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### CEPHALIC TETANUS,

by

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#### A CASE-REPORT WITH OBSERVATIONS ON THE DISEASE.

Only two cases of cephalic tetanus were observed among the 2,529 cases of tetanus which occurred on the Western front during the Great War, 1914-1918. No apology, therefore, is necessary for briefly recording a further case of this rare variety of tetanus.

#### CASE HISTORY.

*Ho Shu Kun*, a Chinese boy aged 4, was brought to the out-patient department on May 18th, 1939 by his mother who gave the following history. On April 30th the child fell about five feet down a flight of stairs and struck his head on the ground. He sustained a small head wound on the forehead situated approximately 2.5 cm. above the outer canthus of the right eye and 6 mm. below the hair line as the result of this accident. The wound was small and neither the parents nor the child took much notice of it, nor was a doctor consulted.

On May the 7th the mother noticed that the child had some difficulty in swallowing rice. On May the 9th the child became feverish and salivated profusely and on May the 10th he experienced difficulty in opening the mouth. This difficulty increased and finally became so marked that she brought him to the out-patient department for advice. She stated that there had been no generalised spasm or convulsion during the course of the disease nor had she noticed any change in the child's face.

The mother was not a very intelligent woman and her statements could not be relied on implicitly. She was, however, quite certain that the accident had happened nineteen days ago, and that the sequence of events had been dysphagia, fever, salivation and trismus. She was also quite certain that a week had elapsed

between the accident and the onset of dysphagia. The child was at once admitted to hospital.

On admission he was found to have a small dirty looking wound about 6 mm. long on the right side of the forehead in the position already described. The surface of the wound was crusted over with dry pus. No signs of subjacent or contiguous bony injury were detected.

His temperature was  $101.8^{\circ}$  and his pulse 120 a minute. He lay in the dorsal decubitus wearing an anxious expression and it was noted that the right half of his face was paralysed while the left half appeared to be in a state of continuous spasm. The right palpebral aperture was greater than the left and Bell's sign was evident when the child tried to close his eyes. The pupils were equal and reacted sluggishly to direct light. The mouth was a little drawn over to the left, and the nasolabial fold was better marked on the left side. A slight degree of risus sardonicus was present but there was no over action of frontalis. Trismus was marked and it was impossible to pass a tongue depressor between the upper and lower teeth. There was obvious rigidity of the masseters, posterior cervical muscles and sterno-mastoids on both sides, and a slight degree of head retraction could be made out. Both recti abdominis were rigid and the body was covered with a quicksilver sweat. The erectores spinae were not in spasm, but there was obvious hypertonus in both legs, more marked on the left side. The voice was tetanic in quality.

Physical examination was difficult as the child, though conscious, was too ill to co-operate. The heart showed no abnormalities, a few rhonchi only were heard over both lungs and the belly wall was too rigid to permit of palpation. Examination of the central nervous system revealed the cranial nerve abnormalities just described. The corneal reflexes were present and equal on both sides. The arm jerks were not elicited although the arms seemed to be normal in every way. The abdominal reflexes were absent, but the knee jerks were exaggerated on both sides. The ankle jerks could not be elicited but the plantar responses were extensor on both sides. The fundi were normal but the tympana could not be seen for wax.

The child could swallow fluids given by tube or spoon, but it was noted that swallowing tended to increase the spasm of the left facial musculature and physical examination tended to bring on mild generalised spasms. These generalised spasms consisted of a blend of opisthotonos and left pleurosthotonos and were brought on by such stimuli as uncovering the body, palpating the belly or speaking to the child.

His blood examination showed haemoglobin 70%

R.B.C.'s .....	3,790,000	
W.B.C.'s .....	9,000	
Polymorphonuclears .....		59%
Lymphocytes .....		36%
Large mononuclears .....		3%
Eosinophils .....		2%

No parasites or abnormal cells were detected. His urine showed a trace of acetone and numerous crystals of calcium oxalate and his faeces contained ascaris ova.

A diagnosis of cephalic tetanus was made and in view of the seven day incubation period and the protracted and mild course of the disease it was felt best to leave the wound as much alone as possible. 20,000 units of anti-tetanic serum were injected intramuscularly and the wound itself was dressed with hydrogen peroxide. On the 19th his fever had abated although his condition was unchanged, apart from the fact that trismus had lessened slightly. He was given 20,000 units of anti-tetanic serum subcutaneously all round the wound and 20,000 units intramuscularly. The intravenous route proved to be impracticable. He could swallow fairly well and had only four attacks of generalised spasm through the day. Chloral-hydrate gr. X and sodium bromide gr. XV were ordered every three hours. On the 20th his pulse rose from 90 to 120 and his trismus was slightly more marked. The left limbs were still slightly more rigid than the right. 10,000 units of anti-tetanic serum were infiltrated into the tissues round the wound and 30,000 units were given intramuscularly under ethyl chloride anaesthesia. Swallowing fluids was still possible. He had three attacks of generalised spasm during the day, but was much less restless than on the 19th. The rigidity of the abdominal and neck muscles was definitely less.

On the 21st he was able to open his mouth about 8 mm. His condition was improving and he had no generalised spasm through the day. 10,000 units of antitetanic serum were given subcutaneously round the wound and 30,000 units intramuscularly. The abdominal and nuchal rigidity was steadily lessening and the child was taking fluids well.

On the 22nd he asked for food. His pulse and temperature were now normal and the wound was clean. 12,000 units of antitetanic serum were given intravenously and 18,000 intramuscularly. He had one attack of generalised spasm that evening.

On the 23rd he was definitely better. The facial paresis was quite unchanged on the right side but spasm could no longer be elicited in the left facial musculature though hypertonus still persisted. There was still a trace of rigidity in the abdominal and

cervical muscles but he was by now able to open his mouth 15 mm. 30,000 units of antitetanic serum were given intramuscularly. By the 24th the wound was healed and the child was afebrile and asking for food. 20,000 units of antitetanic serum were given intramuscularly. His chloral was reduced to gr. X twice daily on the 25th and on that day he received his last dose of 10,000 units of antitetanic serum intramuscularly.

From then on convalescence was rapid. The child had a little fever,  $99.6^{\circ}$ , on the 31st and 1st of June, which was probably attributable to ascariasis as santonin caused the expulsion of a large round worm. The trismus became intensified again during this fever, and after desensitisation 10,000 units of antitetanic serum were given intramuscularly for fear the child had relapsed. This fear proved to be groundless and he was discharged recovered on the 19th of July.

In all he was given 240,000 units of antitetanic serum, 188,000 intramuscularly, 40,000 subcutaneously around the wound and 12,000 intravenously.

#### DISCUSSION.

Normally tetanus in man develops with tonic spasm of the masseter muscles followed by spread of the spasm to other muscle groups; that is, as descending tetanus; occasionally the spasm begins in the wounded limb and spreads thence to the whole body giving rise to ascending tetanus; rarely tetanic spasm or paralysis may appear in, and remain limited to, one or more of the head muscles, and this group comprises cephalic tetanus proper. Actually the term cephalic tetanus is used more loosely, and is applied to any case of tetanus following a head wound, whether the spasm and paralysis remain limited to the head muscles or not, and it is in this sense that the term has been applied to the case under discussion.

Although cases of tetanus following head wounds have been noted since 1837 (Humphry) the condition was not described as a separate subvariety of the disease until 1897 when Röse published his classic monograph, *Der Starrkrampf beim Menschen*. In this work he describes two such cases, in one of which death occurred after the spasm had become generalised; the other recovered. He stated that the following triad of symptoms was characteristic of the condition: a wound in the area of supply of one of the cranial nerves, facial paralysis usually occurring on the side of the wound, and tetanic spasm affecting the facial muscles, masseters, muscles of the back of the neck and the pharyngeal and oesophageal musculature. Since that date the terms cephalic tetanus and Kopftetanus have come into general use, and Continental writers frequently call these cases Tetanus, type Röse. It is interesting to recall that the case of tetanus which afforded

Carle and Rattone material for their early researches into the bacteriology of the disease (Carle, Rattone 1884) belongs to this group. Their patient inadvertently infected himself by scratching an acne pustule on his chin, and died of cephalic tetanus. By 1911 Brown was able to collect 94 cases of the condition, a figure which shows clearly the comparative rarity of the condition.

Courtois and Suffit-Giroux in their monograph *Les Formes anormales du Tétanos* (1926) recognise four clinical types of cephalic tetanus:—

- (i) A type without paralysis.
- (ii) A type with facial paralysis.
- (iii) A type with oculomotor paralysis.
- (iv) A type with hypoglossal paralysis.

The onset of the disease is insidious, its progress slow, its course treacherous. The wound which gives entry to the bacillus is usually in the territory of the facial nerve and most commonly in the upper part of the face. The incubation period is about eight days, but may range from two to twenty-four.

The premonitory symptoms are sleeplessness, delirium, dreams, and headache. Occasionally the patient complains of giddiness, and his expression is usually anxious. A rare early symptom of the condition is difficulty in micturition, as is sometimes the case in meningococcal meningitis. Over-emotional reactions are by no means uncommon at onset, (Jenkins 1929), and a state of restlessness and terror resembling that seen in rabies sometimes supervenes during the course of the disease (Fletcher 1927).

Trismus is as a rule the presenting symptom and Brown in his review of the literature in 1911 stated that this was so in 84% of the cases. He also found that the mortality was higher if paralysis preceded trismus, being 64.2% as compared with 53.2% for cephalic tetanus as a whole. Facial paralysis, usually on the side of the wound appears shortly after the onset of trismus, and the facial musculature of one or both sides of the face may develop continuous spasm after paralysis has appeared. Dysphonia and difficulty in chewing are, of course, constant findings, and if the spasm spreads to the pharyngeal and oesophageal musculature the resulting spasm may lead to a veritable hydrophobia, a fact which has given rise to the name hydrophobic tetanus. Cervical rigidity and opisthotonos are common if the spasm spreads to the pharynx and ophthalmoplegias of various types and diplopia may occur if the wound is close to the eye. Laryngeal spasm and dyspnoea are by no means uncommon, and these cases not infrequently die in asphyxial attacks. If the wound is in the midline the resulting facial palsy may be bilateral but such cases are exceedingly rare. The course of the disease may or may not be afebrile. Some

observers have stated that it is an afebrile condition, an opinion which is undoubtedly wrong. Death in hyperpyrexia has been recorded in cephalic tetanus (Slimon 1932), and both the cases seen by the writer have shown mild fever.

The facial paresis or palsy may persist long after the patient has recovered. In this case the child still showed an obvious right sided facial weakness when discharged from hospital nine weeks after the accident, by which time all trace of trismus had disappeared. In another case which was under the writer's observation a left external rectus palsy took three months to clear up and facial weakness persisted for six months. In this case a persistence of tachycardia and of exaggeration of the tendon reflexes was also noted.

It can readily be realised that the most varied clinical pictures are seen in this condition, and unless it be borne in mind the diagnosis is only too readily overlooked. Practically any combination of cranial nerve palsies may be seen, the trismus may be unilateral, and the facial palsy may be accompanied by spasm. If the axon-carriage hypothesis of toxin diffusion is correct, then presumably the toxin elaborated in the wound spreads, to begin with, along the motor nerves, and later diffuses through the brain stem via the bulbar synapses. If the spasm becomes generalised one is justified in assuming that diffusion has occurred through the cerebrospinal fluid, for the toxin has been recovered from the cerebrospinal fluid of animals suffering from the disease. The early deaths which are occasionally seen in cephalic tetanus are probably due to complete and rapid neuronofixation of the bulbar centres.

The prognosis of the condition must always be regarded as grave. It is generally considered that the proximity of the wound to the higher centres makes the incubation period a short one, but this is not necessarily the case. The rule applies, in this as in other varieties of tetanus, that an incubation period of six days or less spells death whatever line of treatment be adopted. The prognosis is also impaired by the fact that the disease may be extremely difficult to recognise in the early stages and there is little doubt that some cases which die early escape diagnosis. To avoid missing cases of the disease it is essential to consider the diagnosis in all patients who develop facial palsy after wounds of the head, eye, ear, or nasal mucosa. Numerous cases of otogenous and ocular tetanus have been recorded, and in one such case (Petzal, 1930) cephalic tetanus developed in a man who had had a left radical mastoid operation performed seventeen years earlier. Shore (1931) and Brown (1932) have each recorded tetanus following the impaction of a foreign body in the nostril, the latter's case being one of classical cephalic tetanus which ended in death. Hyman's case (1935) of cephalic tetanus following tonsillectomy appears to be unique in the literature.

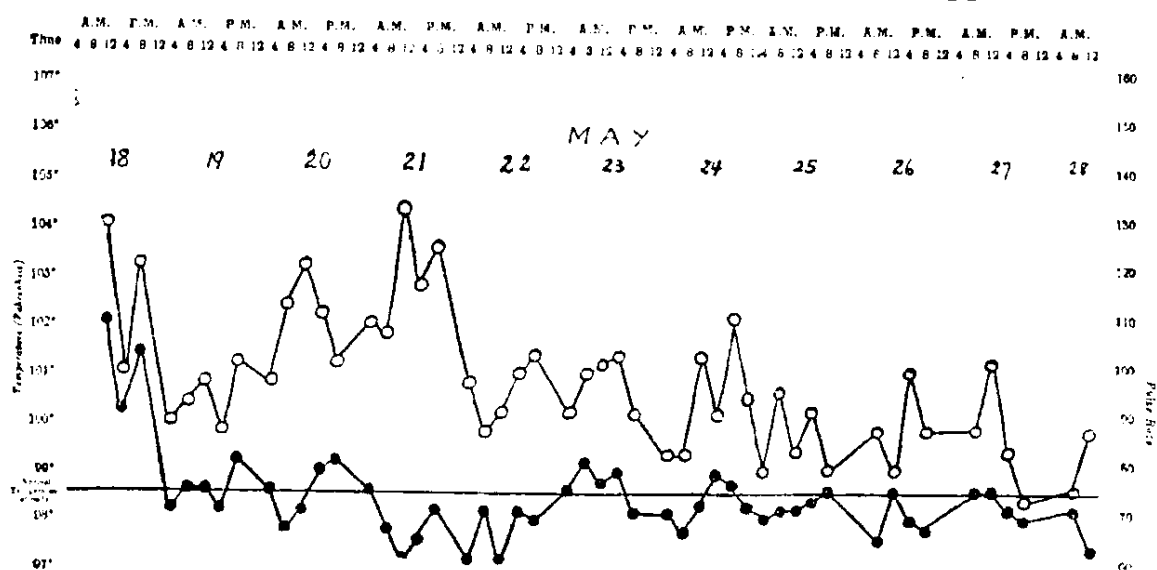
In treating cephalic tetanus, it is necessary to remember that by the time obvious symptoms of tetanus have appeared the tetanus toxin has combined with nerve cells, is circulating in the blood stream and the lymphatics and is possibly still being elaborated in the wound. Once the toxin has combined with nerve cells it is impossible to annul the effects of this neuronofixation by treatment. The fact that cases of tetanus do occasionally recover spontaneously shows that the nerve cells are not irreparably damaged, and it is thought that they destroy the toxin by a process of slow oxidation. Treatment must therefore aim at two things: first, to prevent the elaboration of further toxin or to neutralise it if it be elaborated; second, to conserve the strength of the patient by eliminating generalised spasm as far as possible thereby enabling him to live long enough to oxidise his dose of toxin.

While the validity of these two propositions can scarcely be contested, opinion is sharply divided as to the best method of treating the wound. If frank pus be present the wound should be opened up and thoroughly drained, but generally speaking the less done the better. The use of antiseptic agents such as iodine and hydrogen peroxide which are directly destructive to the toxin is rational, and the injection of antitetanic serum and oxygen into the tissues around the wound is also indicated. Débridement or excision of the wound should never be attempted until after the administration of antitoxic serum. Paterson (1930) and Cole (1932) have shown in the last few years that the best way of administering antitetanic serum is to give a massive dose intravenously as soon as the diagnosis is made. Cole advocates an intravenous dose of 100,000 to 200,000 units intravenously as it has been shown by serum titration that ten days after such a dose the blood stream still contains 1-2 units of antitoxin per cc. If this method be adopted the necessity for daily doses of serum is obviated. The consensus of opinion to-day seems to be that serum given by the intrathecal route does not give the results which were foreshadowed by Sherrington's experimental work, (Sherrington 1917), although Yodh's results afford some support to his claim that the intrathecal is the route of choice for the administration of antitetanic serum (Yodh, 1932).

Appropriate methods of sedation must be employed to conserve the patient's strength and to eliminate generalised spasm, and the basal anaesthetics afford the best means of compassing these ends, coupled if need be with sedatives such as chloral and bromides by mouth.

In the case under discussion the incubation period was seven to eight days. The first symptoms appear to have been dysphagia and salivation, followed after three days by trismus. When the right sided facial paralysis first appeared is uncertain but it had probably been present for some time before the child came into hospital. Both the length of the incubation period and the slowness with which the disease became generalised betokened a favourable issue. Generalised spasms

were not noted before admission to hospital nineteen days after the accident, and this must be interpreted as meaning that it was only at this stage of the disease that tetano-toxin was becoming diffused through the cerebrospinal fluid. Such a slow spread is not unknown in this condition; in Petzal's case of otogenic tetanus facial paresis of slow onset persisted for a fortnight before trismus appeared.



The above chart shows how the child's temperature abated after admission to hospital. Hollow circles show pulse rate, solid circles temperature.

This little boy showed continuous spasm of the facial muscles of both sides, together with right sided facial palsy, spasm of the masseters, the sternomastoids, trapezii and posterior cervical muscles and of the recti abdominis. The hypertonus noted in the legs was not continuous, nor was there any evidence to suggest involvement of the splanchnic nerves.

Treatment on the lines laid down above seemed to be of value. The intravenous route would have been used throughout for serum had it been practicable, but the child's veins were too small. The generalised spasms were never frequent enough or severe enough to need more than chloral hydrate and bromide to control them.

#### SUMMARY.

1. A case of cephalic tetanus in a child of 4 is described.
2. The child recovered after the administration of 240,000 units of antitetanic serum by the intramuscular, subcutaneous and intravenous routes.
3. A brief abstract of the available literature is given.

#### ACKNOWLEDGMENTS.

I have to thank my house-physician Dr. Foo for his interest in this case, and also Dr. K. D. Ling for his attempts to photograph the child.



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## SPINAL ANAESTHESIA—A SIMPLE TECHNIQUE WITH A BRIEF ANALYSIS OF 500 ADMINISTRATIONS.

by

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### INTRODUCTION.

Since spinal anaesthesia was first attempted by Bier in 1896 and brought into common use by Barker in 1906, this method has found a definite place in the anaesthetist's armamentarium. There are still, however, many practitioners, and even a few anaesthetists, who, though they consider a "spinal" indicated in certain cases, hesitate, from lack of experience, to embark upon it.

The object of this paper is to put forward a relatively simple technique for the administration of spinal anaesthesia, and, by the analysis of a series of 500 cases, show the uniform results which may be expected from it. No originality is claimed for the technique described. On the contrary, we hasten to acknowledge our indebtedness to all the anaesthetists from whose writings we have gleaned points of detail which have become incorporated as our technique evolved, especially to Dr. Li Shu Fan (1927) and Dr. G. H. Thomas for the basic idea of using a "home-made" solution of novocaine.

### PREPARATION OF THE PATIENT.

There is a certain degree of psychic trauma involved in all visits to an operating theatre, and especially in those cases in which the patient remains conscious throughout the operation. It is therefore desirable that patients who are operated upon under spinal anaesthesia should be drowsy and not fully conscious of what is going on around them. For this purpose an injection of morphia gr.  $\frac{1}{4}$  or gr.  $\frac{1}{6}$  with hyoscine gr.  $\frac{1}{150}$  is given three quarters of an hour before operation to all adult patients, unless specifically contraindicated as in the case of Caesarean section, obstetrical manipulations, or instrumental delivery.

### PREPARATION OF THE SOLUTION.

Powders are prepared, each containing novocaine grs. 3 and caffeine gr. 1. The caffeine is by no means necessary, as a short series of cases without its inclusion shows entirely comparable results, but it is beneficial, as it acts as a mild stimulant, and increases the specific gravity of the resulting solution. These powders will keep

almost indefinitely if they remain in an airtight tin. One such powder, dissolved in 3 c.c. of water gives a 6% solution of novocaine with a specific gravity of approximately 1.016. As the specific gravity of cerebrospinal fluid varies between 1.004 and 1.007, this solution is definitely hyperbaric. Experience has shown that it "fixes" in ten minutes or less, after which time no change in the patient's position further affects the distribution of anaesthesia.

The solution is prepared in a test tube and sterilised by boiling. As the potency of all novocaine solutions is impaired or abolished by the presence of even the slightest traces of alkali, it is most important that distilled water be used and that the test tube in which the solution is boiled be chemically, as well as surgically, clean. Similarly all syringes and needles used should be boiled in plain water and carefully washed through before use in sterilised distilled water.

#### ADMINISTRATION.

The instruments required are :—

- i. a lumbar puncture needle, with stylet, preferably of a bore not greater than 1 mm.
- ii. a 5 c.c. syringe.
- iii. a 2 c.c. syringe with hypodermic needle.

The site of puncture having been selected, the skin is anaesthetised with a 2% solution of novocaine.

All spinal anaesthetics produce, by paralysis of the sympathetic and consequent vaso-dilatation, a fall of blood-pressure, the amount of the fall depending on the number of segments paralysed by the anaesthetic. This can be counteracted, to a large extent, by the preliminary administration of a vaso-constrictor drug, that most commonly used being ephedrine. The ephedrine, in doses of gr.  $\frac{1}{2}$  to gr. 1, can be conveniently given mixed with the local anaesthetic solution used to anaesthetise the tissues at the site of puncture.

Needless to say, the strictest aseptic technique should be observed in performing the puncture.

#### DOSAGE AND CONTROL.

For the purposes of description the areas usually affected in spinal anaesthesia may be divided from below upwards into four zones :—

1. The "saddle area," that is, the area to be anaesthetised for operations on the anus, perineum, and vulva, and for vaginal and transurethral operations.
2. The legs and inguinal regions.
3. The lower abdomen, up to the umbilicus.

4. The upper abdomen, up to the diaphragm.

This technique is not suitable for application to operations above the diaphragm.

The factors influencing the area of anaesthesia produced by the injection are:—

1. Dosage.
2. Gravity; the position of the patient during and immediately after injection.
3. The lumbar interspace selected.
4. The amount of mixing with C.S.F. and the rate of injection.

The following table shows the method by which these factors are employed to produce anaesthesia of the desired area:—

	<i>"Saddle"</i> <i>area</i>	<i>Inguinal</i> <i>region</i> <i>and legs</i>	<i>Lower</i> <i>abdomen</i>	<i>Upper</i> <i>abdomen</i>
Position for injection .....	Sitting	Lateral Table flat	Lateral 5° Trendelenberg	Lateral 10° Trendelenberg
Interspace used for puncture ...	L 4-5	i. 3-4	L 3-4	L 2-3
Dose in c.c. of 6% solution ...	1-1½ c.c.	2 c.c.	2½ c.c.	3 c.c.
Admixture of C.S.F. ....	None	None	½ c.c.	1 c.c.
Rate of injection in seconds per 1 c.c. ....	10	6	4	3
Position after injection .....	Flat	Flat	5° Trendelenberg	10° Trendelenberg

The doses indicated in the above table are those administered to adults of average stature. The doses for children and short adults should be proportionately less, and the maximum may be slightly exceeded in very tall men. Anaesthesia develops rapidly, and is usually complete in 2-5 minutes. By the time the operation area has been prepared and the towels placed in position, all is ready for the surgeon to begin.

#### SUPERVISION OF THE PATIENT DURING OPERATION.

As soon as the administration is complete, the patient's eyes are covered, and cotton wool may be placed in the ears, though this latter proceeding annoys some patients more than the sounds of the operating theatre.

After anaesthesia has fully developed and the solution is "fixed" the patient is always kept in at least a slight degree of Trendelenberg position. This maintains an adequate blood supply to the medullary centres during the period of lowered blood pressure. It is perfectly

safe to assume the high Trendelenberg position when ten minutes have elapsed after the administration of the anaesthetic.

Serial blood-pressure readings are taken every five minutes in some cases, but as a rule it is found that the value of the information derived from this proceeding is more than counterbalanced by the frequent and repeated awakening of the patient and the annoyance it causes to the surgeon and his assistants. A careful watch is kept upon the pulse, taken at the superficial temporal or external maxillary artery, and it is found that as long as the pulse is clearly palpable in one of these vessels the blood pressure is not so low as to cause any anxiety.

#### POST-OPERATIVE TREATMENT.

Upon return to bed all patients have the foot of the bed raised. This greatly reduces the incidence of "spinal headache" and avoids the possibility of collapse from cerebral anaemia due to sitting up suddenly when the blood pressure is still low. Sometimes the necessity for the maintenance of the head-down position conflicts with the wishes of the surgeon, who wants his patient to assume Fowler's position as soon as possible. In these cases a compromise has been arrived at and the head-down position is maintained for a minimum of four hours instead of the optimum twelve hours.

#### CONTRA-INDICATIONS.

The following groups of patients are regarded as unsuitable subjects for spinal anaesthesia:—

- i. Patients who have abnormally low blood pressure, either from loss of fluid, haemorrhage, or other cause;
- ii. unduly nervous or apprehensive patients, unless premedication is heavy or a light general anaesthesia is maintained throughout;
- iii. patients who have a disease of the central nervous system or lumbar spine;
- iv. patients who have sepsis at or near the proposed site of lumbar puncture.

The following is a brief analysis of a series of 500 consecutive cases anaesthetised by the method outlined above.

Of the 500 patients anaesthetised by this method 206 were males and 294 females. The age of the youngest was five months and of the oldest 72 years.

The distribution of operation sites was as follows:—

i. "Saddle" area .....	162
ii. Inguinal region and legs .....	72
iii. Lower abdomen .....	220
iv. Upper abdomen .....	46

## DURATION.

The longest duration of anaesthesia recorded was two hours and five minutes, and the shortest three quarters of an hour. The average duration was found to be:—

“Saddle” area .....	1 3/4 hours
Lower abdomen .....	1 1/4-1 1/2 hours
Upper abdomen .....	1 - 1 1/4 hours

Anaesthesia was entirely satisfactory from the points of view of both surgeon and patient in 459 cases, 91.4%.

## FAILURES.

The cases in which the anaesthesia has been unsatisfactory may be divided into two groups: (a) those in which supplementary anaesthesia was necessary throughout; (b) those in which the operation was not complete when anaesthesia began to “wear off,” necessitating the administration of supplementary general anaesthesia.

(a) In 6 cases, 1.2% anaesthesia was insufficient for the operation to be started. In one of these anaesthesia was good but there was no paralysis; in the second the converse was the case, and in the other four the injection appeared to have no effect at all. It was subsequently discovered in one case that the test tube in which the solution was boiled had previously held sodium citrate. No explanation of the failure was found in the other five cases, but we suggest the following as possible causes:

- i. the presence of alkali in the solution as was proved in one case;
- ii. the possibility that the bevel of the needle was only partly in the theca, and that while C.S.F. dripped from the needle when the stylet was withdrawn, the greater portion of the solution, when injected, remained extra-dural. It has been suggested, in explanation of failures of spinal anaesthesia, that there is, in some patients, a mysterious immunity to novocaine. It is worthy of note that all the cases in which there was complete failure of anaesthesia occurred early in this series. This seems to suggest that such failures are in fact due to some error in technique on the part of the administrator rather than to any unusual reaction on the part of the patient.

(b) Supplementary anaesthesia had to be administered, through failure of duration of the spinal in 37 cases, 7.4%. The average duration of this supplementary anaesthesia was 33 minutes. In cases in which only a short time and light anaesthesia were necessary for completion of the operation, evipan or nitrous oxide-oxygen were used, but when a considerable amount remained to be done full ether anaesthesia was induced.

In ten cases, in which premedication had been omitted or had proved inadequate and in which the patients were of a particularly nervous disposition, light general anaesthesia was maintained throughout, although the spinal was satisfactory. For this purpose repeated small doses of evipan intravenously were tried in three cases, but the combined action of the spinal and the evipan caused a considerable fall in blood pressure and nitrous oxide-oxygen was used in the remaining cases.

#### COMPLICATIONS.

The only unpleasant complication occurring during operation which has been observed is nausea. This has varied from the mildest feeling of sickness to actual vomiting. It has usually been associated with traction on the stomach or mesentery, and in those cases stops immediately the surgeon ceases the particular manipulation which involves such traction.

There have been some cases, however, in which nausea has occurred quite unassociated with any traction on viscera. It was in all cases transient, persisting at the most for ten minutes even if untreated. Increasing the head-down tilt of the table and encouraging deep breathing, with the administration of oxygen were found rapidly to relieve this distressing condition.

#### SEQUELAE.

Two unpleasant after-effects which have been noted are headache and retention of urine.

(a) *Headache*.—It is somewhat difficult to assess the incidence of spinal headache. About 5% of the patients in this series complained of it spontaneously, and about a further 5% admitted having headaches of varying severity when questioned. The incidence is far higher in those groups of patients:

- (i) who sit up relatively soon after operation, and
  - (ii) upon whom lumbar puncture is performed with a large needle.
- The milder cases tend to clear up in 24 hours, and aspirin and barbitone relieve the symptoms. The severer cases are usually relieved by the rectal administration of 40% magnesium sulphate.

(b) *Retention of Urine*.—This has occurred in a small number of male patients. Catheterisation has never been necessary in otherwise untreated cases for more than three days. The normal function is restored in the majority of cases by the administration of doryl or esmodil. This complication has never been observed in female patients.

No cases of paralysis has been observed in the series, nor has there been any death attributable to the anaesthesia.

## CONCLUSIONS.

The method has the advantages of being simple, reliable, and, as long as it is used only in suitable cases, safe. It is also very inexpensive, an important consideration in certain circumstances. It has, however, as can clearly be seen from the foregoing figures, one great disadvantage, the limitation of duration. The duration of anaesthesia is perfectly adequate for the vast majority of surgical procedures, but there are from time to time cases which take longer than was anticipated, and in these cases the ultimate necessity for administering a general anaesthetic nullifies to a large extent the advantages of the spinal.

With the idea of overcoming this disadvantage and producing a prolonged spinal action, many other techniques were tried, most of which showed no improvement on that described. One drug, however, Pantocain L (Bayer) gave results which seemed to merit a more extensive trial, and it has now been used by one of us (D.S.) in 65 cases. Although this is too small a series on which to base any definite conclusions, the results are so promising that we are prompted to add a short note on its use.

*Pantocain L (Bayer).*—Ampoules are supplied, containing 30 milligrammes of Pantocain in 3.75 c.c. The solution has a specific gravity of less than 1.002, and is consequently always lighter than C.S.F. The injection is therefore always performed in the lateral position, and the dose varies from 1 c.c. for the "saddle" area up to the whole 3.75 c.c. for the whole abdomen, as shown in the following table of the dosage and position used.

	<i>Dosage</i>	<i>Site of puncture</i>	<i>Amount of C.S.F. admixed</i>	<i>Position</i>
"Saddle" area .....	1 c.c.	L 4-5	1 c.c.	10° Trendelenberg
Legs & inguinal regions	2 c.c.	L 3-4	2 c.c.	5° " "
Lower abdomen .....	2½-3 c.c.	L 2-3	2½-3 c.c.	Flat to 5° Trendelenberg
Upper abdomen .....	3-3½ c.c.	L 2-3	3 c.c.	5° "head up"

In anaesthesia of the abdomen the progress of anaesthesia is repeatedly tested and when the upper level of the analgesic zone has reached the necessary height, a 10° Trendelenberg position is immediately assumed, and maintained throughout the operation. The technique used is (in all other respects) the same as that advised by the makers, with the exception that fractional injection is not practised.

The resulting anaesthesia has been satisfactory in all cases except one, and on that occasion it was unexpectedly found necessary considerably to lengthen the incision upwards beyond the zone of anaesthesia, which had already been established.



On no occasion has failure of duration of the spinal necessitated the administration of a general anaesthetic. The shortest duration recorded has been one hour and forty minutes, and the longest actual operating time 3 hours and 35 minutes. The average duration has been found to be somewhat in excess of 2½ hours, a time adequate for almost all surgical procedures, and considerably in excess of that obtained when novocain was used. It must be added, however, that Pantocain L has, relative to novocain, two disadvantages:—

- i. its margin of safety is much less, as its spread up the theca is more rapid, and injection in a sitting or high head-up position quickly endangers the medullary centres;
- ii. it is relatively very expensive and, being a proprietary preparation, is not everywhere readily procurable.

#### SUMMARY.

1. A technique for the administration of spinal anaesthesia, using a freshly prepared 6% solution of Novocain, is described.
2. Records of 500 administrations are briefly analysed, showing that the method is satisfactory in all respects, except that the limited duration of anaesthesia is sometimes insufficient for prolonged operations.
3. A short note on Pantocain L (Bayer) is appended, and the promising results obtained in a short series of administrations recorded.

In conclusion we wish to express our thanks to all the surgeons to whose patients these spinal anaesthetics have been administered for their co-operation and assistance.

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## VITAMIN C DEFICIENCY ESTIMATED BY THE INTRADERMAL TEST,

By

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### INTRODUCTION.

Rotter of Budapest noted in 1937 that when small amounts of the dye 2:6 dichlorophenol-indophenol were injected into the soles of guinea pigs decolorization occurred much more rapidly in healthy than in scorbutic animals. He further found that the disappearance of the dye was not due simply to resorption because methylene blue injected in the same way remained unchanged.

He therefore drew the conclusion that the disappearance of the dye was due to reduction by ascorbic acid, and suggested that the phenomenon might be employed as a skin test for estimating the ascorbic acid content of the tissues, because he had found that human beings on vitamin-C-rich and vitamin-C-free diets behaved like guinea pigs towards this dye. He was also able to show that the time needed for decolorization was an index of the degree of saturation of the patient with vitamin C. In "saturated" patients the dye disappeared in 5 minutes or less, in "normal" cases in five to ten minutes and in "deficient" cases more than ten minutes were needed for decolorization.

### FIELD OF ENQUIRY.

We have employed Rotter's method, with slight modifications, in the investigation of 152 people in Hong Kong. This group was composed mainly of Chinese hospital patients, but also comprises a group of 20 medical students. The patients were chosen at random and no attempt was made to select diseases in which deficiency of vitamin C might play an aetiological part. 97 of them had had no dietetic or other treatment when they were skin tested, 35 were known to have been taking a diet rich in vitamin C for some days before the test was made, and the students were presumed to obtain some vitamin C daily in their diet.

### METHOD AND TECHNIQUE.

We used the ordinary intradermal technique and made up the dye solution as follows. As we were dealing for the most part with

slightly pigmented skins it was thought better to double the dye content of the solution, and we therefore employed a solution containing 4 mgms. of the solid 2:6 dichlorophenol-indophenol in 4.9 c.c. of distilled water. Apparently Rotter in his original investigations used a solution containing only 2 mgms. of the dye in 4.9 c.c. of distilled water (Portnoy, Wilkinson, 1938).

This solution was bacteriologically sterile and no further precautions regarding sterility were taken. The solution was titrated against a solution of ascorbic acid, freshly standardised against N/100 iodine solution. It is necessary to prepare the dye solution afresh every three to four weeks. In this climate it begins to deteriorate after three weeks even though kept dark in a Frigidaire.

The skin of the forearm was used as the site for injection, and two intradermal injections of 0.01 c.c. of the above dye solution were made. These injections produce a wheal about 2-3 mm. in diameter. The injection times and the times of complete disappearance of the dye in the two wheals were noted, and the average decolourization time was taken.

No estimations were made of the ascorbic acid content of the blood nor were any urinary vitamin C excretion tests carried out.

#### RESULTS.

Portnoy and Wilkinson in 1938 found in their series of 68 cases examined from the dietetic point of view that 10 minutes was the upper limit when using the dye in half our concentration, and we have therefore assumed that a decolourization time of 20 minutes would be the top normal limit for the dye used in this concentration. The parenteral administration of vitamin C or the giving of orange juice by mouth for some days before performing the test never brought the decolourization time below 5 minutes and we have therefore concluded that vitamin C saturation point, in this series at any rate, is represented by a decolourization time of from 5—8 minutes. For example, one of the normals who received 50 mgms. of ascorbic acid (1 c.c. of Cantan) hypodermically each day for four days before the test had a decolourization time of 8 mins. 30 secs.; a patient whose decolourization time on admission was 14 mins. gave a figure of 6 mins. after receiving  $\frac{1}{2}$  an orange daily for forty days.

The majority of the patients tested belonged to the Chinese lower and middle classes, and the average diet of these groups of people is as follows:—

## CHINESE DIET

*(Taken by low class people)*

Two principal meals are taken daily; occasionally cakes and congee are taken between meals

Total daily food value of two average meals.

	Weights	Protein	Fat	Carbohydrate	VITAMIN							
					A	B	C	D	E	PP		
1. Rice .....	19 oz.	51.70 gm.	4.86 gm.	416.00 gm.	+	+	+	+				
2. Vegetables.	12 oz.	12.09 "	3.39 "	28.16 "	+	+	+	±	to	+		
3. Bean curd.	2 oz.	5.40 "	1.80 "	0.78 "	+	+	+					
4. Potato .....	1 oz.	0.35 "	0.08 "	5.70 "	+	+	+					
5. Beef .....	½ oz.	2.48 "	2.84 "	0.56 "	+	±	+		0	to	+	
6. Pork .....	½ oz.	1.32 "	8.38 "	0.14 "	0	+	+		0	to	+	
7. Fish .....	½ oz.	2.55 "	0.22 "	0.20 "	±					+	+	+
8. Peanut Oil.	1 oz.		28.35 "									+
Total :—		75.89 gm.	49.92 gm.	451.36 gm.								

Calorie values :—

312

465

1823

Total calories :—2,600

CHINESE DIET

(Taken by middle class people)

Total daily food value of two principal meals.

	Weights	Protein	Fat	Carbohydrate	VITAMIN							
					A	B	C	D	E	PP		
1. Rice .....	16 oz.	43.50 gm.	4.09 gm.	351.00 gm.	+	+	+	+				
2. Vegetables.	10 oz.	10.07 "	2.82 "	24.30 "	+	+	+	+				
3. Bean curd.	3 oz.	8.10 "	2.70 "	1.17 "	+	+	+	+				
4. Potato .....	2 oz.	0.70 "	0.16 "	11.40 "	+	+	+	+				
5. Beef .....	4 oz.	22.00 "	22.54 "	4.64 "	+	±	0 to +	± to +	+	+	+	+
6. Pork .....	4 oz.	10.76 "	67.60 "	1.08 "	0 to +	+	0 to +	± to +	+	+	+	+
7. Fish .....	4 oz.	20.44 "	1.80 "	0.18 "	±	+	0 to +	± to +	+	+	+	+
8. Peanut Oil.	2 oz.		56.70 "									
Total:—		115.57 gm.	158.41 gm.	393.77 gm.								

Calorie values:— 447 1475 1613

Total calories:— 3565

TIFFIN

1. Rice .....	1 oz.	1.69 gm.	0.24 gm.	22.30 gm.								
2. Beef .....	2 oz.	11.00 "	11.27 "	2.32 "	+	±	0 to +	± to +	+			++
Total:—		12.69 gm.	11.51 gm.	24.62 gm.								

Calorie values:— 52 113 103

Total calories:— 268

Total calories for 1 day=3,833

The diet which all these patients received on admission to hospital is shown in the following tables, and is the standard hospital diet. The orange and lemon juice which many of these patients were given between their first and second tests were added to this standard diet, which is dependent for its vitamin C content on the vegetables given at breakfast and supper.

In most of the cases investigated it was found that several weeks on the standard hospital diet did little or nothing to reduce an abnormally long decolourization time, and one must therefore assume that some, at any rate, of the vitamin C content of these vegetables is lost in preparation.

All the vegetables taken by the Chinese are cooked in some way or other and many are taken in the form of vegetable soups. This doubtless results in the loss of some vitamin C but nevertheless 60% of the unselected patients in Group A showed decolourization times within normal limits.

For purposes of rough classification the 152 individuals tested have been grouped as follows:—

*Group A* Patients who were tested directly after admission.

*Group B* Patients who received some foods rich in vitamin C for some days before being tested.

*Group C* Students who were presumably living on a normal and balanced diet.

In Group A (see diagram 1), consisting of 97 people, 63.9% decolourized the dye completely in or within 20 minutes of injection, and 36.1% took longer than 20 minutes to decolourize the dye.

In Group B (see diagram 2), consisting of 35 people, 60% decolourized the dye within 20 minutes, while in Group C (see diagram 3), consisting of 20 medical students, reduction was effected within 20 minutes in 70%. In a word, the diet of the average Chinese of the middle and lower classes is rich enough in vitamin C to keep 60% of the people living on it clinically saturated. The saturation figure for the group of students was slightly higher than for the outpatient class, as was to be expected.

#### DISCUSSION.

Two sub-groups chosen from A and B were subjected to statistical investigation, the first consisting of 35 people, the second of 22. Both these sub-groups were skin tested on admission, and were retested some weeks later, the first having been treated in the meanwhile with orange juice or vitamin C preparations, the second having been kept on hospital diet.

HOSPITAL DIET.  
Full diet for Chinese.  
Breakfast—7.30 a.m.

	Weights	Protein	Fat	Carbohydrate	VITAMIN						
					A	B	C	D	E	PP	
1. Fresh fish or 1 salt egg.	2 oz.	10.22 gm.	0.90 gm.	0.09 gm.							
2. Ground nut oil	½ oz.		14.18 "								
3. Fresh pork	2 oz.	5.38 "	33.80 "	0.54 "			0 to +			+	
4. Salt egg or water chestnuts.	1	14.02 "	16.60 "	4.12 "	+	++				+	++
5. Rice	12 oz.	22.20 "	1.61 "	266.00 "							
6. Fresh vegetables	4 oz.	4.03 "	1.13 "	9.72 "	+	+++	+	+++	+	+	
7. Tea (Chinese)	¼ oz.										
Total:—		55.85 gm.	66.22 gm.	280.47 gm.							

Calorie values:—

228

634

1134

Calorie values:—

1996

Tiffin (Beef congee)—12.30 p.m.

	Weights	Protein	Fat	Carbohydrate	VITAMIN						
					A	B	C	D	E	PP	
1. Rice .....	1 oz.	1.69 gm.	0.24 gm.	22.30 gm.							
2. Beef .....	2 oz.	11.00 "	11.27 "	2.32 "	+	±	0 to +	± to +	+	+	++
Total:—		12.69 gm.	11.51 gm.	24.62 gm.							

Caloric values:—

113

103

Total calories:—

52

268

Supper—4 p.m.

1. Rice .....	12 oz.	22.20 gm.	1.61 gm.	266.00 gm.	+++	+++	+++				
2. Vegetables, fresh .....	4 oz.	4.03 "	1.13 "	9.72 "	+	+	+				
3. Salt egg .....	1	14.02 "	16.60 "	4.12 "	+	+	+				
4. Pork .....	2 oz.	5.38 "	33.80 "	0.54 "	0 to +	+	0 to +		+		++
Acidulated vegetables .....	4 oz.	5.37 "	1.20 "	19.10 "							
or fresh fish with ½ oz. ground nut oil.											
Total:—		51.00 gm.	54.34 gm.	299.48 gm.							

Caloric values:—

507

1228

Total calories:—

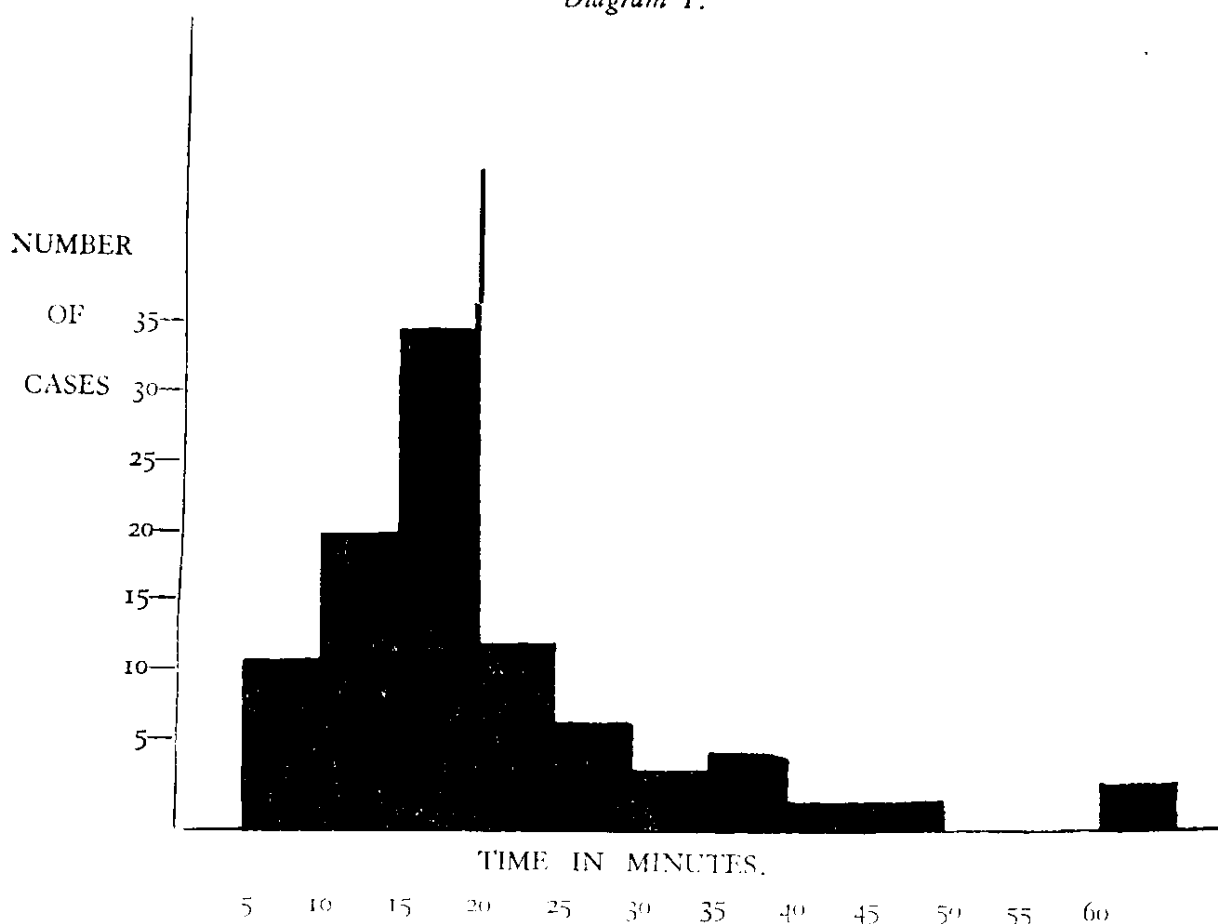
209

1944

Total calories for 1 day = 4208



Diagram 1.



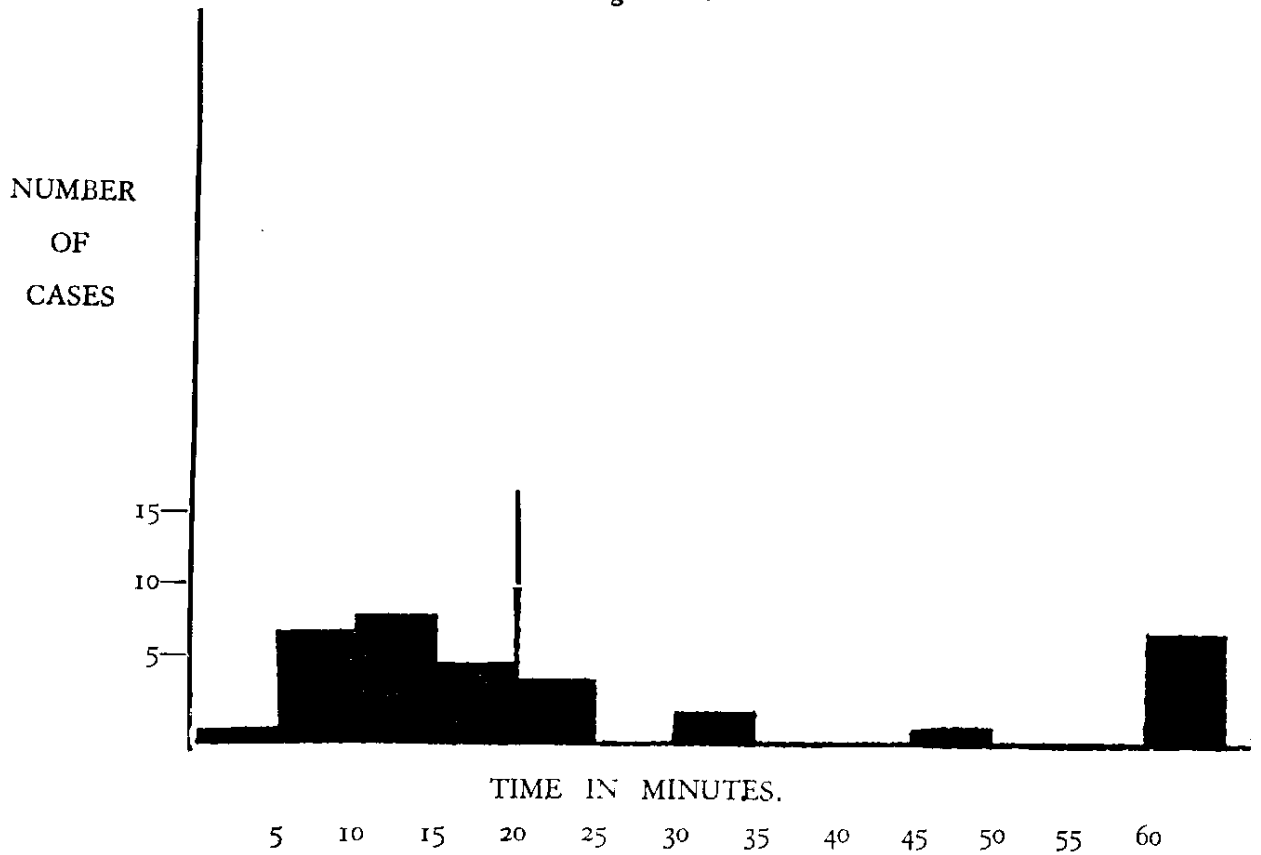
Bar diagram to show how 62 out of 97 patients tested on admission decolorized the dye in or within 20 minutes.

The average decolorization time of the first sub-group on admission was  $23.94 \pm 2.00$  minutes, and that of the second was  $20.00 \pm 2.92$  minutes. The difference between the mean decolorization times in these two groups was  $3.94 \pm 3.54$  minutes which is not significant, and therefore these two groups may be taken together as sample cases of the same big group for the purpose of this investigation. In a word, the patients who were treated with vitamin C were not significantly different, to start with, from those who received only hospital diet.

After treatment with vitamin C the mean decolorization time of the group comprising 35 patients was reduced to  $12.2 \pm 0.70$  minutes; that is to say, they suffered a significant drop of  $11.7 \pm 2.12$  minutes. On the other hand, the group of 22 cases kept solely on hospital diet dropped to an average decolorization time of  $18.82 \pm 2.97$  minutes, a fall of  $1.2 \pm 4.17$  minutes which is not significant. The mean difference between the reduction times of the patients treated with vitamin C and those kept on hospital diet was  $6.6 \pm 3.04$  minutes, a difference which is significant.

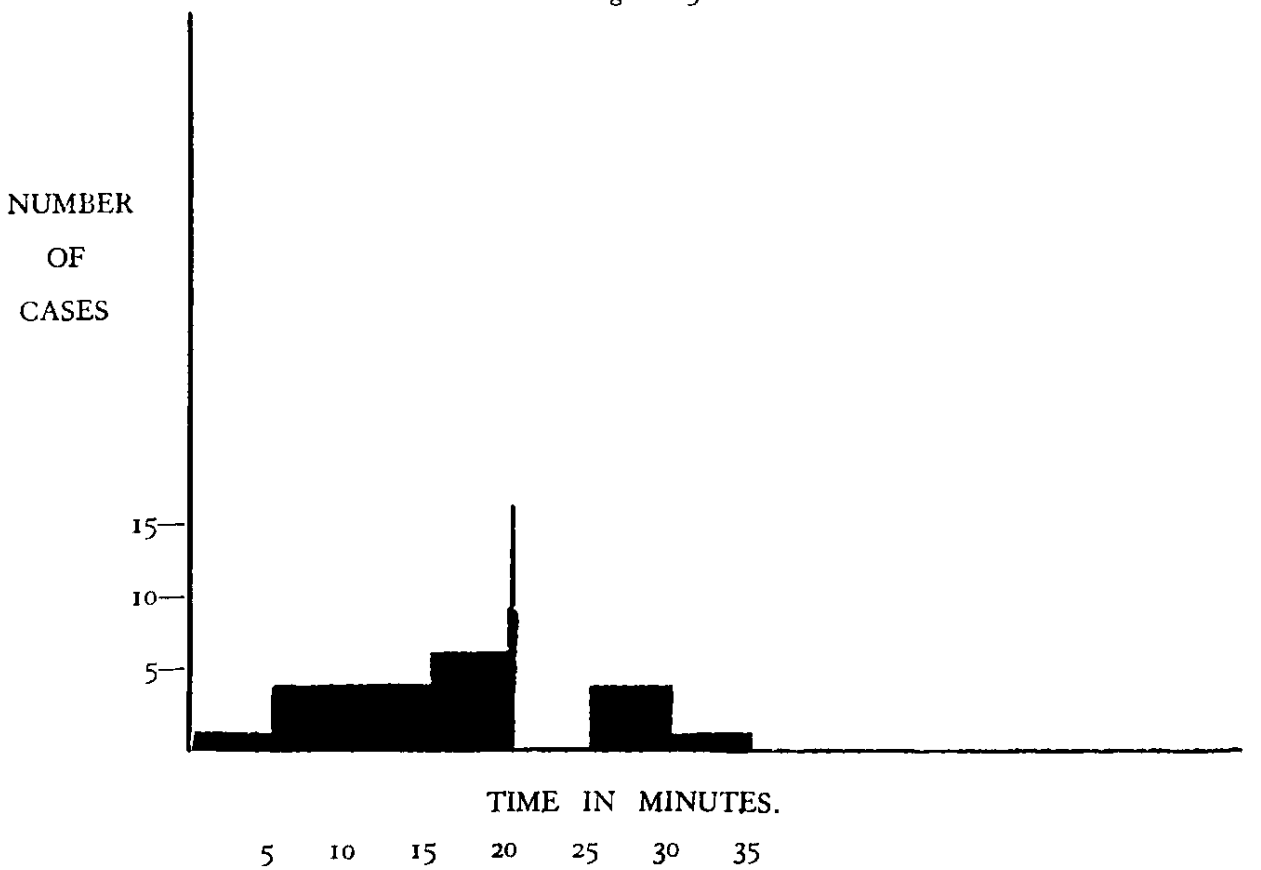
These results lead us to conclude that the standard hospital diet contains little or no vitamin C. They also show very clearly that

Diagram 2.



Bar diagram to show effect of C rich foods on decolourization times.

Diagram 3.



Bar diagram to show decolourization times of a group of medical students chosen at random.

Rotter's test is of use in roughly assessing the degree of saturation of tissues with vitamin C, albeit substances such as glutathione and cysteine may also bring about decolourization of the dye. In this investigation no attempt was made to overcome the inaccuracies due to these sources. It is noteworthy that nine of the fifteen cases of pulmonary tuberculosis tested had reduction times of over 1 hour, and of the six cases remaining in this small group, only two showed reduction times within the normal 20 minutes limit.

## SUMMARY.

1. 152 people were skin tested with 2:6 dichlorophenol-indophenol, in an attempt to assess their degree of vitamin C saturation.
2. More than 60% of the Chinese out-patients tested on admission to hospital appeared to be within normal limits as regards reduction time of the dye.
3. Administration of orange juice or vitamin C preparations caused a significant fall in the reduction time of patients originally outside normal limits.
4. Hospital diet produced either no fall at all in reduction time or an insignificant one only.
5. 60% of the cases of pulmonary tuberculosis tested showed a great increase in reduction time of the dye.
6. Rotter's test appears to be of value as a rough clinical guide to the degree of vitamin C saturation of the tissues.

## ACKNOWLEDGMENTS.

We wish to express our thanks to Professor Byrne and Mr. Hill of the Department of Chemistry for their help and advice in preparing the standard solutions, and to Professor Ride of the Physiology School for allowing us to draw unstintingly on his rich store of statistical knowledge.

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## A METHOD OF RAISING BONE FLAPS IN CRANIAL SURGERY.

by

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The method to be advocated in this note is a combination of previous techniques with slight modifications. The writer has not, however, seen it practised in its entirety in other clinics nor exactly described in text-books or articles.

To explore the interior of the cranium and carry out operative measures therein, it is necessary to make an opening in the cranial wall, and (except for decompression operations) it is very desirable to close this opening securely afterwards.

In out-lining a bone flap there is an obvious objection to the use of trephines, Gigli saws, trench cutting gouges, Roger's skull plough or Souttar's craniectome (Souttar, 1928, )—namely that owing to actual loss of substance the piece of bone raised is smaller than the resulting gap. In consequence, the unsupported bone flap merely floats on the cranial contents and pressure thereon after the operation may mean pressure on the brain (Fig. 1). It also predisposes to cerebral hernia. Moreover the gap involves delay in the development of bone union, and also forms an obstacle to the restoration of normal blood supply to the almost isolated bone flap.

Many years ago the writer remembers watching the late Sir Percy Sargent raise a bone flap by making a number of half-inch holes with a trephine, connecting these with superficial cuts with an ordinary amputating saw and cracking the deeper part of the bone obliquely inwards with chisel and mallet. The base of the flap was broken across in the usual way. When the flap was replaced the deeper parts of the bone flap rested on a shelf, and after the scalp was sutured, the site of operation could be pressed upon and even banged upon without ill effect (Fig. 2). The employment of several half-inch drill holes, however, leaves a series of deficiencies and takes a little time, and an ordinary hack saw is not easy to manipulate in all parts of the flap margin.

Souttar's craniectome can be used for cutting the outer table of bone before cracking obliquely through the inner table; but it has the drawbacks that a separate hole for the split stud or mandrel has to be made and that it does not provide free scope for use of the chisel at the correct angle for the cracking of the inner table. Moreover, it has the serious limitation that it can only cut exact arcs of circles.

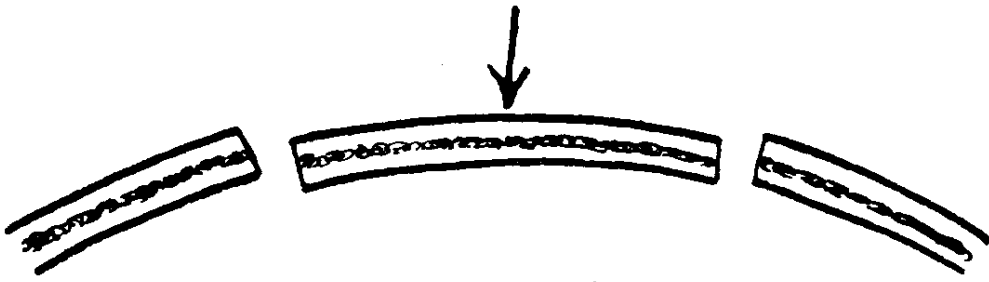


FIG. 1

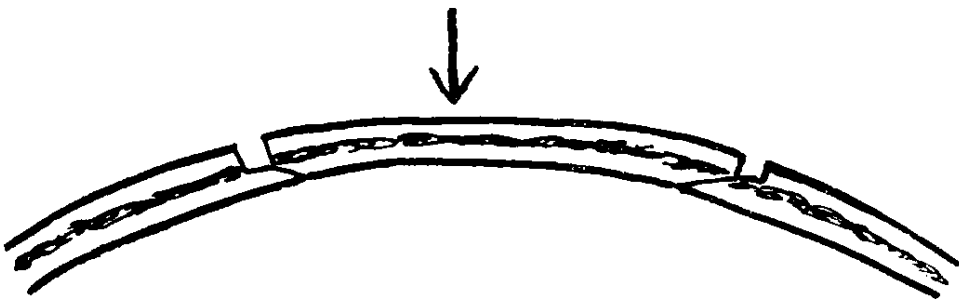


FIG. 2

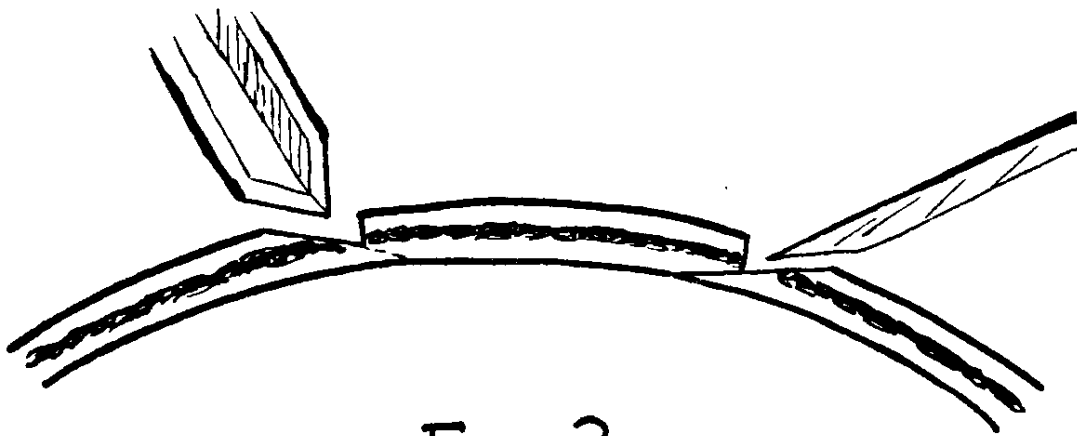


FIG. 3

*Figure 1* shows the loose floating "island" of bone obtained by the usual methods of raising bone flaps. It has the disadvantages of allowing pressure on the brain, of encouraging "hernia cerebri", of checking the re-establishment of vascular connections with the surrounding bone, and of delaying new bony union.

*Figure 2* shows the "island" obtained by a method used at one time by Sargent. The island rests firmly on the surrounding bone. The method avoids all the disadvantages recorded under *Figure 1*.

*Figure 3* shows the "island" obtained by the method in the present communication. The groove is made by a V-cutter (shown left) and the "China crack" by a chisel (shown right). This method also avoids all the disadvantages recorded under *Figure 1*.

The use of V-shaped gouges to cut a line through the whole thickness of the cranium is mentioned by Binnie in Binnie's Operative Surgery, eighth edition, page 9.

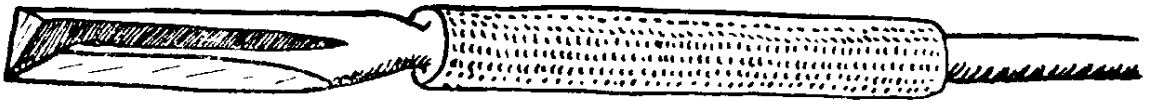


Figure 4. The V-shaped cutter used to cut the grooves (actual size). These cutters were made by Mr. Weller in the Engineering Workshops of the University and were very largely copies of those made for Ogilvie's Compressed Air Bone Cutting Machine manufactured by Messrs. Down Bros. Ltd. of London. (D. 154/8).

The method supported in this note is to use a V-shaped gouge bevelled on the inside (Fig. 4) for making the cut through the outer table of the skull. Used with a mallet this very rapidly cuts a groove in the outer table. By holding the V edge at an appropriate slant, the outer side of the groove is slanting, the inner one vertical. This permits the appropriate slant of the chisel for cracking the inner table. It is easy to see when the diploe is reached. The V cutters must be of finely tempered steel, preferably not plated.

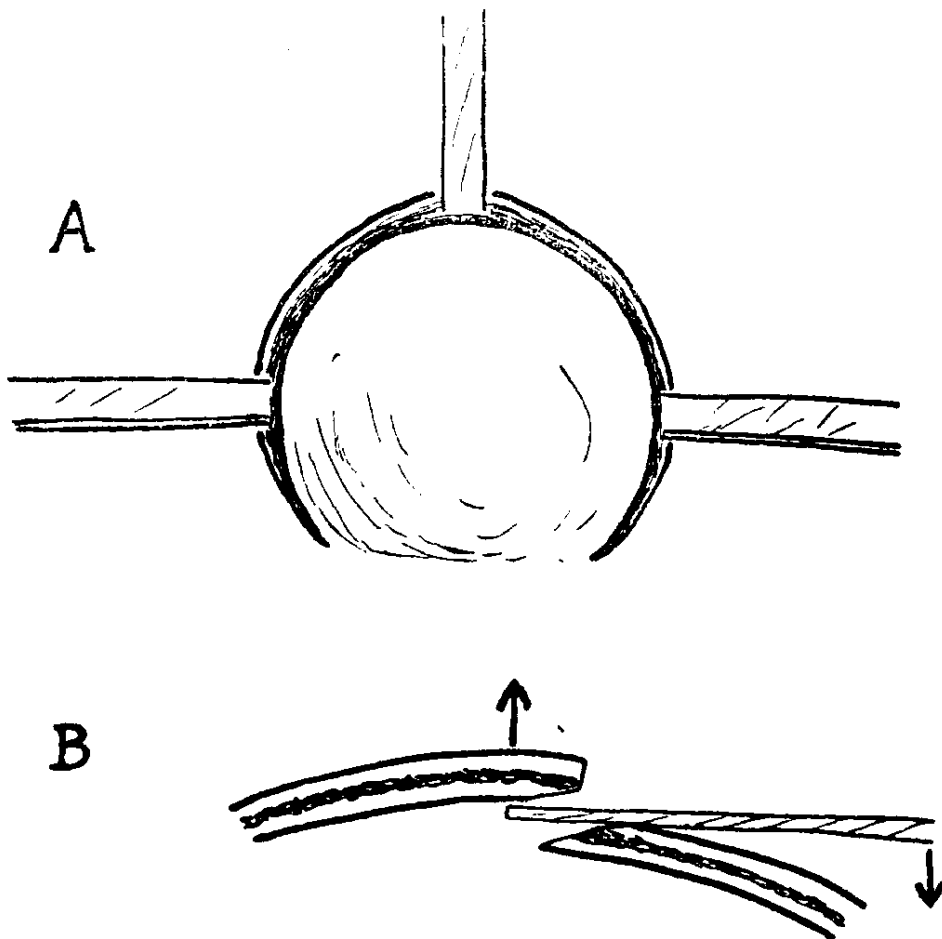


Figure 5.

- A. Diagram of three-lever method of raising flap and cracking across its base.
- B. Section of A showing how the instrument levers up the flap using the edge of the surrounding cranium as fulcrum.

When the arc has been outlined in the outer table by the V cutter, a chisel is applied first at the summit of the arc and given a tap with the mallet, and then all along working both ways from this point. It may be necessary to go round twice. When the flap is felt to give, it can be prised up a little with a thick-ended osteotome. Three levers are then inserted and used to lever up the bone flap using the margin of the surrounding skull as fulcrum (Figs. 5 a & b).

It has been objected (see extract) that the hammering induces a condition of shock. I am sure that this is inaccurate. There is no more shock than there is in a mastoid or frontal sinus operation. The patient whose x-ray after operation is shown in Figure 9 showed no shock or other debility from the operation, putting on 24 lbs. in weight in two months. It must be remembered that the V gouges are very keen and hard and that all mallet blows are directed tangentially. Shock experienced in opening the cranium is nearly always due

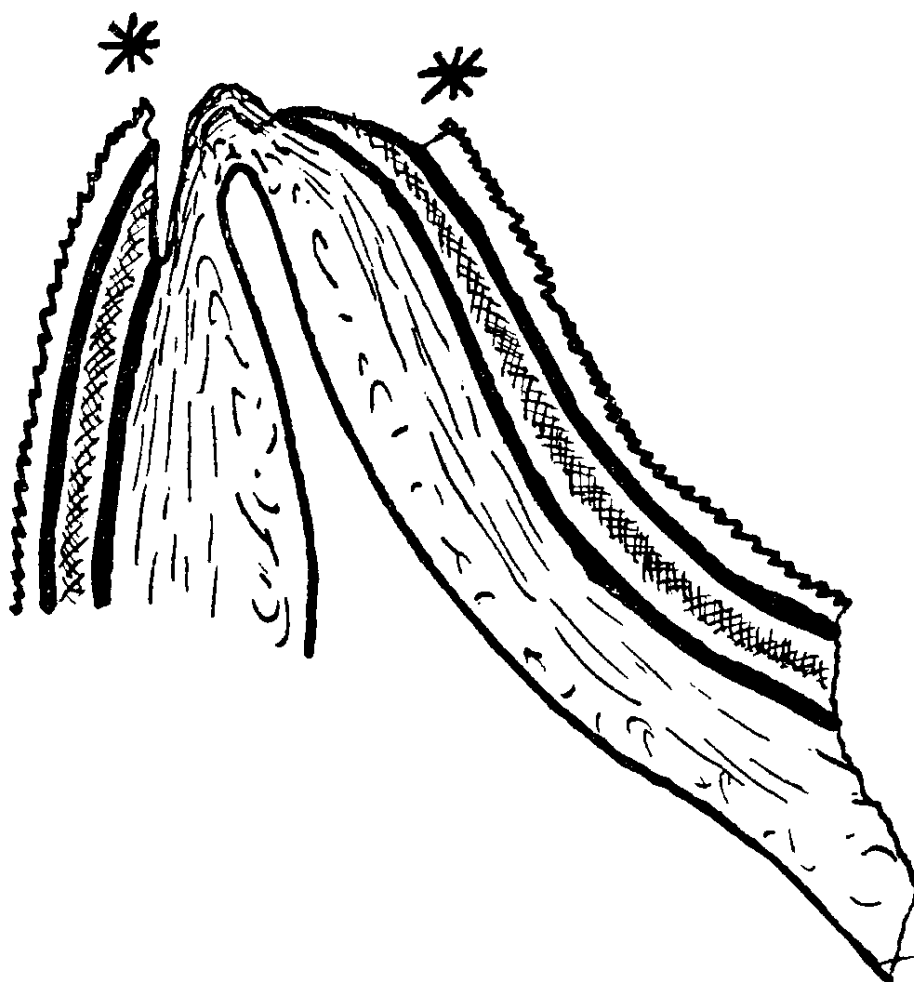


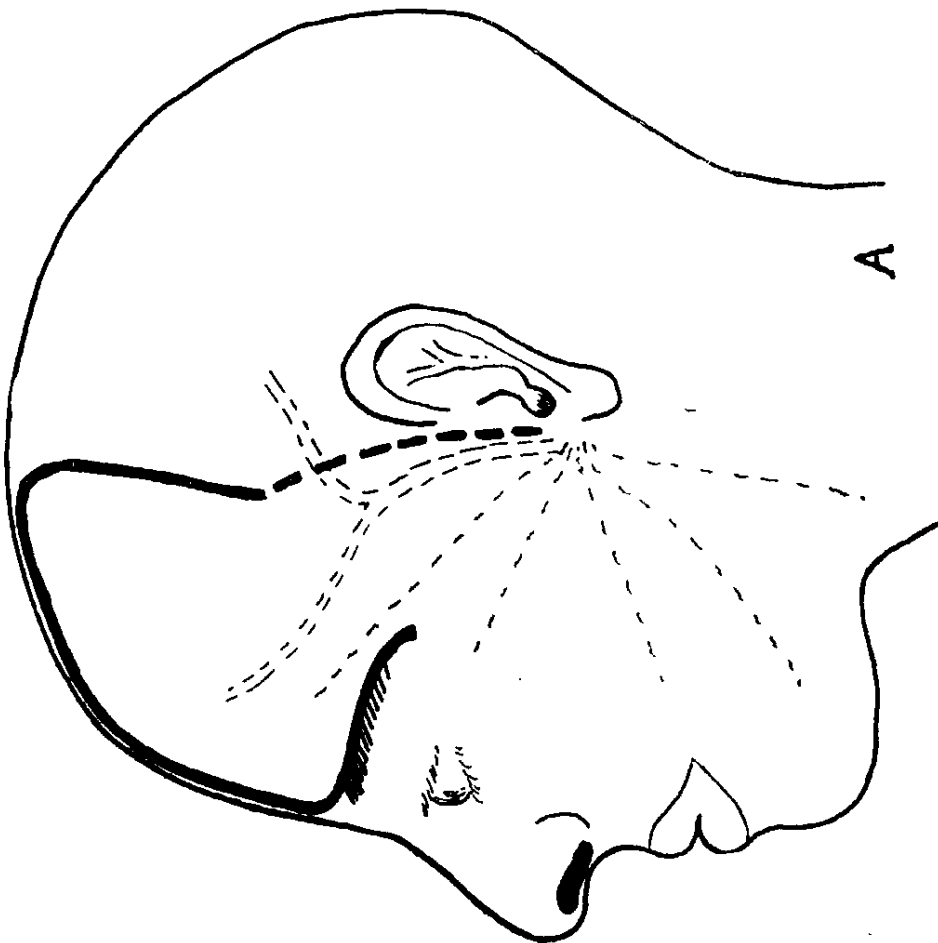
Figure 6.

This diagram shows how the dura mater cannot be raised adherent to the bone flap because of the wide corner (representing twice the thickness of all the tissues of the flap) it would have to stretch across when the flap was turned down.

Wavy line represents the dura mater.

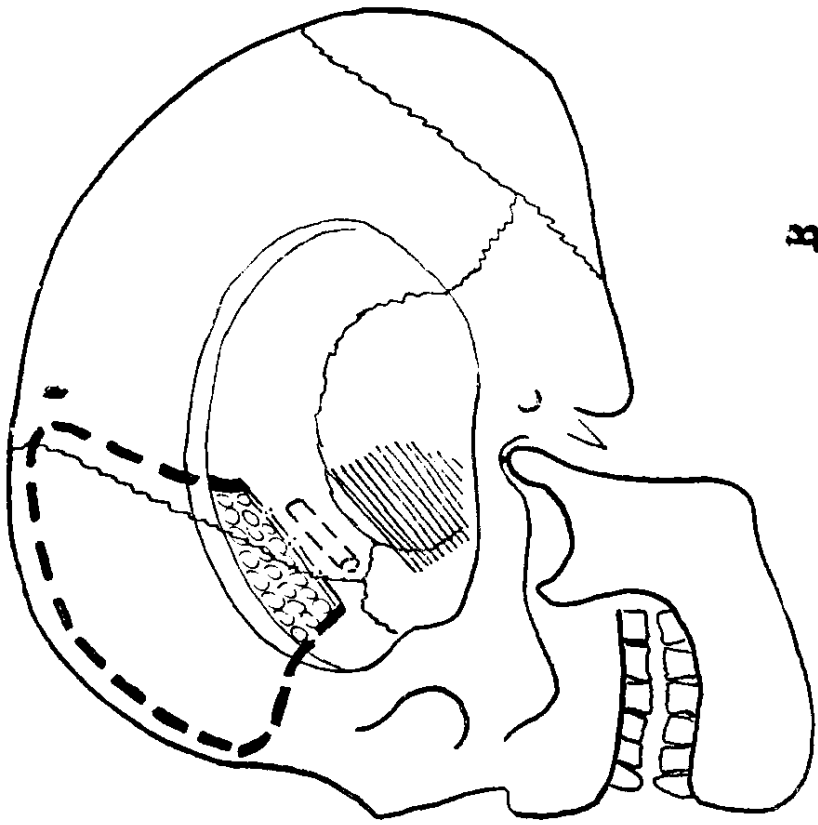
\*—\* represents the unbridgable gap if the dura is to remain adherent to the bone flap.

Figure 7.



A. Skin incision for anterior bone-flap.  
 Thick continuous line=skin incision.

The tunnel for the middle meningeal artery is represented by thin interrupted lines.



B. Line of bone section for anterior bone flap.  
 Shaded part=area of bone removed for decompression if required.  
 Part covered by small circles=area of bone flap from which temporal muscle has origin.

Thick interrupted line=bone section.



to imperfect control of scalp (and to a lesser extent of diploic) haemorrhage, the methods of controlling which are not discussed here.

When the bone flap has been raised a little way the dura mater tears off its deep surface and a little later the bone cracks across at the base or chord of the arc.

For this to take place easily and neatly it is of course requisite that the bone at the base should be flat not arched, that the bone should be thin and that the base should not be over 2 inches across and should be the chord of a major arc. Of course the arc need not be a strict arc but can be cut to any required shape so long as the base to be cracked represents only a small part of the margin. The bone flap has to be designed accordingly. It would of course be desirable to leave the dura mater attached to the inside of the bone flap as the meningeal vessels have communications with the diploic vessels and the nutrition of the bone flap would be improved. The dura cannot however stretch all the way round the thick corner unless a large strip of bone at the base were first removed, a difficult procedure as it is essential not to damage the scalp flap at its base. Even so the double thickness of soft parts at the base of the flap hardly permits the manoeuvre (Figure 6). There is, too, considerable difficulty in incising the dura as desired before the bone flap has been completely raised.

The bone flap for its blood supply has to depend

(a) on vessels running in the unbroken periosteum at the base of the arc. The periosteum receives practically no vascular support across the loose areolar layer between it and the three superficial layers of the scalp;

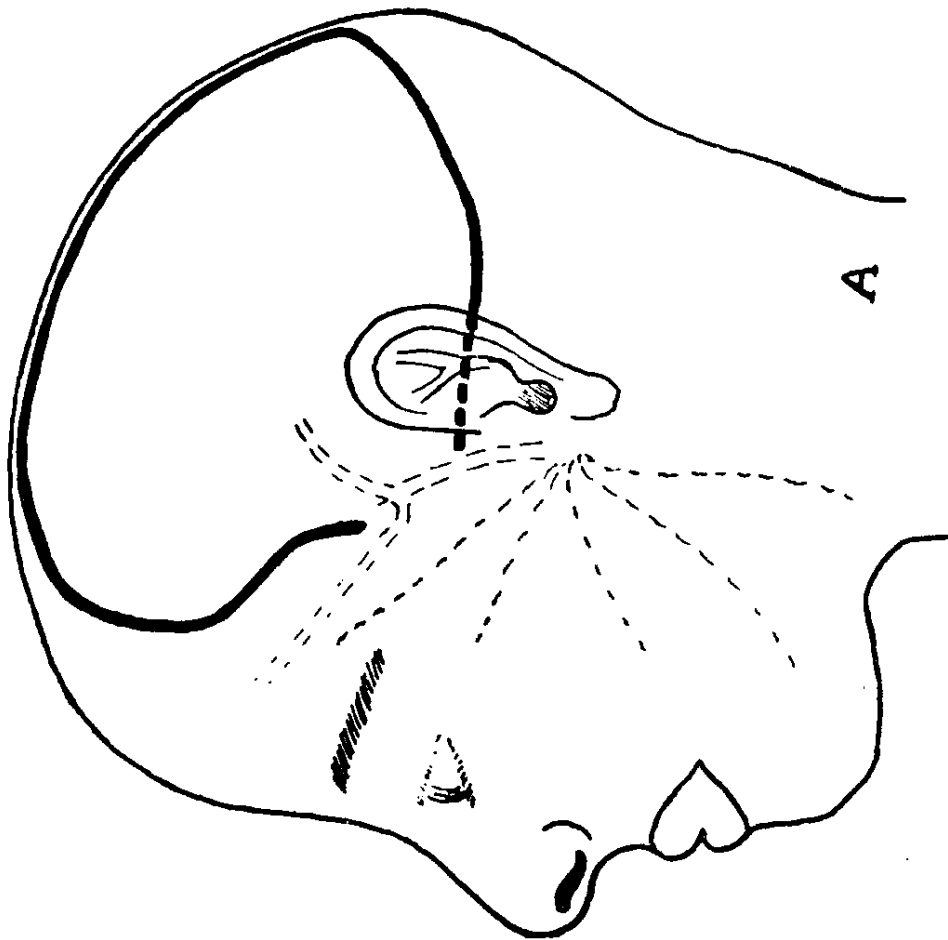
(b) on vessels reaching the periosteum and bone at the attachment of muscles. The muscle attachments of service in this connection are the origin of the temporal muscle, and for occipital flaps the attachment of the suboccipital muscles;

(3) on fresh vessels growing into the bone flap along its severed margins after replacement.

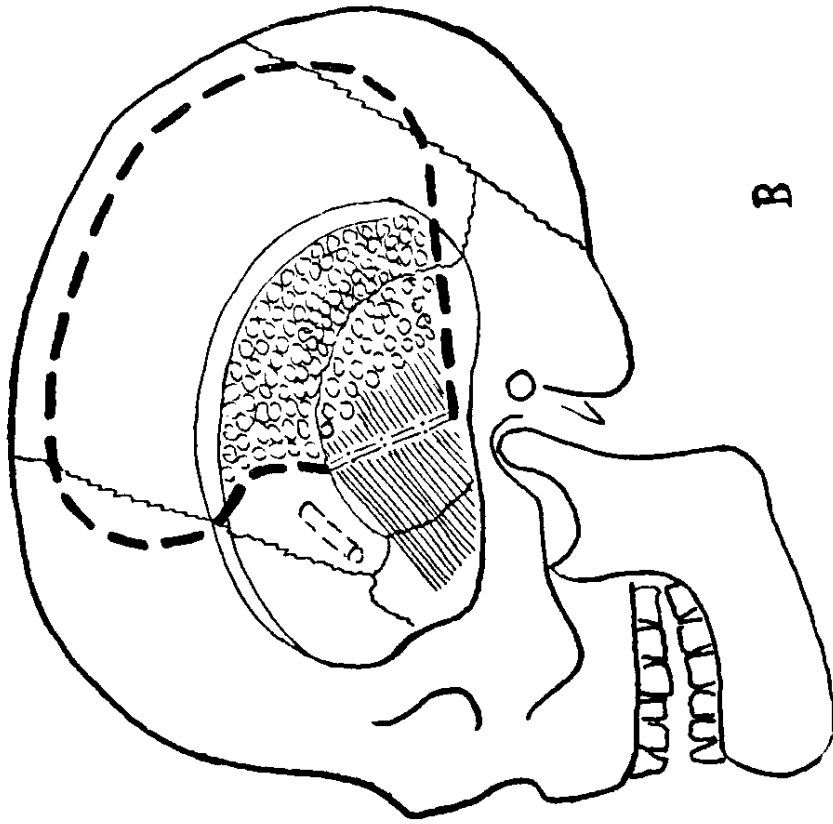
Although the meningeal vessels in the dura mater are severed from the bone flap, it is still desirable to preserve them to secure a good blood supply to the dura and arachnoid membranes as a precaution against adhesions. This is easily done except where the middle meningeal artery lies in an osseous tunnel at the anterior angle of the parietal bone.

It is well therefore to plan the bone flaps so as not to have to crack across the tunnel. Where however adequate exposure of a particular cerebral tumour demands it, the tunnel and its middle meningeal artery must be sacrificed, though it may be just possible

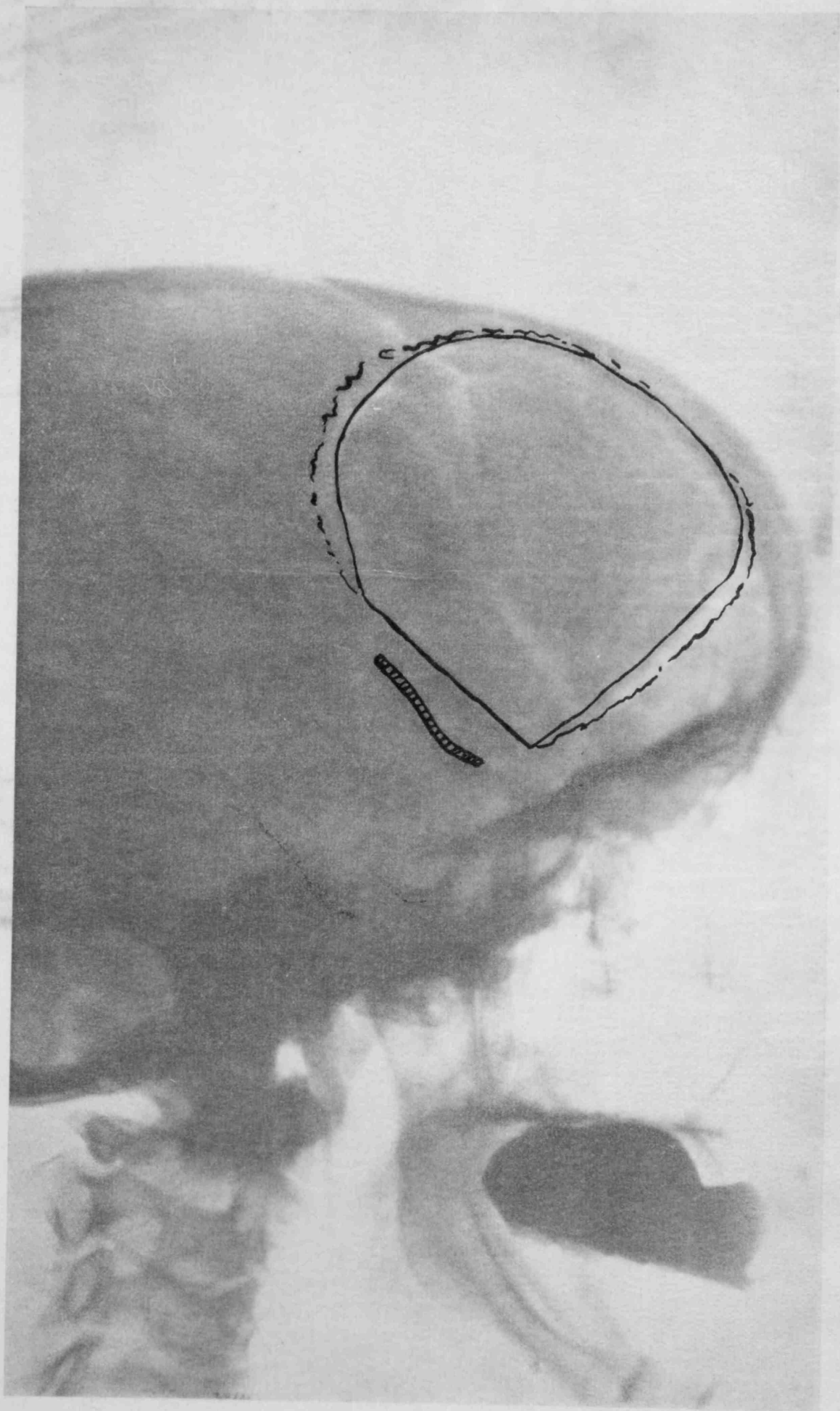
Figure 8.



A. Skin incision for posterior bone-flap.  
 Thick continuous line = skin incision.  
 The tunnel for the middle meningeal artery is represented by thin interrupted lines.

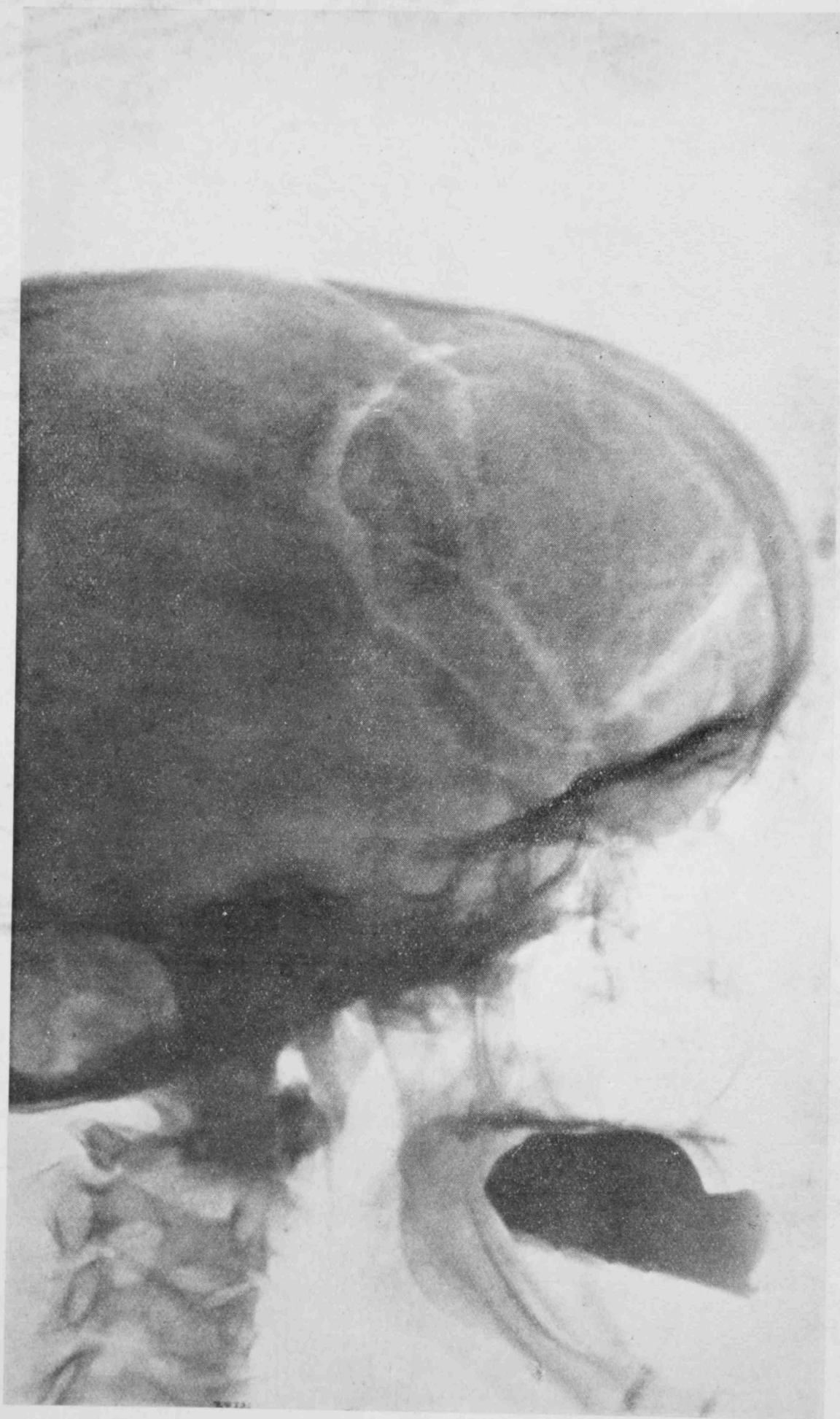


B. Line of bone section for posterior bone flap.  
 Shaded part = area of bone removed for decompression if required.  
 Part covered by small circles = area of bone flap from which temporal muscle arises.  
 Thick interrupted line = bone section.



*Figure 9.*

X-ray of skull of a patient on whom an anterior bone flap had been performed fifty-one days previously. The thin paper tracing indicates the middle meningeal artery of the same side.



*Figure 9.*

X-ray of skull of a patient on whom an anterior bone flap had been performed fifty-one days previously. The thin paper tracing indicates the middle meningeal artery of the same side.

to completely isolate the bony tunnel by removing the surrounding bone with the aid of punch forceps and thus elevate the tunnel together with the dura.

Two flaps, an anterior and a posterior can thus be designed, which one or other or both together will expose most parts of the cerebral cortex, and which fulfil the requirements to which attention has been drawn (Figs. 7 & 8.) The skin incision for each lies well outside the arc of bone section except at the base or chord where skin incision and bone section approximate.

Figure 9 is an x-ray of the skull of a patient on whom an anterior bone flap had been done seven weeks before. The deficiency of the outer table along the arc is well seen and also the thinner crack at the base; and the relation of the latter to the middle meningeal tunnel of the same side is clearly shown.

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## MALIGNANT METAPLASIA IN A THYROID ADENOMA

by

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Although malignant metaplasia of thyroid adenomata is not excessively rare, there are certain features about this case which are unusual and worthy of record.

## CASE REPORT.

T. Shiu Shue, aged 47, was a married Chinese woman who was admitted to hospital on March 27th, 1939 complaining of wasting, weakness, swelling of the throat, distension of the abdomen, and some difficulty in breathing and speaking.

The patient was an only child and married at the age of 25. Her only son and her husband are both alive and healthy. She had no miscarriages. Her parents both died of "paralysis," but unfortunately she was unable to be more explicit about their final illnesses. There was no family history of goitre or thyroid enlargements of any sort.

Her past history had been uneventful. Except for a transient leucorrhoea twenty-two years ago she had never had any illness. She first noticed a "lump," described as "a small nodule which appeared at the bottom of her neck just to the right of the middle line" when she was twenty-one. It never became large enough for her to consult a doctor about it, and after six years—that is to say when she was twenty-seven—it disappeared. She had never been addicted either to alcohol or tobacco, nor had she ever suffered from any form of venereal disease.

She remained in perfect health from that time until one year ago when she noticed that she was losing weight. This symptom particularly impressed her as she had always been rather fat.

Four months ago her belly began to swell and her periods, which had hitherto been regular, ceased. The abdominal swelling progressed rapidly and was accompanied by marked and progressive emaciation and steadily increasing asthenia. One month ago "the swelling in the neck reappeared." The enlargement appeared first on the left side of the neck, and was followed at a very short interval by swelling of the isthmus and right lateral lobe of the thyroid. She now began to complain of occasional palpitation and slight dyspnoea. Her voice became a little hoarse but she had no difficulty in swallowing. The

thyroid enlargement increased apace, and by the time she was admitted to hospital on March the 27th was producing marked dyspnoea and some hoarseness.

Diagram 1

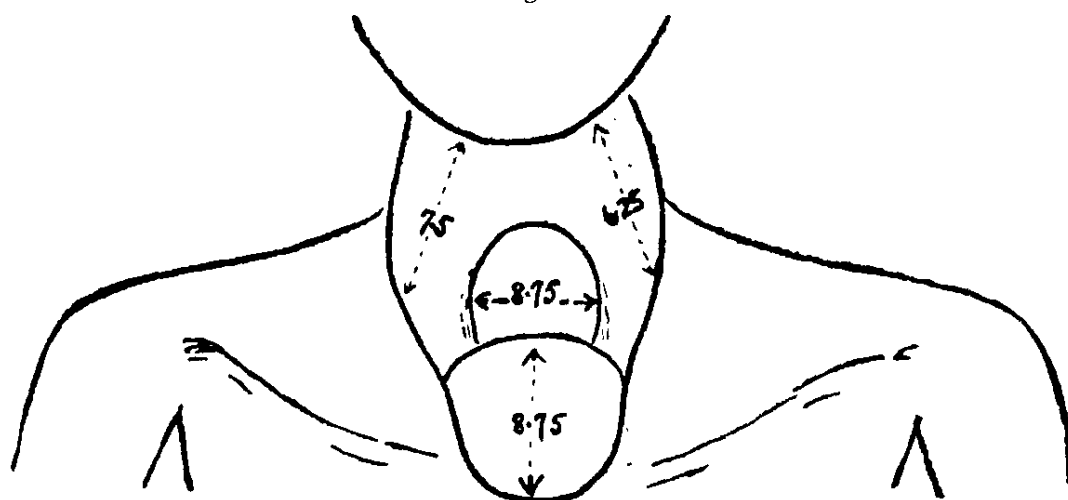


Diagram showing position and dimensions of the swelling in the neck of the patient. The tumour is also shown in the photographs. Dimensions are given in cms.

On admission the patient was in a state of profound cachexia. She was orthopnoic and could only sleep, and then fitfully, by using a bed rest. Her colour was sallow with an underlying earthy tinge, her lips were slightly cyanosed, and she was grossly emaciated. The thyroid gland was replaced by a large four-lobed mass, which measured roughly 9" across and 7" from above downwards. The belly was enormously distended with an ascitic effusion, and there was a well marked lumbar pad coupled with a moderate degree of pretibial oedema on both sides. The left palpebral aperture was slightly narrower than the right but the pupils were equal and active to light. Her pulse rate on admission was 140, her respirations 40 a minute and her temperature 98.2° F.

On physical examination the cardiovascular system showed no gross abnormalities. The heart was displaced a little upwards by the ascites but there was no lateral displacement. The area of cardiac dullness was normal and no bruits were heard. The blood pressure was 80/50 while patient was sitting up (left arm). Carotid pulsation could be on the left side of the neck but not on the right, and venous pulsation could be detected in both supraclavicular fossae. There was well marked pitting oedema over both tibiae extending up as high as the knees. The lungs showed a moderate degree of congestion at both bases but no adventitious sounds were heard.

The belly was greatly distended and showed marked superficial venation. The umbilicus was obliterated. The swelling was uniform and no masses could be made out on palpation. Shifting dullness and thrill were readily elicited, but it was impossible to make out the

lower limits of spleen and liver. There was an obvious lumbar pad extending from the spine of the twelfth dorsal vertebra down to sacrum. Unfortunately no pelvic examination was made.

The central nervous system showed no sign of involvement, and all deep reflexes were present. The mass in the neck consisted of four lobes, which can readily be seen in the accompanying photograph. The three main lobes corresponded to the isthmus and lateral lobes of the normal thyroid gland; the fourth lobe was situated between the swellings of lateral lobes above and isthmus below. The dimensions of the mass as a whole are shown in the diagram below.

The mass was hot to the touch but not tender. It showed no superficial venation nor did it pulsate. On palpation fluctuation could be made out in all parts of it, but nowhere were any nodules or hard masses felt. It appeared to be attached to deeper structures as no movement on swallowing was detected. The lobe corresponding to isthmus was the largest of the four and showed the best marked fluctuation. Lateral head movements were very limited, forward movement was practically nil and backward movement was impossible. No glands were palpable in the neck, axillae or groins.

Dyspnoea and hoarseness were marked and were undoubtedly due in part to pressure on trachea and probably also on recurrent laryngeal nerves by the thyroid mass. Laryngoscopic examination was impracticable. Slight cough was noted, but the amount of sputum brought up was small. It showed pneumococci, streptococci and pus cells on examination. The urine averaged 600 c.c. daily during her time in hospital. The deposit showed epithelial cells, oxalate crystals and a few pus cells.

The faeces showed no abnormality. The blood showed a mild secondary anaemia, the counts being as follows:—

R.B.C.'s .....	3,810,000 per cu. mm.
W.B.C.'s .....	10,300 per cu. mm.
Polymorphs: .....	80%
Lymphocytes .....	19%
Large Monos .....	1%
Eosinophils .....	0%

Blood films showed no parasites or organisms. Haemoglobin was 65% (Tallqvist). The Kahn reaction was negative. X-ray of the thorax revealed "no obvious pulmonary lesion." Both domes of the diaphragm were considerably raised by the ascites, and some vague shadows could be made out in the thyroid swelling just to the left of the mid-line. These shadows were not correctly interpreted until the mass was examined at autopsy.

The ascitic effusion was tapped on the day of admission and 750 c.c. of homogeneously blood stained fluid were drained slowly. No



malignant cells were detected on microscopic examination of the deposit.

As a result of these findings a diagnosis of malignant metaplasia in a thyroid adenoma was made, and the surgeons were invited to give an opinion. Most properly they declined to intervene, and that their attitude was right is proved by the fact that the patient died nineteen days after admission.

The patient's ascitic effusion was tapped on two further occasions, on the 1st and the 7th of April, 2,000 and 3,000 c.c. of fluid being drained on these dates. This removal of fluid far from relieving dyspnoea seemed, if anything, to increase the patient's discomfort, and after the third tapping no further active measures were taken. During her stay in hospital she showed an irregular intermittent fever, and during her last week of life the forearms and hands became oedematous, and some petechiae appeared on the inner sides of both arms. At no time was dysphagia complained of, nor were adventitious sounds heard in the lungs, apart from the persistent signs of basal congestion.

Death occurred on the 15th of April, and a complete autopsy was made by one of us (H.K.) on the following, the body having been kept in a refrigerated mortuary during the interval.

#### AUTOPSY FINDINGS.

The body was grossly emaciated and showed petechial haemorrhages on the inner sides of the arms and oedema of the legs. The abdomen was distended with fluid. The thyroid gland was greatly enlarged; the soft central mass was adherent to the sterno-cleido-mastoid muscles on both sides but not to skin. The left lateral mass contained bony and cartilaginous tissue but the central tumour mass was soft in consistence and the cut surface was hyperaemic. No involvement of the lymphatic glands draining the thyroid was found.

Both pleurae contained a small amount of blood-stained fluid. Numerous pleural adhesions were noted on both sides. The left lung was collapsed, and the right lung was found to contain several hard whitish masses with sharply defined edges. The whole of the right lower lobe was replaced by these metastatic nodules, which were necrotic in places.

The pharynx, trachea and oesophagus were normal, and the heart showed only a mild degree of brown atrophy.

The abdomen contained several hundred cubic centimetres of blood stained ascitic fluid. A tumour mass growing from the right ovary rose out of the pelvis as high as the umbilicus. It was soft in consistence and its surface showed numerous haemorrhages and several necrotic areas but it was unattached to surrounding structures. The

left ovary was normal and the uterus showed one small nodular metastasis in the fundus.

The other abdominal viscera, beyond reflecting the generalised anaemia, showed no noteworthy changes.

Histologically the thyroid tumour was composed of malignant cells of the round celled type. Some of the acini were completely filled with these cells. Very few haemorrhages were noted, although in some sections the blood vessels had become almost sinusoidal in character owing to lack of normal supporting structures. Cartilage and bone were both found in section of the left lobe of the tumour.

The metastases in the right lung proved to be of the same nature as the thyroid tumour, only more extensive haemorrhages were found in them. The right ovary was infiltrated with the same type of malignant cells, and showed extensive necrotic and haemorrhagic changes.

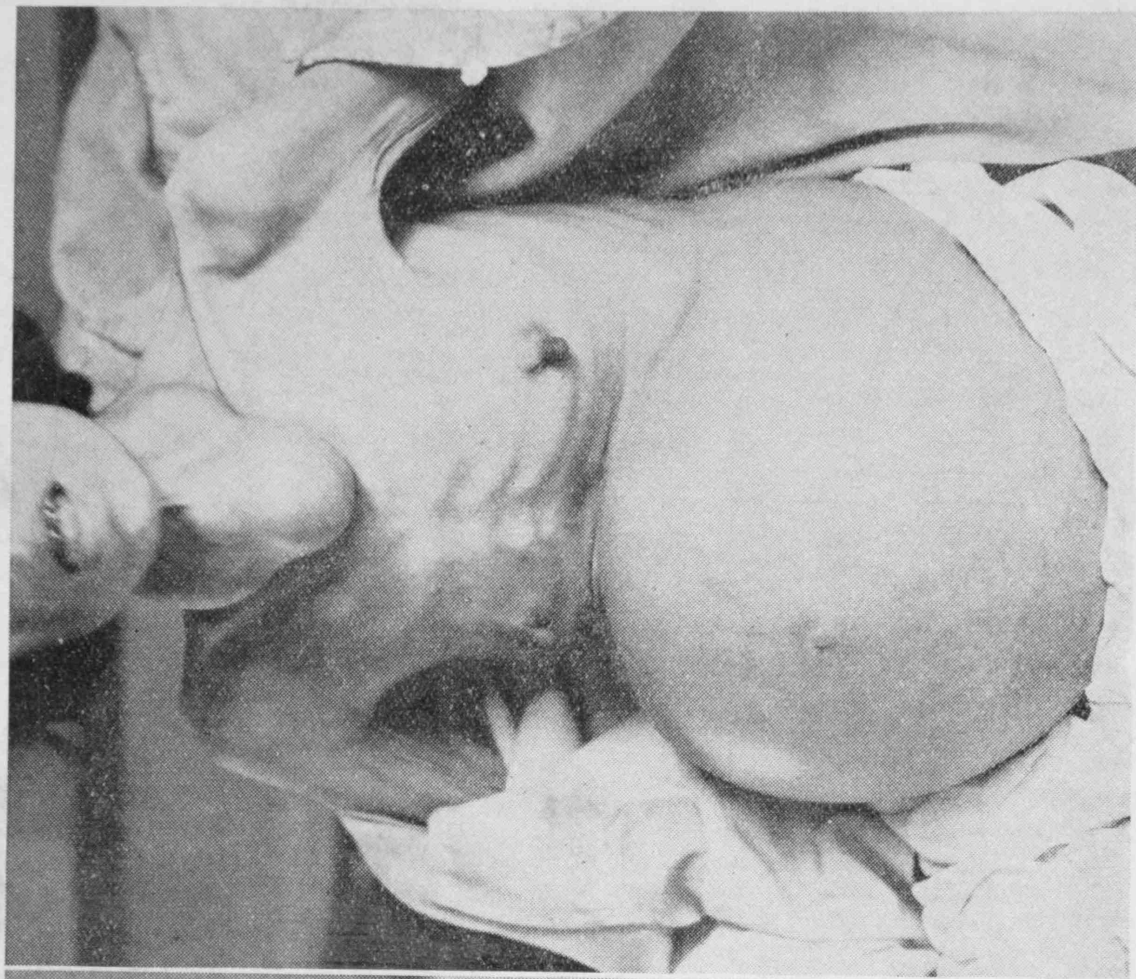
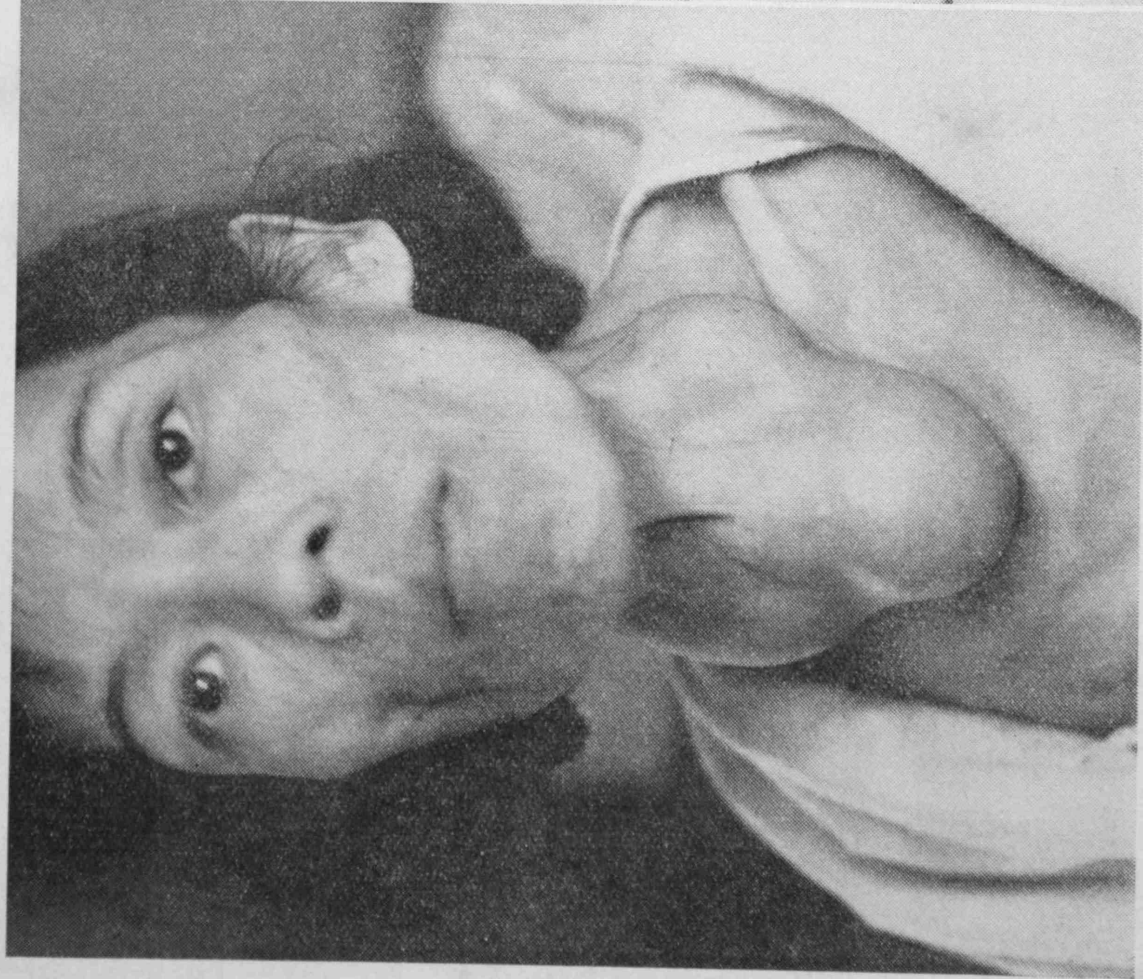
#### DISCUSSION.

Malignant changes occurring in an originally benign thyroid adenoma are by no means uncommon. According to Graham (1934) malignant growths of the thyroid may be classified under the three headings:—

- (I). Scirrhus carcinoma.
- (II). Papilliferous adenocarcinoma.
- (III). Malignant adenoma.

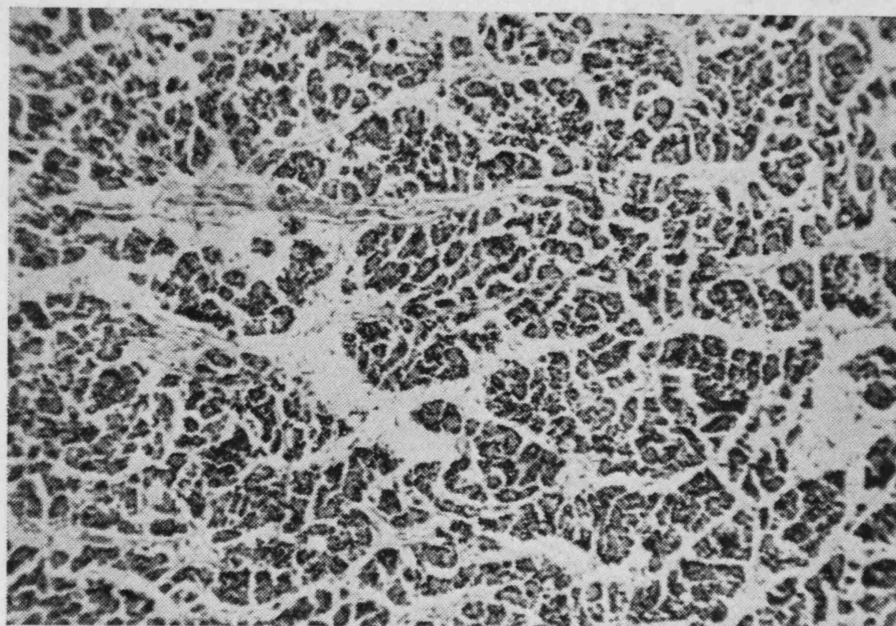
Scirrhus carcinoma, which is by far the rarest of these malignant growths, behaves pathologically as other scirrhus carcinomata and metastasises by invasion of the local lymphatics. It is clear that our case did not belong to this group, first because no involvement of neighbouring lymph glands was found and second because metastasis had occurred in organs as distant as the ovary.

For the same reasons it is unlikely that the case belongs to the second category. Spread by local invasion and lymphatics appears to be the rule in cases of papilliferous adenocarcinoma of the thyroid and the course of the disease is usually long. It is impossible to say when malignant change set in in this case for it has been proved that excessive epithelial activity may occur in a thyroid adenoma for many years before clinical signs of malignancy appear. (Dunhill, 1931). In the earliest stages of malignancy in this condition the excess of epithelial activity is confined within the capsule of the adenoma, and invasion of veins may occur while the growth is still encapsulated. Neighbouring lymphatic glands are not involved and spread takes place by the veins. That this was the condition obtaining in our case is almost certain from the fact that metastasis had occurred in the right lung, the lungs naturally being most susceptible to early invasion

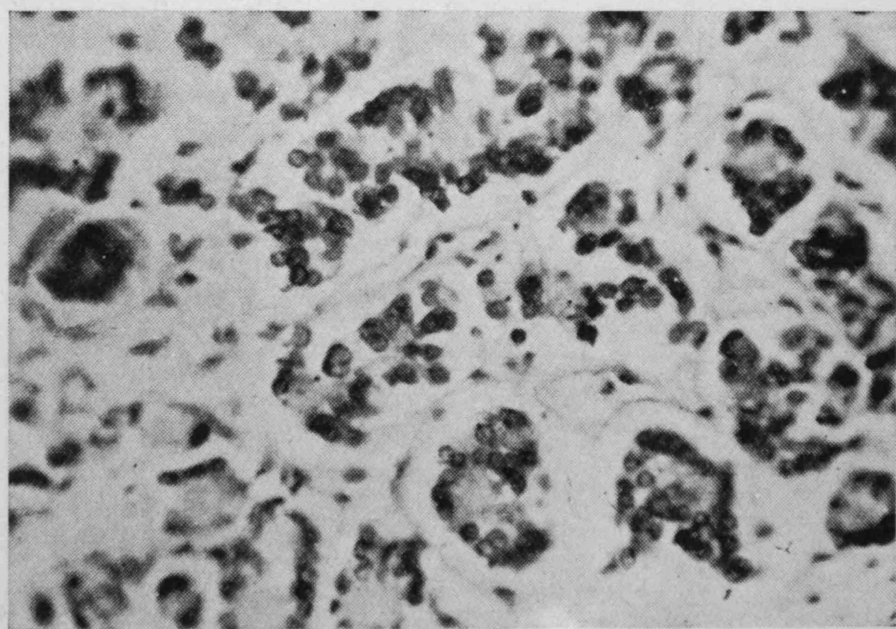


Photographs showing the extent of the thyroid tumour and the ascites.

Malignant adenoma of the thyroid gland.

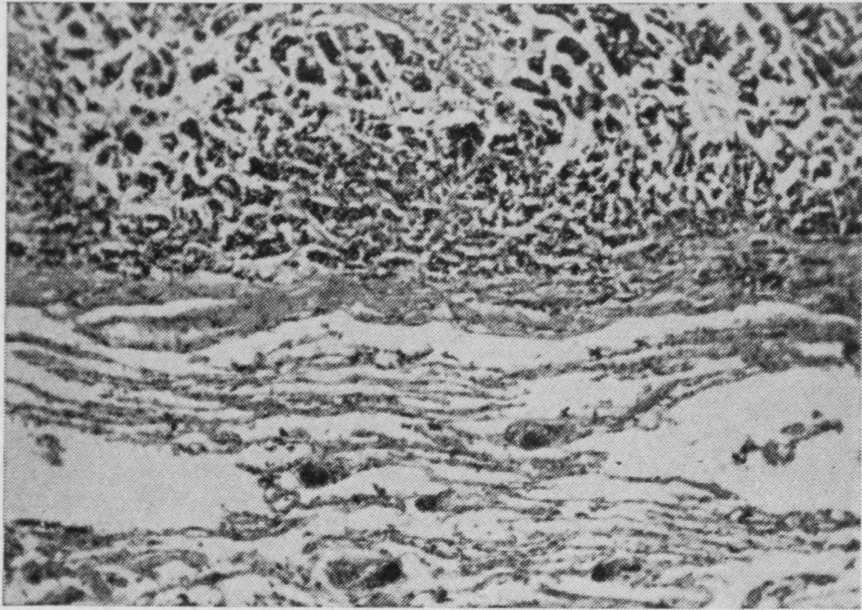


The tumour on section shows the malignant cells arranged in acini, which are surrounded by a delicate network of fibrous tissue. Practically the whole of the thyroid was replaced by tumour tissue, but traces of colloid were noted in some of the surviving normal acini. Few mitotic figures were seen, but in some parts of the growth bone and cartilage were found. The blood vessels had lost their normal supporting structures and tended to be sinusoidal.

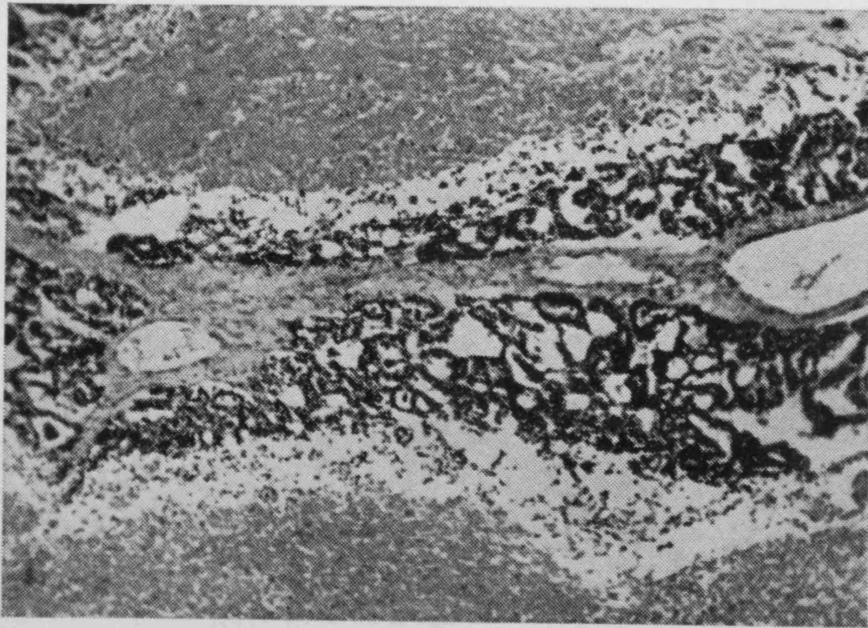


The tumour on section, magnified 450X.





The lungs were both congested and showed a mild degree of anthracosis. The secondary deposits were separated from the normal lung tissue by fibrous trabeculae. The arrangements of the tumour cells and the vascular changes were the same as those seen in the primary growth.



The ovary showed degenerative change and was cheesy on section. It was infiltrated with adenomatous thyroid cells which retained their acinar arrangement. The tumour vessels were sinusoidal in type.



Part of the thyroid tumour from the left lobe showing osteoid tissue.

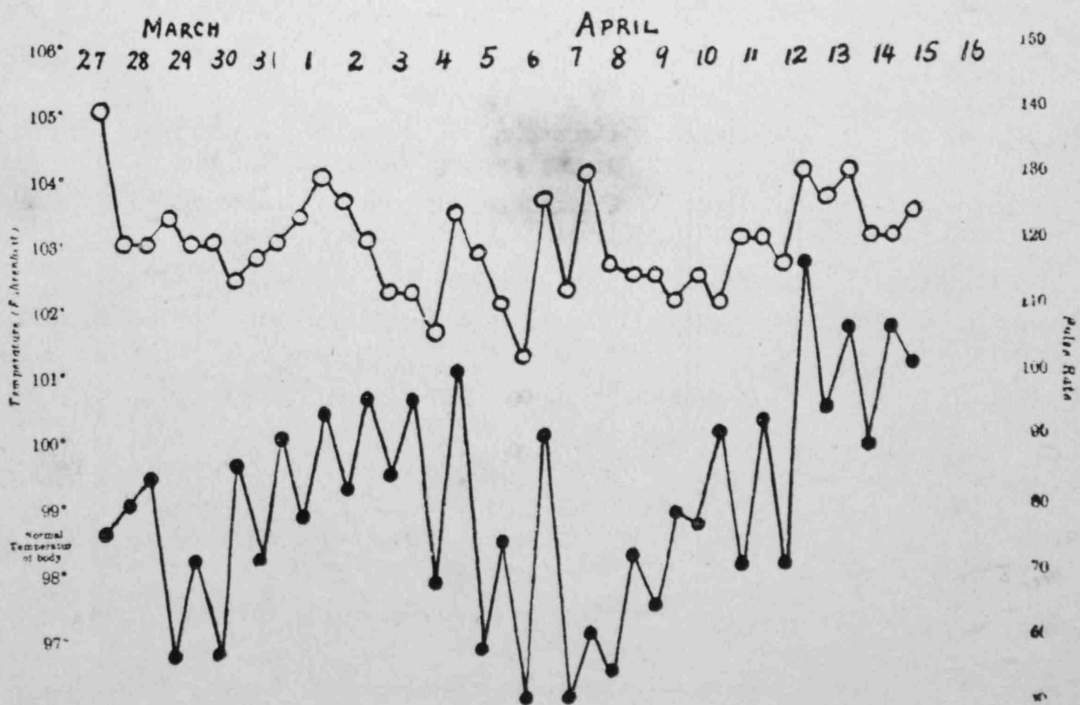


Chart to show temperature and pulse rate during last three weeks of life, Hollow circles show pulse rate, solid circles temperature.

by venous metastases. Despite a meticulous search, however, no evidence of venous invasion was found in the veins draining the thyroid. It is noteworthy that the bones showed no trace of metastatic deposit.

The histological picture seen in the secondary deposits in the right lung and right ovary is identical with that seen in sections of the thyroid tumour. In all three tissues the blood vessels have become sinusoidal in type, and the condition seen is like that described by Ewing, "a network of columns of round or spindle cells surrounding the blood spaces and resembling angio-sarcoma."

### SUMMARY.

1. Malignant metaplasia is described occurring in what was presumably a thyroid adenoma twenty seven years old.
2. The post-mortem appearances and histological findings are recorded.
3. Reasons are adduced for considering the neoplasm a malignant adenoma.

Our thanks are due to Dr. Foo for his help in collecting data for this case report, and to the Surgical Unit for the photographs of the patient.

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## Review of Books

*Modern Treatment Year Book.* Edited by Cecil P. G. Wakeley, D.Sc., F.R.C.S., F.A.C.S. (Pp. 355; 109 figures, 10s. 6d.) The Medical Press and Circular, London, 1939.

Progress in Medicine proceeds at such a pace these days, medical practitioners, who wish to keep abreast of the times, find they have to devote more and more time struggling with the spate of literature which pours forth in a never ending stream. Each day some new work appears in print, and we may well ask of some of them, of what use are they? What particular purpose is served by this book which is not equally well served by another already in print? New journals continue to appear at a time when we are beginning to wonder whether we have not already too many.

The popularity of the various Annuals and Year Books is not surprising, for most of them set out to summarise what is best in the previous year's contributions towards medical progress, and thereby lighten part of our burden for us by sifting the wheat from the chaff. The contents of such books are usually arranged in such a way as to make for easy reference to any particular subject. Thus the busy practitioner who wishes to consult a Year Book on treatment, may quickly find what he is looking for under the appropriate heading. With this type of book we are familiar, and it is obvious that such books serve a most useful purpose to anyone who wants rapidly to acquire information on the most recent methods of treatment of any particular disease.

"Modern Treatment Year Book," however, bears no resemblances to such books in spite of its title. There is no systematic review of recent advances in treatment classified under a comprehensive list of diseases, nor do the various articles confine themselves to treatment alone, for much space is devoted to symptoms and signs, and to differential diagnosis. In a few articles treatment appears to receive almost secondary consideration.

For those who prefer their reading to be random, passing from medical to gynaecological subjects, thence to surgical topics in no particular order, this volume will be popular, for there is very little to criticise in the article themselves, many of which, in the limits imposed by their small compass, are excellent. This book is, in fact, a scrap book containing many good things, but it is certainly not a Year Book in the accepted sense.

As there are no less than forty-eight different articles in this volume, it is difficult to mention more than a few. H. L. Tidy contributes a sound discussion on the treatment of ulcerative colitis. He



might, perhaps, have laid more emphasis on the psychological factors involved. Sir Walter Langdon-Brown gives an all too short account of endocrine disorders in children, which is crisp and much to the point. It is supplemented by a good article on pituitary disorders in childhood by H. S. le Marquand. F. Murgatroyd deals competently with the treatment of malaria, but it is surprising that he should sanction the combination of atebirin and plasmoquin which, in the opinion of many, is more liable to lead to toxic symptoms than when these drugs are administered at different times in the same course.

A most useful and helpful article on the treatment of heart attacks is given by Terence East. Head injuries are well reviewed by G. C. Knight. L. O'Shaghnessy and D. Stone point out that the only patients with lung carcinoma who have survived over a period of years have those for whom radical operation has been performed.

A very sound contribution is that of Charles E. Newman on the diagnosis and treatment of splenic anaemia. In a chatty and informative article he throws much light on a very confused subject. Other useful subjects included in this volume are sterility in women, dysmenorrhoea, strabismus, fractures of the mandible and otitis media. The book ends with a short instructive series of articles on pitfalls in the diagnosis of swellings of the thyroid gland and breast; and swellings in the axilla, groin and neck. There is another short series dealing with pitfalls in the diagnosis of chest conditions, the most notable of which is that by A. Lisle Punch dealing with intrathoracic tumours.

This modestly priced volume is well bound and easy to handle. The illustrations and X ray plates are very well reproduced. Those who are not misled by the title, and care to regard the book as a sort of refresher course covering a wide range of subjects, will find much in it that will appeal to them.

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## Acknowledgments.

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