MENTAL SYMPTOMS IN BROMIDE INTOXICATION

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Skin eruptions are usually thought of when bromide intoxication is mentioned. In the last few years, however, several papers have described and stressed the mental symptoms; they have pointed out that bromide intoxication is quite common—according to Henderson and Gillespie (1940) it comes next to alcohol as the commonest cause of confusion—and that it may be severe or even fatal. Barbour, Pilkington, and Sargant (1936) showed that in 1920 about 5 million prescriptions containing bromide were dispensed under the N.H.I. Act, and it is unlikely that the use of bromide has decreased since then. Below are described 9 cases selected from those occurring in a general hospital and in private practice during the last 3 years; only one was first seen in the psychiatric clinic. Mental symptoms were prominent in all; bromide intoxication was either the main illness or arose during the treatment of some other condition. The blood bromide was estimated by the modification of Walter's test described by Barbour *et al.* One case was fatal; the rest recovered with sodium chloride treatment, although in 2 instances life was seriously threatened.

Case I: Fatal Intoxication

A married woman aged 45 was referred to the psychiatric clinic on Dec. 8, 1939. She was employed as a clerk, and had always been nervous and highly strung. In Jan., 1939, she had become worse, had dropped things, and a rash appeared on several occasions. She had spent a fortnight in bed, and at this time was said to have been rational in conversation. In May she returned to work for 3 weeks and then again collapsed; the rash reappeared. She remained at home and was treated by her doctor for nervous debility. In Oct., 1939, she imagined that the Germans were in the house and that she could hear air-raid sirens all day; her memory began to fail. Three weeks before she attended the clinic there had been a radical change for the worse. Her daughter came home one day to find her screaming without cause. She talked to herself, and said she could see aeroplanes in the room and could hear bombs falling. She refused food, slept badly, and wandered restlessly about. On examination she was seen to be a slightly built woman with a muddy complexion and numerous acne pustules. She looked ill. Her temperature was normal and pulse 88; the tongue was coated and the breath foul; there was a coarse tremor of the fingers. Mentally, the striking feature was a state of confusion. Consciousness was clouded: she could remember her name but not her age. She was disorientated for time and place, and could give no account of herself. She muttered incoherently, and wandered restlessly round the room in a stumbling and ataxic manner. She was emotionally unstable and wept without cause. Bromide intoxication being suspected, the blood bromide was estimated and found to be 325 mg. per 100 c.cm. She was removed to the appropriate mental observation ward, but died within 24 hours. At necropsy no visceral disease was found; the heart was small, with flabby myocardium.

From her daughter it was learnt that she had had medicine from various doctors, possibly bromide, for some time. It was confirmed that she had been having bromide just before being seen, but details of the quantity and the total period the drug was taken could not be ascertained.

Case II: Severe Intoxication

The history in this case, that of a married woman aged 47, was one of prolonged psychological maladjustments. She had always been a nervous hysterical woman. She became intensely annoyed when thwarted in any way, and was theatrical, peremptory, and emotionally unstable. For 7 years before being seen she had been under numerous doctors and had been taking various nerve sedatives "more on than off." A gradual mental

change had been progressing insidiously for 3 years. She had become more emotional than ever, had depressing thoughts of suicide and manifestations of self-pity, and had made minor, rather half-hearted, attempts at ending her own life. A fortnight before being seen her condition became more acute. On examination she was quite disorientated for time, did not know the date, and mistook the identities of her relatives. She was visually hallucinated, and stated that she saw the devil; she heard voices coming from the walking-sticks in the hall, and could see people wandering about and hear them talking to her. She was extremely restless; she neglected her housework and wept without cause. At times if spoken to sharply she would pull herself together and be rational for a few moments. The blood bromide was 280 mg. per 100 c.cm. Treated with sodium chloride, all her acute symptoms cleared up in 2 weeks; she was then very much as she had been 6 years previously. The underlying hysterical personality was of course unchanged, but she was fully orientated, all hallucinations had disappeared, and she could carry on a completely rational conversation. She refused further investigation, so that a second blood-bromide estimation could not be made.

Case III: Severe Intoxication

A married woman aged 55 was admitted to hospital on Feb. 26, 1940, with severe spasmodic torticollis, which had been present for some 12 months and was getting worse. All investigations for a possible focal basis proved negative, and she was treated by physiotherapy.

On admission her mental condition was apparently quite normal. Three days later, in the evening, she suddenly became confused. She was disorientated for time and place, attempted to get out of bed, and stated that she could see relatives about her and that they were talking to her. She was given hyoscine and phenobarbitone, and within a week her mental condition quieted. On March 3 a mixture of bromide and chloral was prescribed. Ten days later her confusional condition returned acutely. She failed to recognize people, was disorientated for time and place, was extremely restless, and repeatedly attempted to get out of bed. She shouted and talked to herself and addressed imaginary people. She said there was a hole in her head which was stitched up with wire. Her conversation was completely irrational and incoherent, and she could give no account of herself. Emotionally she was very unstable, alternately shouting and angry or tearful and depressed. The hands were tremulous; her temperature was normal and the tongue clean.

Since she had been taking medicine for 12 months a toxic confusion due to bromide was suspected, and the blood bromide was found to be 300 mg. per 100 c.cm. The cerebrospinal fluid also had a bromide content of 300 mg. The bromide was stopped and she was given sodium chloride, 60 gr. four-hourly, and also 2½ pints of intravenous normal saline. She began to improve after 5 days. After 12 days the blood bromide was 125 mg. and she was very much better. She knew who and where she was. She recognized people normally, ceased to talk to herself, and was more restful. Frequently at night-time she became mildly confused again and lost her orientation. At the end of another week her mental condition was quite normal and she was able to give a rational and coherent account of herself. She then said that before coming into hospital she had, over a period of several months, taken a total of 60 bottles of salty-tasting medicine. On April 3 she was still perfectly well, and the blood bromide was 75 mg. per 100 c.cm. The torticollis remained unchanged.

Case IV: Severe Intoxication

This patient, a single woman aged 27, had been in hospital during Feb., 1939, for ulcerative colitis. On March 1 she had to be readmitted on account of a relapse. At this time her weight was 6 st. 4 oz., and as part of the treatment she was placed on a low-residue diet. She was regarded as a rather nervous type, and on April 15 potassium bromide, 45 gr. daily, was begun. On May 15 this was increased to 90 gr. daily. On May 17 mental symptoms were first noticed. She seemed bewildered and had difficulty in recognizing people about her.

At night she was apt to be restless. I saw her on May 27, when she was confused, did not know the date or where she was, and thought that the hospital was probably a barracks; she did not know when she was admitted, and stated that people were against her, without any real feeling about this. She was restless at night and tried to get out of bed. She was extremely thin and her tongue was furred. There was no rash. Toxic confusion, probably due to bromide, was suspected; the blood bromide was 280 mg. per 100 c.cm. She was treated with sodium chloride, 60 gr. four-hourly, and the blood bromide fell steadily: it was 110 mg. on June 17, and 75 mg. on the 24th, by which time she had become mentally clear and fully orientated.

There was no evidence that she had had bromide before admission, and only a relatively small amount had been given in hospital; yet several factors may have contributed to this unusual susceptibility—the feeble physical condition, prolonged treatment with a low-residue diet containing little salt, and an idiosyncrasy to bromide.

Case V

This patient, a married man aged 50, had in his youth been very athletic. Psychologically he had always been unstable and had been of an ambitious, aggressive, and dominating type. Ten years ago he developed pulmonary tuberculosis. This was adequately treated and had become quiescent, but as part of the treatment he had been given an iodide preparation which caused an intensely irritating rash. The resulting sleeplessness was treated with bromide and chloral, and he had fallen into the habit of taking a draught every night, increasing the dose as necessary to ensure sleep. So far as could be estimated, his nightly dose had recently reached at least 60 gr. of bromide.

He was referred to me because of gradual and insidious mental changes over the last 18 months. His business had not prospered, and he had been depressed and emotionally unstable. He lost interest in his hobbies, complained of excessive fatigue, and ceased to take exercise, which he formerly enjoyed. Often he was extremely irritable, and at times talked of suicide. He complained of inability to concentrate and of mixing words, particularly when dictating letters. He was quite rational and fully orientated. Bromide intoxication was suspected, and the blood bromide was found to be 270 mg. per 100 c.cm. The next day he entered a nursing home for treatment. Within 24 hours an acute confusional state developed. He was extremely paranoid, said that everyone was against him, and demanded police protection. He was visually hallucinated, and said there was a hole in the floor through which straw was pouring. He recognized people, but had no idea of the date, and was disorientated for place. He did not know where he was, and thought it was an asylum. He was acutely restless, refused to stay in bed, and walked all over the house. He was extremely resistive to attention. Physically he was ataxic, perspired profusely, and had a coarse tremor of the fingers. There was no rash. He was treated with sodium chloride, the acute confusion then settling in 2 days. Five weeks later his wife stated that he was better than he had been for 8 years. All his symptoms had disappeared; he was jovial and cheerful, and showed initiative in dealing with his problems. His zest for life had returned, and he had again resumed his hobbies and exercise. The blood bromide 6 weeks later was within normal limits. As in another case, this patient's condition worsened when he was removed from his home into strange surroundings.

Case VI

In Aug., 1941, a married woman aged 60 complained of slight giddiness. This persisted for several weeks, and medicine, presumably bromide, was given. In Oct., 1941, she fell down indoors and became nervous and depressed. On Dec. 15 her relatives stated that she made peculiar statements at night, was quarrelsome, and accused them of cheating her. She stated that the food was doped and they were trying to poison her, and that someone had stolen her money. She developed an unreasonable hostility to her son-in-law, and became mentally confused, being admitted to hospital on Dec. 12. She was disorientated for time and place, was restless, and attempted to get out of bed. She said that someone was standing at the foot of the bed day and night pulling faces at her. She mistook the identities of people, including her relatives, and expressed rambling paranoid ideas in a disconnected and disjointed way. Physical examination revealed no notable signs of organic disease. Tremor of the hands was present; the complexion was muddy; there was no rash; the cerebrospinal fluid was normal. Blood bromide was 305 mg. per 100 c.cm. On treatment with sodium chloride the blood bromide fell rapidly. On Jan. 9, 1942, it was 175 mg. and on the 19th 85 mg. All the symptoms cleared and she became mentally normal. After recovery she said that she had been taking "salty medicine" for at least

10 weeks before admission; the daily dose of bromide was probably 60 to 90 gr. It is noteworthy that, as in the previous case, the confusion became more apparent after she was admitted to hospital, owing to the removal to strange surroundings causing further loss of her failing grasp of reality. As the confusion cleared it tended to persist longest at night-time, when similar conditions obtained.

Case VII

Since 1931 this patient, a married woman aged 68, was known to have had hypertension, with periodic attacks of loss of consciousness attributed to spasms of the cerebral arteries. A functional element had always been recognized in her symptoms; she was apt to be garrulous and over-complaining, and from time to time was given various hypnotics and sedatives, especially bromide. In June, 1941, insomnia and headaches recurred, and bromide was prescribed. From June 18 to Sept. 30 she took bromide continuously, the average daily dose being 40 to 50 gr. On Sept. 29 mental symptoms appeared. She had previously been noted to be ataxic and to be slurring in speech. She now accused her husband of inviting orientals into the house, and her daughter of inviting men. She asserted that Indians caused noises at night, and that she saw them sitting in her bedroom. She was disorientated for time and mistook the identity of people around her. Her symptoms were worse at night, improving in the morning. Restlessness was not pronounced, but occurred at night-time. On physical examination there was no rash; her speech was slurred and there was tremor of the fingers, but no physical signs of organic nervous disease. Marked hypertension was present, with some cardiac failure. Blood bromide amounted to 300 mg. per 100 c.cm. She was given 80 gr. of sodium chloride daily. In 2 weeks all her hallucinations had disappeared. She became correctly orientated and able to carry on a conversation quite rationally. Her physical condition improved and the ataxia disappeared, so that she was able to get about the house again. Unfortunately it was not possible to obtain a second blood-bromide estimation, but from the history, the mental and physical signs, and the response to treatment, coupled with the high blood bromide, there was no doubt of the diagnosis.

Case VIII

On May 23, 1940, this patient, a married woman aged 46, was admitted complaining of pains in the legs and arms, a sensation of falling, and throbbing in the head. She had always been a nervous woman, and her condition had grown worse since March because of domestic and marital difficulties. Examination revealed chronic rheumatic carditis with mitral and aortic lesions and auricular fibrillation.

She was treated for the cardiac condition and given a bromide mixture for her nervous symptoms. On June 28 she suddenly became mentally confused. She talked irrationally and insisted on going home. She said that she could see people around her who were pulling faces. This delirious state was worse at night. She failed to recognize people about her and did not know the day or date. She was extremely restless, and attempted to get out of bed. Bromide intoxication was suspected, and the blood bromide was found to be 300 mg. per 100 c.cm. Later, on investigating the history more fully, it appeared that she had been taking medicine from various doctors for a long time before admission, and also a patent preparation containing bromide. Because of her extreme restlessness and the severe cardiac lesion her condition became dangerous within a few hours. The pulse became very rapid and she was cyanosed. As soon as bromide intoxication was diagnosed she was given 1½ pints of intravenous saline and a lumbar puncture was performed, 30 to 40 c.cm. of clear fluid being withdrawn. The restlessness was controlled with paraldehyde, and elimination was further promoted by jalap and mersalyl. She was also given sodium chloride by mouth in as large doses as possible. Within 3 or 4 days restlessness settled, and subsequent blood-bromide estimations revealed a steady fall: on July 3 it was 150 mg. per 100 c.cm.; on the 11th, 125 mg.; and on the 21st, 30 mg. She became completely rational and coherent, and was fit to be discharged to a convalescent hospital on Aug. 5, 1940.

Case IX: Mild Intoxication

This patient, a single woman aged 37, had complained of feeling tired for the last two or three years. In April, 1941, a ganglion was removed from her hand under local anaesthesia. Two days later she had an attack of vomiting; similar attacks lasting for a day or so recurred for no apparent reason. She complained also of increasing tiredness, unsteadiness in walking, and failing memory. She would put things down and forget where they had been placed. In May her doctor suspected

alcoholism because she had slurred speech and a tremor of the fingers. She was admitted to hospital on July 19.

On examination tremor of the fingers, slurred speech, and slight failure of memory for recent events were observed. There were no physical signs to account for the vomiting, which was regarded as probably functional. In view of the ataxia and impaired memory, of recent development, the blood bromide was estimated on July 27 and found to be 220 mg. per 100 c.cm. Mild bromide intoxication was diagnosed and she was treated with sodium chloride. The blood bromide fell steadily to 160 mg. on July 31 and 45 mg. on Aug. 11, and finally to 5 mg. on Sept. 23. All the mental symptoms disappeared; she became bright and alert, and could walk without difficulty. She still complained of occasional vomiting and headache, but once the toxic symptoms had cleared up it became evident that she was of a psychoneurotic type. These symptoms were due to an anxiety state associated with depression connected with her life generally, and their persistence in hospital was due to unwillingness to return home. After a psychological explanation she left hospital and the vomiting ceased. It was later found that for a long time before admission, she had been having medicine from her own doctor which, in view of the findings, was presumed to be bromide.

Discussion

From these case records it will be seen that the diagnosis of bromide intoxication depends on the mental and physical signs and the history; it is confirmed by the blood-bromide estimation and the response to treatment with chloride. Of the mental signs confusion is the most important. "Confusion" is so often loosely used that further definition is necessary. The cardinal feature of confusion is clouding of consciousness—i.e., of the awareness of environment and response to external stimuli. In bromide intoxication this clouding is most often gradual in onset, and in such cases the earliest sign is frequently a tendency to confuse words in relation to objects. Objects are called by the wrong name, and at this stage the patient may have insight into the fact and be worried because he cannot put his tongue to the appropriate word. For example, one patient in this series noted first of all that when he wanted to write the word "rival" he was apt either to dictate or write the word "civic." As is to be expected, such phenomena usually show themselves in situations in which a high degree of concentration is called for, as in dictating a letter. In this early phase there are great diurnal variations. As the intoxication progresses the perceptual defect becomes more marked. Complex and relatively uncommon objects, such as a hand lens or a paper-knife, are not recognized. Names become confused, and the patient fails to recognize the identity of people about him. Memory, which depends very largely on perceptual normality, becomes impaired. Later, orientation is lost; the patient fails to recognize the day or the date, or where he is, and may even forget his own name. This clouding of consciousness, the hall-mark of confusion, does not occur in melancholic, manic, or schizophrenic states unless toxic factors are added. The confusion is usually worse at night with the withdrawal of contacts from the world that occurs in darkness. Removing the patient from home to a nursing home may precipitate an attack of acute confusion through a similar mechanism, as in Cases V and VI.

In bromide intoxication the predominant tone is generally one of depression with causeless weeping and impaired emotional control. Motor restlessness was present in every case in this series, sometimes being severe enough to make nursing difficult. The movements are not often violent; but the bedclothes are thrown off, and attempts to get out of bed and wander aimlessly about are seen, and when the patient walks he shows an ataxia similar to that of alcoholic intoxication. The habits are often faulty. Hallucinations are common; the important point about them is that they are frequently, and predominantly, visual, and seldom auditory. Such visual hallucinations were present in 8 of my cases. Auditory hallucinations are present also, but if occurring apart from visual hallucinations they should always give rise to a suspicion of schizophrenia, which may, of course, be complicated by bromide intoxication. In the acute and severe cases no definite picture may be described; there is only incoherent continual muttering, and the associations are so distorted that no signs can be made out.

A common feature in the syndrome associated with bromide intoxication is the presence of paranoid ideas; they occurred in 8 cases. Patients stated that they were being poisoned, that their

relatives were plotting against them, that they were being detained against their will, and that the police were after them. These paranoid trends are not fixed, and the ideas vary from day to day, disappearing completely as the intoxication clears. Now, there is nothing in such a picture that is specifically characteristic of bromide intoxication *per se*, but what is emphasized is that in 8 of these 9 cases such a state of confusion, with clouding of consciousness, existed, and could be recognized clinically without undue difficulty.

The physical signs are no more specific than the mental symptoms. In general they suggest a toxic state: the complexion is sallow and muddy in most cases; the tongue is dry and coated, and the breath foul; and tremor of the fingers is present. Skin rashes were seen in only one patient. Barbour, Sargant, and Pilkington (1936) noted them in 20% of their cases. Craven (1933) found a skin rash only once in 8 cases of severe intoxication, and Sharpe (1934) in only one of 10 cases.

Thus the mental and physical signs found in severe bromide intoxication are those of a state of toxic non-febrile confusion. Such a state is no difficult to recognize with careful history-taking and examination. It should at once call to mind bromide intoxication as a possible cause. If the history reveals that the patient has been taking medicine, usually described as "salty," over a period of weeks, the possibility becomes a probability, and a blood-bromide estimation is indicated; if this exceeds 200 mg. per 100 c.cm. then it can safely be said that a state of bromide intoxication exists.

The normal blood bromide is 0 to 2.5 mg. per 100 c.cm. The level at which toxic symptoms begin varies with several factors: idiosyncrasy, tolerance due to prolonged intake—as in epileptics—age, the presence of renal or hepatic disease, or restricted diet as in Case IV. Chronic debilitating disease or exceptional psychological stress, such as sudden change of environment, may act as a precipitating factor; but experience substantiates the view of Barbour *et al.* that levels under 100 mg. can be ignored, from 100 to 200 mg. may produce symptoms in elderly patients or those with cardiovascular or renal disease, and over 200 mg. produce symptoms in most patients. Other causes of a toxic non-febrile confusional state, such as chronic renal disease, diabetes, and lead poisoning, can easily be excluded by the usual clinical methods.

Finally, there is the therapeutic test; this is almost as specific and dramatic as the relief of symptoms in acute rheumatism by salicylates. If sodium chloride causes rapid amelioration of symptoms the diagnosis of bromide intoxication becomes a certainty. The dose of sodium chloride should be limited only by the occurrence of vomiting. Its administration in cachets is more pleasant than in a mixture. The usual dose given is 30 to 60 gr. four times daily. The excretion of bromide may be promoted by additional measures, such as lumbar puncture, diuretics, and purgatives. Immediate lumbar puncture and the removal of 20 c.cm. of cerebrospinal fluid greatly benefited 2 patients, producing rapid relief of symptoms and abatement of restlessness and noisiness.

It is not intended to imply that bromide is a dangerous drug or that its administration should be hedged around with restrictions. Bromide is most useful, and in fact indispensable, in many illnesses, including psychoneuroses; it may become less necessary in psychological work as facilities for psychological treatment improve, but at present it is of great value both intrinsically and psychologically. What must be stressed is that it is by no means a harmless drug: its unchecked use over a more or less prolonged period may give rise to toxic mental symptoms of great severity. If bromide intoxication is kept in mind when symptoms like those here described are met with, it will not be missed, and the mental state can easily and rapidly be turned towards normal.

Summary

The case histories of 9 patients with severe mental symptoms due to bromide intoxication are given; one patient died.

The mental symptoms were confusion—i.e., clouding of consciousness—depression, motor restlessness, visual and auditory hallucinations, and paranoid ideas.

The physical signs were not specific, and skin rashes were unusual.

A history of the taking of bromide, often for a long period, was usually obtained.

Among the precipitating factors were change of surroundings—as removal to hospital—and restricted diet.

The blood bromide was over 200 mg. per 100 c.cm., as compared with the normal level of 2.5 mg.

Treatment is by sodium chloride, 30 to 60 gr., repeatedly by mouth, or intravenous saline infusion; a favourable response, with lowering of the blood bromide, confirms the diagnosis.

I wish to acknowledge with thanks the permission of many colleagues at Manchester Royal Infirmary to publish cases under their care, and to express gratitude to my colleague, Dr. M. C. G. Israëls, for his helpful criticism and advice.

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INDUCTOTHERM TREATMENT OF SULPHAPYRIDINE ANURIA

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Disturbance of renal function developing during treatment with the sulphonamide series of drugs has been described in a considerable number of cases by various authors. Clinically this disturbance may range from transient haematuria to anuria with resulting death from uraemia. The pathological changes in the urinary tract have been shown by experiments on animals (Antopol and Robinson, 1939; Gross, Cooper, and Lewis, 1939) and by post-mortem examinations in fatal cases (Backhouse, 1939; Stryker, 1940; Pepper and Horack, 1940; Plummer and McLellan, 1940) to be due to the precipitation of crystalline derivatives of the sulphonamides in the renal tubules and pelves, and in the ureters. It has been pointed out that owing to the greater solubility of sulphapyridine and its acetyl derivatives in an alkaline urine the possibility of this condition arising may be minimized by the administration of alkalis and abundant fluids to cases being treated with this drug (Lebel, Schroeder, and Simesen, 1940).

In cases in which this complication has resulted in anuria the most successful therapeutic measure, apart from the administration of abundant fluids by mouth and of intravenous solutions of non-threshold salts (Leedham-Green, 1941), has been catheterization and lavage of the renal pelves (Tsao *et al.*, 1939; Lebel, Schroeder, and Simesen, 1940; Scurry and Wittenborg, 1940). Recently we have had under our care such a case in which inductotherm therapy of the kidneys has yielded a satisfactory result.

Case Report

An airman aged 36 was admitted to a hospital for venereal diseases on Aug. 25, 1941, suffering from a urethral discharge. Treatment with sulphapyridine was started on the 26th, when 8 g. was given. On the 27th a further 7 g. was administered. That evening at 8 p.m. he passed a small quantity of brown urine. Sulphapyridine therapy was discontinued. Thereafter, although a feeling of urgency remained, he was unable to pass urine until 11 a.m. on the 28th, when he voided 1 oz. of deeply blood-stained urine. An hour later he developed intense aching pain in both loins radiating to the testicles, more severe on the left side. The pain rapidly became more intense and the sense of urgency increased. Intractable vomiting set in at about 3 p.m. No further urine was passed, and at 10 a.m. on the 29th he was catheterized. No urine was obtained. The patient was then transferred to this hospital. On admission he was vomiting, and complained of very intense pain in the loins. He was afebrile; the tongue was dry and coated; and there was marked tenderness in both renal angles. Routine examination revealed

no other abnormality. Blood pressure was 135/85. Fluids were given in large quantities, but absorption was minimal owing to the vomiting.

At 3.20 p.m. inductotherm treatment was started. The apparatus used was the General Electric Corporation's inductotherm, model B. Treatment was given to both kidneys alternately. Two coils were used behind and three in front. The immediate progress of the case is illustrated in the chart.

It will be noted that the passage of 6 to 8 oz. of urine followed about an hour after the termination of each of the first three applications, and that during the night of Aug. 29-30 the passage of urine, though in small amounts, indicated the return of renal function. 12 oz. of urine was passed after the final application; thereafter diuresis set in. The first specimen of urine was heavily blood-stained and acid in reaction. Unfortunately it was disposed of before it had been examined microscopically. The second specimen was "smoky" in colour and acid in reaction, and contained red blood cells in profusion. No crystals were seen. Subsequent specimens were clear, and red blood cells had disappeared from the urine by the 31st. The passage of urine after the first application was followed by marked relief of pain, which ceased shortly after the last application. By the evening of Aug. 31 vomiting had subsided. Thereafter convalescence was rapid and uneventful.

We are indebted to Major J. Bull, R.A.M.C., for the following report on subsequent investigation of the case by excretion urography.

Radiological Investigation

Sept. 4.—The kidneys were normal in size, shape, and position. Excretion urography (20 c.cm. of pyelocan intravenously) showed the right kidney excreting with fair concentration into the pelvis and ureter after 5 minutes. The calices were not seen throughout the examination. Excretion from the left kidney was abnormal. Not until 20 minutes was it seen to be filling with dye. It was assuming a white appearance. At 90 minutes the whiteness was very pronounced, but at no time were the calices, pelvis, or ureter outlined with dye. The right renal pelvis still contained dye. On no occasion was compression applied to the ureters. The examination was not pursued after 90 minutes.

Sept. 15.—A second intravenous pyelography (20 c.cm. of pyelocan) was now carried out. After 5 minutes the right calices, pelvis, and ureter were excreting the dye in fair concentration. The left calices and pelvis contained rather less dye. Compression of the ureters was applied for from 7 to 30 minutes. Just before releasing compression a film showed that there was a moderate concentration of dye in both calices, pelves, and ureters. Both kidneys were white. Radiographs taken at 3 hours, 6 hours 40 minutes, 60 hours, and 84 hours showed the kidneys to be partially white, the intensity decreasing with time.

Radiological Conclusions

At the first examination on Sept. 4 the right kidney was excreting moderately. The left renal apparatus at no time showed excretion into the calices, pelvis, or ureter. The kidney itself, however, became homogeneously white, indicating that the dye had entered it. The conclusion is that the dye was being held up proximal to the calices. Thus the excretory mechanism of the left kidney was functioning very poorly indeed, whereas that of the right was moderate. At the re-examination after 11 days the calices of both kidneys contained the dye even before ureteric compression was applied. Compression improved the concentration. Both kidneys were partially white, indicating that the dye was being held up to some extent in the