FRONTAL BLOCK.

Some Observations on the Effects of Local Anaesthetic Injections into the Cerebral Hemispheres of Rabbits and Psychotic Patients.

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There appears to have been little investigation of the effects of local anaesthetic infiltration of the brain. Occasional reports mention the possibility of such procedures for diagnostic purposes.

The following two sections of this paper are preliminary reports.

Animal Experiments.

With the collaboration of W. V. Macfarlane, three rabbits were first craniectomized over the greater part of the convexity of the cerebral hemispheres. Rabbit C sustained some meningocortical injury and died on the 15th day.

Rabbit A.—On the 9th day after operation three injections were made into the left hemisphere. The first, 0·05 c.c. half per cent. percaine, was injected about the mid-hemisphere. This resulted in a moderate hemiparesis lasting 10 minutes, unassociated with any other detected change. When the rabbit appeared to be normal again, 0·075 c.c. of procaine base in oil were injected anteriorly in the same hemisphere. As there was no detectable change, a further 0·1 c.c. of the same base was injected about 5 mm. further back. Again there was no detectable change in the rabbit's behaviour.

On the 12th day the right hemisphere was injected about the midzone with 0·15 c.c. procaine base in oil. There was no detected change in 10 minutes. A further 0·15 c.c. was infiltrated in the same region. Shortly after the rabbit defaecated. After 5 minutes the rabbit micturated and showed some weakness of the left foreleg. Liveliness decreased; there was no running, but walking, in circles to the left, appeared in another 7 minutes. These changes only remitted slowly, and there was some left hemiparesis and a tendency to circle to the left still noticeable after 24 hours.

On the 19th day the right hemisphere was infiltrated with 0·1 c.c. of 1 per cent. decicain (containing India ink) about the midzone. A left hemiparesis and deviation of the head to the left soon developed. The rabbit remained lying, but could right itself if turned over. After 5 minutes it was sitting, looking to the left, twitching the ears. It was very responsive to noise, and the

left foreleg was still obviously weak. After another 5 minutes it was jumping about and more lively. Recovery ensued by 15 minutes after the injection.

On the 23rd day the left hemisphere was infiltrated with decicain (0·2 c.c. of 1 per cent.). There was again a hemiparesis, though not so severe. Recovery followed in 10 minutes. 0·1 c.c. of 1 per cent. decicain were injected on the left side on the 30th day. Hemiparesis was obvious in 2 minutes, together with a reduced response to pain on the right. After 10 minutes the rabbit was able to stand again, but still with a right-sided weakness. In another 10 minutes full recovery was apparent. The rabbit was then killed, and the head placed in fixative.

Autopsy showed no abnormality. The rabbit had remained well nourished, and throughout the course of the month had shown no abnormality except those noted above.

The head was dissected after fixation. The only significant gross change was the presence of a small amount of blood in the cisterna pontis and the right frontal pole. There was some subarachnoid India ink. Microscopic sections were cut of the hemispheres. In one section the last needle track was apparent with fresh red cells and India ink particles not yet phagocytosed. In the adjacent subarachnoid space there were fresh red cells, not clotted, and India ink. At more remote points there were some (intracellular) India ink particles but no noticeable increase in the fibrous tissue of the pia arachnoid.

Rabbit B:—On the day after operation five injections were made in the left hemisphere. Each was of 0·05 c.c. of 2 per cent procaine, and each placed a little further caudal. No detectable abnormality was found. Between each injection the rabbit ran around the room with as much vigour as before.

On the 9th day an injection of 0·05 c.c. half per cent. percaine was without effect. This was followed by one of 0·075 c.c., which produced a slight dragging of the right legs. Recovery was rapid. Then the rabbit was injected with 0·2 c.c. half per cent. percaine in the mid-hemisphere. Within 30 seconds rapid running movements occurred, which continued when the rabbit fell over. There was no clonic element. Within another minute complete flaccidity developed with pilo-erection. Respiration stopped, and the heart slowed, and was recorded at 50 per minute. It was irregular. Artificial respiration was instituted, and at no stage was cyanosis allowed to develop. The pulse rate started to accelerate 10 minutes after the injection. Fifteen minutes later a few irregular breaths occurred spontaneously, and in another 4 minutes regular respiration was re-established. This changed to a tachypnoea for about 10 minutes. During this time there was some rigid extension of the legs, with movements, however, in response to local pain. There were occasional twitches of the legs. Forty-five minutes after the injection the rabbit appeared to be as though recovering from a general anaesthetic. There were purposive avoiding movements, and it could be aroused, but appeared to go to sleep again the moment the stimulus was stopped. The speed of the onset of the disturbance and the severity thereof suggests that the injection was intraventricular. In 12 hours the rabbit had recovered.

On the 12th day 0·15 c.c. of 5 per cent. Stovaine were infiltrated into the

right hemisphere. A paresis was definite in 1 minute, and then the rabbit fell on its side but made vigorous running (righting) movements. Pilo-erection occurred. The righting element was easily demonstrated. If the head was held vertical no particular leg movement occurred, but if the head was allowed to fall to the left movement of all legs occurred. The rabbit could not get up when lying on its left side. It would not remain lying on the right side.

On the 19th day 0·1 c.c. of 1 per cent. decicain was injected (with India ink). An almost complete left hemiparesis quickly developed. The rabbit lay on the floor curled up convex to the right, with only occasional movements of the left limbs. It was unable to stand, but could move a little on the floor if annoyed. For the next 3 minutes it lay, head turned to the right, forelegs spread on either side, but the hind legs to the left. Righting occurred to this position if displaced, but was not always successful at the first attempt. After 10 minutes the rabbit was able to lift the trunk off the floor and advance. It was able to run after another 10 minutes, but remained very docile and placid to handling and examination.

On the 23rd day 0·1 c.c. of 1 per cent. decicain (with India ink) was given posteriorly with no detected effect. This was repeated on the 30th day, but a deliberate attempt was made to infiltrate it into the ventricle (left). A right hemiparesis ensued rapidly, breathing stopped, and the heart continued beating for 2 minutes. No attempt at resuscitation was made.

Examination of the head after fixation revealed a little subarachnoid blood and India ink. On the left side there was a well-organized needle track with almost complete absorption of blood, and well-marked phagocytosis of the India ink. This was probably due to the injection 7 days before death. On the opposite side in the same section there was a smaller portion of an older lesion, again with India ink. There was also subarachnoid ink, and in places some increase in the fibrous network with small traces of cellular debris, which suggested organized subarachnoid blood.

Rabbit C:—Nothing new was observed during three injections of procaine base in oil. Dissection of the head after fixation showed extensive subarachnoid clots, in the sulci, especially of the right temporal lobe, and around the brain stem. Microscopically there were red cells, cellular debris and delicate strands of invading connective tissue. The appearances were consistent with a lapse of 3 days since the bleeding from the last injection.

While these experiments were being carried out (1947) the papers of Soulairac and Barbizet (1946) became available. Their results are comparable, though carried out on rats.

The purpose of these experiments was to determine the safety, or otherwise, of local infiltration, the most suitable (and safest) agent to use, and the feasibility (or otherwise) of the procedure in man. The region particularly of interest was the operative field of prefrontal leucotomy. If it were possible to infiltrate this region with safety a diagnostic test could be undertaken before the irrevocable surgical incision.

Risks.—From these experiments two risks became apparent. The first is that of respiratory paralysis, but this can be tided over by artificial respiration.

The second is the injury inflicted by the injection. Injury in the proposed site, the field of operation for prefrontal leucotomy, does not matter if this is the ultimate purpose. Provided the needle does not leave the white matter it should be as safe as the use of the leucotome. Bleeding into the subarachnoid space appears to be more serious. In the rabbits the needle was inserted blindly through the intact meninges and cortex. In man, in order to avoid this risk, part of the cortex beneath the necessary trephine would need to be coagulated. This condition obtains in cases submitted to leucotomy by the lateral blind approach (see later).

The fact that the local anaesthetic may reflux along the needle track and so enter the subarachnoid space does not appear to be important. Thus, in Rabbit A, India ink was present in the sulci and cisternae, but no respiratory paralysis or untoward event ensued. Operatively induced adhesions beneath the trephines would tend to obviate this risk.

Dose.—The approximate average weight of the three rabbits' brains used was 10 gm. The human brain weighs from 1,250 to 1,400 gm. The comparable figures for injection volume for the human brain are: 0·05 c.c. in the rabbit, 6·5 c.c. in man; and 0·2 c.c. in the rabbit, and 26 c.c. in man. Even though the rabbits were craniectomized, the dura mater was not incised.

Observations in Man.

Following the observations previously recorded it seemed that local anaesthetic infiltration of the frontal lobe was a feasible procedure. The most suitable subject for the procedure appeared to be an already leucotomized patient who had failed to respond, or who had done so temporarily. The possibility of re-operation might be thus explored. Only three such cases have been under the writer's care since 1947.

Case 1.—This patient was 63 years old at the time of her admission in 1943. She was born in N.Z., the middle of a family of five. Her upbringing was uneventful, and she married at 27 years. There was one deceased issue. Before the onset of her illness she was always nervous and a chronic worrier.

On admission she was depressed and vaguely apprehensive of some impending calamity. She deteriorated, becoming more agitated, solitary, resenting touching or any care. By the time E.C.T. was started she was limited in conversation to "Go away!" and moaning. With E.C.T. she showed a considerable improvement, but required maintenance treatment. With too few she remained agitated and noisy, and with too many, confused, gluttonous and faulty.

After a lengthy trial of E.C.T. she was submitted to operation on 28.10.47 when a relatively conservative operation was carried out. The next day she showed no gross confusion, and any alteration in her condition was virtually undetectable. She might have been slightly less depressed but still conversed: "Take your filthy bloody hands off me. Don't come near me, take your foot off the bed." "Nurse, you haven't washed your hands." At other times she moaned and called out "Oh! Christ!" for periods of up to 30 minutes. She was not eating well, and often covered her head with sheet or blanket. There was no change in the first week, and re-operation was considered.

On the 9th day after operation a control manoeuvre was carried out. The region of the burrholes was infiltrated, with resistance and distress. She tried to pull the sheet over her head, crying and moaning, "You're putting paper on my head," cursing and abusive. An L.P. needle was then introduced into each side and the ventricle tapped on the left. All this resulted in a great deal of abuse, resistance, a little sweating, and later a little vomiting. There was no alteration

in the temperature, pulse or respiration. The abuse did not subside for 30 minutes.

On the next day the procedure was repeated, with similar distressed behaviour and assertions that I was putting paper (and this time jelly) on her head. With the L.P. needle directed towards the orbital regions (where most of the spared fibres were thought to be), 4 injections, totalling 5 c.c. of 2 per cent. procaine, were made. On the opposite side, the left, 3 injections, totalling 4 c.c., were made. Owing to restlessness no more was done. Within a few minutes the distress associated with the procedure was over, and she had the best meal she had had since operation. She would allow me to touch the bed without comment, but still resented her head being touched: " Don't touch me. Go away ! " She then went on eating. There was no doubt that she was quieter, more placid, and less agitated and resistive to attention. For the first time since operation she showed disorientation sufficient to be unaware of the day (Saturday for Sunday). The temperature, pulse and respiration were unaffected.

The change is best recorded in the nurses' notes. The nurses in question were not present during the procedures and were not told of any difference between the two.

Control (12.30 to 1 p.m.).

1.30 p.m. Has looked flushed (? from exertion) and has vomited.
3 p.m. Has been quite unhappy, saying " Christ, Oh my, Oh my ! " continuously.
6 p.m. Has not eaten very much tea—is very noisy and restless.
9 p.m. Has been very talkative. (Sedative.)
2 a.m. Awake again after morph. and hyoscine at 9 p.m. Monotonously repeating her earlier statements.
7.30 a.m. Would not eat much breakfast.

Actual Infiltration (at the same time of day).

1.30 p.m. Has had a good dinner.
3 p.m. Is fairly quiet but very friendly and co-operative.
4.30 p.m. Vomited.
6 p.m. Is very bright; managed some jelly for tea but would not have anything else as she thought she might vomit. Is talking rationally and is more amiable.
9 p.m. Morph. again with hyoscine.
4 a.m. Sleeping soundly still.
6 a.m. Is now awake and noisy.
9 a.m. Is very bright.

On the 11th day the wounds were re-opened and the incisions in the white matter extended. Subsequently the post-operative course was not unusual. She was muddled, and denied that she had had an operation. Her mannerisms persisted, but were by no means so gross. A fortnight after operation she was getting up, eating and sleeping well, and obviously relieved of her emotional distress. She said she felt contented and happy. On the 21st day she struck a nurse when ordered to go against her own feelings. She continued to improve for 3 months, with minor fluctuations. She became cleaner, tidier and no longer faulty, but her obsessional routine and agitation became re-established more and more. During episodes of this nature she was much less amenable to nursing care than previously.

The agitation slowly returned. Four months after operation she was tried with E.C.T. again. Three treatments made her confused, gluttonous, and faulty. This remitted in about a fortnight and she was better conducted, most of the time sitting quietly, and at times able to work provided she was not asked to do anything against her obsessions. She relapsed in another few weeks, and the treatment was repeated with the same sequence of confusion and improvement. Thereafter, for another 12 months, she continued with E.C.T. and ups and downs. When she was subject to her obsessions and agitated she was more uninhibited in her behaviour than before operation, and even at her best still inclined to edge away from people and to dislike handling things.

On 27 September, 1949, she was at her worst before or after operation. She was filthy and dirty. Screaming and abuse followed any attempt to touch

her. Left alone, she was fairly quiet, cringing, and turning her head away, not caring for her dress or person. She was unemployable in any capacity, and at times inclined to strike or push anyone in her way.

On this occasion pentothal was given intravenously (0·5 gm. in all). Until she was unconscious she was resistive and screaming abuse. With an L.P. needle the tip of the frontal horn was located on the left side. Then in front of this plane four radiating injections were made. In each 1 c.c. of 2 per cent. procaine was infiltrated. This was repeated on the right. The patient showed no upset, was never deeply anaesthetized and was returned to her bed. She had dinner in bed, and taking advantage of her improvement she was bathed in the afternoon. During the afternoon she was able to answer simple questions relevantly, and even make spontaneous comment about other patients. There was some disorientation in time and circumstance, but this may not have been new, as she was inaccessible to such questions before.

The bathing, customarily the most difficult nursing task with this patient, went smoothly.

> Nurse : " Come along Mrs. — please, it's bath time."
> Patient : " Oh ! Am I going to have a bath ? "
> Nurse : " Yes, come along, please."

The patient went co-operatively, was quietly spoken without abuse, and even started to wash herself once. She was inclined to be fussy about the folding of her clothes. She was afterwards returned to bed and remained well behaved for the rest of the day.

Next morning she was again dirty, resistive, screaming abuse, and all real improvement had evaporated, except that she was slightly more accessible to questioning.

The procedure of the previous day was repeated, using 5 c.c. for each side. During the recovery from the pentothal there was more movement and vocal efforts than before. This settled down, but the patient remained grossly confused. She thought first that she was not married, then it was the year 1929 and her husband was at work, then she was speaking to her young daughter, and so on.

She was asked if she wanted a bath and became abusive. She quickly changed, and within a minute was pleasantly reminiscent about the past. Other fleeting and transitory evidence of her previous agitation also occurred. She was 100 per cent. faulty. On one occasion she attributed her wet bed to the fact that she had only wiped her hands there.

During the next three or four days she was incontinent, confused, but with a good deal of the pre-existing resistive and abusive conduct reappearing. The next four days were perhaps even worse, as the patient had diarrhoea. However, on 19 September improvement set in. The confusion started to clear and behaviour settled down, and in another week she was back to a level approximately that of her previous good levels with E.C.T. In one respect, the incontinence, this was not so, for this persisted for some weeks. This improvement lasted on the upgrade for about four weeks, and was then stationary for about another two months. There was then a gradual decline. At the end of the year she would only speak spontaneously on rare occasions, and was very limited in her replies to questions. She was still so obsessed with contamination ideas that she would urinate anywhere, even in her chair, provided she could avoid using the ward lavatory. She required full nursing supervision, and was still at times resistive.

CASE 2.—This 50-year-old man was admitted to a mental hospital in 1929. There appeared to have been a previous attack in 1927, treated in a private hospital. From the records little information could be obtained of the patient's upbringing. The early notes stated that he was excited, noisy, exalted, stubborn, negativistic, but with no actual aggressive conduct. He was expressing many unfinished comments on all and sundry, singing alternately hymns and ribald ditties. The initial provisional diagnosis was acute mania, and the patient continued in a grandiose exuberant frame of mind until a period of acute aggression and impulsive behaviour. This early phase was complicated by a violent haematemesis, from which he recovered uneventfully. Throughout this period and subsequently he has expressed delusional ideas that the Holy Spirit was entering his dog, that his

reproductive organs had been destroyed, and that he could faith-heal. During the subsequent years he has shown a fluctuating course. Periods when he was well conducted, though always delusional, alternated with noisy, restless and occasional aggressive episodes.

By 1947, in the better phases, he was lugubrious, solitary, with little conversational ability, but amenable to full nursing care. Early in 1948 he again passed into a restless, excited state, pacing up and down his room, violently aggressive towards the staff, and obscene in language. He would throw his excreta about the room and was frequently coprophagic. No permanent improvement was effected with E.C.T., and in this state he was referred for operation.

Operation was performed on 25 March, 1948, by the lateral approach. Return of consciousness was slow, but the next day he was eating well but had to be fed. For the next four days he was fed, and would only answer, " I don't know," sometimes preceded by some blasphemous remark. He was not incontinent until the 5th day, and then, as a result of a bout of diarrhoea, he had some trouble, and also a return of coprophagy and faeces-smearing. On the 8th day he urinated on the floor, but otherwise was clean in his habits. From the 6th day onwards he used a knife and fork and was clean in his eating. On the 14th day he was asked how he enjoyed himself in hospital, and answered, " Not bad at all."

Q. " What did they do to you ? "
A. " Shoved something in."
Q. " Where ? "
A. (Pointed to the scar on the side of his head.)
Q. " Did it have any effect ? "
A. " It should have " (fits of laughter).

He continued to improve, he was clean and tidy and well dressed. Instead of a scowl and solemn silence he was able to smile, and pleasantly chat for short periods on simple topics. Six weeks after operation he was making his own bed and going for regular drives into town and the country.

He asked to be supplied with a tooth brush, and was able to visit a public hairdressing saloon.

More spontaneous conversation was present after another two months and he would make quite lengthy comments. Later he was able to be employed in gardening and ward duties. He would proceed with and complete these tasks without any supervision, though in the garden and ward he kept a constant watch for any chance of a ride in the car.

In the next few months there was little change, but the patient remained, after 19 years, at a much improved level. He took care of himself, never overworked, and was always ready for anything special.

The patient continued at this level until about the middle of 1949. From this time he started to worsen. This was a gradual relapse, punctuated by two or three noisy spells. These lasted a few days, but after they were over there was more deterioration. At the beginning of November he was sullen, uncommunicative, stalking about and glowering. Tirades of abuse and curses were his only expressions apart from grunts. He was untidy in dress, unclean in habits, and interested in his faeces again, although he was not known to be coprophagic. He was treated conservatively for 10 days but showed no improvement. E.C.T. (6) in the next 7 days produced no amelioration in his conduct ; rather the confusion only added to his pre-existing symptoms.

On 26 November, 1949, the patient was anaesthetized with 0·8 gm. pentothal intravenously, and the skin over the burr-holes prepared and infiltrated with local anaesthetic. Three injections were made on each side, and totalling 2 c.c. of 4 per cent. procaine (on each side). All were in front of the previous surgical incision and radiated up, forward, and down from the burr-hole. The procedure was uneventful.

The patient was able to speak within 60 minutes from the start. He then said he had a headache, felt " dopey," and the usual " I don't know." An hour later he still felt " dopey." After another three hours he was answering simple questions without abuse or swearing. He said he still had a slight headache to insistent questioning. He remained in bed for the rest of the day.

Next morning he was up early, talkative, always on the move, walking hither and thither, and examining first this and then that. He was quite eloquent when

spoken to, but not always relevant, as his talk was disconnected. Instead of "I don't know" he changed to "I don't know; Heigh diddle dumpkin, my son John." In the morning he did the washing up, giving everything an extra polish, but missing nothing that was going on in the ward. In the afternoon he became more and more excited, over-active, singing and elated. He was put to bed.

The next day showed some return to normal. He was still over-active and without purpose, but his conversation was less erratic, and contained more "I don't know's." Conversation could be sustained for about three remarks. Although walking about he did not look very amenable, nevertheless he was, in actual fact, very obedient and co-operative, and would do whatever he was told. This trait persisted for some time. On the next day, 29 November, 1949, he was better than he had been for months. He was sensible in simple conversation, and could talk about his family at length. He took more than the usual interest in things during a drive (for him).

The next day the patient learnt his mother had died. This he took very well, but the next morning he dressed in his best and thought he was off to his mother's funeral, which had already taken place. He accepted this, but was a bit restless for the rest of the day. During the next three days he was industriously employed in his usual routine, but subsequently started to interfere with the running of the farm unless supervised. At this time he might abuse an attendant from a safe distance, and become quite childishly embarrassed when the attendant came up to him. By 17 December he was again confined to the ward. His surly manner, abuse, and aimless pacing had returned. He was again dirty in habits and untidy in dress. From the 20th to 24th he had a further noisy spell, with rowdy, abusive and pseudo-aggressive behaviour. On the 23rd he was given one E.C.T., with no benefit. His conduct, however, improved on Xmas Eve, and he continued to improve over Xmas, without further treatment. By the New Year he seemed to have returned to the level which he had been maintaining before this acute 5-day relapse.

CASE 3.—This patient was a single man, aged 23 on admission in 1947. He was the second child of a family of a well-to-do farmer. One uncle was in a mental hospital. He was very shy, though clever enough at school to matriculate, after failing twice. Soon after he became exalted, thought he was a superman, and was admitted to a mental hospital at the age of 19. He was given E.C.T., and was able to return home and work on the farm, but could not talk to people or mix with others. When he was 22 years old he began to slip again, and he was taken to Australia for insulin and further E.C.T. There was no lasting effect from these treatments.

When he first came to this hospital he was dull, very childish in talk and manner, slow in his answers, and vague and halting in talking about himself. He would often smile to himself, and show other mannerisms. Untidy and lacking drive, he would, nevertheless, do what he was told. There was a history that he had once struck his attendant recently.

After coming to hospital he settled down. Although he said he did not day-dream, he showed, in the next 12 months, that he was still thinking about a romance with a Roman Catholic girl. This day-dream was mixed up with religious and sexual ideas. When talking about these things he would turn away, with at times a curious staring look in which his eyes seemed to protrude and an odd glow pass across his face.

After about 10 months he started to get worse again. He started to spit, and said that he could not help it because he had "catarrh." He began to complain that he did not fancy the company he had to keep, and wanted to go home. Leucotomy was suggested, and the parents were agreeable. Until this could be done the patient was given 10 electronarcosis treatments, which seemed to control his spitting habits to some extent, and certainly as a result he seemed better.

The operation was carried out in February, 1949. There was some sparing of the uppermost fibres. The operation was spectacularly unsuccessful. Within a few days after the operation he would yell if the bed was touched, throw things about his room, and spit. This settled in 3 weeks, and he was then cleaner and tidier. After a few days of laughter he began to show his earlier thought abnormalities, but in a gross form, with markedly erratic conduct. He said he was about to marry the girl in question, and was in direct touch with various spirits

and the Holy Ghost. He found everything " objectionable." He would not eat with, mix with, or talk to other patients. He disliked any attempt to make him do these things. Every trait present before operation was made more obvious, including the protrusion of the eyeballs. Hatred of his father also came to the surface. The only improvement was a lessening in the number of extrasystoles which had been noted for some months before operation.

Eight weeks after operation he was getting worse. He was given a short course of intensive E.C.T., with short-lived benefit. As he had earlier improved with electronarcosis, he was then changed on to a course of 19 treatments, totalling 153 minutes. With this course, lasting 3 months, 7 E.C.T. were given. There was no lasting improvement or change during this course of treatment, and after the 19th electronarcosis 6 further E.C.T. were given. The patient then was fairly well for 3 weeks. He then worsened again, and in the next 6 weeks received 12 E.C.T. with benefit. These treatments were given whenever his conduct became unruly, and not to any plan.

On 15 and 16 October he was visited by his parents. By the evening of the 17th he was noisy, demanding to go home, over-active, and difficult to cope with. He settled down for the night with sedatives, and was still quiet next morning. On this morning he was softly spoken and hesitant in replies. He was preoccupied with religion, saying he could see the Ghost (Holy and also " not Christly " ones) in the outline of trees and bushes. He also accused Roman Catholics of drinking.

The infiltration was carried out on the morning of the 18th. The patient was given 0·8 gm. of thiopentone. Two infiltrations, each of 2 c.c., were made on each side. Both were in the upper quadrants, one just in front of the coronal plane and directed well up, and the other at a lower level and more forward. The patient was able to speak, though somewhat slurred, in 30 minutes. The plantars were then flexor.

An hour later he was sitting up eating his dinner with pleasure. Four hours later he was up to go to the lavatory on his own initiative. He said he felt " Very well thank you." He had no recall of the morning without prompting, and then could only remember talking to me. He firmly denied that he had catarrh in his nose. He was not interested in talking about ghosts or Roman Catholics. He remained quiet and orderly in conduct, with vague but polite answers to questions.

During the next day he was quiet and orderly, following his usual daily routine. During the afternoon he recapitulated a phase of his post-operative course with the mouthing of saliva and the preparations to spit. He did not spit. He was able to eat in company, whereas before the others were " such objectionable people " that he could not dine with them. On 22 October there was return of the more overt post-operative symptoms, with references to his genitalia and masturbation in his conversation. This occurred after wetting the bed, but did not last. He remained quiet, eating well, able to carry out allotted tasks, but without initiative. He remained well conducted but increasingly withdrawn until 31 October. He then broke two windows " because he didn't like them."

The infiltration was repeated on 31 October, under 1·0 gm. thiopentone. Three injections, each of 2 per cent. procaine (2 c.c.), were made into the upper quadrants only on each side, radiating from the burr-holes and in front of the original incision. Ninety minutes later he was sitting up in bed, happy and confused, rather restless and talking a good deal of nonsense. He stuttered over some consonants, and was unable to pronounce the " th " as in " father." In the next 90 minutes he became more and more excitable and happy. He was throwing things around his room, laughing uproariously, talking and shouting to himself and others. His attention was readily diverted, and he was easily managed. He was put to bed with a sedative, but roused and sat up if anyone passed the door. He would then talk spontaneously for minutes, if he was answered or not.

Three hours later his speech was no longer continuous, some of his meaning intelligible, and he would occasionally answer a question after a pause in his talk. This was mostly about his previous ideas, Roman Catholics, his girl friend, his masturbation, etc. He was nevertheless very happy about most things.

" This is funny, Ha ! Ha ! What's that . . . (unintelligible), Doctor ? Ha ! Ha ! Don't worry about me, Doctor, Ha ! Ha ! Blast you ! Blast you !" (This last abuse may have referred to the writer, but probably was intended for his penis, which he then exhibited.)

" Hick ! Hick ! and Dick ! Dick ! Ha ! Ha,! Ha ! Ha ! " (Smiles, and pulls the bed-clothes about. His tea is brought in at this point.)

" Hick ! Hick !, cup o' tea, Hick ! Hick ! Hiccough ! By Gosh, not much tea, Ha ! Ha,! pie, Ha ! Ha ! By Gosh, Dick, you're being stupid, that's what you're being ! Hick ! Hick ! " (Starts on his tea.)

Q. " Enjoying your tea, Dick ? "

A. " Yes, very good, thank you ; there is something there, look at it. Doctor, it's not mine, Ha ! Ha ! It's not mine " (spells out the linen mark on the sheet). " Ha ! Ha ! Look at it " (goes on eating).

Q. " Would you like another pie ? "

A. " Yes, that would be very good, yes, two pies, Doctor, Ha ! Ha,! yes, that would be very good . . ." and so on.

He slept during the night with sedatives. He was noisy and cheerful by 8.30 next morning. He got himself up but was returned to bed. In the afternoon he was much quieter, but still happy, using a lot of gesture, and with a lot of laughter interspersed in his remarks. Conversation was repetitive.

Q. " What year is it ? "

A. " What year is it ? " (Pause.) " 1949."

Q. " And what month is it ? "

A. " And the months ?, Oh ! goodness me, months ? Ha ! Ha ! " (Spits.)

Q. " Is something the matter ? "

A. " There." (Rubs his teeth.) " Dashed if I know what it is called. There." (Points.) Ha ! Ha ! " and so on.

By the following day, 2 November, he was quite settled. There were no restless movements of hands or features, and he was amenable and co-operative in a sustained fashion.

Q. " Why were you told to go to bed ? Was it because you broke a window ? "

A. " Yes, I broke *two* windows ; I'm very sorry about it."

Q. " Do you remember why ? "

A. " Yes, I remember why."

Q. " Why ? "

A. " They didn't look very nice."

He would not enlarge on this point.

Q. " What are you going to do ? "

A. " I am going to be very good in the future."

On 3 November, 1949, he was up all day, talking freely and pleasantly. He, of his own intiative, wrote a four-page letter to his girl friend. This consisted of a brief résumé of his family, his life, his present whereabouts and previous daily routine. In this letter, and in another written the next day to his family, he attributed his insanity to masturbation. On these two days, and the next, he was distinctly better than for a long while. Very co-operative, and occupying his time ; he was showing some understanding of his condition, and would accept it as such.

Unfortunately this did not last, and he relapsed over the next 36 hours. On 7 November, under 1·0 gm. of thiopentone, 2 infiltrations were made in the lower quadrants. Into each 1 c.c. of 4 per cent. procaine was injected. He was awake in 30 minutes from the start, and able to speak slurredly. Ninety minutes later he was lying quietly in bed. He said he was well, and could remember writing a letter two days before (three, in actual fact). He said he was quite upset about having mentioned roses in the letter (flowers were mentioned, but not specifically roses), for he realized that they were not in season now. The date he gave as 6 November, which was in agreement with the previous remarks. During the rest of the day he was quiet, sleeping at times, eating a good tea, and remarkable for the absence of gesture and facial expression. Questions were answered slowly with pauses, and often in the third person.

Q. " How long have you been here ? "

A. " I have been here one year."

Q. " Why ? "

A. " There is something wrong."

Q. " With catarrh ? "
A. " Because my head is not right "
Q. " In what way ? "
Q. Repeated.
A. " Dick's head is insane."

The next day he was still rather disinterested and inactive. He was more talkative in the afternoon, and his manner was more natural. The following day he said he was not too well, but it was too important and too personal to mention or discuss. In the later part of the same day he was again quite friendly and co-operative. He reached the maximum improvement the next day, 10 November. There was some superficial insight, and he was well conducted.

In the next three days he relapsed, first by blaming the staff for making him insane, and then by retiring into solitude, refusing to be in the same room as others. He then began to find his fellow patients " objectionable," and finally struck one, after another three days. This occurred again the next day. By this time he was for long periods, during the day, in a catatonic stupor, sitting in one position for hours, but with frequent small movements of the hands and an increase in the degree of " stare." In the next two or three days episodes of excitement became more frequent. Nevertheless, on 21 November he wrote home. This letter concluded thus :

" I have written in my other letter that I am insane, I can tell you all more about this. The left front of my brain has gone and I still have the right side.

" Goodbye all, etc."

By 25 of November he had relapsed back into a state where he was worried by spirits, by sexual matters, and by loss of the left half of his brain. This latter appeared to have replaced the " catarrh." On this particular day he was a Protestant, but influenced by various spirits. There was considerable blocking, or as he put it, " I want to say something but only get the first letter, and then something else comes." (There was still some stuttering over some initial consonants.) Most of his excited, erratic conduct appeared to be motivated by sundry spirits and the Holy Ghost.

Eighteen days had elapsed since the previous injection, and all improvement had evaporated.

On the 26 November the infiltration was repeated. This time only one injection (2 c.c. of 4 per cent. procaine) was made on each side, and the needle directed through the burr-hole to the opposite pupil. 0·7 gm. thiopentone was used. The course after this procedure was somewhat like that following the second injection (31 October). During the rest of the day he was cheerful, with laughter interspersed in his remarks. Conduct, however, was reasonable, he kept his bedclothes tidy, and was politely co-operative. On this occasion he wet the bed twice. The next day he was improved, with less exuberance of spirits, but with more return of his previous ideas. He was clean and tidy, and prepared to discuss his ideas in a friendly manner.

Several comments he made were :

" I'm in good health now." " The left side of my conscious brain is not with me but all on the right side is in good health." " Some Spirit has been troubling me." " Either God or the Devil." " I have been going about and the Spirit told me to keep in time." " As far as the Spirits are concerned I have prayed a lot." And so on.

His troubles slowly re-asserted themselves, and on 2 December he was again refusing to associate, because people were " objectionable." E.C.T. on 4 and 8 December controlled this return of symptoms. Subsequent to a visit from his parents on the 15th December he was again aggressive towards other patients. Further E.C.T. ultimately controlled his behaviour at a reasonable level, and was given symptomatically for this purpose, thereafter, during the period of observation (6 weeks).

Summary.

In the first section of this paper some animal experiments are described. These were carried out in 1947 without knowledge of the work of Soulairac and Barbizet on rats (1946). Subsequently 8 infiltrations of the white matter

of the frontal lobes have been carried out with local anaesthetic agents (in 3 psychotic patients). On some occasions there was immediate improvement, and in others improvement only after a period of altered conduct. The duration of the benefit over several days is noteworthy. The first case showed immediate benefit, but the repeated infiltration led to confusion.

The second case showed some benefit, which was sustained for weeks, apart from one of his short excited episodes.

In the third case 4 injections were more effective in controlling behaviour over a 6-week period than 12 E.C.T. in the preceding 6 weeks, and an equal number of E.C.T. in the subsequent six-week period.

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LITERATURE

SOULAIRAC, A., and BARBIZET, J. (1946), "Sur la production de sections encéphaliques temporaires par injections intra-cérébrales de substances anaesthésiques," *Compt. Rend. Soc. Biol.*, **140**, 966.