line; both pupils contract to light and on convergence. The optic discs are normal.

The articulation is much affected, slurring and indistinct, and is accompanied by inco-ordinate movements and tremors of the lips and tongue. "Hippopotamus" and other test sentences are pronounced in the characteristic G.P.I. fashion.

All the deep reflexes are distinctly exaggerated. The plantar reflex shows active flexion; the abdominal and cremasteric reflexes are present. The organic reflexes (bladder and rectum) are normal. There are no signs of disease in the other systems or organs.

Lumbar Puncture.

An examination of the cerebro-spinal fluid revealed some very interesting facts. The fluid came out under distinct pressure; it was very slightly turbid; this turbidity was not due to the admixture of blood; it was alkaline in reaction, and had a specific gravity of 1001.

After centrifuging 5 c.cm. of the fluid for ten minutes, decanting and examining the deposit, it was found that the film presented an extraordinary appearance. Here and there the leucocytes were collected in great masses several layers thick; between these masses they were more sparsely distributed (Fig. 1). In places where the distribution was fairly uniform there were, under a magnification of 450 diameters, about 3,400 leucocytes to the field (Fig. 2).

In a fresh specimen of the fluid which had not been centrifuged, there were on an average 285 leucocytes per c.mm.

In the dense parts of the film all the leucocytes appeared to be lymphocytes, but in the thinner parts it was found that polymorphs were present in the proportion of 1 to 5. The lymphocytes varied considerably in size, the great majority being small.

Chemical examination showed that the fluid contained a large amount of albumen.

A lumbar puncture was made on several different occasions and the results verified by Dr. Edwin Bramwell, Dr. Ford Robertson, and Dr. W. T. Ritchie. Dr. Ford Robertson and Dr. Ritchie made bacteriological examinations of the fluid, with negative results.

ANAESTHETICS IN GENERAL PRACTICE.

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It is my intention in this paper to recount some of the details which procure success in the administration of anaesthetics in general practice. It would not be wise to refrain from the preliminary remark that safe anaesthesia cannot be conducted without actual personal practice on the part of the administrator, for the larger his experience of its difficulties the greater becomes his facility in preventing their onset, and in correcting untoward symptoms when they have arisen.

There are two main principles by which the administrator must be guided in his care of an unconscious patient: (1) To retain a weakly active corneal reflex, and (2) to keep the airways clear.

1. The Corneal Reflex.

The most sensitive spot on the eye is the centre of the cornea opposite the pupil. This is protected from injury in daily life by the smart closure of the upper eyelid on contact with a foreign body. When a patient is unconscious the muscular reflexes are gradually lost in a definite order as narcosis deepens, but the sensitiveness of the centre of the cornea does not disappear until last of all, and this happens *before* the respiratory and cardiac centres are themselves invaded.

I cannot lay it down too emphatically as an invariable law that it is impossible under any known conditions for the respiratory centre or the cardiac centre to be poisoned by chloroform or ether whilst the upper eyelid still closes when the centre of the cornea is touched by the finger.

This sign, therefore, furnishes an absolute guide to safety, in that, if by careful frequent testing of both corneae a condition of weakly active reflex closure of the upper eyelid is always retained, any complications which occur cannot be due to central poisoning of the respiratory or cardiac nervous mechanisms. An extraordinary fact connected with this simple procedure is that so very few know how to do it. The administrator stands behind the patient, and uses only one finger with which to raise the upper eyelid and touch the cornea. That is, he should insert the pulp of his middle finger between the palpebral edges, drawing the upper eyelid upwards and at the same time brushing that finger pulp lightly against the centre of the cornea. When he has arrived at the upper limit of

the pupil he should let go altogether, noting both by the senses of touch and sight the degree of briskness with which that upper eyelid closes.

The frequent mistake which is made verges on the ludicrous, for the eyelid is held open with one finger so that it cannot move at all, and then the cornea is rubbed with another finger whilst the observer gazes doubtfully at the inert ocular globe.

An improperly-elicited corneal reflex is not only useless but dangerously misleading. The sclerotic portion of the eyeball is weak in tactile sensibility, and is useless as a guide in surgical anaesthesia. The lower eyelid in man does not and is not intended by Nature to cover the cornea, and corneal contact has practically no effect upon it in the unconscious state. There is only one proviso with regard to this sign, which is that when a definite difference exists in the activity of the two upper eyelids, we must be guided by the more active. Working on this principle, on account of the fact that a large pupil is found both in the second and fourth stages of anaesthesia, which can only be differentiated by reference to the activity of the corneal reflex, pupillary signs may be neglected altogether. A progressive dose of chloroform or ether having been given until the upper eyelid is weakly active in response to corneal contact, this condition can be exactly retained throughout by stopping the anaesthetic for a few breaths to quicken its activity, or giving more anaesthetic to weaken it as required.

Put in another way, the addition of more anaesthetic by the administrator should always be a guarantee to the surgeon and onlookers that the patient has at that moment a demonstrable corneal reflex.

2. To Keep the Airways Clear.

It is necessary to know by the sound of the breathing when they are clear. There is, of course, a distinct difference between the sounds of inspiration and expiration; but this is only known instinctively after careful practice. The rule in anaesthesia is that every expiration must be either heard or felt by the administrator in order to make sure that efficient breathing is going on. It is of no use to see the abdominal and thoracic movements, for they may proceed for a considerable time after obstruction to air entry has taken place. Fifteen years' experience has taught me that unrecognized obstruction to air entry is the main factor of danger and death in anaesthesia, that dosage regulated by the corneal reflex is rapidly learnt and easily adjusted; but that elimination of asphyxial factors in all cases is the avocation of an artist and the study of a lifetime. The successful elimination of the numerous possible asphyxial factors as they arise depends upon their immediate detection, causal differentiation and application of the proper remedial measure without hesitation. So subtle in their action are some of these factors that the clinical effect first noticed is often only a secondary syncopal result upon the heart and circulation, when the general condition is graver than it ought to have been allowed to become.

Duskiness of the lips and ears is a sign that air is not entering the lungs in adequate amount, and is due to this absence of air-intake, not to ether or chloroform *per se*. Here we have a definite physical sign, and the man who guides himself by the sound of breathing, putting in a small mouth prop, raising the jaw or drawing the tongue forward directly the sound of breathing through clear airways is replaced by that of partially obstructed respiration, prevents the onset of duskiness and its consequent additional dangers.

I venture to assume that the operations for which anaesthesia is most frequently required in general practice, with the exception of dental extractions, are those undertaken by general practitioners themselves, and do not include those for which a surgeon has been engaged.

Dental Extractions.

In the employment of nitrous oxide gas for dental extractions, practice is especially required, not because of danger of giving an overdose, but on account of the extremely short anaesthesia which results from its administration.

Attention to a number of small details which greatly assist the dentist in his work is the only means of ensuring a painless operation under its influence. We

should remember that patients usually obtain their first practical knowledge of surgical anaesthesia in the dental chair, and in order to obtain the confidence of the public we should be most particular that no pain whatever is felt during dental extractions, so that when serious surgical operations have to be faced fear of a semiconscious condition may not be added to the patient's other trials.

There is a very great difference in the amount of nitrous oxide required by lethargic persons of slow speech and nervous, rapid talkers; the well-nourished, healthy girl of 15 provides the ideal subject; the powerfully-built plethoric man the most difficult.

In the first place, in order to prevent the tongue gravitating backwards and obstructing the airway, the patient *must* be seated quite upright in the chair with the head in a line with the body, *not* extended backwards. Dentists soon learn the value of this precaution, but if one should still insist that he cannot operate on a particular tooth in this position (though I think it is quite a fallacy), the chair may be inclined a little backwards after anaesthesia has been induced just before the removal of the facepiece. Dr. Hewitt's mouth props for insertion between the molar teeth are the best, because they bridge across two or three teeth and do not become dislodged. They should be placed in the mouth upon the side opposite to the site of the first extraction and kept in place by slight pressure upwards against the lower jaw.

The dental chair should not be raised very high, for unless both are tall men the doctor's control of the patient and the poise of the dentist are both lost by the patient being out of proper reach.

Movements of the patient's legs nearly always take place during gas anaesthesia, and his heels should therefore be either resting loosely on the floor of the room on either side of the chair or over the *end* of the chair platform, so that the legs are relaxed and no fulcrum exists for the limbs to push the body backwards and disturb the position of the head. Many an otherwise successful case has been ruined for lack of this simple precaution, which should never be neglected. The fingers of the patient's hands should be interlaced and clasped together in the lap for similar reasons.

Men's collars should be removed to prevent their being soiled by blood, which always runs out of the mouth straight down the chin and neck. Patient's friends should not be allowed near the chair, but placed some way off behind it where they cannot see the patient's face and the actual operation, but most patients behave better without friends in the room.

Too much should not be promised nor attempted at one sitting. I have a very great respect for the difficulties of tooth extraction, and one tooth may often require two doses of ordinary gas for its extraction if it should break off before its roots are all out. Two, or at most three, average teeth should only be promised at one sitting, unless they are loose.

Supposing the teeth to be extracted to be on both sides of the mouth, the doctor can give the best help in keeping the mouth open if the extractions are first made on the patient's left side—that is, the side upon which the doctor stands, for when these are finished he can then most readily slip in a Mason's gag on this left side, and pull out the mouth prop from the right side ready for the next extraction. The doctor should always have a clean sponge at hand to aid the dentist in sponging blood away from the alveolar margins during root extractions.

Oxygen in varying quantities from 6 to 15 per cent., added to nitrous oxide according to requirement, in order to eliminate asphyxial factors, aids enormously in the management of all kinds of patients, and personally I never administer it without. Great advantage can be obtained by the use of nitrous oxide and oxygen through Paterson's nose-piece for continuous administration, which I employ for difficult cases requiring four or five minutes' anaesthesia. The nearest approximation to the good colour and tranquillity ensured by the addition of oxygen is attained with the simple gas apparatus by admitting one breath of air after ten respirations of gas, and another breath of air at each succeeding fifth respiration until the eyes are in a fixed position, and some stertor has arisen. Absolute silence should be maintained during the operation as talking is remembered by the patient afterwards. Towards the termination of the period of anaesthesia the

dentist should be told to "stop" at the moment when, the left eyelid being held open, voluntary movements of the eye in looking round recommence. Sensation to pain is the last faculty to recover from nitrous oxide anaesthesia.

Gas and ether is most valuable in more extensive dental operations, and may quite safely be given to patients sitting upright in the dental chair, though it is best to lay them flat on a sofa for the after-period of recovery. With a Clover's gas and ether apparatus, a small mouth prop always being first inserted, five breaths of nitrous oxide are first given, the valves are then thrown out of action, and rebreathing into the gas bag commenced; immediately after this, ether is gradually introduced; when stertor has arisen, the small ether bag is applied instead of the gas bag, and a breath of air allowed at every fifth respiration. One good dose of ether taking five or six minutes to administer produces more satisfactory anaesthesia and less after-effect than two or three short doses, and when ether has been chosen this plan should always be followed. Children awake very quickly from a single dose of ether.

Circumcision.

More deaths and conditions of danger under chloroform have occurred during circumcision than are warranted by the gravity of the operation. In infancy and early childhood the C_1E_2 mixture followed by ether on an open mask should be used, because the reflex effect upon the respiration always produced by nipping and cutting the prepuce is not so marked nor so dangerous when respiration is fairly deep, and the circulation well stimulated by ether.

It is not wise nor necessary to obtain a degree of anaesthesia free from all reflex movement of the thighs for circumcision in childhood; but, having weakened the corneal reflex, it is well to get the nurse to place her hand on the patient's knees to prevent their upward reflex movement when the prepuce is first seized and to keep them down during the operation. Reflex laryngeal crowing almost always arises also at this moment, and the lips should then be rubbed briskly with a towel to stimulate deeper breathing; the jaw should be pushed forward and the anaesthetic withheld until respiration is more regular.

For adults gas and ether or open ether is the proper anaesthetic.

Ingrowing Toenail.

If nitrous oxide and air be the anaesthetic selected, an assistant should be present to hold the leg above the ankle, or it must be tied down securely to the bed, because the extremities are extremely sensitive, and reflex movements of the feet and legs are certain to take place and cannot be controlled by this anaesthetic.

I am, however, of opinion that in order to complete the operation when undertaken at the patient's house, it is far more satisfactory to put the patient under the influence of the C_1E_2 mixture or open ether, when all need for undue haste is avoided, muscular flaccidity is obtained, and if the patient is prepared by four or five hours' abstinence from food, after-effects are very slight indeed.

Adenoids and Enlarged Tonsils.

It must be borne in mind that patients with these affections have more or less obstructed air passages, and that the operation and the bleeding it causes also cause intermittent respiratory obstruction.

Chloroform *plus* asphyxial factors of this severity is unnecessarily dangerous. The C_1E_2 mixture is, without doubt, the most appropriate anaesthetic, because it keeps the patient's colour pink, and maintains moderately deep breathing, a condition which allows of short intermittent spells of air limitation without much fear of depression. Dosage should proceed until the corneal reflex is definitely weak, then three or four respirations of air should be allowed before beginning the operation, so that it may be done during the *return* from the maximum dose, thereby retaining the coughing reflex to reject the blood from the throat.

It is wrong to anaesthetize small children in one room and then carry them into another room for operation. The movement lowers the blood pressure dangerously, and greatly increases the risks of the whole proceedings. Children are not dismayed by lying down upon a proper table in a warm room prepared for operation, but are only mildly interested in the novelty of its appearance. The

induction of anaesthesia in a child's iron cot with high barred sides is very difficult, and the child is most apt afterwards to associate its experiences with its own sleeping bed instead of with a table which has then been taken quite away.

The mothers of these children are frequently absurdly lacrymose, and unnerve the child by their presence at the beginning of affairs. The surgical nurse or doctor should therefore take them into the room and the mother should go downstairs until called for after all has been completed.

Sebaceous Cysts.

These cannot be completely removed under nitrous oxide gas owing to venous oozing obscuring the cyst wall, and the C_1E_2 mixture is the most satisfactory anaesthetic for the patient and operator. These cysts are not very sensitive unless inflamed, and there is no need for a very deep anaesthesia. Their position on the scalp is often somewhat inaccessible when the patient is lying down, and a table should be used instead of a bed, so that the head may be properly reached from its upper end. If the patient has to be laid partly on his face he should be anaesthetized lying on his side and then rolled into position, care being taken that the chest walls can freely expand in respiration.

Dislocations.

Patients meeting with an accident causing dislocation of a limb are unprepared by abstinence from food for an anaesthetic, and are not likely to take it well. A jaw gag must be at hand in case of semi-solid vomiting, and, whatever anaesthetic is used to make the patient unconscious, ether should afterwards be given to obtain muscular relaxation. A great many deaths have occurred under chloroform unwisely pushed for this purpose. C_1E_2 followed by ether or gas and ether are the most suitable and safe anaesthetics to employ.

Diagnostic Examinations.

Chloroform may be wisely administered for examinations, except in rectal cases, where dilatation of the sphincter and causes reflex laryngeal spasm and ether should be used.

As chloroform requires some days for its complete elimination from the blood, it is wise not to employ it for a lengthened examination the day before a contemplated operation. After an interval of four days less after-effects result from the second anaesthetic.

Just as much careful watching of the patient must be practised as during a surgical operation; but two great factors, namely, the inhibitory reflex effects produced by surgical stimuli and haemorrhage, are absent.

Parturition.

One observation only is needed in conclusion. It should not be forgotten that all the conditions during confinements are extremely favourable for the administration of chloroform—the lateral posture, the higher blood pressure, the deeper respiration, all assist materially in the maintenance of circulatory equilibrium. The absence of difficulties and depressing effects from chloroform at confinements must not be looked for in other patients during other operations.

RESECTION OF THE TRACHEA FOR CICATRICAL STENOSIS.*

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So far as I can gather, it seems usual in cases such as that about to be described to attempt to dilate either through the larynx or a tracheotomy opening, but these methods are exceedingly tedious and admittedly unsatisfactory. In a *System of Practical Surgery*, by Professor E. von Bergmann, vol. xi, p. 220, it is stated that "extensive circular scar stenoses or complete occlusion form an indication, according to the experience of Kuster

and v. Eiselsberg, for circular resection with subsequent suture of the trachea." In my case the trachea rapidly became obliterated by a considerable mass of new tissue, and it seemed to me in accordance with surgical principles to excise the involved segment when dealing with a non-collapsible tube of large calibre like the trachea. The occurrence of so serious a complication as secondary haemorrhage may appear as a fitting rebuke for adopting an audacious proceeding, but it appeals to me rather as a warning against the close suture of the external wound in cases where the area has become septic from the constant presence of a tracheotomy opening.

The patient was a man of 25, who inflicted the injury in a fit of depression following alcoholic excesses.

He was admitted to the infirmary on April 16th, 1908, in such a collapsed condition that his recovery was despaired of. There was a fearful gash in the neck almost completely severing the trachea, though the great vessels had escaped.

Next morning he was so much better that chloroform was administered and the injured parts thoroughly examined by the house-surgeon. It was then found that the trachea had been divided just below the cricoid cartilage, and that the sterno-mastoid and infra-hyoid muscles had been partially divided. The wound was thoroughly cleansed and the trachea drawn up to the cricoid with three catgut sutures, the muscles being separately repaired with catgut. Tracheotomy was not considered necessary, but the superficial wound was left partly open.

From the time the patient first began to talk the voice was characteristic of recurrent laryngeal paralysis, and this condition never altered. Unfortunately suppuration occurred, and the wound only healed slowly by granulation. The sutures holding up the trachea gave way, and it was found necessary to introduce a tracheotomy tube. As cicatrization proceeded all attempts to dispense with the tube gave rise to much distress, and it was obvious that the trachea was becoming stenosed.

On May 15th an anaesthetic was again administered, and just above the tracheotomy opening the trachea was found so much stenosed that it would only admit a fine probe through a channel at the summit of a funnel-shaped narrowing. It was found possible with a pair of sinus forceps, followed by artery forceps, to easily dilate the stricture, and an attempt was made to keep it patent by a silver tracheotomy tube passed upwards into the larynx through the top of a large rubber tracheotomy tube introduced in the usual way (in imitation of Störk's tracheal cannula and dilator). As might have been expected, this plan was not successful, and, in spite of all our efforts to keep the trachea open, it became necessary to interfere again, or let the case drift into one of permanent stenosis with its necessary tracheotomy.

On June 12th the last operation was performed, again under general anaesthesia. This time complete obliteration was found, the lumen of the trachea being filled by a mass of scar tissue; it was therefore decided to resect the involved portion. The cricoid and the upper part of the windpipe were accordingly thoroughly exposed through a vertical incision, and a complete segment of the trachea excised. The resulting gap was very wide, but the trachea was freed without fear until it could be easily approximated to the cricoid, to which it was fixed by several No. 1 chromic catgut stitches passed around the upper ring of the trachea and through the cricoid, care being taken to tie the knots on the outside. The posterior and lateral surfaces were brought into perfect apposition, but there was a little irregularity of the union in front. A vertical opening was made into the trachea about $\frac{1}{2}$ in. below the line of suture for the introduction of a small silver tracheotomy tube. The skin incision was then carefully closed by silk worm stitches. The part removed consisted of a complete transverse section of the trachea with two rings, the lumen being completely obliterated by a mass of scar tissue.

For five days the patient went on very well, but there was then a little suppuration with rise of temperature, and the skin wound gave way. On the eighth day, without any warning, he had a sudden profuse haemorrhage. The bleeding clearly came from the left side of the wound from a recess by the side of the trachea, and, after resisting all the efforts of the house-surgeon, it stopped spontaneously. As the source of the haemorrhage was doubtful, and its spontaneous arrest probably only temporary, I thought it wiser to give an anaesthetic, and, if possible, deal directly with the bleeding point. As a matter of fact, I was only able to curette a small cavity, which I packed with gauze soaked in turpentine. As one or two of the sutures in the front part of the tracheal wound had given way, two silk worm stitches were introduced and subsequently removed.

After this the patient made a straightforward recovery and was soon able to leave the hospital, the wound healing completely in the sixth week following the resection operation. When shown at the meeting in December, 1908, he was very well and had no difficulty in breathing except on severe exertion or when suffering from cold. The scars in the neck were not very obvious, but on palpation the trachea was found to be a little narrowed from before backwards and this was well shown on x-ray examination.

Dr. S. S. Whillis kindly examined the larynx and reported paralysis of the left vocal cord, general hyperaemia of the laryngeal and tracheal mucous membranes, but no evidence of stenosis as far as could be seen.

* The case that forms the subject of this note was shown at a meeting of the Newcastle-upon-Tyne Clinical Society.