclonus, it may be due to the "extraordinary increase in the mechanical excitability of nerves and muscles" observed in the "lethargic state" by Charcot and others of the Salpêtrière school. Many cases have been described which lead one to this belief. The patient of Marianne Olivonne[8] was a woman who on March 1 of each year fell into a lethargy which persisted without break until the nineteenth of the same month; during those nineteen days her teeth were clenched, the limbs were stiff, the eyes were closed, there was an incessant tremor of the eyelids and general anesthesia to all stimuli. The sleeper of Thenelles[9] is reported to have slept for twenty years, finally awakening because of the onset of pulmonary tuberculosis from which she died shortly thereafter. She presented complete anesthesia, absent knee jerks, contractures following passive movement of the limbs, jaws firmly clenched and spasmodic movements of the eyes upward when the lids were retracted. The Sleeper of Alençon[10] was brought into a hospital because of hysterical aphonia; while there she entered a prolonged sleep which lasted for forty days. She had a pulse rate between 65 and 70, general cutaneous anesthesia, absent abdominal reflexes, lively knee jerks and a constant tremor of the eyelids.

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6. Angell, James Rowland: Modern Psychology, New York, Longmans, Green & Company, 1912, p. 134.

7. Bramwell, I. M.: Hypnotism; Its History, Practice and Theory, London, G. Richards, 1903.

8. Paul, M. E.: Pathological and Prolonged Sleep, a Critical Digest, J. Ment. Sc. **57**:540, 1911.

9. Berillon, M.: Lethargies et sommeils prolongés, Rev. de psychotherapie, December, 1910.

10. Farez, P.: La dormeuse d'Alençon, Rev. de psychotherapie, August, September, 1910.

She was awakened by the ingenious method of first placing her under a general anesthetic, then, as she came out of the narcosis, hypnotizing her; therapeutic suggestions were made to prevent future attacks. I was unable to awaken my patient by using this method. This patient was reported as having thus been cured. Speaking of this patient, Janet[11] wrote: "Experiments of this kind ought to be carefully repeated for I think they serve as a starting point of a new form of hypnotism independent of hysteria, whereas today hypnotism is entirely dependent on this neurosis, or if you like upon this spontaneous form of intoxication."

The Sleeper of Chambrey is reported to have been found asleep standing naked in front of a window. He was put to bed and presented the phenomena observed in the other sleepers. He awoke spontaneously in seventy-two hours. No history is given of subsequent attacks. Bramwell[7] describes a patient, Sarah L., who had been previously hypnotized and exhibited by a stage performer; since, she had been able voluntarily to hypnotize herself, producing two distinct states. In one instance she changed from a shy, quiet, respectable girl into a woman who was full of mischief, boisterous, talkative and sarcastic. At other times, especially when she was called to perform a task that displeased her, she would induce self hypnosis, with profound lethargy, and would remain apparently deeply asleep for hours. This patient was operated on under ordinary hypnosis for the purpose of correcting a bilateral strabismus; this was successfully performed without pain. Finally, under hypnosis, Bramwell suggested that she lose the power of creating self-hypnotism, and the condition never reappeared.

SUMMARY

This is the report of a case in which a patient who had attacks of periodic sleep and myoclonus was closely observed for nearly a year. Studies with hypnosis revealed a close analogy between the spontaneous and induced states and suggested, in the absence of definite organic symptoms, a diagnosis of autohypnotism. The lowered metabolic rate noted in the sleeping states may account for the ability of these patients to go without food and for diminished secretions during the attacks.

DISCUSSION

Dr. Hugh T. Patrick: I hesitate to say anything about this, but I feel that I should. It seems to me that the only mistake was the continued study of the case. The best thing to do is to ignore the patient's symptoms and to help her make a social and industrial adjustment. The literature has been full of reports of these cases, every one of which is much the same. Hypnosis may be useful for diagnosis, but it seems to me that here it was entirely unnecessary. Hypnotism has been going on for a long time, coming up periodically for at least forty years to my knowledge, and the conclusion always has been that hypnosis is not the best measure with which to treat patients with psychoneuroses. A short time after the death of Charcot (1893), when I was in Paris, there was at the Salpêtrière a large ward full of hysterical patients — women. For years before that, Charcot had been studying these cases, and there was much publicity. The patients remained year after year, and the cases of some of them were studied continuously. Some left and came back. As the years went on, the number of cases rapidly diminished. Why? Because they were ignored and not studied. In going through a big ward, in about 1908, I saw a woman lying three-fourths in and one-fourth out of bed. She seemed only partially conscious and was continuously sobbing like a child.

11. Janet, Pierre: Psychological Healing, New York, The Macmillan Company, 1925, vol. 1.

A couple of nurses were sitting within 6 or 8 feet, quietly sewing and talking, not paying the least attention to her. The physician, Dupré, went past, and nobody looked at her. One man said, "I suppose hysteria." Dupré said, "Yes, she will be all right in two or three days. They get well and go home."

To come back to my original statement, it may seem severe and unkind, but the most unkind thing is prolonged study of such a patient in the hospital. The reason this girl continued to have these attacks was that they accomplished something for her. The way to cure that girl was not to study her in this way, but to help her by occupation, by education, by sending her away and making life tolerable to her without these attacks. I hope Dr. Solomon will pardon this criticism. The case is not a novelty, except so far as the metabolic study was concerned. Aside from that it is stereotyped.

Dr. George W. Hall: I do not think this was a case of pure hysteria. There is no question that the patient had manifestations of hysteria, but in reply to Dr. Patrick's remarks, the staff physicians were interested in determining, if possible, the relationship between the symptoms and a postencephalitic state. I believe this woman is suffering from encephalitis. In the second place, one cannot explain the constant presence of an Oppenheim sign on a functional basis. The patient also had facial paralysis, which to me is evidence that there is an organic basis for the trouble, on which is superimposed the hysteria.

Dr. John Favill: In defense of the reader, I might add that it was only about eight weeks ago, after the patient had been under observation for ten months, that a functional condition was even considered.

Dr. G. B. Hassin: What did the cutaneous examination show?

Dr. Solomon: Cutaneous examination during the waking state was entirely negative for areas of anesthesia. Hysterogenic zones were not painful, and the corneal, conjunctival and pharyngeal reflexes were present, although slightly diminished. The positive Oppenheim sign was noted during the period of induced sleep, as well as during the spontaneous attacks.

A CLINICAL AND NEUROPATHOLOGIC REPORT OF A CASE OF LEPRA MIXTA*

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Leprosy may so closely resemble syringomyelia that a differential diagnosis is not always possible.[1] Zambaco-Pacha[2] and others even consider these two morbid conditions one disease process, while Pestana and Bettencourt[3] claimed to have

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* From the neurologic service of the clinical hospital of the 1st Moscow State University, Dr. Tarassewitch, Director.

* Translated from the Russian by Dr. G. B. Hassin, Chicago.

1. Hassin, G. B.; Burke, G., and Nuzum, J.: Leprosy or Syringomyelia? J. A. M. A. **65**:235 (July 17) 1915.

2. Zambaco-Pacha: État de nos connaissances actuelles sur la lèpre, Semaine méd. **13**:289, 1893.

3. Pestana, C., and Bettencourt: Ueber die Anwesenheit des Leprabacillus in der Medulla eines an Syringomyelitis gestorbenen Individuums, Centralbl. f. Bacteriol. **19**:698, 1896.

seen lepra bacilli in the syringomyelic cavities of the spinal cord. On the other hand, cases are on record in which cavities of the spinal cord were found in leprosy, as in the cases of Steudener,[4] Langhans,[5] and Gerber and Matzenauer.[6] In Steudener's case (lepra mutilans), a cavity extended from the medulla oblongata to the lumbar region, and was surrounded by greatly thickened blood vessels. Steudener thought that the cavity was not caused by leprosy but was the result of colloid degeneration. In contrast, Langhans considered the cavity in his case, in which it involved the gray matter of the lower cervical and all the thoracic segments, a product of leprosy. Both of these cases were looked on by Schultze and Vogt as cases of syringomyelia, while Nonne classified as leprosy only the case of Gerber and Matzenauer.

The case recorded in this paper was one of unquestionable leprosy and showed a distinct cavity in the cervical enlargement which one is inclined to regard as syringomyelia.

REPORT OF CASE

A man, aged 40, entered the hospital on Nov. 28, 1926, complaining of general weakness, bloody diarrhea, dryness of the mouth and loss of appetite. The patient's mother died from a tumor; the father and two younger brothers died (the latter in infancy) from an unknown cause. The patient had been in good health until the age of 27 when he began to experience pain in the right great toe. Here a black spot appeared and was soon followed by ulceration. The face became swollen, and five years later tuberosities appeared over the eyebrows; three years later, severe pain began in the toes and this was followed in three years by pain in the upper extremities. Two weeks prior to the patient's admittance to the hospital, bloody diarrhea set in; this was accompanied by weakness, loss of appetite and dryness of the mouth.

Examination.—The patient was emaciated, the face cyanotic and bloated, and the legs were edematous. The nose was saddle shaped; the nasal cartillages were destroyed and over the eyebrows, which were devoid of hair, four bluish tuberosities, the size of a bean, were present (fig. 1). The uvula was missing and the tongue was covered with hard infiltrating masses, some of which were ulcerated; the mucous membrane of the right portion of the lower lip was missing. A large gangrenous sore covered a third of the right leg and numerous superficial ulcers, the size of a dime or of a quarter, were present on the elbows, wrists, legs, soles of the feet and the scrotum. The toes of both feet were gangrenous. Lepra bacilli were isolated from the cutaneous sores and from the nasopharynx.

Neurologic Examination.—The mental condition was normal. The voice was hoarse and the speech slow and monotonous; the right corner of the mouth was slightly drooping; the sciatic nerves were thickened and painless to touch and pressure. Active and passive movements were somewhat restricted; the muscle tonus was diminished; both hands were atrophied; fibrillary twitchings were not noted. The sensibility was markedly diminished in the areas of the atrophic scars as well as over the left half of the chest and the left upper extremity; it was completely lost in the lower extremities, especially on the right side, where the anesthesia was in the form of stockings. The reflexes could not be tested because of profound trophic changes.

4. Steudener: Die Lepra anesthetica sive mutilans, Halle, 1867; abstr. Jahresb. ü. d. Leistung u. Fortschr. in. d. ges. Med., 1868, p. 404.

5. Langhans: Zur Casuistik der Rückenmarksaffectionen, Virchows Arch. f. path. Anat. **64**:169, 1875.

6. Matzenauer and Gerber: Lepra und Syringomyelia, Oberst. Arb. a. d. neurol. Inst. a. d. Wien. Univ. **9**:146, 1902.

Necropsy.—At necropsy, Dr. P. P. Dvizkow found, among other changes, a bilateral thickening of the tibial, peroneal, ulnar, radial and median nerves; the muscles appeared opaque; the epiglottis exhibited many defects; the upper third of the trachea, the vocal cords and the larynx were ulcerated and covered with yellowish scars; ulcers were also present in the tip of the tongue, in the fauces, the upper third of the esophagus and on the fingers; there was consolidation of the apex and of the margin of the upper lobe of the right lung; in the apex there was a calcified, partly caseous, encapsulated focus, the size of a walnut, surrounded by whitish scars. The most noteworthy change in the viscera was amyloid degeneration of the spleen and kidneys.

Microscopic Examination.—The meninges of the cerebrum and spinal cord were opaque, hyperemic and thickened, especially over the posterior columns. The cortex, basal ganglia, pons and medulla were practically normal. The spinal cord contained a cavity within the cervical enlargement, with especial involvement of

Fig. 1.—Tuberosities over the eyebrows.

the fifth and sixth segments. The cavity was represented by the dilated spinal canal; it had the shape of a cross (fig. 2) and was lined by ependymal cells. These cells were proliferated and formed two or three rows. Around the cavity, the blood vessels were excessive, hyperemic and possessed a thickened adventitial membrane (angiofibrosis), which was especially in evidence in the posterior horns. The layers of the ependymal cells were covered with erythrocytes and fibrinous deposits that contained a number of small lymphocytes.

The posterior roots of the cervical enlargement showed tumefied axons and mild lymphocytic infiltrations. These were marked in the left ventral and dorsal horns where the blood vessels were hyperemic and occasionally contained red thrombi. There were, in addition, neuronophagic phenomena.

In some segments the cells of the anterior horn were elongated and atrophied; some showed chromatolysis and their nuclei were indistinct. In the lower cervical region, a long process emanated from the lateral part of the anterior horn of the gray matter (fig. 3), and in the posterior columns there was a wedge-shaped area of degeneration along the septum posticum.

The posterior roots were pale and, in specimens stained with the method of van Gieson, exhibited a thickened connective tissue stroma. In the thoracic region, the spinal canal was in the form of a small transverse opening surrounded by

proliferated ependymal cells, often gathered in heaps. No changes were seen in the cells of the anterior horn or in the white substance of the spinal cord, but the Clarke's columns exhibited a paucity of ganglion cells. In the lumbosacral region, the blood vessels were distended, hyperemic and the anterior as well as the posterior roots were somewhat infiltrated.

Fig. 2.—A cross shaped cavity in the center of the spinal cord surrounded by proliferated blood vessels; van Gieson.

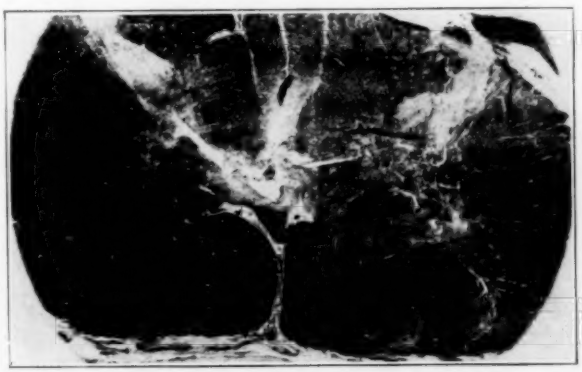

Fig. 3.—An anomalous horn with a large process (*A*).

The cauda equina exhibited pale fibers and the cells of the spinal ganglia showed vacuolization; some showed homogenization or pigmentation. In addition, there was marked satellitosis and fibroblastic proliferation with elongated nuclei and sclerosed capsule. Some cells dropped out and were replaced by infiltrations. The nerve cells of the sympathetic ganglia stained profusely and contained vacuoles

and large amounts of pigment. The capsule was thickened and showed numerous fibroblasts.

The microscopic examination of the peripheral nerves—radial, ulnar, median, sciatic, tibial and peroneal—revealed nodular tumefaction and fragmentation of the myelin with marked fibrosis of the endoneurium, perineurium and epineurium. Transverse sections revealed here and there single nerve fibers in a fair state of preservation and divided from one another by thick bundles of connective tissue. These fibers showed also vascular changes, such as stasis, thickened and infiltrated vessel walls, proliferation of the intima and enlargement of their nuclei. The membranes of the nerves (especially the tibial) were hyperplastic and infiltrated with lymphocytes. Stained with the method of Bielschowsky, the specimens revealed a diminished number of axons and an increased amount of connective tissue. In some nerve fibers, the myelin was in a state of fatty degeneration.

Lepra bacilli were abundant in the viscera, but were absent in the peripheral as well as in the central nervous system.

SUMMARY AND COMMENT

The observations may be summed up as an inflammation mainly of the peripheral nerves (interstitial neuritis), with formation of a cavity in the cervical region of the spinal cord and a degeneration of the columns of Goll, with an anomalous anterior horn. It is rather uncertain whether the cavity resulted from the leprosy or was a congenital defect of the ependymal epithelium or glia. It was most likely a maldevelopment, as evidenced by the accumulation of cells around the central canal and the anomalous anterior horn.

CONCLUSIONS

The neuritis occurring in leprosy may be termed interstitial and was also, in this case, responsible for the trophic changes.

The cavity was evidently a manifestation of a congenital anomaly, such as syringomyelia, and was an accidental complication. The differential diagnosis between leprous neuritis and syringomyelia, always difficult, is especially so in the presence of a cavity.

Abstracts from Current Literature

Occlusion of the Posterior Inferior Cerebellar Artery. Masaki Hashiguchi, Arb. a. d. neurol. Inst. a. d. Wien. Univ. **29**:232 (Sept.) 1927.

The clinical picture resulting from occlusion of the posterior inferior cerebellar artery is extremely variable, owing to the fact that the areas supplied by the vertebral arteries are in themselves extremely variable. Recent investigations, especially those of Luna, concerning the part of the medulla oblongata supplied by the vessels in question have cleared up many heretofore obscure points. Hashiguchi reports his observations on two cases, the first of which he considers to be unique, and the second of which represents a not uninteresting variation of the usual type of case.

The patient in case 1 was sent into the institute with a diagnosis of apoplectic bulbar paralysis. No history was obtainable. Histologic examination revealed the presence of two lesions. The first was in the left pyramidal tract at about the level of the inferior olive. From all appearances, it was an old lesion and in it could be recognized vascular changes and occlusion of the smaller arteries. In this area the pyramid was shrunken but not destroyed. Lower down in the cord, however, there were many normal fibers, and the only evidence of damage to the pyramidal tract was some diminution in the size of the tract and some paling in the periphery. There can be no doubt that the vascular changes found in the pyramid in the medulla were the cause of the damage in that area. The second lesion was on the right side, contralateral to the pyramidal lesion and involving the hypoglossal nucleus. It extended for a short distance ventrally into the posterior longitudinal fasciculus. This lesion appeared to be more recent, and several small hemorrhages suggest that possibly the process had not yet run its full course, although already some sclerosis was present.

The question now arises whether it is possible to explain both lesions on the basis of a common cause. First, it must be stated that there was also a lesion in the cerebellum such as is seen in occlusion of the posterior inferior cerebellar artery. It is questionable, however, whether such an occlusion could produce so small a dorsal lesion as was found in the hypoglossal nucleus. According to Luna, this area may be supplied by a small branch of the vertebral artery—arteria olivaris prima—or by small branches of the posterior inferior cerebellar artery. In this case the olive remained intact, so it is impossible that the degeneration could have been caused by a lesion of the olivary artery. One must assume, therefore, that the occlusion occurred in one of the terminal branches of the posterior inferior cerebellar artery. However, there was also a lesion in the cerebellum indicating damage to the main stem of the posterior inferior cerebellar artery. According to Luna, this vessel sometimes takes an anomalous course, at first circling around the medulla oblongata, then running far medially and inward, making a curve dorsally almost over the restiform body and then turning outward to be distributed to the under surface of the cerebellum. From the dorsal curve of the artery, small branches dip into the medulla and supply the region of the hypoglossal nucleus. Therefore, one must assume that a thrombus formed in the posterior inferior cerebellar artery in the region of the dorsal curve just before its distribution to the inferior surface of the cerebellum shutting off the supply to the small branch running down to the region of the hypoglossal nucleus and also to the under surface of the cerebellum. But how can the lesion of the contralateral pyramid be explained? According to Luna, the anterior spinal artery supplies the region of the pyramids while the medulla is supplied by the medial olivary branches. One must assume, therefore, that in the pyramidal region a process analogous to the one in the vessels of the floor of the fourth ventricle took place.

If both lesions in the medulla were to be explained on the basis of one process, one would have to assume the existence of an endarteritis with thrombosis of the terminal branches of the anterior spinal artery, and that these branches

supplied the pyramid on one side and the region of the hypoglossal nucleus on the other. Hashiguchi does not incline favorably toward this explanation because usually in lesions of the anterior spinal arteries the damage to the structures near the floor of the fourth ventricle is bilateral.

Case 2 was that of a patient, aged 74, who was syphilitic. In 1915, he suddenly fell from a chair to the floor without losing consciousness. After the attack he became hoarse, was dizzy for twenty-four hours and had difficulty in swallowing. After one month, he was able to walk again but complained of vertigo. He also was unable to open his right eye, and for two years subsequent to the spell experienced paresthesias over the left half of the body and the left arm and leg. A neurologic examination, in 1924, showed diminution of both corneal reflexes and paralysis of the soft palate and pharyngeal wall on the right. The right vocal cord was paralyzed and abducted, and the voice was hoarse. Temperature and pain sense was absent in the left upper extremity and over the left half of the body. It was impaired in the left lower extremity. There was a tendency to fall backward. Touch and position sense, reflexes and all other observations were normal.

A diagnosis of a lesion in the lateral part of the medulla oblongata was made and was confirmed at autopsy. Section showed a lesion in the most caudal portion of the medulla involving the beginning of the decussation of the medial lemnisci. It involved a large part of the spinal root of the trigeminus and its nucleus with the adjacent portion of the formatio reticularis. It then extended ventrally to the dorsal part of the inferior olive and upward to the spinal root of the glossopharyngeus. The position of the lesion explains the extensive involvement of the ambiguus.

Concerning the disturbance in the pain and temperature senses, it is apparent that the fibers of the spinothalamic and spinotectal tracts must have been damaged. Since the lesion did not extend to the periphery of the medulla, the medial fibers of these tracts must have been principally involved — those for the upper extremity completely and those for the lower extremity to a lesser degree. It is striking that, aside from the corneal hyporeflexia, there were no symptoms of trigeminal involvement.

One learns from these observations and from others cited in the literature that a great variety of clinical symptoms can be produced by occlusion of the posterior inferior cerebellar artery, and that clinical symptoms do not invariably result from destruction of any one part of the medulla. This is seen in the case of the trigeminus in case 2.

Concerning lesions in the lateral part of the medulla, three different vessels must be taken into consideration. The first is the posterior inferior cerebellar artery which, according to Luna, may be absent on one or both sides in a considerable number of persons. The second vessel is the arteria olivoradicularis caudalis. According to observations by Luna on forty cases, this vessel arose from the posterior inferior cerebellar artery in nine and directly from the vertebral in thirty-one. Frequently, the area of distribution of this vessel in the medulla is similar to that of the posterior inferior cerebellar artery. Finally, one must not forget that now and then the vertebral arteries may supply the more ventral as well as the lateral and dorsal areas; so it is almost impossible to classify the enormous number of variations that can occur. Therefore, one must be content to hypothecate a lesion in the lateral part of the medulla in the vascular area of the vertebral arteries without being certain as to which vessel is actually involved.

KAMMAN, St. Paul.

COMBINED FAMILIAL NERVOUS AND MUSCLE DISEASE. A. WERTHEMANN, Ztschr. f. d. ges. Neurol. u. Psychiat. **111**:683 (Dec.) 1927.

About twenty years ago, Birg described the case of the brother of the patient reported in this paper and diagnosed a combined spinocerebellar ataxia with progressive muscular dystrophy. Werthemann's patient had a similar affliction.

The father and mother were blood relatives — uncle and niece. The birth of the patient was normal. He was well until 2 years of age when he began to complain of weakness in the legs; in the ensuing years he developed a waddling gait. Simultaneously, he developed disturbances in the arms and hands, and from the twentieth year he could walk only with support. At that time there was noticed a tremor of the hands and a shaking of the body when he was at rest.

At 29 years of age, shakings of the head and eye developed, and reading was impossible. Examination revealed shaking of the head with severe vertigo, convergent strabismus on the left, horizontal nystagmus and hesitating speech. The upper extremities showed a tremor of the hands; the thumbs were abducted and markedly hyperextended and the interosseal spaces clearly marked. Power was not diminished, but movements in the joints were uncertain and choreiform. Eating and writing were impossible. The legs were extended, the muscles neither atrophied nor hypertrophied, the knees in slight valgus position, the feet in equinovarus, and a marked excavatus with hyperextension of the great toe was noted. Movements of the legs were ataxic. Gait was possible only with support, and Romberg's sign was positive. Sensation was normal; muscle tone was unchanged; the tendon reflexes were lost, and the Babinski sign was mildly positive. The electrical reactions were slightly decreased quantitatively, but there was no reaction of degeneration. The clinical diagnosis was familial Friedreich's ataxia combined with muscular dystrophy.

At necropsy, the brain was found to be very small; it weighed only 974 Gm. The convolutions were small, especially in the frontal and occipital regions. The cerebellum too was small. On gross examination the spinal cord was noteworthy because of its thinness, especially in the thoracic region. In the lumbar and sacral regions, the cord had almost a cylindrical form. The anterior and posterior roots below the cervical region were thinner than normal. The ischiadic nerves were small. The same was true of the peroneal and tibial nerves; all of them were overgrown with fat. The brachial plexus seemed normal. The musculature of the lower extremities was markedly changed; it was filled with fatty tissue. The pelvic musculature had almost disappeared. The iliopsoas and abdominal muscles were much thinned out and overgrown with fat. The muscles of the chest and upper extremities were in good condition, as were the muscles of the back.

Microscopic examination of the spinal cord showed a general diminution in the size of both the gray and the white matter. In all sections of the cord there was a symmetrical degeneration of the columns of Goll. In the columns of Burdach there was some degeneration which was more marked in the lower portions and involved the peripheral fibers, leaving the more central fibers intact. The column of Flechsig was degenerated, but not wholly, and so also was the lateral column. The posterior roots were entirely demyelinated. The ganglion cells of the anterior horns, particularly in the lower sections of the spinal cord, were diminished in number. Furthermore, the cells of Clarke's column could not be found in any area of the cord. The cells themselves showed various stages and types of degeneration, with a fatty infiltration of the cytoplasm. The cerebellum showed a markedly reduced molecular and granular layer. The layer of Purkinje cells was markedly changed; the cells were few and those remaining were degenerated; they were filled with fat droplets, had no nucleus, and were shrunken. Degeneration of the fibers in the cerebellum was not visible, but the white matter was reduced in size. Changes were not seen in the dentate nuclei, which, in contrast with the rest of the cerebellum, were well developed. The cerebellar peduncles did not show any evidence of fiber degeneration.

The basal ganglia were carefully studied because of the presence of choreiform movements in the patient. The caudate nucleus showed changes in the posterior field, the other parts being normal. In the posterior portion, degenerated ganglion cells were plentiful. The large cells in particular were involved. Similar changes were found in the putamen, but here the process was much more marked. The small cells especially were involved, and neuronophagia was evident. Large

ganglion cells were few in number. The pallidum showed mild changes in the ganglion cells; the thalamus, however, was most markedly involved. Severe degeneration could be demonstrated in all the cell groups. Changes of various sorts were seen in the cell, from shrinking to swelling of the cells and even to the formation of shadow cells. The normal fibrillar network had disappeared in the cells and neuronophagia was rampant. Severe changes in the cell, leading to sclerosis, were seen in the cell groups of the subthalamic region. Neuronophagia was active here also. The substantia nigra also showed severe changes in the cell. Thus, most of the basal ganglia were involved, the thalamus being more implicated than any other parts.

The muscles of the calf and the biceps were examined microscopically. The calf muscle was completely degenerated. Muscle fibers were not visible. Only fat could be seen, with many vessels and a rich network of connective tissue. In only one place was a thin bundle of atrophied muscle fibers visible. The biceps muscle, which had appeared normal on gross examination, was also partially degenerated on microscopic view.

In addition, there was severe degeneration of the peripheral nerves. Myelin sheath stains did not reveal a normal fiber. The nerve fasciculi were replaced by fat and connective tissue, and axis cylinders were no longer present. This was true especially of the nerves of the lower extremities. Those of the upper extremities, which seemed normal on gross examination, also showed widespread degeneration, which was not so pronounced as in the nerves of the lower extremities, but normal axis cylinders were not present.

ALPERS, Philadelphia.

THE BLADDER IN TABES. E. D'ARCY MCCREA, Irish J. M. Sc. **6**:658 (Nov.) 1928.

Bladder symptoms in tabes may be continuous or periodic (Schaffer). The symptoms are: (1) vesical paralysis, (2) incontinence, (3) frequency, (4) vesical anesthesia and (5) vesical or urethral crises (Fournier). The author in a review of thirty cases divides them into: (1) paralytic, (2) incontinent and (3) a small group with mixed symptoms. Cystoscopy may supply three valuable symptoms: two positive and one negative: (1) there may be trabeculation, which Thomson Walker attributes to atrophy; (2) the bladder may appear to taper into a dilated and funnel-shaped posterior urethra, the condition being attributed to paresis of the vesical sphincter; (3) the cause of the symptoms may not be discoverable. The funnel neck was found in one or at most two of the author's cases, but Burns points out that it is rarely found in treated patients, to which class most of the patients in this series belonged. Trabeculation was found to be inconstant and did not bear any relation to the severity or the type of symptoms. Other cystoscopic observations were: (1) complacency on passing instruments and lack of need of an anesthetic; (2) the presence of residual urine; (3) the bladder abnormally filled; (4) deformity showing in the cystogram. From his experience, the author has formed the opinion that the paralytic and incontinent types are not merely stages in the development of a syndrome, but that the patients who are incontinent commence and remain incontinent, and that the paretic type remains paretic.

Resection of the posterior sacral roots was carried out in animals by Barrington, Burns and Dennig, who afterward observed the changes in the bladder. Dennig's late results are quoted. Following voluntary micturition, there invariably occurred an involuntary act unnoticed by the animal, and immediate catheterization yielded residual urine. Dennig's conclusions were: (1) A slight degree of incontinence followed the operation; (2) involuntary micturition always occurred; (3) voluntary micturition was difficult; (4) the stream was interrupted, and (5) residual urine was present. Vesical sensibility was diminished. In addition, absolute loss of vesical sensibility followed if the hypogastric nerves were divided. The "funnel neck" developed after operation. When these results are compared with clinical observations on man, it is found that they agree fairly closely with those of the

paralytic bladder, but they present, in addition, incontinence and diminution of urethral sensibility, which are found with the incontinent bladder. Sacral or caudal anesthesia in man is nearest in its effects to section of the posterior sacral roots in animals.

The author discusses the normal acts of micturition, based on the review of Fearnsides and the work of Barrington. Reflex micturition is made up of the following components: (1) rise of intravesical pressure; (2) afferent impulses along the pelvic nerves; (3) reflex discharge of pressor impulses to the bladder by the pelvic nerves; (4) inhibitor impulses to the urethra and internal vesical sphincter by the pudic and pelvic nerves; (5) further relaxation of the urethra caused by the flow of urine through it, the nerve fibers lying chiefly in the pudic nerves; (6) further vesical contraction through the pelvic, pudic and hypogastric nerves; (7) emptying of the bladder, and (8) contraction of the muscles around the urethral canal to empty it. The author believes that the internal vesical sphincter contains striated as well as unstriated fibers, and it is the voluntary relaxation of these which initiates "micturition without desire." When the urine enters the urethra, desire is felt and reflex evacuation continues.

An advanced degree of tabes involving the bladder should, in theory, approach the condition found after section of the posterior sacral nerve roots, for in tabes the root fibers of the posterior ganglion cells are first affected, then the cells themselves and lastly the afferent fibers of the peripheral nerves. In practice, however, one rarely finds the complete picture. The first explanation offered for this is that the detrusor and sphincter muscles suffer unequally; if this were true, mixed paretic and incontinent symptoms should be the rule. The second theory, to which the author holds, is that the varying clinical types depend on the relative involvement of the autonomic pelvic (nervi erigentes) and the pudic nerves. The reflex is interfered with on its afferent side. As the efferent path remains intact, imperfect voluntary sphincteric control may be retained, and so external stimuli — sensory and psychic — may act on the viscus. When the posterior roots of the pelvic nerves are destroyed, the sense of distention is lost, the reflex arc is interrupted and atony of the bladder and of the involuntary component of the internal sphincter results, and paralytic symptoms ensue. The intact pudic nerves and the voluntary path to the sphincters preserve urethral sensibility, and, while reflex micturition is impaired, micturition without desire is complete although hindered by the atonic detrusor. When the pudic nerves are involved, urethral sensibility, the main guard against incontinence, is diminished, and the reflex act also is impaired. Reflex micturition is reduced to the primary detrusor contraction with coordinate sphincteric relaxation, and emptying may be incomplete, as the secondary contraction, induced by the flow of urine along the posterior urethra, is lacking and urethral relaxation only partial. Later the absence of secondary contraction and increased urethral resistance may lead to an hypertrophy followed by dilatation and atony of the bladder.

PETERSEN, Montreal.

EXPERIMENTAL INVESTIGATIONS OF CARBON MONOXIDE POISONING OF THE CENTRAL NERVOUS SYSTEM. A. MEYER, Ztschr. f. d. ges. Neurol. u. Psychiat. **112**:187 (Jan.) 1928.

Few studies of an experimental nature have been made in carbon monoxide poisoning. In 1921, Photakis made such a study and found hyperemia of all the vessels in acute cases. He found also hemorrhages in the basal ganglia, which, when death ensued several days later, had become softenings in the same areas. In chronic cases there were bilateral symmetrical softenings in the basal ganglia. He did not make any differentiation between different parts of the lenticular nucleus in his description of the softenings. Meyer, therefore, undertook a careful pathologico-anatomic study of the effects of carbon monoxide poisoning in animals, with little emphasis, however, on the clinical aspects of the question. His experimental animals consisted chiefly of dogs, with an occasional cat. The histologic changes in nine animals are carefully reported.

The pallidum is affected in the carbon monoxide poisoning in experimental animals just as in the human being. The foci are sharply demarcated from the putamen and internal capsule, although they may show a slight tendency, just as in man, to overstep the boundary, especially with regard to the capsule. Sometimes there may be foci of degeneration in the caudate nucleus and pallidum, and in one case there were foci in the internal capsule. The location of the foci varies in the pallidum. In some cases only the innermost section may be involved. In one case, only the dorsal tip of the oval part of the pallidum was most involved. In addition, there were total degenerations of the anterior parts of the pallidum. Thus, while the foci are within the pallidum, the form of the focus is variable. Meyer says that in every instance the most posterior parts of the pallidum were either completely intact, or else marked shading off of the process occurred in this region. In a few cases, the condition of the pallidum was slight and was much less than other changes. In one case, there was a severe change in the head of the caudate nucleus, while the pallidum, except for a mild proliferation of the protoplasmatic neuroglia, was intact. In another case, the pallidal changes were much less severe than in the depths of the cortex and white matter.

Similar changes are found in cases of carbon monoxide poisoning in human beings. Meyer says that, despite these mild changes in the pallidum in certain cases, the softening of the pallidum in man and animals is a constant observation. This predilection of the pallidum in man and animals speaks against the hypothesis of Kolisko that the changes in the pallidum in man are due to poor blood supply as a consequence of overgrowth of the cerebral hemispheres. Yet in animals, in which the cortex is less well developed, similar changes occur. Meyer believes there is a relation between the deposit of pseudocalcium in the vessels of the anterior two thirds of the pallidum and the establishment of carbon monoxide foci in the same region. This is similar to the conception of Lewy and Spatz who do not believe that the deposit of calcium is pathologic, but that this deposit causes a decrease in the function of the vessels. Spatz has shown that the iron deposit also is heavier in the anterior two thirds of the pallidum than in the posterior third. Meyer did not find evidence of pseudocalcium in the vessels of the pallidum, nor was the iron deposit as heavy in animals as in man. Despite these differences, an involvement of the anterior two thirds of the pallidium was noted in Meyer's animals just as in man. Meyer states definitely that it is not known exactly why the pallidum is so vulnerable in cases of carbon monoxide poisoning. It can be said that the changes occur in an area of definite blood supply.

Besides the changes in the pallidum, those in the lowermost parts of the cortex and in the corpus callosum are constant. Meyer reported a case in which the hemispheral changes were the outstanding observations. Meyer says, from the standpoint of the frequency of occurrence of hemispheral changes, that the hemispheral changes are hardly less frequent than the changes in the pallidum, at least in animals. In certain cases in which the cortical and callosal changes are marked, those in the pallidum are slight. The changes in the white matter of the cortex spare the fibers markedly. On the one hand, the foci spare the *U* fibers and, on the other hand, penetrate into the lower cortical layers. In certain cases in human beings the uppermost part of the white matter and the lowermost part of the cortex were involved. There is a diffuse condition of the pia and the layer of the cortex underlying it in every case.

In addition to the changes in the pallidum and the cortex, there are few changes of any localizing value. Often the anterior part of the caudate nucleus was involved. In one instance, the changes in the caudate were more marked than those in the pallidum. The putamen showed mild foci in another case. Once the substantia nigra was totally destroyed, and this foci involved the corpus luysii. The cerebellar cortex did not show any changes except in one case. In another case, there were severe changes in Sommer's sector of Ammon's horn. This lack of changes in the cerebellum and cornu ammonis is surprising in view of the observations in cases of human beings. Two possibilities present themselves:

(1) that the incidence of foci in these areas has been overemphasized; (2) that in animals different relations prevail.

The vascular changes were of great interest. There was a marked productive endarteritis with infiltrative changes in the adventitia (lymphocytes, plasma cells and swollen adventitial cells).

ALPERS, Philadelphia.

ALTERATIONS OF BRAIN VOLUME AND BLOOD VOLUME. EDITORIAL, J. A. M. A. **90**:1630 (May 19) 1928.

In 1919, Weed and McKibben (Am. J. Physiol. **48**:512 and 531 [May] 1919) of the Johns Hopkins Medical School published a striking report of the significant demonstration that it is possible to reduce the cerebrospinal fluid pressure and diminish the bulk of the brain by injecting a hypertonic solution into the blood stream. Conversely, they found that hypotonic solutions had the opposite effect: a rise of cerebrospinal fluid pressure and an increase of brain bulk. These observations have repeatedly been verified. The original investigators realized that the ease and rapidity of these changes in brain volume are of considerable interest in view of the old idea of the incompressible character of the brain and its relation to the conception of a constant vascular volume within the cranial cavity. They concluded that the changes in size are independent of the volume of the fluid injected and are probably due to fundamental osmotic effects of the hypotonic and hypertonic solutions.

The clinical bearings of these studies were soon appreciated, particularly in relation to the states commonly referred to as "pressure symptoms." Cushing and Foley (Proc. Soc. Exper. Biol. & Med. **17**:217, 1920) of the Harvard Medical School were able to apply the procedure of Weed and McKibben to patients with increased degree of intracranial tension. It was felt that the undesirable effects on pulse, respiration and blood pressure of such intravenous injections might contraindicate their use. For this reason the effects of gastro-intestinal doses of hypertonic solutions were studied. In a large series of animal experiments it was demonstrated that practically the same effects may be obtained by the gastro-intestinal route of administration. By this method the intracranial changes are not attended by disturbances of pulse, respiration or blood pressure; also the possible alterations of the cellular elements of the blood are avoided. In patients with brain tumor and cerebral hernia subsequent to decompression operations Cushing and Foley observed a lowering of tension when hypertonic saline solutions were given by mouth. Occasionally striking results could be obtained, in which case the tense convex protrusion became a soft concave area over the decompression site.

It is logical to assume that a decrease in brain volume such as has been described is caused by a withdrawal of water from its substance with liberation into the blood stream. There is experimental evidence that other organs too, notably the muscles, give up part of their water content at the same time. It is assumed, therefore, that the water content of the blood, and hence its volume, is thereby increased. The validity of these deductions has just been established at the University of Louisville School of Medicine by Kinsman, Spurling and Jelsma. Following the intravenous administration of hypertonic solutions there is a temporary rise in the cerebrospinal fluid pressure, which is followed by a consistent fall, varying in degree with the amount and the hypertonicity of the solutions injected. There is a marked and immediate fall in the specific gravity of both whole blood and serum, following the intravenous administration of hypertonic solutions. Estimates have been made by Kinsman, Spurling and Jelsma of the volume of fluid that may enter the blood under the conditions that lead to reduction of cerebral volume. In man the volume is estimated to vary from 300 to 1,000 cc. (from 7 to 19 per cent of the blood volume). The extent of the increase is closely correlated with the molar concentration of the blood in terms of the substance injected. Hypertonic solutions of dextrose also were employed with success. Indeed, the Louisville surgeons conclude that as there seems to be slight appreciable difference in the efficacy of dextrose versus saline solution in reducing

the pressure, and since clinically dextrose is not productive of any apparent ill effects on the patient, while saline solution may be, for practical purposes dextrose is preferable to saline solution for use in lowering intracranial pressure.

CHAMBERS, Syracuse, N. Y.

STATUS LYMPHATICUS. DAVID MARINE, Arch. Path. **5**:661 (April) 1928.

This article is a comprehensive review of present knowledge of the problem of status lymphaticus. Status lymphaticus may be defined as a constitutional defect, usually congenital (although it may be acquired), dependent on an inadequacy of some function of the suprarenal glands, the sex glands and the autonomic nervous system and associated with lowered resistance to a great variety of nonspecific, physical and chemical agents. Anatomically, it is characterized by delayed involution or hyperplasia of the thymus, hypertrophy and hyperplasia of the lymph glands and lymphoid tissue of the various organs, underdevelopment of the chromaffin, gonadal and cardiovascular systems and by certain peculiarities of external configuration.

At present, it is believed that the reticulum and Hassall's corpuscles of the thymus are the only elements derived from the original epithelial anlage, while the small cells and eosinophils arise from mesenchymal cells that have migrated into the epithelial structure from the surrounding tissues. Despite their resemblance to lymphoblastic cells, there is still doubt whether the small thymic cells are true lymphocytes. Anatomists, in general, agree that the absolute weight of the thymus increases rapidly up to the end of the second year of life, remains stationary till the seventh year, and then increases slightly up to the eleventh year. Atrophy sets in at puberty and proceeds rapidly for the first four or five years. Later it becomes more gradual. New reticular cells, Hassall's corpuscles and small thymic cells continue to be formed during involution, but at a greatly decreased rate.

The function of the thymus is unknown. There is no proof that it produces an internal secretion. It seems to play some rôle in the maintenance of normal nutrition. Probably because of the difficulties of complete removal, the occurrence of infection and the presence of accessory thymic tissue, there is no definite knowledge of the effect of removal of the thymus. All observers agree, however, that the thymus is an important source of blood lymphocytes and possibly of eosinophils.

There is no known disease entity in which the thymus occupies the central or causal rôle. Status lymphaticus seems to be a nutritional deficiency disease tending toward spontaneous recovery and manifesting itself at different ages. There is no constant marked anatomy. The lesions observed are distributed over the whole body, and their relative importance cannot be evaluated. The thymus is usually larger than it should be, but authorities are not agreed on its histology. In some cases the parenchyma is increased, in others sclerotic changes have been found. Hyperplasia of the medulla is fairly characteristic, while the cortex may be atrophic.

The spleen is moderately enlarged. The malpighian bodies are prominent. The endothelial elements are hyperplastic. The pharyngeal, thoracic and abdominal lymph nodes are enlarged, and there is hypertrophy of the oral and nasopharyngeal lymphoid tissues. The bone marrow often shows changes. The thyroid gland is enlarged. The suprarenals are small, and the chromaffin tissue is reduced in amount. Significant changes are not observed in the sex glands. The cardiovascular system is underdeveloped. The blood shows a relative lymphocytosis. There are marked disturbances in ossification of the bones.

There is a close association between rickets and status lymphaticus. The close relationship between status lymphaticus and lowered resistance to a great variety of physical and chemical agents is one of the most outstanding characteristics. There are no constant or characteristic clinical symptoms by which the

condition can be diagnosed. There is urgent need for some drug that would indicate the presence of hypersusceptibility as an aid to the diagnosis of status lymphaticus. The immediate cause of death is stoppage of the heart. MacLean and Sullivan have advanced the theory that status lymphaticus is due to suprarenal insufficiency.

PEARSON, Philadelphia.

WHY DO THE CONDUCTION PATHS IN THE CENTRAL NERVOUS SYSTEM CROSS?
L. JACOBSOHN-LASK, Ztschr. f. d. ges. Neurol. u. Psychiat. **112**:317, 1928.

Several theories have been propounded to explain the crossing of the pyramidal tracts; of these only the theories of Cajal and Spitzer are discussed. Cajal derives the crossing of the tracts in the central nervous system from the optic decussation in vertebrates. According to his view, these are isolated connecting fiber systems which occur first in vertebrates, it is in vertebrates also that crossing fibers first occur. As a result of the great predominance of visual fibers in lower animals, the crossing first took place in the form of the optic chiasm, and other fiber tracts, in the course of phylogenetic development, adapted themselves to this crossing. Cajal says that the crossing of the optic fibers was essential because otherwise one would project an inverted image on the cortex and this would appear in consciousness as inverted. Jacobsohn-Lask criticises Cajal's theory on various grounds: 1. Cajal has too lightly evaluated the relations in invertebrates. 2. It is not the visual organ which is the predominant one in lower animals, but rather the olfactory organ. 3. If Cajal's theory is true, fibers should cross in the vertical as well as the horizontal plane. They do not do so. 5. It is improbable that a single decussation has affected all the "fibre tract" decussations. The process was probably a general one.

Spitzer traced the development from invertebrate to vertebrate animals. According to his assumption, the animal body in the course of this development has rotated about 180 degrees on its long axis in its posterior portion. By this process the dorsal part of the original entrodermal sac has been rotated ventrally, and the ventral sac dorsally. The point of rotation was at the anterior pole of the chorda dorsalis. The dorsally rotated segment of the entrodermal sac developed into the neural tube and became a central nervous system which originally consisted of two longitudinal bundles. In the rotation of the body these bundles crossed, and all other decussations had their origin from this original crossing.

Jacobsohn-Lask brings new evidence to the problem. He states that the evidence of many investigators shows that nerve tracts in invertebrate animals do cross for the most part. This crossing is noticeable earliest in animals with a metameric and bilateral body arrangement, with a concentration of the nervous system in the longitudinal and transverse sections. The nervous system of the lowest invertebrates is a diffuse network of nerve cells and fibers, and is situated in the wall of the ectodermal sac. Consequently, a stimulus, either external or internal, is spread in all directions through the body and causes a reaction of the whole body. In further development the nervous system is concentrated within the body in accordance with metameric arrangement. While the diffuse nerve net remains in the position already mentioned, there is, in addition, a concentrated longitudinal nerve structure within the body, with collections of nerve cells therein corresponding to body segments. With this segmentation, there first begin isolated movements of the body. Some of these fibers are crossed, and some are uncrossed. The view of Cajal therefore that the decussation was first total, and then later became partial, is not true. It is much more likely that the decussation was first partial and later became total in certain instances due to certain definite circumstances. With the further advance of the animal the concentration of the nervous system internally became more marked, and the collection of ganglion cells became more pronounced in accordance with the metameric arrangement, leading finally to the formation of ganglia and their tracts. The central nervous system forms, therefore, a collection of ganglia of which the most anterior, the brain ganglia, are the most voluminous. In these lower animals, some of the fibers cross and

some remain uncrossed. Jacobsohn-Lark says that the metameric arrangement may be distinct, but that segments may coalesce. So long as the ganglia are regular in regard to segments the crossing fibers are merely commissural fibers, while, when they coalesce, the crossing becomes more pronounced. These crossing fibers connect areas which are far removed, and if they connect important sense organs they become numerous. Jacobsohn-Lask says that the decussation of fibers occurs in invertebrate as well as in vertebrate animals. The crossing tracts have their common origin in the ground nerve net of the lower animals, and the majority of the nerve fiber tracts are only partially crossed.

ALPERS, Philadelphia.

SPECIFIC READING DISABILITY-STREPHOSYMBOLIA. SAMUEL T. ORTON, J. A. M. A. **90**:1095 (April 7) 1928.

Various causes have been ascribed for cases of children with a more or less selective difficulty in learning to read. In 1885, Berkham assumed a general relationship between difficulty in reading and mental defectiveness. Soon after, however, cases of disability in reading in children of normal intelligence were reported, and Morgan, in 1896, named the condition, which he considered a specific disease entity, congenital word blindness. Psychologic studies have pointed out unstable attention and short memory span for letters as causative factors. The functional school of psychiatrists have called attention to emotional disturbances.

Orton, while conducting a mental hygiene clinic, found fifteen cases of disability in reading in 125 patients. The intelligence quotients ranged from 71 to 122. There were thirteen boys and two girls, and Orton states that this same disproportion holds true for stuttering. Certain features common to the group were: (1) difficulty in differentiating *p* and *q*, and *b* and *d*; (2) a tendency to confuse pallindromic words like "was" and "saw," and "not" and "ton," and to reverse paired letters or even whole syllables or words in reading, so that they were read from right to left rather than from left to right; (3) a certain capacity for mirror reading; (4) a greater facility in producing mirror writing. There was not any usual defect in the ordinary sense, nor was there any retardation or difficulty in calling the names of objects and pictures promptly and quickly.

The dysfunction exists at the third level of visual elaboration, in which association between the printed or written word and its concept takes place. Difficulty with auditory memory is not observed.

The first level furnishes external awareness. The second level is that of objective memories. A bilateral lesion is required to suppress completely the function of either of these levels. At the third or associative level, however, destruction in one cerebral hemisphere may result in acquired word blindness, while exactly the same lesion in the opposite hemisphere does not produce any symptoms. The usual records of one side only are used in symbolic association —those of the other side are elided or inactive. Structurally, however, such a contrast does not exist between the two hemispheres. A record is produced in the cells of the nondominant side which is the mirrored or antitropic pattern of that produced in the dominant side. Usually only the engram of the dominant hemisphere operates in reading, that of the opposite side being elided. If this elision were not established, then the persistance of the nondominant engrams would account for failure to differentiate *p* and *q*, was and saw, and would account for facility in mirror reading and writing. Orton offers the term strephosymbolia, or twisted symbols, in place of congenital word blindness.

Orton's preliminary study led him to conclude that disability in reading forms a graded series in severity; that it is not related generically to mental retardation; that it is explainable not as a pathologic condition, but rather as a variant in the establishment of the physiologic dominance in the hemispheres, and that, therefore, proper retraining methods, if started early enough, may be expected to overcome the difficulty.

The foregoing beliefs were put to the test in a study made through a grant from the Division of Studies of the Rockefeller Foundation in which the tenets

that have been stated were well supported in 175 cases of disability in reading. The striking fact is that 2 per cent of the total population are shown in this survey to have disability in reading. The author calls attention to the relation of emotional disturbances to this condition.

Orton offers a few suggestions as to retraining methods. He believes that stuttering may be on the same basis.

CHAMBERS, Syracuse, N. Y.

A CASE OF FACIAL NEURALGIA ASSOCIATED WITH PULMONARY ABSCESS. R. C. HUTCHINSON and J. S. B. STOPFORD, Lancet **1**:494 (March 10) 1928.

The case reported is that of a woman, aged 39. She gave a history of slight hemoptysis at 10 years of age. From 1914 onward, she had a cough and occasionally staining of the sputum. In 1917, she had pneumonia of the upper lobe of the left lung and the fever persisted for six months. In 1918, she again had pneumonia in the same lobe and convalescence was again slow. In March, 1924, she was found to have a definite pneumonic consolidation of the upper lobe of the left lung. From that time she had cough, slight fever and sputum which was negative for tubercle bacilli. From 1919 to April, 1925, when she was admitted to the hospital, she had repeated attacks of hemoptysis. On admission, there were signs of a cavity in the lower and anterior part of the upper lobe of the left lung, confirmed by x-ray examination which suggested that the cavity was adherent to the pericardium. The walls of this abscess cavity were so rigid that artificial pneumothorax failed to collapse it. In August, a single broad diaphragmatic adhesion was noted and as this was thought to be an additional cause for the troublesome cough a left-sided phrenicotomy was performed. Less than ¼ inch (1.27 cm.) of the nerve was resected. An x-ray report on October 3 stated: "The diaphragm has not lifted in the chest; it shows a paradoxical movement — inspiratory rise, very slight expiratory fall. There is apparently a very definite lateral decrease in the size of the cavity." On Jan. 1, 1926, the patient developed neuralgic pain at the inner left canthus and along the left nasal bone. There was pain and some tenderness over the upper border of the left trapezius and in the hollow of the left shoulder. When the patient coughed and expelled sputum the pain diminished, sometimes disappeared; after a period when she did not cough, and when secretion accumulated in the lungs, it was invariably worse. Death occurred in March, 1926.

Any explanation of the cause of the facial neuralgia and the reflex pain in the shoulder must be founded on the assumption that the phrenic nerve was at that time capable of conveying afferent impulses to the central nervous system. Three possible explanations are offered: 1. Some fibers of the phrenic nerve may have crossed the gap and descended the distal segment of the nerve to reach the vicinity of the abscess; this is highly improbable. 2. Fibers from the distal end of the proximal segment may have sprouted out into the surrounding deep tissues, and some may have passed down between the fascial planes in the thorax and so extended to the neighborhood of the abscess. The short time which elapsed between the phrenicotomy and the onset of pain seems hardly enough to allow for this. 3. Probably the most likely explanation is the occurrence of an accessory phrenic nerve. This arises usually from the fifth cervical nerve and, after passing in front of or behind the subclavian vein, joins the main trunk near the thoracic inlet or in the thorax, which would be distal to the level of the section performed.

The pain in the shoulder is explained by the connections between the central terminations of the accessory phrenic and the central connections of the descending cutaneous branches of the third and fourth cervical nerves which are distributed to the skin in the region where the pain was experienced. The facial neuralgia must involve connections between the phrenic and the central terminations of the trigeminal nerve. The spinal nucleus and tract of the latter descends well into the cervical cord, at least as low as the second cervical segment. The caudal part

would be the segment nearest the central fibers of the phrenic and this probably explains the localization of the facial pain, inasmuch as the caudal part of the spinal nucleus receives fibers only from the ophthalmic division.

PETERSEN, Montreal.

ANATOMY OF THE BRAIN FROM A CLINICAL POINT OF VIEW. FRIEDRICH VON MÜLLER, Am. J. M. Sc. **175**:1 (Jan.) 1928.

The author describes the anatomy of the surface of the brain and of its internal configuration. The corpus callosum acts as a bridge between the two hemispheres and allows their cooperative function. Destruction of the posterior part causes mental blindness. Below the corpus callosum is the third ventricle which is surrounded by central gray matter, supposed to be the seat of the elemental vital and vegetative functions of life. On each side of the third ventricle is the thalamus opticus and nucleus caudatus covered by the tela choroidea. The tela is rich in sensory fibers; pressure on it is supposed to cause headache.

The thalamus is the center for sensation, including sense of exhaustion, fitness, pleasure and aversion. It may also be the center for sleep. Conductive paths lead from the thalamus to the nucleus lenticularis, which in turn is connected to the nucleus caudatus. The gray matter of the caudate and putamen are of the same character and have the same structure as the third layer of the cortex. They are called the striatum and do not have any connection with the cortex. The striatum receives fibers from the thalamus and sends fibers to the pallidum. The fibers in the pallidum are myelinized at birth, while those of the putamen are not. Optic and acoustic paths are fully developed at birth; the unborn child is able to hear and has coordinated movements of the eyes, which shows the correlation of function and physical development.

A new-born child represents a thalamopallidal animal, because a reflex can be established from the sensory thalamus to the motor pallidum by ansa lenticularis; all the fibers of these are myelinized at birth. The medulla, pons and peduncular region are also myelinized at birth, and in this region are located centers for respiration, circulation, sucking movements and movements of the head and eyes.

The rubrospinal pathway—the pallidum to the corpus Luysii to the nucleus ruber to the rubrospinal tract in lower animals—functions in man after destruction of the pyramidal tract. It has been noted that after destruction of the ganglion cells in the basal ganglia, corpus Luysii, substantia nigra and olive, and to a certain extent in the nucleus lentiformis, as in encephalitis, there is abolition of automatism, rigor of muscles and loss of emotional expression.

Symptoms of both hypokinesia and hyperkinesia may occur in lesions involving various parts of the extrapyramidal system. Degeneration of the caudate and putamen results in hyperkinesia, athetosis and chorea; so it is inferred that the automatic movements of the pallidum are inhibited by these structures.

It is thought that there are definitely located centers for vital functions and that these centers are activated by physical and chemical means. The position of these centers has not been determined. The author states that the "vital energy," the mainspring of the organism, is not located in the cortex but in the ductless glands. Mentality is influenced by the physical state. Psychic processes not only are located in the brain cortex, but are the result of function of the entire organism.

WAGGONER, Philadelphia.

CONVULSIONS IN EPIDEMIC ENCEPHALITIS. THE QUESTION OF SO-CALLED "SUBCORTICAL EPILEPSY." G. SOKOLANSKY, Ztschr. f. d. ges. Neurol. u. Psychiat. **112**:603 (Feb.) 1928.

In spite of the manifold symptomatology of epidemic encephalitis, paroxysms or attacks of one sort or another are rare. Neal, Henry, Jackson and Appelbaum did not find a single case with attacks in a series of 450 cases. Paroxysms of

the eye muscles have been observed frequently. Van Hogaert and Nipsen observed bradykinetic movements of the tongue and tonic labiopalatopharyngeal and cervical spasms in epidemic encephalitis. Westphal observed dyspneic attacks in this disease. Benedek described convulsive attacks with delirium as a postencephalitic hyperkinesis. Minz, Glaser and others described typical attacks of epilepsy in cases of encephalitis. Schuster observed a case which began with shouting, ocular spasm and general tremor, and later developed tonic spasms.

Sokolansky reports a case of postencephalitic parkinsonism with peculiar attacks. Subjectively, before the attacks came on, the patient experienced pain in the heart, a marked feeling of anxiety and a desire to die. He asked for poison and requested that he be put to death. His attacks began with tonic spasms of the eye muscles, the eyes looking upward and to the left, so that the pupils remained half covered by the eyelids and remained in this position until the end of the attack. Then there followed a general tremor which passed over into severe general convulsions of a myoclonic character and were so severe that the patient was thrown upward in the bed. The saliva flowed freely, perspiration broke out, and the pulse rate rose to from 110 to 120 per minute. The patient, who could not otherwise get out of bed, jumped out during such an attack, and ran along the corridor, striking and spitting about. Despite the fact that he was put back to bed, these myoclonic attacks persisted and he secreted much saliva. Consciousness was completely maintained in an attack. The attacks lasted for four or five hours, with paroxysms of from fifteen to twenty minutes' duration and pauses of from five to ten minutes between paroxysms. Toward the end of the spasm the single paroxysms became shorter and the intervals between them longer, until the paroxysms finally ceased. The spasms were always the same and always occurred at intervals of from six to eight days. After an attack the patient complained of pains in the region of the heart. Hyperosis was without effect.

Sokolansky does not believe these attacks were epileptic or hysterical. He looks on them as subcortical convulsions. Wimmer described such attacks as "striate epilepsy" with hemispastic tonic convulsions and torsion movements of the body. Consciousness was retained and salivary flow was free. Marinesco and Radovici observed convulsions in a few cases of epidemic encephalitis in which the eyes turned to the right and upward, the muscles of the neck were spastic, generalized tremor was present and consciousness was clear. Sterling has also described cases of "subcortical epilepsy" of a spasmodic and pseudotetanic nature, without loss of consciousness.

ALPERS, Philadelphia.

ESSENTIAL NARCOLEPSY AND SYMPTOMATIC NARCOLEPSY OR LETHARGY. G. R. LAFORA, Arch. de neurobiol. **7**:49 (March-April) 1927.

Two cases of genuine narcolepsy and a rare case of symptomatic narcolepsy of unknown origin are described.

Case 1 was that of a man, aged 35, who suffered from frequent attacks lasting sometimes one or two hours. On some occasions, especially during periods of emotion, the patient felt sudden debility in the legs, an important symptom of true narcolepsy. Nothing abnormal was found in the somatic nervous system. The blood showed increase in lymphocytes and neutrophilic polymorphic cells. The urine showed excess of purin bases and no skatoxyl. The Wassermann test was negative, and there were no signs of congenital syphilis, although the patient was the son of a syphilitic father.

Case 2 was that of a boy, aged 13, the son of an alcoholic father, who suffered from sudden dizzy spells, which were followed by sleep. Tendency to sleep was present as soon as the patient sat down, and in some cases he fell asleep while standing. Before laughing or crying, he felt debility in the legs, followed by a dizzy spell and sleep. Anti-epileptic treatment with phenobarbital and bromides did not improve the condition of the patient, but some improvement was noticed after administration of calcium chloride ad valerian U. S. P.

Case 3, that of a boy, aged 19, who was strong, tall and thin, was diagnosed at first as a case of psychic epilepsy and treated with phenobarbital. After two months of marked improvement, a clinical picture of narcoleptic attacks of increased severity and length, accompanied by a few epileptic seizures and polyneuritis, presented itself. The disease developed gradually for six months, ending in the death of the patient after several days of deep lethargy with high fever and pronounced tachycardia. Autopsy was not performed. Repeated tests of urine, blood, feces and cerebrospinal fluid gave negative results; the only features in the urine, such as a reduction in the elimination of chlorides and increase in creatine, do not seem to be of enough importance to account for the polyneuritis, narcolepsy and convulsions. Analysis of the cerebrospinal fluid and other clinical data failed to disclose the presence of a tumor or of epidemic encephalitis. On the other hand, serodiagnosis and hemocultures gave negative results, as did inoculations of the cerebrospinal fluid in rabbits.

NONIDEZ, New York.

MODIFICATION OF METASYPHILITIC OCULAR LESIONS BY MALARIA THERAPY. SABBADINI and PISANI, Riv. oto-neuro-Oftal. **4**:682 (Sept.-Dec.) 1927.

The authors report eight cases of tabetic patients who were given the malarial treatment. All these cases presented ocular lesions which varied from slight changes in one or both eyes to severe changes in both eyes. The cases are reported in detail, giving the acuity and fields of vision and the observations of the fundus. These patients were given the usual treatment with malaria; within from one to four weeks after the febrile reaction was completed a reexamination showed definite improvement in vision in four cases, slight improvement in three cases and no improvement in one case. This last case was one of chorioretinitis; in it vision had become worse. The most constant variations as the result of the malarial therapy were found in the visual fields.

The authors also studied the pupillary reflex and found it slightly improved in four cases and not improved in four cases. The patient in one case in which improvement was shown became worse after an intravenous injection of neoarsphenamine, but remained in good condition as far as sight was concerned for twelve months. At this time a reexamination showed a decrease of vision with a central scotoma. He was given a second course of malarial treatment with sudden though slight improvement in sight and five months later he was no worse. Another one of the patients who showed improvement continued to improve under arsenobenzol therapy. Five months after the first examination, the patient did not show any deterioration.

In their summary, the authors state that the scope of their work was to study the modifications of the visual disturbances in tabetic patients who had undergone malarial therapy. They state, further, that definite conclusions cannot be drawn because of the small number of cases. As arrest of the degenerative process of the optic nerve can be considered an extremely favorable result, the value of the malarial therapy will be determined only when more observations are made. They state that up to the present time there have been no favorable results in the treatment of tabetic optic atrophy with specific methods of therapy; it seems to them that malarial therapy should be tried in all cases, especially in early ones. The authors do not have any exact knowledge as to how the malarial therapy influences the process in the optic nerve.

VAIL, Cincinnati.

VESTIBULAR DISORDERS IN SYRINGOBULBIA. J. A. BARRÉ, Rev. neurol. **2**:586, 1927.

The vestibular syndrome is one of the most important in syringobulbia. Rarely lacking, it sometimes dominates the situation, and while not responsible for death, contributes largely to the disturbance in equilibrium and walking and augments

disability. Up to the present, nystagmus has been the principal symptom studied, yet there are other vestibular symptoms that deserve consideration. While vestibular disturbances are not sufficiently characteristic to allow one to distinguish syringobulbia from other diseases of the lateral portion of the medulla, there are certain peculiarities such as gyratory nystagmus which are seldom found in other cases. The location of the fissure is often erroneously diagnosed since the fissures are usually bilateral. It would seem, particularly in view of Leidler's experiments, that the major lesion dominated the clinical picture to the extent of appearing solitary. If all the vestibular symptoms are considered, however, one will find that both sides are represented to varying degrees, and prolonged observation of the syringobulbic patient will allow the proper determination of the condition.

Nystagmus changes both in the type and in the direction as the fissure develops. Lateropulsion and deviation of the extended arms are probably more important in deciding which side is affected. These phenomena are observed almost always on the side of the major lesion and apparently change less than the nystagmus. Differential diagnosis between syringobulbia and other lesions of the medulla may well depend on the slowness in development and the bilateral character since both these are always present in syringobulbia. It is rather remarkable that the symptoms should be so grave when the fissure is so small, but, if one considers that the fissure usually traverses the vestibular area, the explanation for these dominating vestibular phenomena is understood.

The author reports five cases of his own, one of which was followed to necropsy.

FREEMAN, Washington, D. C.

ACUTE ASCENDING LANDRY'S PARALYSIS. L. BRUSSILOWSKI, Ztschr. f. d. ges. Neurol. u. Psychiat. **111**:515 (Dec.) 1927.

Brussilowski reports a case of ascending paralysis. He brings up again the question of whether Landry's paralysis is a disease entity, and says that every case is worthy of report because of the great uncertainty which prevails regarding this question. His patient was a child, aged 2, who awoke one morning unable to move the lower limbs. In two days there was inability to move the arms and the voice was changed; by evening there was complete paralysis of the upper extremities. On the third day after onset, paralysis of all four extremities was complete; on the sixth day after onset death ensued. The pathologic observations in brief were: acute changes in all the cell groups of the anterior horns and of Clarke's columns with a loss of neurofibrils, especially in the sacrolumbar and cervical levels; diffuse degeneration of the myelin sheaths in the cord with degenerative changes in the axis cylinders in form and diameter, amounting at times to complete loss of the axis cylinder and a mild reaction on the part of the neuroglia. Degeneration was present also in the peripheral nerves; here there was destruction of the myelin, with changes in the axis cylinders similar to those found in the central nervous system, except that the entire nerve fiber was not involved, only sections of the nerve being implicated. The lower part of the medulla was similarly involved in the process. Vascular changes were found in the form of mild dilatation of the vessels, thickening of the walls, and almost complete absence of infiltration. Brussilowski states that his case of Landry's paralysis is a combined process in which the maximum changes were in the peripheral motor neuron—anterior horn cells and peripheral nerves. He says that Landry's paralysis is an acute toxic disease of the entire central and peripheral nervous system; it is not a disease entity and should be called Landry's syndrome.

ALPERS, Philadelphia.

PSYCHIC FACTORS IN THE CAUSE OF CARDIAC DISEASE. NELLIS B. FOSTER, J. A. M. A. **89**:1017 (Sept. 24) 1927.

The author included not only obvious disorders of intelligence and reason, but also the less clearly defined personality changes. One finds changes resulting

from organic mental reaction due to cerebral congestion or anemia or to toxic states resulting from cardiovascular failure, and at the other extreme a pathetic failure of adaptation due to personality or constitutional defects. It is well known that sleep is disturbed and broken by periods of semiconsciousness in severe states of cardiac insufficiency. Why this picture occurs in some patients and not in others is not known.

If there is rather generalized arteriosclerosis, one sees transient periods of delirium, delusions, usually of persecution, or maniacal outbreaks. The significance of these symptoms or psychoses is ominous. The more subtle changes that develop in personality on the basis of physical restriction are not easily observed in childhood. Here enters the personal equation—those who, adults as well as children, make the minimum concession to physical defect and at the other extreme the invalid reaction. Notions of heart diseases are probably as clear cut in the minds of the public as any disease.

One sees then, concludes Foster, in severe cardiac diseases: psychic disorders representing toxic or exhaustion psychoses, changes in personality which are only psychic readjustments and lastly emotional states producing physiologic effects which are often interpreted as somatic abnormalities.

CHAMBERS, Syracuse, N. Y.

TUMORS OF THE BRAIN AND SYPHILIS. FREDERICK P. MOERSCH, Am. J. M. Sc. **175**:12 (Jan.) 1928.

The problem of tumors of the brain and syphilis is divided by the author into four parts: 1. The first part concerns positive Wassermann reactions of the blood in cases of tumor of the brain. In a group of 1,000 patients with tumor of the brain, eighteen had positive Wassermann reactions of the blood; thirteen of these were verified and five were unverified. In four, the two conditions were coexistent; in the others, a positive Wassermann reaction of the blood was not considered an index of syphilis. 2. The second part concerned positive Wassermann reactions of the spinal fluid in cases of tumor of the brain. In one of the group of eighteen patients, the Wassermann reaction of the spinal fluid was positive without any evidence of syphilis, and it is assumed that in certain cases of tumor of the brain some physiologic factor may account for the positive Wassermann reaction. 3. Confusion of data such as a pleocytosis and positive colloidal curves do not necessarily rule out a diagnosis of tumor of the brain. 4. Cases are cited in which there was choked disk, headache and vomiting, but with positive serologic reactions; the patients were either cured or improved by antisyphilitic treatment.

Cases of tumor of the brain may be diagnosed as syphilis because of positive serology. On the other hand, cases of syphilis may be diagnosed as tumor of the brain because of choked disks, headache and vomiting when tumor of the brain is not present.

WAGGONER, Philadelphia.

THE RELATION OF ARTERIOSCLEROSIS OF THE CEREBRAL VESSELS TO HYPERTENSION. ORAN L. CUTLER, Arch. Path. **5**:365 (March) 1928.

In order to determine whether the high blood pressure observed in patients with arteriosclerosis and hypertension was the result of an attempt to provide sufficient blood for the vasomotor center the normal supply of which was restricted by sclerosis of the vessels supplying it, the author studied the vessels of the lower part of the pons and the upper part of the medulla of more than forty brains by roentgenograms taken after arterial injection and by microscopic sections, and attempted to correlate the condition of the vessels with the blood pressure records and the amount of cardiac hypertrophy found at autopsy. For roentgenographic study, he found a mass containing 125 Gm. of lead carbonate in 100 cc. of a 12.5 per cent solution of acacia to be the most satisfactory for injecting vessels the lumen of which was less than 25 microns in diameter. In ten of eighteen patients with hypertension, the walls of the vessels were not thickened; in four

there was slight thickening and in four moderate sclerosis. The most marked sclerosis was noted in patients suffering from cerebral hemorrhage. The author concludes that if high blood pressure is due to lack of blood supply to the vasomotor center, the interference is not due to gross anatomic lesions of the blood vessels.

PEARSON, Philadelphia.

THE RELATIONSHIP BETWEEN THE DEXTROSE OF THE BLOOD AND THE SPINAL FLUID: ITS DIAGNOSTIC VALUE. S. KATZENELBOGEN and M. STOILOFF, Ann. de méd. **23**:160 (Feb.) 1928.

The normal quotient "dextrose of spinal fluid: dextrose of blood" is, according to Derrien, approximately 0.5. In other words, the content of dextrose per cubic millimeter of blood is twice as high as in the same amount of spinal fluid. An increase of this factor points to an increased permeability of the meninges for dextrose, and vice versa. Other authors report similar values with the exception of Polonowsky and Duhot, who found a normal quotient of 1.0.

The results obtained in different diseases are condensed in the following table:

Purulent meningitis	0.05 — 0.30
Cerebral abscess (with purulent spinal fluid)	0.27 — 0.34 — 0.36
Mental disease	0.51 — 0.74
Other diseases of the nervous system	0.53 — 0.82
Different other diseases	0.41 — 0.83

The values for the dextrose quotient of the spinal fluid and the dextrose of the blood are similar in different diseases and do not help in establishing a differential diagnosis.

WEIL, New York.

A FORM OF SENILE SEIZURE. HUGH BARBER, Brit. M. J. **1**:492 (March 24) 1928.

The author has witnessed six cases of the following sort of seizure: Without any warning, an apparently healthy elderly person falls down unconscious. There may be some degree of clonic spasm of the face or limbs, perhaps more pronounced on one side. In a few minutes, loud shouting and violent behavior follow, necessitating restraint, but possibly aggravated by it. After a variable time, the patient regains consciousness and reason, although perhaps a little dazed and inconsequent. On full recovery of his faculties, he will say that the whole incident is a blank. The duration of the attack is three quarters of an hour or more. All the patients were between 60 and 75 years of age and five were men. There was some evidence of cardiovascular degeneration and some degree of hyperpiesis, but no serious renal disease. In one patient, anger precipitated the attack; in the others there was no apparent exciting cause. The attacks have not recurred and no other symptoms have made their appearance. It would seem that the attack is due to a slight hemorrhage on the surface of the brain, perhaps below the pia mater, producing coma and cerebral irritation, analogous to what may be seen occasionally after concussion. The one lumbar puncture revealed normal fluid.

PETERSEN, Montreal.

EFFECT OF ONE HUNDRED INJECTIONS OF TRYPARSAMIDE UPON THE SPINAL FLUID IN GENERAL PARALYSIS. HENRY A. BUNKER, JR., Am. J. M. Sc. **175**:265 (Feb.) 1928.

Two questions are discussed: 1. Should treatment be given in an effort to obtain negative serology in cases of asymptomatic neurosyphilis? This is comparable to the treatment of patients with syphilis when there is no evidence other than a positive Wassermann reaction. It is probably better to treat such patients in order to prevent untoward conditions of the future. The patient may have latent paresis or tabes. 2. Should treatment be continued after the maximum possible remission has been obtained by malaria therapy in order to

make the Wassermann reaction negative? It is well to continue treatment in these cases, because the positive Wassermann reaction may indicate a tendency toward later development of syphilitic manifestations. Tryparsamide is considered the best arsenical to use after malaria therapy to obtain sterilization of the cerebrospinal fluid. Twenty-three cases of paresis are reported and analyzed to show that usually 100 injections will be necessary, but that negative serology generally can be expected.

WAGGONER, Philadelphia.

PSYCHIC AND EMOTIONAL FACTORS IN THEIR RELATION TO DISORDERS OF THE DIGESTIVE TRACT. JAMES S. MCLESTER, J. A. M. A. **89**:1019 (Sept. 24) 1927.

McLester, using as a basis 1,000 subjects, believes that about one third of the patients who come to the internist for digestive complaints are of the psychoneurotic type; he does not include those with an obvious psychoneurosis. He believes that the majority of these neurasthenic persons who find their way to the consultant are born and not made neurasthenic. Sexual impulses played small part in initiating the troubles of the psychoneurotic persons studied by McLester. He believes that those situations which bring unhappiness, perplexity and unsatisfied longings do not play the predominating rôle accorded them in psychiatric literature. The digestive distress of the psychoneurotic is genuine, as a rule. The emotions exert a profound influence on digestive functions—both on secretory activity and on what causes the patient distress, disturbance of motility. The association of many obviously unrelated symptoms and their bizarre nature will sometimes tell the tale. McLester then discusses treatment, including a thorough examination, psychotherapeutic procedures and hygienic advice.

CHAMBERS, Syracuse, N. Y.

A CASE OF JUVENILE GENERAL PARESIS. H. R. C. RUTHERFORD, Irish. J. M. Sc. **6**:49 (Feb.) 1928.

A boy, aged 10 years, was admitted to hospital in a restless and elated condition, with grandiose ideas. He had sluggish pupils and increased knee jerks on both sides. At the time of birth the boy had had a rash, which had disappeared under treatment. When the patient was 3 years old, his father had developed mental symptoms, and a diagnosis of general paralysis had been made. The Wassermann reaction with the boy's blood was found to be positive, and he was treated with mercury, arsenic and iodides. The first mental changes noted were an addiction to lying and stealing money. He told stories of extraordinary achievements. One day he knocked down a woman who failed to return his salutation. Then he passed into a state of excitement and violence. After a few weeks he became depressed, but a short time after that changed again into a stage of excitement. The cerebrospinal fluid showed ninety cells, mainly mononuclears, increased globulin, negative Lange and positive Wassermann reactions.

PETERSEN, Montreal.

THE CROSSED ADDUCTOR REFLEX. WEGENER, Monatschr. f. Psychiat. u. Neurol. **66**:342 (Dec.) 1927.

1. Clinical Significance: (*a*) Bilateral crossed adductor response is not pathologic. Unilateral crossed adductor response does not occur in normal persons. (*b*) With unilateral disease of the pyramidal tract, a crossed adductor response is a common concomitant of spastic reflexes. (*c*) Bilateral occurrence with unilateral spastic reflexes does not mean bilateral disease of the pyramidal tract. (*d*) With bilateral disease of the pyramidal tract the crossed adductor response is almost always bilateral.

2. Neurophysiologic Significance: (*a*) The crossed adductor response is a true crossed reflex. (*b*) It represents a functional connection between the two sides; it is always present in latent form; it is closely related to the tendon reflexes.

SELLING, Portland, Ore.

A Brief Discussion of Thalamic Syndrome with a Case Report. E. S. Gurdjian, Am. J. M. Sc. **175**:18 (Jan.) 1928.

A case is reported of a woman, aged 34, who, five days after confinement, noted that suddenly her right side felt as though it were asleep. Although conscious, she was unable to speak for two hours. Dragging of the right foot was present for about one year after the attack. She also had spontaneous paroxysmal pains on the right side. Examination revealed right facial weakness, weakness of continued grip of the right hand, partial astereognosis on the right side, hypalgesia over the right half of the body, although light touch was felt as pain, some loss of sense of motion and position on the right and marked diminution in deep pain and vibratory sense on the right. These symptoms are given as typical of a pure thalamic syndrome.

Waggoner, Philadelphia.

A Relation of Cardiovascular Disease to Hemiplegia. Louis F. Bishop, J. A. M. A. **89**:952 (Sept. 17) 1927.

Bishop stresses the point that the cardiologist wishes to impress the neurologist with the fact that hemiplegia is the end result of a degenerative process and not merely a mechanical accident. He states that exercise has been postponed too long after hemiplegia occurs because of an inordinate fear of high blood pressure and believes that hemiplegic patients who maintain a compensatory high blood pressure have done better than those who remained of the asthenic type. He speaks emphatically concerning the abuse of the rest cure in organic disease.

Bishop instructs patients with coronary disease of the heart that after a reasonable amount of rest, graduated exercise must begin; he employs glyceryl trinitrate symptomatically to relieve pain and builds up in every way possible the physical strength and general condition of the patient. He looks on blood vessel disease as inflammatory and degenerative rather than mechanical. He reports the case of a patient with coincident hemiplegia and angina pectoris.

Chambers, Syracuse, N. Y.

Modification of Corneal Sensibility in Neurosyphilis. Sabbadini, Riv. oto-neuro-oftal. **4**:516, 1927.

The author calls attention to the frequency of insensibility of the cornea in cases of neurosyphilis. It may be the underlying cause of neuroparalytic keratitis which occurs in certain cases. In testing the corneas, however, Sabbadini found that the different quadrants of the cornea might present different degrees of anesthesia, and he recommends particularly the testing of each quadrant. In testing the sensibility in the ordinary manner with a fine strand of cotton, he found variations in the sensibility of the cornea, in five of the sixty persons with tabes or paresis examined. Sensibility was sometimes entirely absent in one quadrant and acute in another. Hypesthesia was much more common than anesthesia.

Freeman, Washington, D. C.

Psychic and Emotional Factors in General Diagnosis and Treatment. R. T. Woodyatt, J. A. M. A. **89**:1013 (Sept. 24) 1927.

Woodyatt reports a case of spasm of the sigmoid colon superinduced by an emotional conflict. He reports also another case of increase of sugar secretion in a diabetic patient, in which a careful checking up showed no errors in technic or otherwise; the patient had received news causing an emotional upset. The author stresses the importance of emotions and emotional conflicts in all men, normal or sick. He issues the challenge: Are medical men making the type of examination necessary for the recognition of psychic causes of physical disease?

Chambers, Syracuse, N. Y.

A New Colloidal Reaction of the Cerebrospinal Fluid. (Reaction of Takata-Ara). St. Draganesco, Ann. de méd. **23**:747 (Jan.) 1928.

The claims of the Japanese authors that their reaction with sublimate-fuchsin gives specific results could not be sustained. Though precipitation is always found in paresis, the same reaction occurs in meningitis, multiple sclerosis, cerebral abscess and compressions of the spinal cord. The change in color from a blue-violet to rose without precipitation is not typical for meningitis. It could not be observed in cases of meningitis which were under observation, but it occurred in extramedullary tumors and in one case of cerebral tumor.

Weil, New York.

Psychogenic Anorexia in Adolescent Women. G. R. Lafora, Arch. de neurobiol. **7**:121 (May-June) 1927.

The article describes a case in a girl, aged 17, and discusses the symptoms, diagnosis and treatment of psychogenic anorexia. The author believes that the prognosis is favorable, and that when the disease is not caused by somatic disturbances, isolation of the patient from relatives and a change in environment will succeed in effecting a cure.

Nonidez, New York.

Prevention of Anorexia in Children. C. A. Aldrich, J. A. M. A. **89**:928 (Sept. 17) 1927.

Although this article does not merit abstracting as regards neuropsychiatry, it is interesting to note that stress is placed on psychologic aversion of food due to forced feeding, on avoidance of emotional stress at meals and also to note that when the child was about 1 year of age all parents were asked to begin reading books on child psychology.

Chambers, Syracuse, N. Y.

Society Transactions

THE PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Dec. 16, 1927

M. A. BURNS, *President, in the Chair*

The evening was devoted to a symposium on "Errors of Diagnosis." No papers were presented.

Regular Meeting, Jan. 27, 1928

M. A. BURNS, *President, in the Chair*

RELATIVE VALUE OF DIAGNOSTIC MEASURES IN THE LOCALIZATION OF TUMORS OF THE BRAIN. DR. M. A. BURNS.

Despite its supposed rarity, the brain is actually one of the most common sites of tumor growth. According to the literature, when a physician claims that he has never encountered an instance of tumor of the brain, he acknowledges that patients with neoplasms have passed through his hands unrecognized. During the past twenty years, many contributions have been made concerning the diagnosis of tumors of the brain, and yet too often does one discover at the autopsy table an undetected tumor growth. Why one does not see as many tumors of the brain as one should is often due, I believe, to the physician's acceptance of a roentgen-ray report like the following: "There is no evidence of intracranial pressure, no discernible pathology, and the suture markings are normal." Although the general physician may recognize that something unusual is wrong with the patient, on receipt of such an observation he is liable to dismiss all thought of an intracranial lesion. When the physician learns not to stop at such a negative observation, but extends his studies to an eye-ground examination and a general neurologic survey tumors of the brain will be detected more frequently.

A few months ago, a prominent educator was admitted to the Jefferson Hospital in an unconscious state; he died in less than fifteen hours after admission. The only history obtainable was that for years the patient had been suffering from epilepsy. This man had been studied by a number of capable physicians; roentgenograms were reported as normal, and the diagnosis of epilepsy had been accepted as correct. Examination revealed that in the upper extremities the deep reflexes were increased on both sides and were more exaggerated on the left. There were: slight ataxia in both upper extremities, weakness of both hands and tremor, intensified by effort, of the fingers and of both hands. In the lower extremities the reflexes were increased on both sides and were somewhat greater on the left; there was no muscle wasting, but weakness was present; a definite Babinski sign existed on the right, and a suggested Babinski sign on the left; a suggestion of ankle clonus was present on both sides. Spinal puncture did not reveal an increase of pressure in the fluid; it was clear and contained 2 cells per cubic millimeter. The Wassermann reaction of the blood was negative. An examination of the eye showed the right pupil 4.5 mm. in width and irregular in outline; the left was about 2.5 mm. and regular. The pupils did not react to light; the left eyeball deviated outward; rotations were unobtainable. Ophthalmoscopically, the disks of both eyes were striated and the margins blurred. There were numerous hemorrhages in the vicinity of the disks and the arteries were narrowed. The diagnosis was bilateral thrombosis of the central retinal veins. The patient died of pulmonary

edema. Postmortem examination revealed a mass in the right temporal lobe; it involved the entire anterior portion of the right temporal lobe and fitted into the middle fossa of the skull on the right side.

I believe that if the neurologist had had an early opportunity to study this patient, the tumor would have been discovered in time to permit its extirpation.

In another recent case at Saint Mary's Hospital, Philadelphia, the neurologic signs proved clinically that the patient was suffering from a left frontoparietal tumor (there were definite eyeground changes); the roentgen-ray report was negative for evidence of intracranial pressure or any intracranial pathologic process.

The question arises as to how much help one receives from roentgenography and ventriculography in localizing tumors of the brain. Roentgenography was first applied to the study of intracranial tumors by Obici and Bollici (*Riv. di patol. nerv.* **1**:435 [Oct.] 1897) and at almost the same time by Oppenheim (*Arch. f. Psychiat.* **24**:303, 1901). Heuer and Dandy (*Bull Johns Hopkins Hosp.* **26**:311 [Nov.] 1916) from a series of 100 consecutive cases, reached the following conclusions: Except for the comparatively few that reveal definite tumor shadows, roentgenograms are merely an important aid in the diagnosis of tumor of the brain. There is no shadow from uncalcified tumors except in cases where the accessory sinuses have been attacked by tumor tissue. However, this rule may not apply in hypophyseal lesions which are viewed against the dark temporal fossa. The shadows cast by bony or calcified tumors are easily recognized. The signs in the skull of increased intracranial tension, that is, enlargement of the skull, separation of the cranial sutures, general convolutional atrophy and destruction of the sella turcica, have considerable value in the differentiation between cerebral and subtentorial lesions, for they indicate internal hydrocephalus which is rare in cerebral tumors but usually accompanies tumors of the posterior fossa. These authors believe that the local changes in the skull due to tumor of the brain are of the most importance in the diagnosis of hypophyseal or suprasellar lesions. The combination of characteristic eye changes and local sellar destruction or enlargement makes the diagnosis the most certain, perhaps, of all intracranial conditions. Local hypertrophy of the skull over cerebral tumors and local atrophy of the skull over tumors are of definite diagnostic value. These authors also warn of the usual position and characteristic appearance of shadows caused by calcification of structures normally present in the intracranial chamber.

According to Purves Stewart (*Oxford M. Publ.*, 1927, p. 8), radiograms of the skull are of special diagnostic value in a limited class of cases; in pituitary tumors, the sella turcica is often abnormally deep or otherwise deformed; one may see the shadow of a pituitary tumor, especially if it is partially calcified, bulging downward into the sphenoidal air sinus. In tumors situated in other parts of the brain, it is in only a small proportion of cases in which roentgenograms give local indications of the tumor. Calcification of the pineal gland, sufficient to be recognizable by roentgen rays, occurs in about 50 per cent of the brains of normal adults. Sometimes the position of the calcified gland can be utilized, as Naffziger has pointed out, for purposes of localization. The pineal gland, together with the falx cerebri and other structures, may become displaced beyond the mesial plane of the skull by tumors on the contralateral side of the cerebrum. This so-called "pineal shift" occurs only in supratentorial tumors; subtentorial and basal tumors do not cause any lateral displacement of the pineal gland. In rare cases, especially in psammoma, angiolithic sarcoma and tuberculoma there may be a visible roentgenographic shadow due to calcareous deposition within the tumor itself. In others, one may demonstrate localized bony thickening or bony absorption by tumor infiltration of the cranium immediately superjacent to a meningeal endothelioma. More usually, roentgenography shows nothing abnormal until evidences of increased intracranial pressure appear; this is shown by widening of the bony grooves for the venous sinuses, dilatation of the vessels of the diploë, widening of the sutures, and, most characteristic of all, thinning of the posterior clinoid processes, in cases of internal hydrocephalus. Unilateral widening

of the internal auditory meatus has been seen in some cases of neurofibroma of the auditory nerve.

Spiller (personal communication, Nov. 10, 1927) makes stereoscopic plates in all cases of suspected tumor of the brain; the results are often of great value, sometimes making a diagnosis certain. By revealing atrophy of the dorsum sellae or enlargement of the sella with atrophy of the clinoid processes, whether a tumor is in the pituitary body or is suprasellar is determined. To quote: "Doctor Pancoast has instituted a method of taking antero-posterior films in such a way that in two instances he has been able to determine great atrophy of the petrous portion of the temporal bone, and his findings have made the diagnosis in each case certain. In some instances where a tumor has been a calcified meningioma or an enchondroma, or where there has been a pituitary cyst with calcified wall, the roentgen rays have fully defined the outline of the lesion. In other instances the calcified mass has suggested the position of the tumor even though it was much larger than the mass. The optic foramina can be determined by roentgen rays, and it has been possible to determine alteration in these openings. The same is true of the internal auditory meatus."

Fay (personal communication, Nov. 10, 1927) believes that clinical and neurologic studies should be superior to all others, and should reveal the necessity for roentgenograms and indicate the region to be considered in the study of the films. He believes that if this is done numerous roentgen-ray reports which are negative may give information as to the size of the venous or arterial channels shown along the inner table of the skull which may help in localizing the lesion and its character, if their abnormality corresponds to the location of the neurologic and clinical observations.

Frazier (personal communication, Dec. 7, 1927) reports that in about 10 per cent of his cases the roentgen-ray studies yield some suggestion of localization, which may be the nature of atrophy, calcification, endostosis or bony thickening.

It is Grant's (personal communication, Nov. 10, 1927) experience that the neurologic and clinical observations are more valuable than the roentgen-ray study, and he believes that tumors located by the roentgen-ray examination give definite neurologic and clinical signs of localizing value.

According to Pancoast (personal communication, Dec. 9, 1927), the entire value of the roentgen ray depends on the spirit of cooperation. The roentgen ray gives some information which may be of help when considered with the clinical observations; otherwise it will be of little or no use.

Cushing (*Oxford M. Publ.*, 1925, pp. 116-117) states that stereoscopy and the improvements in roentgenography have permitted not only the corroboration of a clinical diagnosis but have given information through tumor shadows of the character of the lesion and its exact location. He is of the opinion, however, that instrumental diagnostic measures cannot equal in value a detailed and exact chronologic history of the symptoms. He believes that this will always be the chief reliance and that it may require greater skill and experience to secure an accurate clinical history than to make a detailed neurologic examination.

Manges (personal communication, Dec. 12, 1927) makes the following statement: "A diagnosis of brain tumor, by means of the roentgen ray, depends upon finding evidence of increased intracranial pressure, which is followed sooner or later by deepening of the convolution depressions on the inner table of the skull and the separation of the skull sutures, when the tumor is not in contact with bone but does make pressure on some of the interventricular passages, causing internal hydrocephalus. When the tumor is in contact with bone, then it very soon produces erosion or pressure atrophy, which may or may not be demonstrable by means of radiographs. In this type of lesion, one may get very definite evidence with excellent quality of radiographs and very careful study, whereas with indifferent quality of radiographs, the lesion would be entirely overlooked. Growths in the region of the sella turcica are very apt to produce some pressure destruction of bone. Then, there is another group of tumors in which there is found calcareous deposit — sometimes in very small quantities and again in rather massive amounts.

I have no idea how large a percentage of brain tumors falls in this category but I do know that with the aid of ventriculography an additional group of tumors is definitely diagnosed by means of the roentgen ray."

In my efforts to ascertain of just how much value the roentgen ray was in localizing tumors of the brain I issued a questionnaire to some members of the American Neurological Association. The following figures are the result, based on 100 cases, seventy-six of which are reports from members of the association and twenty-four from the service of the Jefferson Medical College Hospital: diagnostic, 3 per cent; confirmatory, 36 per cent; valueless, 47 per cent; negative, 7 per cent; not done, 7 per cent. It strikes me that the percentage of 61 revealing no aid from this diagnostic measure is much too great, and indicates lack of cooperation between the neurologist and roentgenologist — in the one case, with incomplete histories and physical signs and, in the other, with improper interpretations of these physical signs. Therefore I feel it behooves the neurologist and roentgenologist to work together in a stricter spirit of cooperation; then these figures may become more encouraging.

The second topic in my questionnaire was: "Were ventriculograms done; if so, how much did they help?" According to Grant (*Am. J. Roentgenol.* **18**:264 [Sept.] 1927), "Ventriculography consists in the replacement of the cerebrospinal fluid in the ventricles with air. Air casts a definite shadow on the roentgen film which sometimes is in marked contrast to that of the cranial bones. Thus the outlines of the ventricles are thrown into bold relief. A variation from the normal in the position, size and shape of the ventricles due to the presence of any lesion may thus be readily demonstrated. By a proper interpretation of the significance of these variations the position of the lesion may be determined. Ventriculography in experienced hands is not a hazardous procedure. By its use it is possible to determine accurately the position of otherwise unlocalizable intracranial tumors, but this method should only be used when all others have failed. Technically, in our opinion, the most important single factor in avoiding errors in interpretation of roentgenograms is the complete removal of the fluid by bilateral ventricular tap. In reaching a conclusion only obvious defects which are apparent on all the films should be considered. In spite of its danger, in spite of the possible errors in technic which may render abortive attempts at localization, ventriculographs may afford more positive information about the situation of the lesion than any other procedure. It is our firm conviction that no patient should be given a hopeless prognosis and sent away to die as comfortably as may be because we are unwilling to risk a mortality through the use of air injection. Until we have attempted ventriculography we have no right to tell the patient that he has an unlocalizable intracranial neoplasm and is beyond our help."

Adson, Ott and Crawford (*Radiology* **2**:65 [Feb.] 1924), in reviewing a series of cases, found that the ventriculogram gave information in localizing tumors of the cerebellum, but it did not always localize small lesions of the frontal and temporal lobes unless unilateral hydrocephalus was present. They believed that ventriculography is an aid in the localization of tumors of the brain and that it should be more frequently employed. They thought that it might be used as a diagnostic measure, as it is not dangerous for patients who do not have deep-seated lesions. It was the opinion of these authors that ventriculography, because of its mortality, should not replace a thorough neurologic study but should supplement it in the diagnosis and localization of cases with vague histories and observations.

According to Spiller, ventriculograms and encephalograms have been made frequently and have been of considerable importance. In one recent instance the diagnosis of tumor of the fourth ventricle was made possible before operation through the use of ventriculography.

Fay says that, in addition to the neurologic and clinical observations, encephalograms and ventriculograms are next indicated when doubt as to the character of the lesion itself, its extent and location in a silent area have not been sufficiently demonstrated by neurologic and clinical examinations.

Frazier states that he employs ventriculograms in about 30 per cent of his cases, and finds that in not more than one third of this number does the ventriculogram give information which determines accurately the location of the growth.

According to Dandy (*Surg. Gynec Obst.* **30**:329 [April] 1920), "Ventriculography is invaluable in the localization of obscure tumors of the brain. So-called unlocalizable tumors comprise at present over half of the total number. Practically all tumors of the brain either directly or indirectly affect some part of the ventricular system. Hydrocephalus is easily demonstrable by ventriculography and when present usually, though not always, restricts the location of the tumor to the posterior cranial fossa — that is, the brain stem or the cerebellum. Local changes in the size, shape and position of one or both ventricles as shown by the ventriculograms will accurately localize most obscure tumors of either cerebral hemisphere. Every effort should be made to localize the tumor before resorting to any operative procedure. The usual subtemporal decompression is useless and dangerous when a hydrocephalus is present, that is when the tumor is in the brain stem or cerebellum. A suboccipital decompression is extremely dangerous when the lesion is in the cerebral hemispheres. To differentiate between cerebral and cerebellar lesions is frequently one of the most difficult tasks in intracranial localization. Ventriculography at once separates these two groups and indicates the operation of choice. The only cure for tumor of the brain is extirpation. The results in terms of complete cures of tumors of the brain will be in proportion to the early localizations which are made. A decompression is a purely palliative procedure and should be adopted only when the tumor cannot be located. Ventriculography permits of an early and accurate localization of the growth when all other methods fail. It is possible to get a separate profile ventriculogram of the whole of each lateral ventricle. Any change in size or contour is easily demonstrated. Anteroposterior views will show the same points in cross section, but they are chiefly useful in showing any lateral dislocation of the ventricles. The results in localization of five types of cases of tumor of the brain are shown with ventriculograms. In all except one of these, the ventriculogram was the only means by which a positive localization could be made. One tumor occluded a lateral ventricle and dislocated both lateral ventricles. Another tumor altered the size and shape of one lateral ventricle. In a third case, a cerebral tumor though suspected was eliminated by the hydrocephalus. In a fourth case, a unilateral hydrocephalus was demonstrated. Occasionally the size of both ventricles is so reduced that air cannot safely be injected. In one case the dislocated position of both ventricles, which were greatly reduced in size made the localization possible. Ventriculography is also useful in precisely localizing the growth. This permits of an exploration directly over the tumor and greatly simplifies the operative procedures. Many useless and harmful operations will be spared the patient by a judicious use of ventriculography. Doubtless the type of tumor will often be indicated by the ventriculogram. Such knowledge will be useful in prognosis and in determining whether radical or palliative operative treatment should be instituted. These determinations will result from accumulated experience in the interpretation of the ventriculograms together with the correlative operative observations presented in a large series of cases. With experience and care in the use of ventriculography I believe few tumors will escape accurate localization."

McConnell (*Brit. M. J.* **2**:796 [Nov.] 1923) believes that to any one who has studied postmortem specimens of intracranial tumors, it is clear that information about the size and shape of the lateral ventricles would be of inmmense value in the localization of tumors during life. He thinks that ventriculography is indicated when there are insufficient or no localizing signs. When a definite clinical diagnosis is made, ventriculography is not resorted to unless an operation fails to find the growth. When successfully performed it has yielded definite and accurate information regarding the position of intracranial tumors. Ventriculography cannot replace clinical measures but in special cases it is necessary; it is not without danger and is not simple; it requires patience and minute attention to details, and it is not to be attempted without a sound knowledge of the anatomy and

physiology of the central nervous system. It is reasonable to assume that the risks will diminish with increasing experience.

Towne (*Arch. Surg.* **5**:144 [July] 1922) summarizes as follows: "By means of ventriculograms three cases of obstructive hydrocephalus in infants were diagnosed as being caused by occlusion of (1) the foramina of Magendie and Luschka; (2) the aqueduct of Sylvius and (3) the right foramen of Monro. No other method could have thus shown the exact location of the obstruction. In all three, the disease was so far advanced that the cortex was markedly thinned and secondary enlargement of the head had followed. Large amounts of cerebrospinal fluid, from 500 to 1,500 cc., were replaced by air. In two cases new interventricular passages were made; but, though the operations were fairly well borne, the hydrocephalus was not cured and both patients died at a later date. The third patient died of shock following extirpation of a choroid plexus. The results emphasize Dandy's statement that these cases must be diagnosed by ventriculogram and operation must be performed before the head enlarges. He has shown that before the ventricles are greatly dilated the points of obstruction can be successfully attacked. Even when the diagnosis is delayed, it is more satisfactory, if forced by the hopeless outlook to do something, to try to correct the cause of the condition rather than to attempt to palliate the result by a drainage operation. Dandy has reported two cases of cerebral tumor, one occipital, the other frontal, which were localized by the ventriculogram after other methods had failed."

Bassoe and Davis (ARCH. NEUROL. & PSYCHIAT. **9**:178 [Feb.] 1923) believe that ventriculography in the hands of inexperienced men may prove dangerous and misleading. In one of their two cases, not enough air was injected into the posterior horn to fill the anterior horns completely and in the second case, in which the ventricles proved unusually small, death was caused by acute compression evidently due to the introduction of too much air. Other than determining the absence of hydrocephalus they thought that the ventriculogram did not help them to localize the tumor with any better success than the neurologic signs. However, they believe that in certain cases and in more experienced hands this method could be favorably used to reveal the site of otherwise unlocalizable tumors of the brain.

Davenport (*Illinois M. J.* **44**:179 [Sept.] 1923) states that one should not depend on roentgen ray alone for the diagnosis, which is true of all diagnostic laboratory methods. In his opinion a correct diagnosis and localization should be based on a complete history, detailed examination and study of the case, supplemented by proper interpretation of the roentgen-ray report following ventriculography.

The results obtained through ventriculograms, according to the questionnaire, were as follows: diagnostic, 1 per cent; confirmatory, 18 per cent; of slight value, 4 per cent; valueless, 3 per cent; not done, 74 per cent. Here again it appears that the percentage which denotes lack of assistance from ventriculograms, 77, is exceedingly high. This is evidently due to the fact that few are capable of performing this operative procedure. In my opinion, the indications for ventriculography depend on each individual case. It should not be used routinely in all cases where tumor of the brain is suspected. Reactions to the procedure are frequent enough to contraindicate its use when a definite diagnosis can be made by any other means. It is especially desirable to avoid the use of air when the intracranial pressure is very high, but if the diagnosis is not reasonably certain injection of air is of the greatest assistance and should prevent many negative explorations. It should therefore be used without hesitancy in such cases. Its services may be two-fold: to demonstrate the presence or absence of a tumor, and to inform the surgeon of the size and location of the ventricles which may be of help during the performance of an operation.

The third topic in the questionnaire asked whether the physical and neurologic observations were more important from a localizing standpoint than roentgen-ray observations. To this question came the following opinions: physical and neurologic observations of more value than roentgen-ray reports, 82 per cent; roentgen-

ray and other diagnostic measures considered of more importance than physical and neurologic observations, 3 per cent; of equal merit, 15 per cent. The figure indicating the importance of neurologic and clinical observations, 82 per cent, proves conclusively that a careful examination of the patient in four fifths of all tumors of the brain will enable the making of a diagnosis by this method. It leaves, then, approximately 20 per cent of all cases of tumor of the brain which must be diagnosed by other means than clinical and neurologic observations alone. I believe that by the judicious use of ventriculography, with closer cooperation between the roentgenologist, the neurologist and the neurosurgeon, this remaining 20 per cent could surely be diagnosed. To quote Cushing again: "No instrumental aid to diagnosis can equal in importance a detailed and exact history of the symptoms in the chronological order of their appearance. This must ever remain our chief reliance, and the ability to elicit a dependable and correct clinical story is an art requiring perhaps even greater experience and skill than the making of a detailed neurological examination."

The fourth question in the series concerned the Bárány test and the results obtained from its use. Hunter (personal communication to the author, Jan. 16, 1928) says that "the question is frequently asked 'Are the vestibular tests of any value?'" The neurologist is interested in investigating all the pathways of the central nervous system. He routinely looks at the pupils, takes the patellar reflexes and others, therefore any method of measuring the function of the vestibular branch of the eighth nerve must be of value. The question should be: 'Do these tests accurately indicate a particular definite part of the pathways?' The answer is yes, we can tell a great deal about the condition of the end organ and we can generalize about the intracranial pathways. On repeated examinations we frequently get varied observations showing that the paths are not inherently defective but are most likely cut off by pressure or affected by a toxemia rather than an actual inflammation. This has led some careless observers to feel that the tests are without value. The great trouble with these tests in the past has been that interpretations have been made on the basis of theoretical pathways rather than those actually demonstrated. This period has largely gone by, but it was of great value because it definitely focused our attention on these tests and led to further study which has demonstrated their true value.

"Yes, the vestibular tests are of value to the neurologist because they can show whether impulses are transmitted to the central nervous system. We cannot always tell what the significance of abnormal phenomena is but by careful physiological, pathological and clinical studies we are correlating our knowledge and getting a more definite idea of the pathways."

One of the most valuable and scientific contributions to this method of diagnosis was presented by Grant and Fisher (*J. f. Psychol. u. Neurol.* **36**:3, 1926). They believe that other methods have stood the test of time and their relative value is clearly understood; on others, final judgment is withheld, and this examination of the vestibular apparatus presents one of the newer methods. It may take a long time to decide of just how much importance this method of procedure is. As ordinary clinical examinations make the diagnosis in a great many cases, is it worth the time and trouble necessary to perform it? It was believed that the reactions might be of considerable value in early or difficult borderline cases —proper interpretations of the observations requiring skill and judgment gained only from a wide experience. They have proved that the Bárány test will certainly localize cerebellar lesions, cerebellopontile angle lesions and supratentorial lesions. In going over the literature, I find this presentation by Grant and Fisher far excels what has been written concerning the Bárány test in tumor of the brain. Their results were most gratifying, although one must remember that it was the outcome of expert application of this means of diagnosis.

The response to the questionnaire in regard to the Bárány test follows: diagnostic, 2 per cent; confirmatory, 10 per cent; of slight value, 6 per cent; valueless, 5 per cent; confusing, 5 per cent; negative, 7 per cent; not done, 65 per cent. Once more the percentage (82) of patients with tumors of the brain who either

were not examined by this method or in whom, if examined, the results were of no value is high. This I believe is due to the lack of experienced and qualified men to perform this diagnostic measure.

CONCLUSIONS

1. Statistics compiled from the questionnaire indicate that the roentgen ray does not give localizing aid in 61 per cent of cases. If a closer spirit of cooperation existed between the roentgenologist and the neurologist this high percentage could be much lower. The neurologist should cooperate by sending complete histories and physical signs with the patient who is to be studied by the roentgen ray, and, equipped with these, the roentgenologist will doubtless be able to give more valuable information in his report.

2. Ventriculograms, I believe, are not resorted to with sufficient frequency as in 77 per cent of the cases reported this measure was of no value or was not used at all. This, I believe, is due to the lack of capable men to perform this highly technical procedure. Ventriculograms should be judiciously employed in patients with suspected tumors and in those with vague symptoms. The dangers associated with ventriculography are well known, but in experienced hands this valuable diagnostic measure could be carried out more often and should give much helpful data.

3. The questionnaire showed that the physical and neurologic observations in tumors of the brain are of more importance in reaching a diagnosis than any other means; by their use it is possible to localize approximately 82 per cent of all tumors, leaving about 18 per cent in which it is necessary to employ other methods. Surely the time has come when one should hesitate to acknowledge that even so small a percentage exists today — when there exist as many modern aids to the definite diagnosis of intracranial lesions. It is agreed, I believe, that no measure can replace a careful neurologic survey; in spite of the most complete examinations one is many times at a loss to find the exact site of the growth; too often defeat is confessed without first utilizing every other diagnostic measure. The neurosurgeon and the neurologist should discuss vague cases in great detail and should not allow a tumor of the brain to go undetected without exhausting all mechanical means of diagnosis.

4. The status of the Bárány test is similar to that of ventriculography. More trained men are needed and they in turn should have complete histories with physical signs to assist them in reaching definite conclusions. Too often one receives negative reports from the otologist, and this deficiency may be caused by lack of cooperation. In the present study, the statistics revealed that in 82 per cent of cases the Bárány test was either of no value or was not performed.

The Successful Removal of Tumors of the Brain and of the Spinal Cord. Dr. Francis C. Grant.

The following cases of successful extirpation of tumors of the central nervous system are reported for the purpose of emphasizing the results that may be obtained by surgical methods, provided an early and accurate diagnosis has been made. The operability of these tumors depends: (1) on the type of tumor, and (2) on the time at which its presence is recognized. Even growths like the meningiomas, which can be completely removed, if allowed to reach a large size through delay in diagnosis, may as a result present unsurmountable operative difficulties.

Case 1.—P. A. S., a white man, married, aged 33, was admitted to the Neurosurgical Clinic of the University Hospital in August, 1927, complaining of failing vision. In January, 1922, his voice became husky and examination showed paralysis of the right vocal cord. In 1924, he noted marked impairment of hearing in the right ear, without tinnitus. In January, 1926, he noted dimness of vision and diplopia, and began to stagger, mainly to the right. In September, 1926, he

began to vomit and until January vomited twice daily; this has been less frequent since January. At present he vomits once in every four or five days. Since November, he has had attacks of head shaking lasting about five minutes. In July, 1927, numbness appeared in both legs and in the tongue. Headache has not been noted at anytime. The man had been a sign painter, working with lead paints.

Neurologic Examination.—Mentally, he was normal. He has had some increase in libido in the last six months.

Cerebellar Symptoms: Romberg sign was positive. The patient fell to the right and left when standing on one foot with eyes open. He staggered to the right when walking a straight line. Moderate adiadokokinesia and dysmetria were present in the right hand. He past pointed in the vertical plane with the right hand to the right.

Sensation: There were no objective sensory disturbances, but subjectively he complained of numbness about the mouth and tongue on both sides.

Motor Function: There was no gross motor disturbance except that he had attacks in which he shook his head from side to side. The head was carried somewhat to the right. The grip by dynamometer was: 125 on the right, 110 on the left. He was right handed.

Cranial Nerves: The first, third, fourth and sixth were normal. There were no objective sensory disturbances, but subjectively he complained of numbness about the mouth and tongue on both sides. There was decreased motility of the seventh nerve on the right. There was deafness in the right ear; 6 inch hearing in the left ear: deafness on the right with loss of bone and air conduction. He experienced occasional choking, with food lodging in the right side of the throat. Taste was lost on the anterior portion of the tongue on the right. The voice was husky; there was complete paralysis of the right vocal cord. The palatal reflex was lost on the right and the palate deviated to the left. The eleventh and twelfth nerves were normal.

Reflexes: Biceps and triceps jerks were lost on both sides. The patellar jerk was lost on the left and was questionable on the right. The achilles reflexes were prompt and active on both sides. The corneal reflexes were prompt and active on both sides. There was no clonus, no Babinski sign.

Report of the Eye: The right eye showed 8 diopters of choking and a few small hemorrhages; the left, 5 diopters of choking. There was bilateral concentric contraction of the visual fields, also diplopia. Slow horizonal nystagmus was present on looking right and left. Slow rotary nystagmus occurred on looking up.

The roentgen-ray report was normal except for enlargement of the sella.

The serologic examinations were normal. No lumbar tap was performed.

The preliminary Bárány report was that of an angle tumor on the right.

The diagnosis was neuroma of the tenth nerve or endothelioma in the right posterior fossa.

Course.—A suboccipital craniectomy was performed with removal of a fibroma arising in the right cerebellopontile angle. The tumor and its capsule were completely extirpated. The seventh nerve on the right was damaged and facial paralysis resulted. Postoperative recovery was otherwise uneventful. In January, 1928, the patient returned, having been relieved of his cerebellar symptoms and having gained 15 pounds (6.8 Kg.) in weight. At this time a right facio-hypoglossal nerve anastomosis, in an effort to restore facial symmetry, was performed.

Comment.—At the time of the first operation it was decided, since it seemed possible to extirpate the tumor completely, that it was justifiable to do so even though the seventh nerve might be damaged at the same time. In our opinion facial weakness is a cheap price to pay for total extirpation of an angle tumor.

Case 2.—J. N., a white man, married, aged 40, was admitted to the Neurosurgical Clinic of the University Hospital, having been referred by Dr. W. G. Spiller, Dec. 3, 1927. He complained of weakness of the entire right side, pain

in the back of the head and aphasia. He had been well until one year before when there appeared weakness in the right side of the body, involving first the right side of the face and later involving gradually the right arm and leg. Intermittent pain in the back of the head began about one year before and was not well localized. The patient was markedly aphasic but the date of onset was not ascertained.

Physical Examination.—The blood pressure was 108 systolic and 68 diastolic. The patient had urinary incontinence. General physical examination revealed right hemiparesis involving the entire right side of the body. He was aphasic, but otherwise was essentially normal.

Neurologic Examination.—There was complete motor aphasia; the patient understood simple commands at times—at others he did not, so that he probably had sensory aphasia as well. On being given a cigaret and matches he fumbled greatly before he lighted the cigaret and was rather awkward about it, showing some ataxia. There was a right hemiparesis of the entire body. The dynamometer readings were: right 20, left, 40.

There was hypesthesia on the right side of the body, probably more definite over the right side of the face and the upper extremity. He was able to distinguish between hot and cold over the entire body. There was definite right homonymous hemianopia. He had weakness of the left external rectus. There was astereognosis in the right hand.

Examination of the eye revealed 5 diopters of choking in the left eye, and 5.5 in the right eye. The pressure of the spinal fluid was 30 mm. of mercury. The blood Wassermann reaction was negative. The roentgen-ray report was atrophy of the dorsum sellae and posterior clinoids with some atrophy of the floor of the sella indicative of an extrasellar tumor.

Diagnosis: It was the opinion of the neurologic conference, headed by Dr. Spiller, that there was a tumor situated probably in the left temporoparietal lobe.

Operation.—A left frontotemporal osteoplastic flap operation revealed an encapsulated tumor 7 by 8 by 5 cm. lying in the anterior part of the sylvian fissure and pressing on the left temporal lobe from in front. It was completely extirpated. The microscopic diagnosis was meningioma. Complete postoperative recovery occurred from the aphasia and the right hemiparesis.

Comment.—It is interesting that a tumor situated so far frontal in position could have produced such marked sensory disturbances and defects of the visual field. It had been expected to encounter the growth more posteriorly, probably in the temporoparietal region. Dr. Spiller, in his discussion of the case, emphasized that when symptoms of involvement of the left temporal lobe are present it is impossible to state with certainty whether these localizing signs are due to actual involvement of this area or to pressure on it from without. The bulk of the tumor lay in the depths of the hemisphere. Relatively little of it was presented on the surface. This marked encroachment toward the midline accounts for the defect of the visual field and the sensory disturbance accompanying such an anteriorly placed tumor.

Case 3.—J. R., a white man, aged 53, was referred to the Neurosurgical Service of the Philadelphia General Hospital by Dr. M. A. Burns on April 6, 1927, complaining of stupor. One year before he had complained of extreme fatigue in the limbs. Seven months before he had noticed that the first two fingers of the right hand had begun to twitch. One month later severe occipital headaches had developed, with drowsiness and inability to walk properly on account of headache. Two weeks previously he had developed mental confusion and drowsiness with stiffness of the neck. The previous history and family history were without significance.

Neurologic Examination.—Positive observations: (1) in accommodation, rigid pupils both right and left; (2) suggestive early choked disk on both sides; (3) nystagmus, particularly on looking to the right; (4) dyssynergia, particularly with the right hand and right leg in the finger-to-nose and heel-to-knee tests; (5) a positive Romberg sign; (6) a cerebellar gait with a wide base and inability to stand in tandem position, to walk a line or about a chair steadily.

Examination of the eye revealed the visual fields grossly normal, engorgement of the retinal veins and haziness of the disk margins but no measurable choking.

The roentgen-ray examination gave normal results.

The lumbar puncture pressure was 16 mm. of mercury.

Diagnosis.—The condition was diagnosed as cerebellar tumor, right lobe, provided that syphilis could be excluded.

Operation.—On May 3, 1927, a ventriculogram was made by Dr. Grant, by bilateral vertex puncture. The left ventricle was in a normal position and contained 10 cc. of fluid. The right ventricle was in normal position and contained 25 cc. of fluid. Ten cubic centimeters of air was injected into the left, 20 cc. into the right ventricle. Plates showed obliteration of the anterior horn of the left ventricle with displacement of the bodies of both ventricles to the right. The diagnosis made was left frontal lesion.

Comment.—When I first saw this patient, I believed that he had a cerebellar tumor; he gave no evidence of a left frontal lesion. Curiously enough, he had no choking of the disks, but lumbar puncture revealed a pressure of the spinal fluid of 16 mm. of mercury. This seemed to be the only positive evidence of the presence of a tumor. He had improved during his short stay in the hospital and if it had not been for the lumbar puncture I should have been willing to think that he did not have a tumor, as a great many of the cerebellar symptoms disappeared. However, in view of the pressure, I made a ventriculogram which showed dys-symmetry of the lateral ventricles and that the anterior horn of the left lateral ventricle was obliterated. I, therefore, made a diagnosis of tumor in the left frontal lobe.

Operation.—Under local anesthesia a left frontotemporal flap was turned down with removal of a large subcortical, encapsulated, discrete pinkish tumor. The patient recovered from the operation.

The pathologic diagnosis made by Dr. N. W. Winkelman was hemangioendothelioma.

Comment.—This case illustrates well the difficulties often encountered in distinguishing between cerebral and cerebellar tumors. The cerebellar symptoms seemed so clean cut that the twitching of the fingers of the right hand was discounted. On consultation with Dr. Burns he acceded to my suggestion that a ventriculogram be done to clear up the situation although he thought that a frontal tumor was probably present. The air shadows confirmed his opinion.

CASE 4.—M. R., a white woman, aged 38, was admitted to the Neurosurgical Clinic of the University Hospital, having been referred by Dr. William G. Spiller in July, 1927.

She was unable to use the right hand and right arm. In April, 1926, she had noted a tingling sensation in the fourth and fifth fingers of the right hand. Sensation was described as a cramp or a drawing sensation. At this time there was no spontaneous pain, pain on motion or numbness. There was marked diminution in the speed with which she could move the fingers. As she was a typist, inability to move the fingers rapidly was an annoyance. At first these attacks lasted about five minutes, but they gradually increased in length and severity. However, they did not tend to spread to other fingers of the hand or to involve the arm. During the interval between attacks, no symptoms of any kind were noted in the fingers or hand.

In February, 1927, the paresthesia spread to involve the whole right side of the body. She had a convulsive seizure beginning in the right hand and involving the leg. She lapsed into unconsciousness following this attack. Subsequently the right hand and arm were definitely weaker. In June, 1927, she had a second similar seizure with preliminary sensory aura followed by a convulsion beginning in the right hand.

Positive Neurologic Observations.—The important points noted from the neurologic examination were: (1) weakness of the right seventh cranial nerve; (2) weakness of the right extremities, more marked in the arm than in the leg;

(3) sensory loss to pain and touch over the right arm; (4) complete astereognosis in the right hand; (5) no choked disks or changes of the visual field.

Diagnosis.—The condition was diagnosed as a tumor in the left posterior central convolution, in the center for the right hand, and extending into the anterior central convolution and possibly further.

Operation.—A large frontoparietal flap was thrown back and an encapsulated but extremely friable tumor removed from the rolandic area without difficulty. Recovery followed.

Pathologic Diagnosis.—Meningioma.

Comment.—There was nothing particularly difficult about the localization or operative removal of this tumor. The diagnosis was promptly made, hence surgery in a tumor of this type achieved good results.

CASE 5.—F. W. B., a white man, aged 65, was admitted to the Neurosurgical Clinic of the University Hospital Jan. 25, 1927, having been referred by Dr. William G. Spiller. Five years before he had noted pain in the dorsal region at the posterior iliac crest and a girdle sensation about the waist. Two years before, numbness and tingling occurred in the left leg; this was followed by dragging of this leg. Constipation became pronounced. One year before, he noted numbness and tingling in the right leg followed by weakness and increasing difficulty in walking. Definite loss of libido also was noted. Six months before, there were contraction of the left leg, loss of sphincter control and loss of the power of erection. Three months before, he developed contraction of the right leg. The previous and family histories were without significance.

Neurologic Examination.—He walked with a slow limping gait, dragging the left foot. The left pupil was larger than the right. There was a spot painful to deep pressure over the ninth thoracic spine. Sense of pain was slightly but definitely impaired on both sides up to the first lumbar segment with slight hyperalgesia to the eighth thoracic segment; there was slight impairment of temperature up to the first lumbar segment, the loss being most marked in the right calf and foot. A vasomotor level was found at the upper level of the eighth thoracic segment, with a lower level at the first lumbar segment.

Reflexes: The lower abdominal were diminished on both sides; clonus was absent on the right and abortive on the left; the patellar was increased on the right and exaggerated on the left; a Babinski sign was doubtful on the right and positive on the left; the achilles reflex was sluggish on the right and subnormal on the left.

Roentgen-Ray Examination.—This revealed hypertrophic spondylitis involving the lower thoracic spine.

Queckenstedt Test.—Complete block with a xanthochromic fluid.

Diagnosis.—This was considered to lie between hypertrophic spondylitis and a tumor at the level of the first lumbar or twelfth thoracic segments. Removal of the laminae of the eighth to twelfth thoracic vertebrae was advised by Dr. Spiller.

Operation.—Laminectomy was performed from the eighth thoracic to the first lumbar spines. A tumor was found lying to the left of the cord extending from the transverse process of the ninth thoracic down to the second lumbar vertebra. The tumor was attached to the dura and seemed cystic. At the level of the first lumbar vertebra it had hollowed out a nest in the vertebral lamina large enough to admit the tip of the index finger. The tumor was removed completely with its dural attachment. Recovery followed.

Pathologic Diagnosis.—An endothelioma of angiomatous type was diagnosed by Dr. N. W. Winkelman.

Comment.—The roentgen-ray evidence of hypertrophic spondylitis and the lack of clean cut sensory disturbances, which might have been expected from a tumor having a history dating back five years, confused the picture.

A Favorable and Unfavorable Result with Ventriculo-Encephalography in Two Similar Cases of Brain Tumor. Dr. Frederic H. Leavitt.

These cases are of interest in that they were both proved to be subcortical gliomas of the temporoparietal region of the left hemisphere, one at operation and the other at autopsy. The defining of the similar location of the lesion in each instance was clearly demonstrated by ventriculo-encephalographic roentgen-ray studies, despite the marked difference in the clinical observations in each instance. Case 1 was replete with physical signs at variance with each other and the differentiation was between a supratentorial and an infratentorial lesion. The diagnostic procedure was carried through successfully; the neoplasm was found at operation in the expected location, owing to its deep situation it could not be removed. A palliative and extensive decompression has made life endurable for the patient, the headaches and aphasia having disappeared and the vision being saved, but there has been a continuance of some unilateral motor focal symptoms.

The patient in case 2 had few localizing symptoms and the diagnosis appeared to be between a left cerebral glioma and a cerebellar tumor. The ventriculo-encephalogram was carried through successfully and the plates clearly showed a left hemispheric growth. The patient did well following the ventriculo-encephalographic technic until a lumbar puncture was done five hours later in an attempt to relieve headache; after this procedure he went into a condition of dyspnea with projectile vomiting and died a few hours later of respiratory paralysis. At autopsy, herniation of the edge of the left occipito-temporal convolution through the incisura tentoria was noted which may have produced the cerebellar symptoms by direct pressure. There was also herniation of the cerebellar tonsils and the medulla into the foramen magnum. The subcortical glioma was found in the left temporoparietal region and had completely occluded and distorted the left lateral ventricle, as was clearly shown by the ventriculo-encephalogram studies. The fatal outcome in this case may possibly be charged to the sudden release of pressure by the second lumbar puncture; the observations at autopsy appear to bear out this theory.

REPORT OF CASES

Case 1.—S. M., aged 19, was referred because of a slowly progressing right hemiplegia and with a history that in October, 1926, she noticed some difficulty in writing with the right hand; this was followed six weeks later by a mild but persistent headache and a tendency to vomit. Unsteadiness of gait was the next development, with increasing weakness and awkwardness in the use of the right arm and leg and of the right side of the face. In June, 1927, a gradually progressive obscuration of vision became manifest. On examination in July, 1927, the patient exhibited an ataxic type of right sided hemiplegia with partial motor aphasia. There was marked weakness and slight ataxia in the right arm. The gait was ataxic. The right pupil was larger than the left and both reacted promptly to light and in accomodation; there was extra-ocular unbalance from beginning weakness of the third nerve in the right eye. Both knee jerks were absent. The sense of smell was not impaired.

Ophthalmoscopic examination of the eyes by Dr. Langdon revealed: "The vision of the right eye was 5/15, of the left eye 5/30. The fields for form were full but there was concentric contraction for colors, blue being the only color recognized. The level of the right disk was plus four and of the left disk plus three. She had 2 diopters of papilledema in the right eye and 1 in the left eye. There were no hemorrhages." In two weeks the choking had increased to 5 diopters in each eye. There was slight impairment of touch and sensation of pain on the right side of the face with marked diminution in both conjunctival reflexes. Audiometer tests gave practically normal hearing on both sides.

The Bárány examination showed that the station was slightly unsteady with the eyes closed and that the patient had a tendency to sway to the right. Station was good with the eyes open. Air conduction was better than bone conduction in both ears and about equal in both. There was no spontaneous nystagmus. She normally past pointed to the left with the right hand. Turning to the left ten times caused the patient to past point 3 inches to the left with the left hand. After turning there was a tendency to past point to the left with the right hand, but this was not definite because of the movements she described even before turning. Turning the patient to the right six times caused her to past point with both hands to the right. Douching the right ear caused nystagmus, which began in seventeen seconds and lasted forty seconds without nausea. Douching the left ear caused a few indefinite nystagmic movements in eighty seconds which lasted ten seconds and caused the patient to become nauseated. There was slight deviation of the eyeballs with external rotation of the right eye at this time. Turning the patient to the right caused the ocular divergence to disappear.

Roentgen-ray examination of the skull showed definite evidence of erosion and pressure in the region of the sella. The posterior clinoids could scarcely be distinguished. The floor of the sella was eroded and thinned and seemed to show evidence of downward pressure. The remainder of the skull did not show any definite pathologic changes.

There was a right hemihypesthesia involving the lower right side of the face, the right arm and the right leg. There was slight impairment of the sense of pain and of the sense of cold without recognition of heat and of gnostic sensations, and there was loss of the sense of position and impairment of the sense of vibration over this same area. On the right side of the body there were astereognosis, dysmetria, adiadokokinesis, asynergia, motor ataxia, marked general muscular hypotonia and loss of the deep tendon reflexes with the exception of the right biceps jerk. There was a Babinski reflex on stroking the sole of the right foot but there was no Hoffman's sign. Memory tests were fairly done with a tendency to forget certain incidents. There was a slight motor aphasia and questionable slight word deafness. The patient cooperated well throughout the examination. The blood Wassermann test was negative and the blood count, urinalysis and renal function tests were normal.

These observations were conclusive evidence that the patient had tumor of the brain involving the sensory and motor fibers to the right side of the body with a considerable admixture of cerebellar symptoms. In order to determine whether this new growth was supratentorial or infratentorial it was deemed expedient to inject air into the ventricles. Because of the high degree of choking of the optic nerve heads a combined ventriculo-encephalogram was decided on and it was performed under local anesthesia. A puncture of the left ventricle was not attempted. The right ventricle was prepared by the usual trephining of the skull; the needle was introduced but it failed to reach the ventricle in its normal position. It was then decided that the ventricle was displaced outward to the right and the needle was introduced more laterally when clear fluid was encountered at once. Ventricular drainage was established and 20 cc. of fluid was removed; an equal quantity of air was immediately injected. Two roentgen-ray plates were made, but they were unsatisfactory because of insufficient air. The patient was returned to the operating room where a spinal puncture and drainage were done; 90 cc. of fluid was removed and 80 cc. of air introduced. As the ventricular needle had been left in place the injection was considered complete when bubbles of air appeared in the cannula of the brain. Roentgenograms were then taken and readings of the wet plate showed complete obstruction of the left ventricle from a tumor which appeared to be growing from below upward in the region of the thalamus; its situation seemed to indicate a gliomatous nature. The clinical reaction following this procedure was slight but extremely suggestive of glioma in that the patient became drowsy but not stuporous.

As a result of this procedure the growth was deemed to be a subcortical glioma in the left temporoparietal region. A decompression operation, with a large osteoplastic flap, was performed to relieve pressure headache and to save the sight. At operation the subcortical growth was clearly demonstrated but it was found to be impossible to remove the neoplasm.

After a rather stormy convalescence the patient was removed to her home and I am in receipt of a letter from the family stating that she is living and is comfortable but has considerable ataxic weakness in the right half of the body. The eyesight has improved and the headaches and motor aphasia have disappeared. At the present time she is receiving deep therapy roentgen-ray treatments for the direct effect on the pathologic tissue.

CASE 2.—F. R., aged 25, was admitted to the Philadelphia Orthopaedic Hospital in September, 1927, suffering with headache, vomiting and failing eyesight. He stated that in October, 1926, he had experienced faintness followed by nausea and vomiting. Attacks of vertigo followed and vision became somewhat blurred; the headache increased in severity. Two weeks prior to admission to the hospital he developed severe headache which seemed to be localized in the occipital region. The headache was accompanied by diplopia, vomiting and unsteadiness of gait. For the past two months he had been mentally confused, and had become emotionally unstable; memory had become unreliable. On examination it was noted that the patient arose from the recumbent position fairly well and that station with the eyes closed was normal. There was a slight tremor of the left arm. There was bilateral adiadokokinesis and there was no astereognosis. The sense of position was normal in all four extremities as was the sense of vibration. The sensations of touch, pain, heat and cold were perceived normally throughout. There was a slight demonstrable weakness of the right arm and definite weakness of the right side of the face. There was a Hoffman's reflex on the left side. All abdominal reflexes were exaggerated. The patellar reflexes were greatly exaggerated on both sides but more markedly on the right and the achilles reflexes were increased. There was a definite ankle clonus on the right side and an abortive ankle clonus on the left. There was no Babinski sign on either side. The cranial nerves were essentially normal except for beginning swelling of the optic disks and lower right facial weakness. There was no true nystagmus and no extra-ocular paralysis. The report of the examination of the eye by Dr. Langdon showed the vision of the left eye to be 5/9 and of the right eye 5/6. The left fissure was not as wide as the right; the pupils were equal and normal and the motions were full. There was no diplopia. The media were clear; the disks were hyperemic and the nasal margins blurred. There was no swelling or other fundus change. The fundus level was plus 4 diopters. In two weeks the fundus level had increased to plus 6 diopters but hemorrhages were not seen. "Examination of the form and color fields showed a normal form field on both sides with a marked contracture of the color fields on both sides, except for blue."

The Bárány examination revealed the hearing tests to be normal. There was no spontaneous nystagmus. Douching the left ear produced a horizontal nystagmus in thirty seconds and both hands past pointed 3 inches to the left. Douching the right ear produced a horizontal nystagmus after two minutes and the patient became nauseated, but there was no vomiting and the left hand past pointed to the right whereas the right hand did not. After injecting warm water in the right ear to stop the nystagmus the right hand past pointed spontaneously 3 inches to the left. The Bárány reaction was indicative of a right lateral lobe cerebellar lesion.

These observations showed that the essential subjective symptoms were headache, vomiting, dimness of vision, diplopia and some ataxic weakness on the right side of the body. The localizing symptoms were essentially those of slight motor weakness on the right side with ataxia. In order to determine if the lesion was supratentorial or infratentorial it was deemed advisable to make a combined encephalo-ventriculogram.

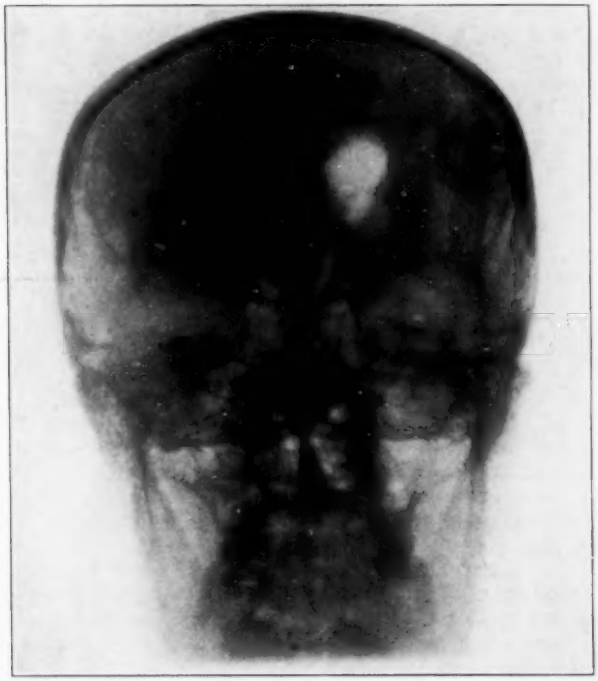

Fig. 1.—Roentgenogram showing filling difficulty of the left ventricle; front view.

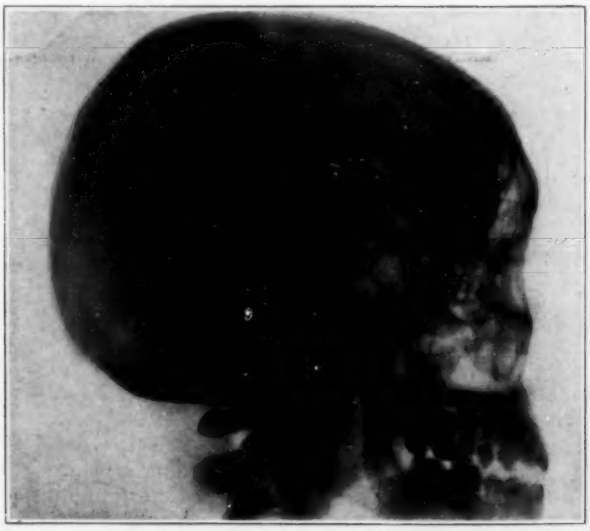

Fig. 2.—Same as figure 1; lateral view.

The usual occipital trephine opening was made and insertion of a cannula revealed a patulous right ventricle which was displaced somewhat to the right side. Fluid was withdrawn and an equal amount of air injected into this ventricle. A lumbar puncture was then done; 70 cc. of fluid was withdrawn and 60 cc. of air injected. Roentgenograms were then taken which showed a filling difficulty of the left ventricle as air had not entered this ventricle (figs. 1 and 2). The right ventricle seemed to be distorted somewhat to the right and it was distinctly enlarged. Air had entered the right ventricle from the lumbar region which indicated that the aqueduct was patulous. Air could

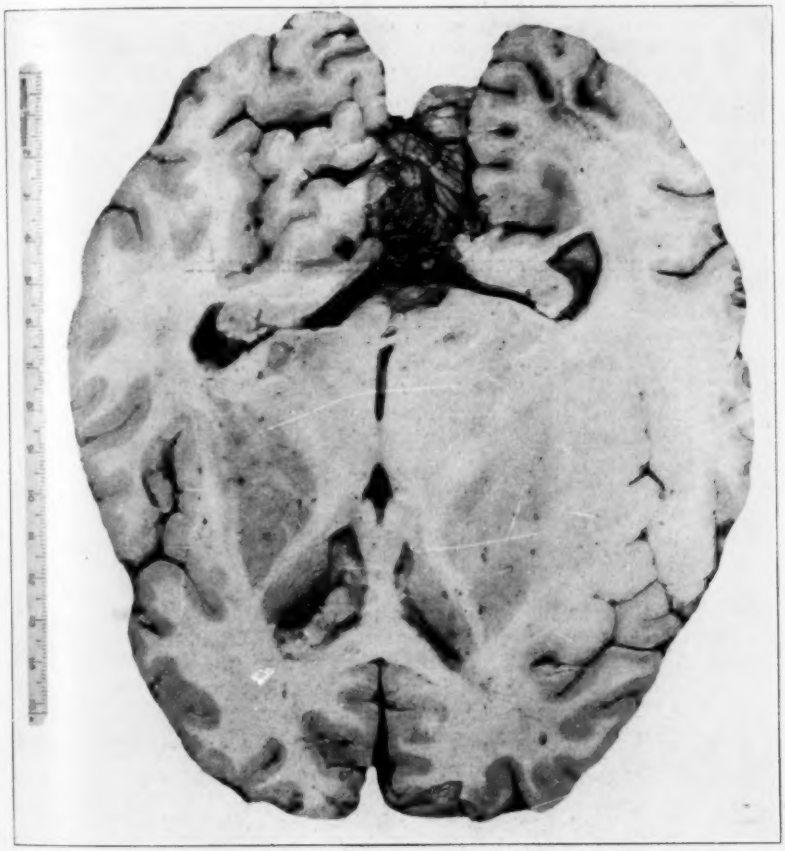

Fig. 3.—Horizontal section of the brain showing increased size on the side of the tumor with occlusion of the anterior horn of the left ventricle.

be detected in the posterior fossa around the cerebellum, and some air had reached the region of the chiasm and was present in the cisterna pontis. This would seem definitely to rule out a posterior fossa lesion as obstruction would have been expected not only of the aqueduct but also of the cerebellopontile angle. The air had reached the right side of the cortex but was not present on the left. This would seem to point to a lesion on the left side of the brain sufficiently large to produce obliteration of the sinuses over the cortex, to obliterate the left ventricle and to cause displacement of the right ventricle from pressure. These observations strongly suggested a glioma within the

hemisphere itself which was invading the motor area as observed from the physical observations.

The patient reacted in a favorable manner during the technic of the examination which was made at about 11 a. m. Because of severe headache at about 5 p. m. another puncture was done and 20 cc. of fluid was removed to relieve intracranial pressure. Soon after the withdrawal of this lumbar fluid the patient experienced difficulty in breathing and rapidly went into a state of shock; he died at 3 a. m. the following day of respiratory paralysis. An autopsy was performed, and on removing the calvarium it was noted that the left hemisphere was considerably larger than the right; on reflexion of the dura the cortex showed flattening of the convolutions on the left side, but the optic nerves were intact and appeared to be normal. The pituitary body was not enlarged. The basilar structures appeared normal. On removal of the brain it was evident that the occipitotemporal convolution of the left hemisphere had become herniated through the incisura tentoria (fig. 3). The uncinate lobe had herniated through the foramen and a piece of temporal lobe was jammed into the cerebellopontile angle on the left side. This had pressed on the pons on the left and had produced some distortion in the pons. This was not tumor tissue but was the result of pressure through the hemispheres. The chiasmal region showed definite evidence of a tumor pressing from the left causing the subthalamic region to be distorted toward the right. There was also present a foraminal hernia, the cerebellar hemispheres and the brain stem being partly herniated through the foramen magnum. The brain weighed 1,620 Gm. and appeared edematous. On cut section the infiltrating glioma was not readily distinguishable in the left subcortical temporoparietal region. The pathologic report by Dr. N. W. Winkelman at the Laboratory of the Philadelphia General Hospital is as follows: "The tumor tissue is very fibrillar and has widely separated glial cells which have for the most part large nuclei and whose protoplasm is fairly definite with numerous long processes. Occasional glial, round, naked nuclei are seen. The tumor is not very vascular. The margins show the beginning of a softened area. Microscopical diagnosis: fibrillar astrocytoma glioma."

The interesting note about this case is that the encephaloventriculogram established definitely the locus of the growth which was proved at necropsy. The observations at autopsy revealed herniation of a part of the left temporooccipital lobe through the incisura tentoria, and herniation of the cerebellar tonsils and brain stem into the foramen magnum. This latter condition apparently took place because of the sudden withdrawal of spinal fluid; had a second lumbar puncture not been done it is possible that death might not have resulted at that time. It is also possible that the sudden expansion of the glioma following the release of intracranial pressure may have produced distortion of the brain stem and caused death.

SUMMARY

In final analysis it is evident that ventriculo-encephalography is still a dangerous procedure and that secondary lumbar punctures for the relief of pressure symptoms should not be done. It is also obvious that ventriculoencephalography is one of the greatest single aids that we have for the localization of cerebral distortion, being exceeded only by a complete, painstaking and carefully-made physical examination.

DISCUSSION

DR. N. W. WINKELMAN: With close attention some little demarcation of the tumor can be observed. I have had several cases in which on first glance there did not appear to be any tumor. Microscopic section of this type of tumor usually shows a form of glioma which has been termed a fibrillar astrocytoma. It is a tumor which, apparently, does not have a tendency to degeneration.

APPLICATION OF THE TOBY QUECKENSTEDT TEST TO THE LOCALIZATION OF CEREBELLO-PONTILE ANGLE TUMORS. DR. W. J. GARDNER.

This paper will be published in full in a later issue.

VOLUNTARY NYSTAGMUS IN CHRONIC EPIDEMIC ENCEPHALITIS. DR. CHARLES W. BURR.

This paper will be published in full in a later issue.

FRONTAL LOBE TUMORS. DR. PAUL E. KUBITSCHEK.

This paper will be published in full in a later issue.

Regular Meeting, Feb. 24, 1928

N. W. WINKELMAN, M.D., *President, in the Chair*

PRACTICAL PROBLEMS IN THE METHODS OF DIAGNOSIS OF TUMORS OF THE BRAIN IN GENERAL, AND A DISCUSSION OF TUMORS OF THE FRONTAL LOBE IN PARTICULAR.

This meeting was devoted to a discussion of the papers on tumors of the brain, presented at the January meeting of the society.

DISCUSSION

DR. CHARLES K. MILLS: One of the main purposes of a good medical, scientific or other society is to increase wisdom by free discussion. As some one remarked regarding the January meeting of this Society, its proceedings show that it is a "very live" organization. The half dozen papers read exhibited the results of careful work and, in the main, of sound thinking. My only criticism, one which I have already expressed regarding other meetings of this Society, was that the program was overloaded and did not allow sufficient time for the discussion of even one of the papers let alone of the six.

How is one to improve this situation? Only by patience and personal self-denial. It is only in rare cases that the presentation of a paper cannot be postponed for a time without disadvantage. Members of this and of other societies have a tendency to think that the facts and theories with which their minds at a given time are afflicted should immediately be placed before an expectant world. I am confident that I have been occasionally guilty in this respect. It is worth considering whether one should not have a rule that no member of this Society should be allowed to present more than one or two papers in the course of the working season, or whether one should not consider the question of doubling or extending in some ratio the number of meetings.

In the reported proceedings of some American societies and especially in those of the New York Neurological Society, I notice that a half dozen or more papers are sometimes presented at one meeting, but I learned on inquiry regarding the latter that the readers of the papers are compelled to have their communications carefully prepared and condensed. Allowing three hours as the average acceptable time for a meeting, not more than two or three papers can be discussed during this time. The number of projections to be used on the screen should be as carefully curtailed as should be the nonillustrated portions of the contributions.

Mindful of my criticisms of others, let me now abridge this introduction and proceed to the real work of the evening — the actual discussion of the proceedings of the last meeting.

In some associations, here and abroad, the meeting at which a presidential address is delivered is made a red letter occasion, like the famous meeting at Oxford in which Darwinism was both attacked and defended. It was on such

an occasion that the great doctrine of the origin of species first fixed the attention of the scientific world. A presidential address should not be held inviolate as the last word on the subject, but its views should be free to be challenged by the antagonists and to be defended by the protagonists for the benefit of the rest of the world.

Personally, I do not think that anything else should be on the program of the evening when the presidential address is delivered. If this address does not contain matters worthy of discussion, it is not worthy of presentation to a learned society. This, however, could not be said of our last presidential address, which was based on independent consideration of new materials of interest to the neurologist, and it also gave the results of a carefully prepared questionnaire sent to all the members of the Society and to neurologists in other parts of the country.

Dr. Burns in the early part of his paper makes a significant statement with regard to the manner in which a general practitioner, after receiving a negative roentgen-ray report, may allow the patient to go on until life is threatened or lost without having a complete neurologic examination made. He also calls attention to a second case in which roentgen-ray examination gave negative results but in which the clinical study pointed clearly to a frontoparietal tumor. This was actually revealed by operation and subsequent necropsy. This emphasizes the idea that however important roentgen-ray examinations of the head may be in a suspected lesion of the brain, such examinations should never be relied on to the exclusion of a thorough clinical investigation.

Dr. Burns in his paper cites the opinions arrived at by Heuer and Dandy from the investigation of 100 cases. These authors reported that "There is no shadow from uncalcified tumors except in cases where the accessory sinuses have been attacked by tumor tissue. However, this rule may not apply in hypophyseal lesions which are viewed against the dark temporal fossa. The shadows cast by bony or calcified tumors are easily recognized."

If I understand this statement, I do not think it is entirely correct, and it is not in accordance with my personal experience. In 1902, with the assistance of Dr. G. E. Pfahler (*Phil. M. J.*, Feb. 8, 1902), the second case of tumor of the brain revealed by the roentgen ray was reported by me. This was an endothelioma. Dr. Church, (*Am. J. M. Sc.*, 1899, vol. 117) of Chicago, had previously shown the presence of a tumor by roentgenography. Since the report of this case by Dr. Pfahler and myself, I have somewhat frequently resorted to the roentgen ray and in some instances with success, but I have never examined a patient in this way in which the tumor could not have been located by a thorough clinical investigation.

One thing on which I do not think sufficient stress has been laid by Dr. Burns and Dr. Grant and others is the possibility of showing the existence of tumors or cysts the structure of which is of less density than that of the brain tissue. As a rule, such cysts are more readily revealed by roentgenograms than are hard tumors. It is known that calcified growth, foreign bodies, endostosis or exostosis of the cranium and widening of the sutures, can all be revealed by roentgenologic examination. It is known that the condition of the sella turcica can be shown, and on the other hand a thorough clinical examination may be sufficient for the same purpose.

Dr. Harvey Cushing in a portion of his reply to the questionnaire to Dr Burns hits the nail on the head with regard to one of the most important matters in making a diagnosis of the presence and location of a tumor of the brain. Dr. Cushing expressed the opinion that "no instrumental diagnostic measure can equal in value a detailed and exact chronological history of the symptoms." He feels that this will always be our chief reliance, and believes that it may require greater skill and experience to secure an accurate clinical history than to make a detailed neurologic examination.

My experience of many years emphasizes this opinion of Cushing. In trying to obtain the previous history of the patient with a serious organic condition of

the brain, one of my first objects has always been to fix the time of the beginning of the symptoms which pertain to the present diagnosis. This is by no means always an easy matter. The tendency of the patient is to fix on the time when some symptom or symptoms first greatly impressed him, as, for instance, difficulty or awkwardness in using the arm or any part of it, subjective impairment of sensation so marked as to hold his attention, or interference with his facility in speaking. The real beginning of his condition may have been a year or several years before the first symptoms alluded to by the patient began to attract his attention.

In a case of tumor in the parietofrontal region, reported by me in 1900, (*J. Nerv. & Ment. Dis.*, May, 1900) the first symptoms were slight impairment of muscular and cutaneous sensibility, and these were not followed by motor loss for several years. In the latter part of this time, ataxia, astereognosis and finally motor paralysis appeared, evidently from invasion forward and downward by the tumor. The patient in this case was successfully operated on, and a large endothelioma was removed. Such growths are sometimes slow in developing, a fact which must be borne in mind in fixing the probable original position of the growth and its subsequent advance.

If the chronologic clinical course of a case can be thoroughly made out, this and the neurologic symptoms accurately and fully studied will in most cases permit a diagnosis without the help of instrumental methods. Let it be understood, however, I do not disparage or discourage the use of such methods and especially the roentgenologic examination and ventriculography. Just as a man on trial for his life is, in the language of the law, entitled to the use of every means possible for his defense so the patient in whose case one is seeking to make an accurate diagnosis is entitled to the use of every measure known to the medical profession.

The series of five cases of tumors of the spinal cord and of the brain reported so clearly and succinctly by Dr. Grant is worthy of special attention and comment. His first case proved to be one of tumor or a cystic endothelioma extending from the ninth thoracic to the second lumbar vertebra. The position of this growth was corroborated by the use of the roentgen ray which revealed the existence of a hypertrophic pachymeningitis. This case strikingly shows the importance of an exact clinical study in such cases. Even without the use of the roentgen ray or the Queckenstedt methods it was clear by the sensory, motor, vasomotor and reflex observations that a tumor or localized pachymeningitis was present in the lower thoracic and upper lumbar region; nevertheless, the roentgen-ray examination had important corroborative value.

The second case reported by Dr. Grant was one in which the clinical observations received real support from the use of the ventriculographic method. The clinical symptoms were undoubtedly indicative of interference with the functions of the cerebellum either directly or indirectly. Ventriculography showed obliteration of the left anterior horn with displacement of both ventricles to the right.

In the third case reported by Dr. Grant, although the symptoms are well recorded and a tumor of the left temporoparietal lobe was diagnosed, no report is given concerning the result of the operation. The case, however, shows the value of all the methods, clinical or corroborative, employed in the diagnosis of tumor of the brain.

The fourth case reported by Dr. Grant was one which shows clearly the possibility of making a focal diagnosis by a close study of the clinical course and the symptomatology of a case of tumor of the brain without recourse to any methods like roentgenography and ventriculography. The symptoms seemed to have clearly showed a surface lesion, and the frontoparietal osteoplastic flap revealed a friable tumor which was easily removed.

In Dr. Grant's fifth case the thorough clinical examination was above everything else especially important and was sufficient to enable one to make the diagnosis.

The cases reported by Dr. Grant show the importance of well conducted clinical conferences such as are held at the Medical School of the University of Pennsyl-

vania and the Philadelphia General Hospital. Such conferences improve the diagnostic skill of those taking part and afford the opportunity of making useful critical comments.

Dr. Leavitt's paper on two cases of tumor of the brain, it seems to me, emphasizes the superior importance of clinical examination of the patients. The clinical course and symptomatology in both of these cases were sufficient in my judgment to have determined the presence and position of the tumors. It is true that in one of these cases ventriculography corroborated the clinical observations. The results in both cases show that it is best in some instances to rely on the clinical symptoms in the case of supposed tumor of the brain, and it is clear that in some cases the withdrawal of spinal fluid by a lumbar puncture may result in dangerous or fatal issue.

Dr. Leavitt in summarizing his second case says that "The findings showed that the essential subjective symptoms were headache, vomiting, dimness of vision, diplopia and some ataxic weakness on the right side of the body. The localizing symptoms were essentially those of slight motor weakness on the right side plus ataxia and in order to determine if the lesion was supratentorial or infratentorial it was deemed advisable to make a combined encephaloventriculogram."

The encephaloventriculograms made in this case were of positive advantage in fixing the site of the lesion. Herniation of the brain through the incisura tentoria and foramen magnum undoubtedly took place because of the withdrawal of spinal fluid by lumbar puncture. This case of Dr. Leavitt's sounds a note of warning as regards the possible dangers of ventriculography. When used, the method should be guarded in every feasible way.

One of the refinements in diagnostic methods which has a positive but limited value in fixing the presence and site of a tumor of the brain is the Queckenstedt or the Tobey-Queckenstedt method. This was discussed in a paper at the January meeting entitled "Dynamic Studies on the Cerebro-Spinal Fluid" by Drs. Charles H. Frazier and W. J. Gardner, with regard to tumors of the cerebellopontile angle. This test is, in effect, based on the results caused by the pressure of an angle tumor on the lateral sinus. This pressure causes obliteration of the lateral sinus and marked disturbance of the vascular pressure and interference with the heart action and respiration. The changes in the cerebrospinal pressure are measured by a manometer connected with a needle which is retained in position after the lumbar puncture. This manometer is connected with a tambour on which are recorded the tracings which indicate the variations of pressure. In several cases of angle tumors on one or both sides the observations were such as to assist in locating the growth. In two cases of tumor of the spinal cord, the manometer accurately fixed the position of the spinal block.

It is to be noted, in these cases of Frazier and Gardner, that a diagnosis of the presence and position of the tumors might have been made by a patient study of the history of the development of the case from the first and a study of its present symptomatology. In other words, as already indicated, this Queckenstedt method which has been used and thoroughly weighed by Ayers of Boston is another diagnostic measure which should not be neglected, especially when the neurologist or surgeon is in any doubt.

In the announcement of the program for this meeting I was led to discuss the frontal lobe in particular by hearing Dr. Kubitschek's interesting paper on "The Symptomatology of the Frontal Lobe Tumors Based on a Series of Twenty-Two Cases." First, I might say a few words on the methods of subdividing the frontal lobes. From the standpoint of physiology this subdivision should be in at least three parts, namely, prefrontal or higher psychic, midfrontal or higher motor and postfrontal or motor regions. To attempt the discussion of the physiology and clinicopathology of the frontal lobes without a subdivision of this kind is a futile procedure. A tumor restricted to one of these regions will give symptoms of a special character. A study of the lesions under investigation shows an anatomic and physiologic merging of one of these regions with the others.

I have read carefully the paper by Dr. Kubitschek. One of the defects of the paper is that in none of the cases presented does he give the exact position or limitation of the growth. He makes use of such expressions as a large endothelioma involving the frontal lobe. Evidently, in some of his cases the prefrontal lobe was invaded by the tumor or possibly the tumor originated there. Dr. Kubitschek's paper should be read carefully from beginning to end in order to arrive at a satisfactory opinion of its merits with regards to the question of psychic symptoms.

In Dr. Kubitschek's summary, his first conclusion is that unilateral failure of vision and psychic disturbance are the symptoms most suggestive of tumors of the frontal lobe and that these are not of frequent occurrence; his second conclusion is that psychic disturbance, of an appreciable degree, may be entirely absent in neoplasms of the frontal lobe; his third conclusion is that psychic disturbances are dependent more on the personality make-up of the patient than on the size, character and location of the tumor. His most extraordinary conclusion is that, "the frontal lobe is neurologically a silent area."

The paper of Dr. Kubitschek seems to call in question the opinions of Dr. Ferrier with regard to the psychic functions of the prefrontal lobes. In Ferrier's "Functions of the Brain" (ed. 2, New York, 1899) and also in his "Goulstonian Lectures of 1878" (New York, D. P. Putnam's Sons, 1879) and his "Croonian Lectures for 1890" (London, Smith, Elder & Co., 1890), he distinctly indicates his belief that the prefrontal portion of the brain is concerned especially with psychic functions of some sort. Ferrier's review of the celebrated "crowbar case" and other similar cases and his report on the results of experiments on monkeys all bear out this statement. While the man in the "crowbar case" lived twelve years, his mentality was almost entirely changed. "His contractors who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his mind so marked that they could not give him his place again. The equilibrium or balance, so to speak, between his intellectual faculties and animal propensities seems to have been destroyed. He was fitful, irreverent, indulging at times in the grossest profanity, manifesting but little deference for his fellows, impatient of restraint or advice, at times obstinate, yet capricious and vacillating, devising many plans for future operation which were no sooner arranged than abandoned. A child in his intellectual capacity and manifestations, he had the animal passions of a strong man. Previous to his injury, though untrained in the schools, he possessed a well-balanced mind and was looked on by those who knew him as a shrewd business man. In this regard his mind was radically changed, so decidedly, that his friends and acquaintances said he was 'no longer Gage.'"

In the Croonian lectures, Ferrier in commenting on his experiments on the prefrontal region remarks that "In addition to the paralysis of the movements of the head and eyes on destruction of the frontal lobes, I have also observed a noteworthy psychical defect — a defect which I have endeavored to correlate with the inability to look at, or direct the gaze towards, objects which do not spontaneously fall within the field of vision. It is a form of mental degradation which appears to me to depend on the loss of the faculty of attention, and my hypothesis is that the power of attention is intimately related to the volitional movements of the head and eyes."

It will be seen that Ferrier, while recognizing the existence of higher psychic centers in the prefrontal lobes, apparently interprets their presence somewhat differently from the interpretation given by Hughlings Jackson. In the main, however, these two great neurologists agree. Jackson's well known theories of the different levels of the nervous system is called into play in his discussion of the functions of the prefrontal region. He regards his level as triply representing or to use his own term as re-re-representing the entire nervous system, spinal, sensorimotor and cerebellar. To the cerebellum, however, he gives a special place as belonging in part to the lowest spinal level and in part to the sensorimotor or middle level.

In a paper presented to this Society in March, 1927 (ARCH. NEUROL. & PSYCHIAT. **18**:832 [Nov.] 1927), I remarked that in the process of evolution the highest psychic prefrontal region, as it evolves more and more, becomes more strongly organized, and eventually is nearly independent of the lower levels from which it has been developed. In apparent contradiction to the general law that the last organized is the least organized, this highest evolutional level, taken as a whole, is the most organized. Within this highest level, however, internal evolution is constantly taking place or tending to take place and, speaking only of this level, the last organized becomes the most evanescent or the least organized.

It is within this region that such higher qualities of the mind as will, memory, reason and emotion are represented; they are not represented by limited and separated units or centers, but by the working together of the highest and the most complex nervous machinery here represented.

My conclusions in discussing the papers on tumors of the brain might be briefly summarized: (1) It has been sometimes questioned whether the study of tumors of the brain can be used with advantage in determining the functions of special or particular districts of the brain. Perhaps destructive diseases like softening from encephalitis or from vessel occlusion is of more value in focal diagnosis. Nevertheless, if tumors of the brain are properly studied, they are of great value in localization. (2) From a consideration of the papers on tumors of the brain presented at the last meeting one of the most important truths emphasized is that the study of what is commonly called the past history of the patient is of preeminent importance. (3) The history of the patient before the time of his coming under observation, associated with a thorough study of the present symptomatology will usually be sufficient to arrive at a diagnosis both general and focal. The differential diagnosis in such cases will chiefly be between tumor and such active and irritative conditions as abscess, hemorrhage and foreign bodies. (4) Roentgenologic examinations are useful especially in determining the presence of hard tumors such as endotheliomas, calcified portions of the brain like the pineal gland, and cysts or growths of less density than the brain tissue. (5) Ventriculography is of value especially in fixing the side of the brain on which a tumor is located and in determining the presence or absence of enlargement of the ventricles and their connections. Some dangers attend the use of ventriculography, and these should be carefully guarded against. (6) The effects of pressure of large tumors on the cranial nerves, especially the sixth, and on distant parts is always to be taken into consideration especially remembering Von Monakow's doctrine of diaschysis. (7) In the discussion of tumors of the frontal lobe, one should understand what is really meant by higher psychic symptoms. It is also important to know that a lesion as irritative as a tumor of the brain may give rise to mental symptoms which have nothing to do with the particular location of the growth.

DR. WILLIAM G. SPILLER: No one would suppose that the frontal lobes are isolated from the rest of the brain and have a symptomatology from lesions independent of connections with other cortical areas. The connections of the frontal lobes with other lobes are numerous and well known. It does seem to be established that extensive lesions of the frontal lobes, especially of the left frontal lobe, have a tendency to cause distinct disturbances of cerebration, more so than lesions elsewhere. Four important articles on tumors of the frontal lobe have been published within the past year or two, and the views expressed are somewhat in disagreement.

Takagi studied five cases of tumor of the frontal lobe with necropsy, and he compares his observations with those of other cases in the literature which he selects as suitable, making fourteen cases from which he draws his conclusions. He believes that a definite form of psychosis does not exist in tumor of the frontal lobe, but that the symptoms are such as may be produced by increased intracranial pressure. He states that the infrequent occurrence of psychic disturbances in tumor of the frontal lobe is striking. This paper is from the Neurological Institute of Vienna.

E. Sachs studied twenty-five cases of tumor of the frontal lobe. His observations are different. He obtained mental changes in twenty of his patients. Some were indifferent to the seriousness of their condition and did not worry about operation; or they showed loss of memory for recent events. Some neglected their work. Gordon Holmes, in discussing this paper, remarked that he had studied hundreds of men during the war who had sustained gunshot wounds of the frontal lobe. The mental symptoms were prominent in certain cases but were absent in others.

Vincent and de Martel accept psychic symptoms as indicative of lesions of the frontal lobe. They had eight cases of tumor of the frontal lobe in 1927 in which operation was performed. Pousepp regards mental disturbances as characteristic of tumor of the frontal lobe. The forced grasping (Zwangsgreifen) is receiving much attention as a sign of lesion of the frontal lobe. It seems to be uncommon.

Sachs mentions slight weakness of the facial supply only in speaking as an early sign of tumor of the frontal lobe. I have observed this in cases of tumor of the left temporal lobe, and have explained it as a disturbance of early character from lack of control through the speech mechanism. It has seemed possible to me that such a weakness might be detected sooner than one from voluntary innervation, and in my case in which it was pronounced hemiplegia soon developed with marked involvement of the face. Sachs also speaks of deliberateness of speech in the choosing of words in cases of tumor of the frontal lobe. I have seen this in tumor of the left temporal lobe, and believe it may occur in any moderate disturbance of the speech cortex.

DR. J. HENDRIE LLOYD: In his admirable presidential address, Dr. Burns discussed roentgenography and ventriculography. It served to recall to some of us the early days of the roentgen ray and the hopes which were entertained of its use in the diagnosis of tumors of the brain. Part of the value of Dr. Burns' paper is his careful appraisement of the claims for and against the roentgen ray. It has not met all the hopes which were once entertained for it. I recall my first experience with it. This was in the case of a youth, aged 16, who had a tumor of the pineal body. The tumor gave a good shadow because of the calcareous deposits in it, and the natural impulse was to go after it and get it out. This was done by a competent general surgeon, but unfortunately the patient promptly died. It was a question whether he would not have been just as well off without the roentgen ray, which had led to overconfidence and perhaps to rather reckless surgery. This might be used as a text on the subject of overconfidence inspired by the roentgen ray, for this is an error into which it is possible to fall even today. It is one thing to locate a tumor of the brain, but it is another thing to remove it.

In many cases tumors of the brain can be successfully diagnosed and located without the use of the roentgen ray, and it would be a grave error to allow this method to supersede a careful clinical diagnosis. Moreover, the roentgen ray does not always tell us much even if it does point out the site of the tumor. It may leave entirely in the dark the relationship of the growth to vital structures. This was strikingly shown in the case of a tumor of the hypophysis in my service at Blockley. A correct diagnosis had been made without the roentgen ray; subsequently, when it was used, the roentgenogram showed erosion of the sella and of the base of the skull just around and beneath the sella. At autopsy the tumor was found to be enormous, invading the interpenduncular space, penetrating beneath the tentorium, involving the cerebellopontile angle and making a deep depression in the under surface of one hemisphere of the cerebellum. Nothing of this was shown by the roentgen ray, so I had felt that an operation was indicated; but when the surgeon, Dr. Grant, opened the skull, he found himself faced with an impossible situation; he had the good judgment not to attempt to remove the growth. I fear such an attempt in such a case by any surgeon would result in death on the operating table. Here the roentgen ray was practically of no use, but rather misleading, because it inspired overconfidence in both of us.

The growth of brain surgery has been due not so much to the roentgen ray as to the rise of surgeons who make a specialty of this work and become highly skilled. In former days, we put these cases in the hands of the general surgeons, but today we intrust them to the surgical specialists who have made this field their own.

I believe a warning voice should be raised about ventriculography. It is a dangerous procedure, and demands not only rare skill but also rare judgment; the latter is even more important than skill. It may be a question in many cases, especially if a reasonably good diagnosis has already been made, whether it is desirable or even justifiable to subject a patient to this additional danger.

Dr. Mills' paper introduces a subject of supreme interest in psychology as well as in clinical work, and should be fully discussed. In such a discussion as this, it is important to define our terms to know clearly what we are talking about. Take, for instance, the question of the mental faculties. Are these faculties distinct entities, and are they separable? Can some of them be localized in one part of the cortex and some in another? I think this is doubtful. In a former paper Dr. Mills used the term "mentation" to indicate the functioning of the brain cortex. It is an excellent general term. From this term it seems to follow that the various so-called mental faculties are merely modes of action; that they are manifested by all regions of the cortex. Memory, for instance, is probably a faculty of all neurons, even the neurons of the spinal cord. Intelligence, emotion and will are the modes by which all regions of the cortex act. To attempt to go further than this with present knowledge would lead one into mere academic and metaphysical labyrinths.

Dr. Kubitschek has clearly marshalled all the various symptoms shown in a fairly large number of cases of tumors of the frontal lobe. His paper is based on the careful observation of facts, not on theory. Evidently there is great variety in this symptomatology, and this variety is not difficult to explain as due to the various sizes and locations of these growths. These tumors are not all alike; some invade one region, others another. This accounts for the motor involvement as seen in some but not in others, such as deviation of the head and eyes, forced movements, monoparesis and hemiparesis and even ataxia. It is easy to see how some of these tumors may invade the motor area and others not. There may be pressure (and by interference with circulation and with subcortical association tracts) which may disturb areas even farther back; thus the ataxia may possibly be caused by disturbance of the superior parietal lobule. I think this is more probable than to suppose it is due to involvement of the cerebellum. Unilateral anosmia and unilateral blindness are evidently of localizing value. Dr. Kubitschek failed to find in his series of cases the peculiar syndrome described by Foster Kennedy, namely, optic atrophy from pressure on the side of the tumor and choked disk in the other eye. Many symptoms caused by pressure of tumors of the frontal lobe are also seen in cases of tumors of other regions of the brain, and have little if any localizing value; nor do they throw light on the localizing of psychic functions.

I have long believed that there is a syndrome of frontal lesions (seen not only in tumors but also in fractures of the skull and other lesions) which is fairly characteristic and reliable. I recently saw such a syndrome in a case of fracture of the frontal bone in which operation disclosed a blood clot over the prefrontal region. There is retardation of cerebration, a slowing of the mental processes, which is not necessarily a weakness of them, much less their abolition. These patients, if given a little time and prodded a little, will sometimes answer correctly. They are owl-like, unresponsive and unemotional. This is probably what is meant by "alteration of the personality." The mental functions are disturbed, probably by interruption of the subcortical association tracts. Damage of these association tracts may account for much. Such association tracts may conceivably converge and have a center of control in the frontal lobes. Dr. Alpers, of this society, has recently translated a work by Flechsig in which that observer attempts to trace some of these tracts by the process of early myelinization. But I do not

think that Flechsig succeeded well with his method in this part of the brain. These tracts must be of great complexity, and it may be a question of how well we shall ever be able to unravel them. Dr. Kubitschek also touched on this subject. But it may be that the explanation of Dr. Mills' theory of the localization of the higher psychic functions in the frontal and prefrontal areas would lie in a proper understanding of the functions of these association tracts. If they are interrupted, the proper display of these higher mental faculties is disturbed. This is a subject of great obscurity, leading to speculation, but I think it is indisputable that lesions in this part of the brain do interfere with the normal manifestations of the higher psychic functions, although this does not necessarily mean that these faculties are located exclusively in this region. It is merely a disturbance of their proper correlation, to use a term which is now rather popular among some modern psychologists.

It may be well to observe that many of these cases of tumors of the frontal lobe are not expertly examined and tested in their earlier stages. By the time the patients come into the hands of the neurologist or neurologic surgeon, the growth may have increased so much that some of these finer points may no longer be detected, or they may be massed together and called "disturbance of the personality," without much or any attempt to explain what is meant by that ambiguous term. The exact study and interpretation of these symptoms demand much more time and expert knowledge than are probably often given to these cases, even in some neurologic clinics.

Dr. Mills has quoted Ferrier's opinion that the faculty of attention is largely associated with the musculature of the eyes and head, implying that this faculty is located in the frontal area; but it must be noted that this faculty of attention is probably just as much associated with the sense of hearing. When we pay attention, or concentrate the mind, we are often listening rather than looking. This serves to show how difficult it is to localize the higher mental faculties in one limited region. The same is true of the sense of smell and of taste. These functions may and do demand the exercise of attention. The centers for all these functions are doubtless linked together by subcortical association tracts.

I am in accord with Dr. Mills in believing that there is a frontal or prefrontal syndrome, such as I have described, but I hesitate to infer from this that the higher psychic faculties are exclusively localized in this area. There may be here a center of control over association tracts, linking it with various regions of the cortex, and a lesion here may act, if I may venture so to say, to throw the whole mental mechanism out of tune. This is merely a suggestion, for I do not wish to appear to dogmatize on a subject which is so obscure and so far beyond the reach of present methods of investigation. Dr. Mills' paper shows that he has seen clearly an important problem in psychology, and he has presented this problem to us with valuable suggestions from his own standpoint. This is a great service; it stimulates thought; prepares the way for discussion; and invites the expression of opinions, even if these are not always in accord.

DR. ALFRED GORDON: In reference to Dr. McConnell's remarks, I wish to corroborate them by citing one case which came under my observation. The patient complained of pains in the chest on both sides, which had continued for some months, and the diagnosis of angina pectoris was made because of the pain in the chest. Finally, the physician decided to call in a neurologist. Careful examination revealed great sensory changes strictly limited to certain segments of the spinal cord and the diagnosis of tumor was corroborated by an operation. Frequently, one meets with cases which are absolutely desperate. The patient presents definite symptoms of intracranial pressure but no localized symptoms. Only this week I had a patient who was suffering from constant headache for eight weeks — with abundant vomiting. Ophthalmoscopic examination showed hemorrhage in one retina and some other disturbance, but not a choked disk. I examined the patient carefully on Monday, Tuesday and again on Thursday, and not a single focal symptom could I find to determine the seat of the trouble, and yet the patient, generally speaking, presented clear evidence of increased intra-

cranial pressure. In all such cases additional signs or tests, such as encephalography are certainly welcome.

A Portuguese neurologist, E. Monez, recently described a method by which he can determine changes in the cerebral arterial distribution due to the presence of pressure and point out the location of the trouble, and this is done by injecting sodium iodide into the internal carotid artery. Sicard tried several times to inject iodized oil 40 per cent into the ventricles. Lately, Sicard called attention to the injection of iodized oil into the superior longitudinal sinus. I believe that any of the methods of getting air or other substances into the ventricles and sinuses are worth while and should be followed up, particularly in those cases in which one is at a loss to locate the lesion.

Speaking of mental disturbances, a few years ago I placed on record before the American Neurological Association a series of cases presenting gross lesions of the brain, many of which were tumors. All the patients presented psychoses. Some of them presented the picture of a manic-depressive psychosis, some of general paralysis, some of vague mental disturbances, memory disturbances, etc. If one reflects on the subject of mental disturbances in lesions of the brain, one finds cases of gross disturbances of the brain without mental disorder. As to the localization of special mental disturbances such as those mentioned by Dr. Mills, one may observe them in lesions of any segment of the brain and even in cerebellar lesions. Therefore, I feel that it is not yet time to assign special mental faculties to such and such a part of the brain. The brain as a whole participates in mental operations. An anatomic explanation of mental manifestations is not satisfactory. Mental disorders should also be viewed from a psychogenic angle.

DR. J. W. MCCONNELL: It seems strange to me that in the foregoing remarks no distinction is made between the symptomatology of tumors of the right frontal lobe and that of those of the left frontal lobe. Kubitschek's paper suggested that the frontal lobes, neurologically, are silent areas. Dr. Mills does not entirely agree with him. Tumors in the frontal lobe on the right side frequently progress for a long time before there is any symptomatic evidence of them.

Some years ago, I had the honor to present before this society a specimen of a tumor of the right frontal lobe from a man who had a responsible position on a railroad; until about three weeks before death he had never had any symptoms. He returned from work one evening and sat down to a dinner of pork and sour kraut. During the evening, he was taken violently ill with vomiting and pain in the head. It was thought that it was an attack of indigestion. The attack did not disappear, however, and as the headache continued for several days, it was thought to be something more. He became unable to walk, had difficulty in the handling of the limbs on the left side, and the family, as well as myself, noticed definite mental changes in that while previously he had been a sedate, retiring person, he became a man inclined to make funny remarks. Dr. Spiller saw the man and, after a week or ten days, the patient was removed to the University Hospital, where he suddenly died. He had a tumor involving the right frontal lobe, almost in its entirety.

A woman was brought to me suffering from what was thought to be epilepsy for about six months. On studying her I found that previous to the development of the epileptiform attacks she had been a good bridge player but of late she had been noted as performing poorly. Gradually her playing became so bad that she was rejected as a partner. At the same time she developed other peculiarities of behavior. I decided that she had a tumor of the frontal lobe which was pressing on the motor area. This was proved by operation.

I believe with Dr. Mills and Dr. Spiller that the study of the chronologic advance of symptoms is important in determining where the tumor originates, its size and other factors.

DR. F. X. DERCUM: I was not present at the last meeting and can therefore base my remarks only on the papers Dr. Mills and Dr. Lloyd read this evening. Regarding the roentgen-ray observations, I may say that I have never advised an operation based on these symptoms alone. My main dependence has always

been the close clinical study of the case. Dr. Mills' interpretation of the functions of the frontal lobe is in accordance with the facts available. There is first the well known area in the ascending frontal convolution which contains the emissive motor centers. Immediately in front of this area lies another which probably has to do with those associated or correlated transmissions to the motor convolutions which precede emissive discharges. Still further in advance of this area is another involving the extremity of the frontal lobes, and it is here that in all probability abstract thinking is done. In the parietal and occipital lobes our thinking is largely done by concrete pictures or conceptions. In the extremity of the frontal lobe these various concrete conceptions are resolved into resultant symbols which make abstract thinking possible.

Regarding the mental involvement in cases of tumor of the frontal lobe, there can be no question. In three of my cases reported years ago a mental reduction was noted in every instance. In another, mild confusion was present, and in still another the deterioration suggested general paralysis. In another, which has been under my observation recently and in which it proved impossible to remove the tumor because it was infiltrating in its nature, mental reduction was so pronounced as to be striking.

Whether in a given instance mental symptoms are present or are pronounced depends, I believe, on the extent to which the cortex of the frontal lobe and the white substance immediately below the cortex are involved. It is conceivable that a small tumor, limited to the central white matter of the frontal lobe, could exist without mental symptoms for some time, but I believe that extensive involvement of the cortex and subcortical white matter invariably produces the picture of mental deterioration.

Dr. Charles K. Mills: I believe the position that I have taken with regard to tumors in general and of the frontal lobe in particular has been largely indorsed by those who have discussed the subject. I must differ, however, positively from one of the members who asserted his belief that tumors in the brain did not show any psychic or mental symptoms. In the light of what is known of the subject this seems to be a foolish and futile position. Psychic symptoms of some description are shown by tumors of the brain unless they are small and of slight density. Possibly the growths to which the physician referred were situated in the right temporal lobe, the most silent or latent region of the brain, but even such growths when carefully studied will often show symptoms of invasion of other parts.

One thing that I think must have impressed everybody is the improper and imperfect manner in which tumors of the brain revealed by autopsy and operation are described. Every such growth should be photographed, if possible, at the time of the operation. I have had that done with Dr. Frazier and with others. It should also be photographed after the tumor has been hardened, and photographs should be taken of the sections made. To speak of a tumor of the frontal lobe without describing its exact position is absurd.

Dr. Kubitschek, in trying to explain what he meant when he said that the frontal lobe was a silent or latent region which gave no symptoms, explained that he meant no neurologic symptoms. Yet in his paper he mentions as present confusion, psychic symptoms, convulsions and visual and olfactory symptoms. Are not these neurologic symptoms? Little progress has been made if one is not capable of studying and explaining these and other well known phenomena. There is no region of the brain absolutely latent.

In closing my remarks discussing the subject of tumors of the frontal lobe, I wish to call attention to the description of what seems to me to be a case of tumor involving the prefrontal lobe and exhibiting typical psychic symptoms. These notes have been furnished to me by Dr. George Wilson, but I have had some personal knowledge of the patient described.

The localizing symptoms presented by the patient were at first confusing, but two days before the operation he became definitely paretic on the left side. A Babinski sign was present in the left foot. Sensation and the visual fields, so far as they could be determined, were normal. The tests for syphilis were negative.

The brother of the patient said that he had become placid of late and had shown a more even disposition. The patient when visited a few nights before had said to his visitor apropos of nothing — "How would you like to crack a peanut?" A day or two later the patient informed one of the interns that he should return to the medical school from which he graduated and get his money back because his teachers had not made a physician out of him. Once while the patient was being tested for sense of position, he informed the physician that the tests were "fake," and that the examiner probably was a horse doctor. The day before he was operated on, while he was being examined, he became markedly incontinent and passed feces in bed. He looked up into the face of the examiner without smiling or appearing upset or irritated in any way and said "Doctor, you should go to the bathroom."

It must be remembered that this patient was highly educated, and a distinguished scientific man. He had shown the mental symptoms noted only a short time previous to the examination.

At the operation, which was performed by Dr. Fay, a large osteoplastic flap was so made as to uncover the brain from the parietal lobe to the prefrontal region. This did not reveal a tumor, although the gyri were flattened, and the brain did not pulsate. According to the surgeon, it was what he called a "glioma brain." While the flap was being replaced, the brain suddenly swelled, a condition which is said to be common during operations on gliomas. The flap had to be lifted and active measures taken to prevent the man from dying on the operating table. The patient died four days later.

The tumor undoubtedly present in this case clearly involved the prefrontal region, which was exposed by extending the opening forward and examining with the light and by manipulation.

DR. KUBITSCHEK: Regarding my statement that the frontal lobe is neurologically a silent area, I used neurologic in an organic, not psychic, sense. I was impressed by the observation that tumors of the frontal lobe usually reached remarkable size before they were diagnosed. Dr. Spiller spoke of the importance which Pousepp placed on psychic disturbance in the symptomatology of tumors of the frontal lobe; yet the average size of the lesions in his series was that of a billard ball, which means a large tumor. I did not mean to give the impression that I considered the frontal lobe of no importance. I think it is of great importance in the maintenance of normal psychic life, but I think that this can be explained best on the basis of association functions, as stated by Dr. Lloyd. I also feel that the nature and degree of mental disturbance depends to a great extent on the personality make-up of the person. This is true in cases of toxic-infectious psychoses, cerebral arteriosclerosis, alcoholism and the reactions to any form of stress. In all the cases I studied the first symptoms noticed were those of pressure, although in eight patients, psychic disturbances were observed within a short time. Tumors of the same type, similar in size and position, failed to produce any uniformity in the clinical pictures. One patient with an endothelioma gave a history of most marked mental symptoms and change in personality, while another of similar age did not show any appreciable disturbance; yet the endothelioma in his case was in the same position and considerably larger than that of the former.

DR. DERCUM: What side were they on?

DR. KUBITSCHEK: They were both midline and involved both frontal lobes. About thirty years ago considerable evidence was gathered to show that the involvement of the left frontal lobe only produced mental disturbance. I did not find such relationship. Of the two cases of gliomas which were cited to illustrate variation in the clinical pictures, the man with the pronounced mental disturbance had extensive involvement of the right frontal lobe while the other, who was said not to have shown any disturbance prior to admission, had involvement of the left lobe.

DR. DERCUM: In regard to the large tumor, which was not accompanied by mental disturbance, was it on both sides? Was the tumor situated deeply, and was it free or was the cortex involved?

DR. KUBITSCHEK: In cases of endotheliomas, growing as they do from the meninges, the cortex is first and chiefly involved. In the gliomas the association tracts are affected far more.

Book Reviews

DER SENSITIVE BEZIEHUNGSWAHN. By ERNST KRETSCHMER. Second edition. Price, 13.50 marks. Pp. 199. Berlin: Julius Springer, 1927.

Kretschmer's book "Der sensitive Beziehungswahn," first published in 1918 and now available in a second improved and enlarged edition, is an important contribution to psychopathology. On its first appearance, it met with a great deal of criticism both in Europe and in this country. Kraepelin, whose gradual development of the paranoia concept was one of the starting points of Kretschmer's investigations, did not feel that he could accept the author's conclusions. Some of Kraepelin's pupils ardently discussed the book. In the intervening decade, as Kretschmer shows in the introduction to this second edition, the influence of his monograph has become more and more apparent and widespread.

Kretschmer describes a new disease picture to which he has given the not entirely fortunate name "sensitive Beziehungswahn." What seemed at first glance a continuation of older clinical methods with their creation of nosologic entities was really much less in the fundamental intention and purport of the book than in the receiving attitude of the psychiatric critics. The question of whether the "sensitive Beziehungswahn" exists, that is to say, whether this group of pathologic reactions deserves the name of a new disease picture or reaction type is of secondary importance. In this book Kretschmer has made one of the most successful clinically documented attempts to trace the development of certain paranoid disorders back to their characterogenic components. As he says in this second edition, it is not so much a question of the special problems of his group of cases as of some more fundamental considerations of psychogenesis in a wide sense. He distinguishes five psychopathic reaction forms, the primitive, the evasive, the expansive, the pure asthenic and the sensitive. The primitive, the expansive and the sensitive groups are those which enter most easily into paranoid reactions. As regards the individual elaboration of the emotional experiences which Kretschmer regards as the starting point for these reactions, he wishes to distinguish sharply between complexes and "overvalued ideas" (Wernicke's conception). Complexes are born from affectively accentuated experiences which the individual is unable to cope with fully, which he can neither absorb by forgetting nor make practically useful for his actual life: they become as it were "secondary centers" in the field of psychic forces. The person who is guided by "overvalued ideas," on the other hand, grasps and keeps a hurting experience so that it becomes the chief center for the psychic forces operative in his actual life. Under the influence of his overvalued idea, he sorts out all his further experiences into those which fit into the affective setting of this idea and into those which do not. The former he eagerly assimilates. It thus happens that overvalued ideas lead, on the one hand, to a restricted mental horizon and, on the other hand, to delusions of reference. The sensitive psychopathic reactions are mainly due to "conscious complex formation," which Kretschmer calls "Verhaltung" (suppression) as opposed to repression. Repression is the chief basis for hysterical reaction types, suppression for the psychasthenic and "sensitive-paranoic" reaction types, while overvalued ideas are found in expansive developments and in a somewhat different, namely, unproductive, form in reactive depressions. The psychogenic root, the "key experience" as Kretschmer calls it, of the sensitive reaction type is a "shame-producing insufficiency." The starting points of these sensitive reactions are sexual complexes, and more especially the masturbation conflicts on the one hand and the belated love conflicts of spinsters on the other. Kretschmer emphasizes the point that in his opinion the emotional experiences which serve as these starting points not only are responsible for the specific mental content, but are actually causal agents. The more pronounced pathologic developments of these sensitive reactions lead

along the two paths of either compulsion neuroses or "sensitive Beziehungswahn." Under the latter heading, Kretschmer has emphasized a small group of paranoid psychoses of distinctively benign character midway "between the paranoic and paraphrenic (respectively, schizophrenic) delusional disorders." It seems just thus to delimitate not only his nosologic achievement, but actually his nosologic ambitions. He finds that "asthenic" character traits tend to favor the development of these sensitive delusions, "primitive" character traits increase their benignity and "expansive" character admixtures tend to lead to fixation and chronicity. In the catamnestic statements given in this second edition of his book, Kretschmer can point to a practically complete recovery of the patients in his cases, including the most severe ones. These catamnestic additions cover a period of from fifteen to twenty years.

Whereas in the first edition, Kretschmer regarded the character disposition of the sensitive psychopathic personalities and psychasthenic neuroses as almost identical, he now stresses as a point of difference the sadistic-masochistic traits of the psychasthenic person which are hidden behind a rigid attitude of prudery. Kretschmer finds that in all his cases in which benign erotic delusions of reference grew on the foundation of a sensitive character, the patients without exception faced life situations wherein they were sexually dissatisfied. He concludes from his catamnestic data that the recovery of his patients took place in the way of "religious sublimation"; he speaks of the "flight into the superindividual." He urges that these sensitive psychopathic personalities be analyzed for the detection of hidden guilt complexes. In these, as in other aspects of his thesis, the influence of Freud is clearly evident, although the author handles the subject of psychoanalysis only with gloves.

At the present-day stage of clinical psychiatry, the mapping out of new psychopathologic reaction types can have the sense only of drawing attention to typical dispositions, settings and developments. Kretschmer has shown in this book certain typical psychologic chains of events — mechanisms as they are often too mechanistically called — which allow one to penetrate further into the complicated workings of delusional aberrations.

SPECIAL CYTOLOGY. THE FORM AND FUNCTIONS OF THE CELL IN HEALTH AND DISEASE. A TEXTBOOK FOR STUDENTS OF BIOLOGY AND MEDICINE. Edited By EDMUND V. COWDRY. Two Volumes. Price, $20. Pp. 1348, with 693 illustrations. New York: Paul B. Hoeber, 1928.

These two volumes, edited by Edmund V. Cowdry, are an indication of the progress of modern medicine. Twenty years ago, as is pointed out by Alexis Carrel in the introduction, the conception of cytology and the preparation of such a volume would have demanded an entirely different concept. Laboratory methods have changed and technic has become more refined. The use of the cinematograph in the recording of phenomena has played no small part in the elucidation of science. Another indication of the modern trend is the growing tendency of presenting medical topics by specialists in a given specialty rather than by the writing of a book by one person.

No better idea can be given of the subject of the book than the following quoted from the preface: "The purpose of this book is, through the friendly cooperation of such specialists, to present a detailed statement of the types of cells which make up the body, and which serve different functions; the nerve cells, gland cells, blood cells, and others. It is under these divisions that information is usually required. We have not hesitated to include physiological and pathological conditions, because otherwise the presentation would be both sterile and uninteresting."

"The book is to be regarded as supplementary to an earlier volume called 'General Cytology,' published by the University of Chicago Press in 1924, and now in its second printing. In 'General Cytology' the fundamental principles of architecture and activity, which cells of different kinds possess in common, were

discussed by a group of workers chiefly recruited from the biologic sciences. This involved, primarily, a rapprochement between physicochemical and morphologic points of view, which is one of the most recent and profitable departures in cytology."

"Methods of technique are treated only superficially, but their great importance is recognized. Indeed, a similar cooperative book on 'Cytological Technique' is being prepared under the editorship of Prof. C. E. McClung of the University of Pennsylvania and will soon be published by Paul B. Hoeber, Inc."

Neuropsychiatrists will be specially interested in the following chapters: XV, The Structure of the Hypophysis Cerebri of Man and of the Common Laboratory Mammals, by Percival Bailey; XVI, The Pineal Gland, by Frederick Tilney; XVII, The Thyroid, Parathyroids and Thymus, by David Marine; XXVI, Cytology of the Internal Ear, by George E. Shambaugh; XXVII, The Internal Architecture of Nerve Cells, by E. V. Cowdry; XXVIII, The General Relation of Histological Character to Function in Mammalian Neurons, by E. F. Malone; XXIX, The Sympathetic Nerve Cells, by Albert Kuntz; XXX, Neuroglia and Microglia. The Interstitial Tissue of the Central Nervous System, by Wilder Penfield; XXXI, The Cytology of the Cerebrospinal Pathway, by G. B. Wislocki.

No better indication of our increased knowledge of the finer structure of the nerve cell can be obtained than by a perusal of these chapters. Neurologists are indebted to the Spanish school of histology for this stimulating work. Altogether, it is a splendid presentation of present knowledge of the cells of different structures, well put together and ably presented. The illustrations are excellent and the publisher has done his work well.

EXPERIMENTEEL-ANATOMISCHE ONDERZOEKINGEN OVER DE PROJECTIE DER RETINA IN HET CENTRALE ZENUWSTELSEL. By J. F. A. OVERBOSCH. Price, $1. Pp. 88, with 54 figures and 2 photomicrographs. Amsterdam: H. J. Paris, 1927.

This work is an inaugural dissertation describing the course of the primary optic neuron in twenty-four rabbits and fourteen cats. Various circumscribed lesions were made in the retina of the animals, and after they had lived eighteen days the brains, including the optic nerves, were then prepared by the Marchi technic with complete serial sections and the degenerated fibers, both on the crossed and on the uncrossed sides, were followed to the primary optic centers. The technic is described in detail and the protocol of the experiments, with careful description of the sections and illustrative figures of each are given. The literature is reviewed and conclusions are drawn and discussed.

Dr. Overbosch's experiments are valuable and his observations important. They show that there is a definite plan of localization in the projection of the fibers from the different quadrants of the retina through the optic nerve, chiasma and tract into the primary optic centers in the external geniculate body and anterior quadrigeminate body of the rabbit and cat. The majority of fibers cross to the opposite side in the chiasma but the localization principle is retained through the decussation. The borders of the different quadrants do not overlap in the projected centers in the rabbit although they do to some degree in the cat. The number of uncrossed fibers, which represent binocular vision, are greater in the cat than in the rabbit. These fibers arise from the temporal quadrants of the retina and are projected mainly to the medial border of the external geniculate body; none are projected to the homolateral anterior quadrigeminate body. In no instance was there evidence of fibers terminating in the optic thalamus, thus throwing doubt on the old theory that the pulvinar is a primary optic center. The projection of the fibers from the macula could not be determined in these experiments as the rabbit has no macula, and in the cat it can be recognized only histologically.

Important as these observations are, nothing is given in the dissertation that has not already been published in more accessible languages: Brouwer, B.: Experimentell-anatomische Untersuchungen über die Projection der Retina auf die

primären Opticuszentren, Schweiz. Arch. f. Neurol. u. Psychiat. **13**:118, 1923; Brouwer, B., and Zeeman, W. P. C.: Experimental-Anatomical Investigations Concerning the Projection of the Retina on the Primary Optic Centers in Apes, J. Neurol. & Psychopath. **6**:1 (May) 1925, and Brouwer, B., and Zeeman, W. P. C.: The Projection of the Retina in the Primary Optic Neurone in the Monkey, Brain **49**:1 (March) 1926. The last includes a résumé of the results of Dr. Overbosch's investigation and prints the more important figures in addition to describing similar experiments by the authors on apes and discussing the conclusions of the whole series of experiments of which Dr. Overbosch's work is only a part. This work has also been carried further into the secondary neuron and in man by T. J. Putnam working in the same laboratories; it was published in the ARCHIVES OF NEUROLOGY AND PSYCHIATRY (**16**:566 and 683 [Nov.] 1926). The chief importance of the present publication is obviously that it is Dr. Overbosch's inaugural dissertation in the University of Amsterdam.

GENIUS. SOME REVALUATIONS. ARTHUR C. JACOBSON. Price, $2.50. Pp. 160. New York: Adelphi Company, 1926.

Many books have been written about genius, and there is still much to be said concerning its various manifestations. The method of development of genius is, and I fear always will be, a mystery, because each man of genius carves his own niche, and it is not like any other. This interesting book sums up some of the older ideas and adds a few new ones concerning genius.

It is stated that genius occurs in people with two personalities. "The genius is a superman whose creative spirit resides not in the primary self but in this secondary personality." It must be set free in some manner, and the important agencies for accomplishing this purpose are alcohol, disease and sometimes narcotics; perhaps even a spirochetal infection may cause the release of creative function. Once set free, the power of the genius enables him to make use of inherited racial experience, which is stored in the unconscious mind, without the trouble of acquiring it by conscious effort.

The use of alcohol usually results in the depravity of the individual and in foolish, irrational thinking; however, in a few persons it serves to release pure thought and may thus indirectly produce a thing of intellectual beauty. It is said that there was a "veritable epidemic" of alcoholism during the Elizabethan era coincident with the intellectual awakening. Was there a causal relationship?

Tuberculosis may produce some form of toxin which has an effect on certain persons similar to that of alcohol, which in these few cases serves to quicken and inspire the intellect. It is true that many of the greatest thinkers and artists were victims either of tuberculosis or of a phthisical habitus. And so one is led to believe that tuberculosis plays its part in fanning the young flame of genius. But did this affliction initiate or augment their creative powers? Would the work of these people have borne so well the stamp of artistry had they not been tuberculous? It is true in a few cases that evidences of genius did not appear until tuberculosis had developed.

The question of genius and insanity intrigues the interest. We are told that the genius has an insane temperament, that he is more highly organized, specialized if you please, and is therefore more apt to become insane. This does not mean that to be a genius is to be insane. Usually some and frequently many of the relatives of a genius are insane, and it is not unusual for the genius to have periodic attacks of insanity.

Evidence (says the author) sustains the conclusion "that the genius derives from poor stock." And so eugenists put a curb on the production of genius. "They have no patience, these eugenists, with the biologic relativity which doth hedge the genesis of a genius, no insight into the strange instrumentalities — disease, alcohol, bodily alchemy — which figure in the manifestations of the highest of endowments, and by the same token in the evolutionary scheme of things."

The author may be right; but then again he may be wrong in his claims. He certainly is wrong in claiming that genius comes from poor stock.

SCHIZOPHRENIA (DEMENTIA PRAECOX) ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASES. A SERIES OF RESEARCH PUBLICATIONS. Volume 5. Price, $7.50. Pp. 453. New York: Paul B. Hoeber, 1928.

This volume is the fifth in the series published by the Association for Research in Nervous and Mental Diseases. The subject matter is well arranged and begins with an historical survey and delimitations, this being followed in logical sequence by chapters on statistics; heredity and constitution, including personality; special etiologic considerations: affective, toxic, infectious; investigative aspects, language and art productions, pathology, and ending, as all books should, with a discussion of the prognosis and treatment of the subject. In effect, the work gives an up-to-date conception of the modern view of schizophrenia, and while most of the papers are not original, a few of them are of extraordinary merit.

The conception of the Association for Research in Nervous and Mental Diseases is an excellent one. Year by year the work of the association has increased in value. The plan of having one subject for research has proved to be valuable, as has also been the idea of deciding years ahead the subject for discussion. As exemplified in this volume, the method of presentation used, questions and answers, has proved to be of considerable merit. Perhaps one criticism that can be leveled against the association has been the fact that there has not been enough discussion. The meetings in later years have become too formal. There is not enough give and take, which after all adds to the interests of the society and brings out valuable points.

LES SYNDROMES MENTAUX (FASICULE I). By A. POROT. Price, 55 francs. Pp. 370. Paris: Gaston Doin, 1928.

This volume is descriptive psychiatry, pure and — not so simple. It inaugurates a comprehensive survey of mental diseases. Symptoms and symptom-complexes, says the author, form the best method of approach to the study of mental diseases on account of the paucity of anatomic and pathologic data that are the basis of classifications in other diseases.

Confusion is the topic under discussion in this fasiculus. The presentation is divided along etiologic lines, the natural history of the symptom as well as of the patient being traced from the onset to the conclusion. One would think from this that a different type of confusion existed for each etiologic agent, but the descriptions of the confusion are much the same throughout; only when the author turns his attention to other symptoms and signs do differences appear.

As a presenting symptom, confusion is frequent and important; as a subject for a book, confusion is here worse confounded. The work represents a serious effort in descriptive psychiatry, but the approach is not enlightening.

CLINICAL EXAMINATION OF THE NERVOUS SYSTEM. By G. H. MONRAD-KROHN, M.D., F.R.C.P., Oslo, Norway. Fourth edition. Pp. 202. London: H. K. Lewis & Company, 1928.

The fourth edition of this well known work differs little from the third, which was reviewed in the February, 1927, issue of the ARCHIVES. A short chapter on the interpretation of x-ray pictures of the skull has been added. The fact that a fourth edition has been published so soon after the third is the best indication of its merit.

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