

deteriorating disorder has not been as yet favorably modified, and the epileptic attacks may in the course of time be expected to return.

Finally, one may say that a study of the epileptic make-up and the mental content in epileptics, both everyday conscious ones, as well as those shown in the unconscious state, demonstrates (1) the depth of the unconscious regression; (2) the special type of stress which the epileptic has, and (3) the specific type of primary defect in his endowment which must be handled in reeducation. Its therapeutic value in addition to the foregoing is (4) to furnish a specific point of analytic attack by simple explanatory talks, thus increasing the patient's insight into his disease, and (5) to show more definitely the type of special reeducation which should be adopted for each individual patient.

ABSTRACT OF DISCUSSION

DR. ARCHIBALD CHURCH, Chicago: I would like to ask Dr. Clark to give us more concretely the results obtained by the application of these views in the management of epilepsy.

DR. MEYER SOLOMON, Chicago: I wish to ask Dr. Clark how he can prove that cases which do not develop real reactions of convulsive type, but which are of the sort he has described under the name of the epileptic constitution are really epilepsies if they do not develop the reaction of the convulsive type. It all depends on how you want to use the term epilepsy. If there are no petit or grand mal attacks, how can you say that the patient has epilepsy? The sort of makeup Dr. Clark has described may be found in the feeble-minded, in neurotics, and in many other persons who do not develop epilepsy.

DR. JOSEPH BYRNE, New York: I became familiar with Dr. Clark's work some time ago and have applied it at my own clinic. The method we formerly employed was the usual routine method, thorough examination in every case followed by operation in suitable cases. In epileptics of various grades we now combine the psychologic and operative methods. In other words, before any attempt at decompression is made, analysis of the personality and an attempt at reconstruction through education are made. Our results have been quite good. Perfect cures are not always to be expected, but the improvement in our patients was such as to convince us of the worth of the method.

DR. L. PIERCE CLARK, New York: The method of mental treatment which I briefly outlined in my paper has slowly been built on careful clinical experience and is still being modified and elaborated. It is primarily based on an intensive study of the epileptic as an individual, and the disorder of fits as a more or less necessary corollary of such a potential character makeup when encountering undue stresses. I believe it enhances the former physical and empirical therapy for this disorder at least 50 per cent. It is particularly serviceable in the very earliest cases, but has been found of inestimable value in the care and treatment of the interned cases also. My scheme makes no claim to say exactly what the nature of idiopathic or essential epilepsy really is, but we should seize on those modifiable factors in the epileptic individual and thus improve his social adaptability in its widest sense. To do this most successfully we must detect the epileptic character and habit at the earliest possible moment.

Comparison of Value of Milk with Other Protein Foods.—

With bottled milk at 14 cents a quart, 1 cent buys 46 calories (fuel food), including 1/15 ounce of protein (building food). For porterhouse steak at 35 cents a pound, 1 cent buys 30 calories of fuel food, including 1/15 ounce of protein. With eggs at 60 cents a dozen, 1 cent buys 16 calories of fuel food, including 1/30 ounce of protein. At the foregoing prices 1 quart of milk supplies as much food as 10 ounces of porterhouse steak or 8 eggs.—*Weekly Bulletin* New York City Department of Health.

CARBON MONOXID POISONING: ITS NERVOUS AND MENTAL SYMPTOMS

REPORT OF CASE *

CHARLES W. HITCHCOCK, M.D.

DETROIT

McNally¹ makes the somewhat surprising statement that "deaths from carbon monoxid poisoning in large cities now exceed those from any other poison." The total number of gas cases in Cook County, Ill., for 1916 was 501, nearly 8 per cent. of the entire number of coroner's cases. Much of the increase, of course, is a purposeful one, illuminating gas being an easily available means of suicide. Industrial and domestic sources are, however, not a few.

"The proportion of carbon monoxid differs greatly in domestic and industrial gases, varying between 4 and 30 per cent.—in coal gas, 4 to 10 per cent., and 30 per cent. in water gas, and 20 and 30 per cent. in producer gas—almost all illuminating gas containing a large proportion of water gas. Stoves, salamanders, furnaces, blast furnaces and gas engines are not infrequent sources of this poison. Increased use of gas in the winter months accounts for the large number of deaths at this period of the year. If all gas stoves, plates and heaters were connected by metal instead of rubber, many lives would be saved."

As to the operation of the poison, I quote McNally further: "Carbon monoxid combines chemically with the hemoglobin of the blood to form a stable compound. According to the research of Nicloux, one volume of carbon monoxid acts like 220 volumes of oxygen. The corpuscle is not dead. All it needs is oxygen under sufficient tension to displace the carbon monoxid." In line with this are cases reported by J. Bock.²

Body of man found on floor near defective stove, two thirds hemoglobin of his blood transformed to carbon monoxid hemoglobin. A baby near him showed no signs of poisoning. Body of wife in adjoining room, and only one fifth of her hemoglobin had been so transformed. It is assumed that she was as deeply poisoned as husband, but sought another room where blood threw off the carbon monoxid gas. Bock says: "Evidently the central nervous system becomes irreparably injured from the after-effect of the protracted asphyxia."

With the various tests for carbon monoxid we need not concern ourselves here. My object in presenting this paper is twofold: (a) to call special attention to the dangers arising from automobile exhaust gases in closed garages, and (b) to note the nervous and mental symptoms attendant on carbon monoxid poisoning. Cases of carbon monoxid poisoning from the inhalation of automobile exhaust gas are, I think, more commonly fatal than otherwise. The files of an Accident Insurance Company, which paid the claim for the death, enable me to report the following case:

CASE 1.—S. M., residence, Chicago, employed as a chauffeur of a private car, had entered the garage, a small and closed one, at noon, Nov. 20, 1915, for some work about the machine. About two hours later a maid sent to call him could hear the engine running, but received no response to her summons.

* Read before the Section on Nervous and Mental Diseases at the Sixty-Ninth Annual Session of the American Medical Association, Chicago, June, 1918.

1. McNally, W. B.: Carbon Monoxid Poisoning, *THE JOURNAL A. M. A.*, Nov. 10, 1917, p. 1586.

2. Bock, J.: *Hospitaltid.*, Copenhagen, Jan. 2, 1918.

She at once procured a key, unlocked the door, and the body of the man was found in the seat of the auto, dead, the engine still running and doors and windows closed. There were no marks of violence. There was "pinkish red discoloration all over the body, including the face and extremities. The internal organs were found healthy." The coroner's chemist reported on the blood taken from body for examination (3 ounces) as follows: "A chemical examination shows that the blood was 58 per cent. saturated with carbon monoxid. The blood responded to the tannic acid, lead acetate, palladous chlorid tests, and the spectroscopic examination for carbon monoxid hemoglobin."

In January last, Dr. F. W. Nagle of Montreal, president of the Anesthetic Association of America and anesthesiologist of the Royal Victoria Hospital of Montreal, was found dead in his garage, suffocated by gasoline fumes.

Through the kindness of Dr. R. P. Albaugh of the Division of Industrial Hygiene of the State Department of Health of Ohio, I am able to cite two cases, neither of them directly fatal.

CASE 2.—R., man, aged 39, single, American, suffered from a slight case of malaria fifteen years ago. As a gas combustion engineer, he worked constantly for years in a small, poorly ventilated laboratory, over gas jets. About three years ago, he fell from his chair in an unconscious state and remained in this condition for several hours, when he apparently recovered. He continued his work for about two years, during which time he had three or four recurrences of the unconscious state which came on suddenly. In the interim, he has had frequent occurrences of forgetfulness and at times a complete lapse of memory for a few minutes, during which lapse, he would talk incoherently, and after it subsided would take up the thread of his story and continue the conversation. At times, after these attacks, his memory would remain clouded for several hours.

Laboratory analysis of the patient's blood revealed carbon monoxid in large amounts at different times over a period of more than two years. The blood count was: red cells, 5,500,000; white cells, 8,500; polymorphonuclears, 68; small lymphocytes, 4; large lymphocytes, 24; eosinophils, 4.

After going under the observation of a physician, he has suffered from periods of unconsciousness about once a week, periods lasting about five minutes, and also periods of lapse of memory lasting about a half hour, and averaging five or six a week. At present he is undergoing treatment consisting of breathing exercises, graduated walks and daily inhalations of oxygen. Carbon monoxid has been gradually eliminated from the blood since this treatment was begun, which has lasted for a period of about a year.

CASE 3.—M., man, aged 30, with negative previous history, went to his private portable garage, on an unusually cold morning, started the motor and returned to the house, where he stayed a few minutes. He went back to the garage to put some oil in the machine and while doing so, smelled something very sweet and had a desire to laugh. He saw yellow flashes before his eyes and felt weak in the knees. His first thought was to sit down on the running board, but decided to go to the house. When just outside of the garage he felt a sudden throbbing of the temples and extreme weakness. His wife found him an hour later lying in the snow apparently asleep. He could be roused, but staggered and could not have walked alone. He was placed in bed and proceeded to sleep as if in a normal manner. He awakened in an hour complaining of dizziness and was unable to walk. He complained of a throbbing headache and talked incoherently. He apparently recovered that day and returned to work the following day. Associates stated that he talked incoherently at different times during the day and was unable to remember dates and other simple facts. He returned home in the evening and remarked that he could not get any sense out of the evening paper, which he had been trying to read. During the night, a severe headache and cough developed

with some dyspnea. A physician was called in the morning and found the patient suffering from pneumonia. He developed delirium in a few hours and passed into coma, dying that night.

Still more interesting is the case which I have had the privilege of seeing, and concerning which I entertain a good ultimate prognosis, although recovery is exceedingly slow.

CASE 4.—July 13, 1917, I was asked to examine G. W., a man, aged 32, a chemical engineer of college education. His family and personal history were negative. His complaint was of loss of memory, forgetting even things he had just done, names, events, etc. He had been well up to the following occurrence: He says that, Feb. 10, 1917 (month told by him, but day by his wife), he had been to his place of employment and attended to his duties as usual. He came home soon after noon and after luncheon went out to his garage to charge the battery on his car. He thinks he propped the garage door open, but it blew shut, the engine of the car running to charge the batteries. He did not know that the door was shut. Beyond this point, he has no memory of immediate events. About an hour or more later, his wife found him collapsed and unconscious on the garage floor, near the exhaust and the engine running with a very "rich mixture." Medical help was at hand in five or six minutes, the heart was found racing violently and respirations were only five or six per minute. A little later the pulse was only 40. Artificial respiration, strychnin and digitalis were vigorously made use of. He was unconscious until evening, some four or five hours, and then was irrational, drowsy and but partly conscious, for some time. The week following, he was very weak; knew every one of his friends, but would forget that any one of them had been there, if, for instance, he chanced to leave the room. He gradually improved physically and his pulse became normal, about six weeks after the accident.

When I saw him, he was said to be lax in his personal appearance, quite unlike his normal self. He was able to drive his car in quiet and accustomed places, but felt unequal to driving it where any traffic was. He was able to do a little work in his garden, and improvement was noted as to memory, ability, etc., but he could not collect himself sufficiently for laboratory work, and he lacked initiative for any work. His wife thinks him not as friendly in his attitude toward others as was his wont. In appearance, he was well nourished, of dark complexion, his face wearing a rather blank expression. He was inclined to be despondent and doubtful of his gains. His wife (apparently a good observer) notes his improvement from week to week, and that recently he has been able to listen to and follow short stories, which he could not previously do, appreciating their nice points.

The heart was then normal; the pulse, 65, and of good volume, and the respiration, normal. The urine was normal, and the systolic pressure was 110 mm. of mercury. Both the deep and superficial reflexes were quick and active. His pupils were equal and normal, and speech tests brought normal responses. There were no sensory changes and there was no Romberg symptom present. No cause for any memory defect could be discovered other than the occurrence of February 10.

Aug. 6, 1917, his wife reported his further improvement, and that he was then able to read stories himself, that he had promptly answered a business letter without help, aside from being told the date. The day before he was depressed and easily emotional, had cried several times.

Dec. 13, 1917, his wife wrote from Saskatchewan, where he had gone in September to recuperate: "Although my husband is better, he is still unable to resume work. The memory defect is still there, but not as pronounced. Things happening five or ten minutes back seem the hardest to recall. He can remember what has happened during the day now, but does not seem sure. He seems to recall the occurrences of the past eight months, but the first two months after his illness seem almost a blank. The month past is quite clear to him. His

eyes seem brighter, but he does not smile often and seems to have a worried look." There was, therefore, a continued anterograde amnesic defect and emotional disturbance. He even once gave a hint of possible suicide, if his recovery was not soon complete, and this naturally led to great care in letting him go out alone. Reminded to answer a letter, he wrote a two page letter, but it took him all one afternoon to do what he would ordinarily have done in ten minutes. He lacks his former ambition and energy, and is decidedly wanting in initiative and, at times, though rarely, is irritable, if urged to do other than as inclined. He was less easily emotional than he had been.

March 16, 1918, there had been comparatively little change. He was much inclined to be depressed and discouraged, and doubt his eventual recovery. He has now gone to a farm, where he can have outdoor life and duties, and, April 22, was reported as anxious to help on the farm in any way he could, becoming more alert and grasping things quickly, but (his wife wrote) "The mind does not retain the impression made. He still forgets things as soon as they are past." She says: "If he received a letter, and then after reading it put in his pocket, he would forget all about it and would ask when it came, and if he had read it. He enters into a conversation now more than he used to, if no strangers are present, but is very quiet before strangers. If that memory defect would only clear up he would be as well as ever. Physically he is in splendid condition, although inclined to go to sleep rather easily."

There is, then, in this case, fourteen months after the accident, an anterograde amnesia still present, some emotional disturbance, and some depression, and these were still well marked, April 16.

The mental manifestations of carbon monoxid poisoning are most interesting. The most constant one referred to in the literature is a memory defect, and this is the chief complaint in my case.

Dr. Mary O'Malley³ of the Government Hospital for the insane, reported an interesting case with complete recovery.

This patient, a woman, aged 45, native of Ireland; of negative history, was admitted to the hospital thirty-eight days after an accidental inhalation of illuminating gas, an open window having prevented a fatality. Immediately following her trauma, she had been for ten days in a general hospital, and two weeks after it had attempted to resume work, but it was at once noticed that she was dull and forgetful. A week later, it was noted that her movements were awkward, and peculiar, and that her memory seemed a complete blank. She attempted to put the trousers of a little boy on for a waist. She had outbursts of laughter without provocation. She was lost on the streets, became distinctly confused, and then was admitted to the hospital for insane. Here, in the next three days, "Mentally the patient was dull and apathetic: responded promptly to all questions, but was able to give little additional information in regard to personal matters. . . . Replies were irrelevant and accompanied by outbursts of laughter. . . . She had a mistaken identity of all persons in her environment. . . . There was a retardation and some incoordination in all her movements. Asked where she was, she said she was at home." In the next ten days she showed a tendency to confabulate, showed uncontrollable laughter, and had incontinence of urine and feces.

She then showed gradual improvement, and a mental examination about three months after her accident showed that she had recovered her mental faculties, but there was an anterograde amnesia covering a period of three months. Two months later she was discharged recovered.

Le Dosseur⁴ "has collected a number of cases in which the following mental disturbances were noted: aphasia, acute delirium, transitory chronic delirium,

mental confusion, amnesia, melancholia, dementia. On the physical side he found muscular paralysis of diverse types, hemiplegias, paraplegias and monoplegias, various trophic disorders, convulsions, etc."

Dr. P. C. Knapp⁵ cites a case of retro-antegrade amnesia following a gas poisoning, which occurred May 10, 1910, the patient having been some hours unconscious.

She was then 43, had married at 25, and had led a happy domestic life. Her amnesia blotted out previously acquired memories, and there seemed to be an inability for new memories. She forgot the doctor continually, insisted that she had never seen him before, etc., although she might have seen him but a very short time previously. She did not know where she now lived, nor by whom her husband was employed. She later improved somewhat, but Oct. 3, 1915, more than five years after her accident, her memory was still defective.

"The amnesia may simulate the Korsakoff syndrome in the polyneuritic psychosis with confabulation, pseudo-reminiscences, etc. A defective memory may exist in a certain number of patients who recover. This amnesia is retrograde or anterograde in type: it is variable in course and intensity." In my case, the memory defect was rather of the anterograde type, and complete only for the immediate events attending and immediately following his accident.

Of the amnesia, peculiar to these cases, Sachs has said: "In the early stage of convalescence, a total amnesia is especially typical, either extending over the time before the poisoning, retrograde, or to the things of the present, anterograde." Le Dosseur has cited a case of a physician, who, after an incomplete intoxication, lost his memory totally, recovering only after eighteen months. The aphasia to which some writers have referred as present in some cases, would seem to be an amnesia rather than a true aphasia.

A marked reduction in the field of the emotions has been noted by a number of observers. A masklike expression has been spoken of, and an emotional tone of great indifference. Outbursts of irresistible tendency to laughter, spasmodic in character, have been noted in some cases with an apathetic indifference between the attacks. By the occurrence of thrombotic occlusions and hemorrhages, Mott thinks all of the nervous symptoms are to be explained. It is interesting to note that Mott was the first to notice the marked similarity between the brain of a soldier dead from shell shock, and the brain of a man dead from carbon monoxid poisoning.

There is a lack of observation in these cases continued over a period of years. Various psychoses and psychoneuroses have followed these poisonings but, since many of them have been deliberately suicidal attempts, it is not wise to conclude that any remaining mental aberration is solely due to carbon monoxid poisoning. Memory defect, however, stands out as the most constant and prominent of nervous symptoms due to this toxic agent, and to this Mott in his second lecture on the effects of high explosives as shown in the present war, calls particular attention, demonstrating from photographs the capillary punctate hemorrhages, found in the corpus callosum both in industrial and military cases. Photographs also show cell changes due to carbon monoxid poisoning. The subject, therefore, has also a side of military interest, as well as its industrial phases and its too common occurrence in our every day life.

3. O'Malley, Mary: *Am. Jour. Med. Sc.*, June, 1913.

4. Le Dosseur, Louis: *Thèse de Paris*, 1901, quoted by O'Malley (Note 3).

5. Knapp, P. C.: *Am. Jour. Insan.*, October, 1915.

ABSTRACT OF DISCUSSION

DR. JOSEPH BYRNE, New York: I would like to ask Dr. Hitchcock what his experience has been in blood transfusion, bleeding, etc., in these cases?

DR. G. A. MOLEEN, Denver: Carbon monoxid poisoning is more common than we are apt to believe. It occurs not only with the gas car, but also with the steamer, as one of the cases which I observed evidences. As to the results, some years ago Spiller and his associate reported a case which showed marked destruction, especially in the striate body, and some destructive lesions in the subcortical area, which probably accounts for some of the phenomena that have been described by Dr. Hitchcock, as well as by other observers. Referring to the blood changes and the combining of the carbon monoxid with hemoglobin, William D. McNally, who was speaking from Nicioux's work, said: "Carbon monoxid combines chemically with the hemoglobin of the blood to form a stable compound." This conclusion has been questioned and I believe disproved first by Haldane and second by Yandell Henderson, who says that carbon monoxid does not form a permanent compound with hemoglobin. In the presence of excess oxygen, or even of pure air, carbon monoxid is rapidly given off and the oxygen carrying power of the hemoglobin is restored. This is a very significant statement.

One case to which I wish to refer was that of a physician who, until September 13 last, was in good health. He went to the garage in which he had a steamer; the pilot light had been left burning over night, and he was found unconscious. He later presented the defects in memory which have usually been described, but the peculiar thing that remains at the present time is the fact that his memory seems to be, as it were, punched out. He can do work up to a certain point and then everything stops abruptly. He will go to the laboratory where he has done a great deal of work, start a urinalysis, get up to a certain point, stop there and walk out in the street, and on returning he has forgotten what he has done. The second case was one of rather severe carbon monoxid poisoning. The man started a car in the garage, having closed the door, to make some repairs. At the present time he has a very pronounced apraxia. In both these cases recovery has not taken place, and I am doubtful whether any case of a fair degree of carbon monoxid poisoning ever recovers fully.

DR. CHARLES W. HITCHCOCK, Detroit: In answer to Dr. Byrne's question, I have not seen any recent cases, so the matter of transfusion has not come up. One point mentioned by me is confirmatory of what Dr. Moleen has said with reference to the mode of operation of the poisoning. I quoted McNally as follows: "The corpuscle is not dead. All it needs is oxygen under sufficient tension to displace the carbon monoxid." One other point was mentioned, namely, that the amnesia may simulate the Korsakow syndrome. That is sometimes the case, and a tendency to confabulate appears. With reference to the organic changes, the memory defect stands out as the most constant and prominent of nervous symptoms due to this toxic agent. Mott in his second lecture on the effects of high explosives, calls particular attention to this, demonstrating from photographs the capillary punctate hemorrhages found in the corpus callosum, both in industrial and military cases. Photographs also show cell changes due to carbon monoxid poisoning. Therefore, the subject has a side of military as well as industrial interest. This type of accidental poisoning is an altogether too common occurrence in our everyday life.

The President on Child Labor During the War.—As the labor situation created by the war develops, I am more interested than ever, if that were possible, in throwing all the safeguards possible around the labor of women and children in order that no intolerable or injurious burden may be placed on them. I am, therefore, very glad indeed that the National Child Labor Committee is diligently continuing its labors and extending its vigilance in this important matter. By doing so it is contributing to efficiency and economy of production, as well as to the preservation of life and health. —Woodrow Wilson.

HEAT STROKE

WITH A SECOND STUDY OF CEREBRAL
EDEMA *

PIERCE MCKENZIE AND E. R. LeCOUNT, M.D.
CHICAGO

The meteorological conditions responsible for heat stroke are rare in Europe but common in the Mississippi Valley and states of the eastern and southern coasts of this country; in general, heat stroke occurs in river valleys and low lands.¹ Inability of the air about the body to receive any more moisture because it is already so saturated, together with a high temperature of the air, are chiefly responsible for heat stroke, and this applies equally well to heat stroke caused by exposure to the sun's heat and to heat stroke under other conditions, as in hot kitchens or boiler rooms. The "wet-bulb" thermometer determinations so essential to indicate this relation between increased humidity and temperature² are unfortunately no longer a part of our daily weather reports.

Less important causes are tight and heavy clothing and a too small intake of water, each preventing or lessening cooling of the surface by evaporation as well as adaptive changes in other heat-regulating activities of the body. Evidence that consumption of alcohol in beverages favors the development of heat stroke and increases the mortality has been advanced by Norton³ and by Gauss and Meyer.⁴ Further evidence regarding this relationship is needed and especially from carefully controlled experiments. There is no evidence that actinic, ultraviolet or other rays except those of heat, play any rôle in the causation of heat stroke from exposure to the sun's rays.⁵ Aron⁶ found that monkeys accustomed to tropical heat quickly died when exposed to the sun in still air; those in the shade of an umbrella or in the sun with a current of air from an electric fan suffered no damage.

The possibility of an infectious origin for heat stroke is discussed by Sambon.⁷ Hedinger,⁸ from study of the chromaffin organs of the bodies of two persons dead from insolation, has suggested that a predisposition may exist in their imperfect development.

Some writers⁹ discuss the development of a poison as a consequence of the heat and altered metabolism, and liken it to snake venom, probably because hemorrhages in the skin and elsewhere are observed in heat stroke. Woolley¹⁰ has suggested that this poison may be protein and incompletely split from loss of water, concentration of the tissue colloids and changed metabolism, and also that such substances (Vaughan's thermogenic protein poisons) may cause the high fever.

SYMPTOMS

When heat stroke occurs in hot boiler rooms (heat exhaustion) or other similar places, there may be dizziness, nausea and weakness before unconsciousness; the attack may come on slowly; when more severe, profuse sweating, dryness of the mouth, a red or purple discoloration of the skin, shivering, and a subnormal temperature or one of from 100 to 102 F. may precede death in coma.

* From the Pathological Laboratory of Rush Medical College.

* This investigation was made possible by a grant from the Fenger Memorial Association. A former study of edema of the brain is: Nuzum, Frank, and LeCount, E. R.: The Ability of Brain Tissue to Take Up Water in Delirium Tremens and Other Conditions, THE JOURNAL A. M. A., Dec. 16, 1916, pp. 1822-1826.

* Owing to lack of space, this article has been abbreviated by omission of the bibliographic references. These appear in the authors' reprints.