He plots nine curves at weekly intervals and gives detailed figures for three more, also at weekly intervals, and, taking the twelve together, there is evident a marked fall in the average values, a break in the curve, in the July-August period. So far as published meteorological data enable one to judge, this is not due to change in the weather conditions. It may be noted that in the curve published by Kroon,³ showing the seasonal variation in the frequency of human conception, as calculated from the birth curve, there is a similar break in August.

SUMMARY.

In tuberculous patients undergoing sanatorium treatment there is on the average a steady increase in weight. This increase shows a marked seasonal variation, being greatest in the six months from May to October with the maximum in September, and smallest in the six months November to April with the minimum in March.

The six months of greatest weight are also the months of most sunshine, highest temperature, largest rainfall, and greatest atmospheric water-content. This agreement suggests that the weight variation is due to meteorological conditions, but, if it be so, the climatic influence can only be indirect, and no single factor has predominant effect. Sudden changes from week to week occur in the average weight, and there is nothing in the available records to show that these changes are due to weather conditions.

I have pleasure in expressing my thanks to Dr. S. Vere Pearson for permission to use the Mundesley records, and also to Sir Napier Shaw, of the Meteorological Office, for the loan of records and other kind assistance.

REFERENCES.

- ¹ See, for example, BRITISH MEDICAL JOURNAL, 1916, April 15th, p. 541. ² Strandgaard, *Beitr. zur Klin. d. Tuberk.*, 1914, Bd. 32, H. 2, p. 179. ³ Kroon, *Nederland. Tijdschr. v. Geneesk.*, 1914, December 19th, p. 2010.

A METHOD OF ANAESTHETIZING SOLDIERS.

BY

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I HAVE long noticed that when coughing occurred during the early stages of etherization a change for a few minutes to chloroform stopped the cough and much lessened mucous secretion. The small quantity of chloroform inhaled exercised apparently a prolonged mitigating effect on the irritating quality of the ether. It seemed to me, therefore, that if the short interval of chloroformization had such a prolonged effect it might be worth while to try the addition of a small quantity of chloroform to the ether in Clover's inhaler, with the object not only of lessening irritation but also of obtaining an anaesthesia more nearly approaching the ideal—that is, a sleep-like one. Since chloroform acts as a depressant, but ether as a stimulant, it should be possible to obtain by a mixed vapour of these two drugs an anaesthesia in which, while there is a proper muscular relaxation, the respiratory and circulatory functions are neither depressed nor stimulated but approximate to their condition during sleep. Such a mixture would probably differ in its proportion according as to whether the open or closed method were used, and also according to the type of patient, if the best results were to be obtained. Perhaps the best all-round mixture would be one in which the respiration and circulation are very slightly stimulated by the addition of a little more ether, thus ensuring safety and counteracting any shock arising from the operation. The idea is to take ether as the standard of safety and so to dilute or modify its action as to obtain some of the advantages of chloroform anaesthesia. Ether thus modified by chloroform, as suggested later, possesses practically the safety of pure ether. When we use such mixtures as E_2C_1 , E_3C_1 , we regard chloroform as the main drug and modify its action by the addition of ether. It has been shown of late years that the mixing of chloroform with ether enhances the anaesthetic power of each drug; indeed it has been asserted that a mixture of six or seven parts of ether with one part of chloroform increases the potency fully 30 per cent. without increasing the toxicity.

Having at the 1st Southern General Hospital, Edgbaston, the opportunity of anaesthetizing soldiers—that is, patients of much the same age and type, and trained, fed, and living under the same conditions—I tried the effect of different mixtures of chloroform and ether administered by the closed method from a Hewitt's wide-bore modification of Clover's inhaler. To soldiers a routine method seems particularly applicable. They are mostly strong and fit men, well fed, much accustomed to tobacco and consequently with irritable throats; nearly all have coughs due to exposure to wet and cold indoors and out; their nervous system is on a much higher plane of tension than that of the normal individual during ordinary times, so that altogether as a type they are much more difficult patients in whom to induce anaesthesia than are the general run of those met with in civil practice. On the other hand, when once induced, anaesthesia is maintained in them more safely and easily than in the ordinary non-military patient, because, generally speaking, of the healthy conditions in which the former have been living. In fact, soldiers more nearly approach the normal healthy human being than does any other class of patients.

At the end of October, 1915, I began to use various mixtures of chloroform and ether in Hewitt's wide-bore Clover's inhaler, beginning with mixtures of E_4C_1 , E_7C_1 , E_8C_1 , $E_{16}C_1$, $E_{18}C_1$, $E_{20}C_1$, $E_{32}C_1$, by volume.

In the first three of these mixtures the chloroform factor predominated too much for safety, causing blueness and too quiet respiration, whilst in the last one the ether component predominated too much, and the effect of the chloroform was practically negligible. Finally, in $E_{16}C_1$ I found a mixture which suited admirably my purpose, and have used it in more than 1,200 cases. Since the above-mentioned date it has been my routine method for the induction and often for the maintenance of anaesthesia. The $E_{18}C_1$ and $E_{20}C_1$ mixtures I found very useful for debilitated patients.

In 1916 I administered $E_{16}C_1$ to 732 out of 843 cases at the 1st Southern General Hospital—that is, to practically 7 out of 8 patients.

I look upon it as and call it "mitigated ether," and administer it exactly as I should ether by the closed method, the only difference being that during induction I very often allow one or two inspirations of air.

The respiration and circulation are slightly stimulated, the patient is of a good colour, respiration being about half as deep as that during pure etherization. There is much less irritation of the respiratory mucous membranes than with ether alone, but if much coughing ensues during induction, as so often happens in soldiers, I immediately change down to a mixture of chloroform and ether, or more commonly to chloroform alone given by the open method. In fact, in the last few months, in nearly all operations which last longer than a few minutes, save rectal ones, after induction of anaesthesia has been safely brought about and some degree of stimulation of the vital functions established by $E_{16}C_1$, I change down to chloroform and find it best suited to maintain anaesthesia.

The contraindications to the addition of the small amount of chloroform to the ether are cases in which the fullest stimulation by ether is needed, as in patients in whom there is great shock, loss of blood, or toxæmia, or where rapid dilatation of a sphincter or stricture is necessary.

As compared with pure ether, administration of $E_{16}C_1$ by Clover's inhaler causes less irritation, less muscular spasm, less mucous secretion, less excitation, and less obnoxious smell. The induction of anaesthesia is quicker and quieter and muscular relaxation appears more quickly and is more complete. The addition of this small amount of chloroform seems to make a very great and advantageous difference. The $E_{16}C_1$ may easily be given without any preliminary administration of nitrous oxide or ethyl chloride.

All soldiers have a preliminary intramuscular injection of morphine one-sixth of a grain, and atropine one-hundredth of a grain, as nearly as possible half an hour before the time of operation, so that the maximum effect of these drugs is obtained. This injection is essential for quiet induction and stoppage of secretion. The effect of the morphine helps greatly to quieten induction and to maintain and steady the anaesthesia. It also enables a lighter form of anaesthesia to be used than is possible without it. The disadvantage of the morphine is that

very occasionally, owing to the light respiration, the patient may become a trifle bluish under chloroform.

Since 1901, when I first used it by the closed method, I gave ethyl chloride as a preliminary to etherization, but since administering "mitigated ether" it occurred to me that a better preliminary would be a few drops of a mixture of two parts of ether and one part of chloroform dropped into the bag of the inhaler, just as is ethyl chloride. At first I used to drop the mixture on to a little wad of wool fixed in the angle piece to which the bag is attached, but I soon found it better to spray directly into the bag 15 to 20 drops (not minims— $2\frac{1}{2}$ drops are about equal to 1 minim) of E_2C_1 . This quantity seems to be equivalent to the usual dose of 3 c.cm. of ethyl chloride. The few drops of this mixture do not volatilize so quickly as does ethyl chloride, the vapour does not surge into the head so rapidly, and the transition from the one mixture of chloroform and ether to another mixture of the same components seems somewhat easier, quicker, and smoother than from ethyl chloride to ether or to "mitigated ether." The small quantity of mixture so administered is far less costly and more convenient than ethyl chloride, and I now use it before giving ether in private work.

With regard to the course of anaesthesia during the administration of $E_{16}C_1$ I have had two cases in which respiration ceased, in one of which the fault was due to inadvertence. In both cases the pulse and colour remained excellent, and respiration quickly restarted after a few compressions of the chest. Otherwise I have had no danger or trouble.

With regard to lung troubles I have had four cases of pneumonia and two or three of bronchitis.

Pneumonia.

Case 1.—Patient aged 25; stone in ureter. No cough before operation. Anaesthetic, E_2C_1 , $E_{16}C_1$. Anaesthesia lasted about fifty minutes. Three days afterwards the patient developed a high temperature and cough. The officer in charge said the patient had a bronchopneumonic patch lasting three days.

Case 2.—Patient aged 22; double hernia. Had cough for years and been subject to attacks of bronchitis since childhood. Anaesthetic, E_2C_1 , $E_{16}C_1$, followed by chloroform as soon as under. Developed pneumonic signs at right base, later on had signs at both bases. The patient was very ill, but recovered.

Case 3.—Patient aged 26; appendicectomy. Anaesthetic, $E_{16}C_1$, chloroform for a few minutes, $E_{16}C_1$. Administration lasted half an hour. Had general bronchitis and right apical pneumonia. Denies previous cough.

Case 4.—Patient aged 23; nephrolithotomy. Rather pink and flabby-looking; chest normal, no cough. Anaesthetic, E_2C_1 , $E_{16}C_1$. Perfect anaesthesia for three-quarters of an hour. Next day developed bronchitis and high temperature, then bronchopneumonia; very ill for three days. The ward was a very cold and draughty one.

Bronchitis.

Case 5.—Patient aged 24; hernia. Anaesthetic, E_2C_1 , $E_{16}C_1$. Anaesthesia lasted thirty-five minutes. Bronchitis for two or three days afterwards.

All these patients had morphine $\frac{1}{2}$ gr. and atropine $\frac{1}{150}$ gr. before anaesthesia, and had no mucous secretion; therefore there was no question of inhalation of septic material from the mouth.

Two other patients, in addition to Case 5, had a good deal of bronchitis afterwards. There was no prolonged sickness after any administration. It is very probable that in no case was the lung trouble wholly, or even partly, due to the anaesthetic, because the patients had to be transferred after operation along draughty corridors to wards which were also sometimes draughty and cold, and were never intended for hospital use.

In the pressure of present-day hospital work rapid induction of anaesthesia is necessary. The method described is all round the quickest and least unpleasant one I know, and is practically as safe as the more usual sequences of gas and ether or ethyl chloride and ether. Refinements and time-spending methods of administration, such as gas and oxygen, intratracheal anaesthesia, open ether *ab initio*, percentage inhalers, have little scope and less efficiency, when applied to tough fighting men, in the routine of a big and busy hospital. Safe, simple, and speedy methods are the most valuable.

CONCLUSIONS.

1. The irritation caused by ether vapour administered by the "closed" method is much mitigated by the addition of a very small quantity of chloroform.

2. The addition of this small amount of chloroform to ether distinctly saves the work of the lungs and heart, which during a long or severe operation may be a very important factor.

3. The mixture is practically as safe as the administration of ether alone, because the ether greatly predominates.

4. It is valuable as a routine method of producing anaesthesia in soldiers, being reasonably safe and rapid.

5. A few drops of E_2C_1 are preferable to ethyl chloride as a preliminary to the administration of ether, or $E_{16}C_1$.

6. For maintenance of anaesthesia E_2C_1 or chloroform are preferable to even "mitigated ether," owing to the prevalence of respiratory irritability among soldiers.

MULTIPLE SEVERE INJURIES FROM A BOMB EXPLOSION: OPERATION: RECOVERY.

BY

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THE following case deserves attention on account of the multiplicity of the wounds, their seriousness, and the good recovery following operation.

Pte. J. W. P., aged 25, while practising bombing on December 17th, 1916, threw a bomb which burst prematurely at about a distance of a little over a yard from his head. This occurred about 11.30 a.m. He was dressed by the medical officer of his battalion, and was brought at 12.45 p.m. by ambulance to this military hospital, where he was examined immediately on admission.

He was quite conscious, and complained much of abdominal pain; he said he was quite blind. Pulse 120, temperature $97.4^{\circ}F.$, respirations 20. He showed a considerable amount of blanching, and was suffering from great shock. The wounds were as follows:

1. Wound of the scalp, 2 in. long, on the vertex down to the bone.
2. Perforating wound entering the abdominal cavity at the junction of the ninth costal cartilage with its rib on the right side.
3. Wound of left thigh entering the left groin 1 in. below Poupart's ligament, in a line with the vessels, and with its exit below the left knee, apparently smashing the head of the tibia and tearing the patellar ligament.
4. Wound in the right groin 1 in. below Poupart's ligament.
5. Small superficial wounds of right and left arms, abdominal wall, etc.

Operation: The patient was brought to the theatre at 3 o'clock the same day, and anaesthetized by ether. He had already had $\frac{1}{2}$ grain of morphine hydrochloride and 500 units of antitetanic serum. With the assistance of Lieutenant J. F. Gill, R.A.M.C., the skin around the wound over the ninth costal cartilage was excised, and it was seen that the cartilage had been half torn through and a fragment had perforated the peritoneum. This wound was then sewn up.

The abdomen was immediately opened in the hypogastrium by splitting the right rectus sheath and pulling the rectus towards the middle line, the nerves to that muscle being preserved by pulling downwards. The abdomen was found to contain about a pint of blood and blood-stained serum. This was mopped out, and an examination was made of the abdominal contents. The liver was found to be intact, as was the stomach. The duodenum was found to have a perforating wound at the middle of the second part, practically in the centre of its anterior surface; this was closed with a Lambert stitch of linen thread. The jejunum was next followed, and there was found, about 12 in. down, a perforation at the free edge and another on the mesenteric edge, with a small chunk of bomb-case lying in the mesentery. The missile was removed and the three holes closed by Lambert sutures of linen thread. No further abdominal lesion was found, though it was noticed that gauze which had been placed near the duodenal lesion had a little bile on it, but search failed to reveal any injury. As the patient was in a very exhausted condition the search was not prolonged; a rubber tube rolled up in gauze was inserted down to the duodenum and another at the lower angle of the wound down to the recto-vesical pouch, and the abdominal wall closed in layers. Attention was then turned to the left groin, the skin wound was excised, and there was found to be considerable arterial oozing from the depth of the wound. This was opened up freely, the sartorius muscle retracted inwards, and the track of the foreign body was followed. This caused more bleeding. Digital pressure was put on the femoral artery, and by following the track of the haemorrhage one quickly came on the femoral artery and vein at the upper end of Hunter's canal. The artery was isolated and ligatured above and below with stout catgut. On removal of digital pressure there was only a little venous oozing, but on lifting up the artery there was quite a rush of venous blood. Pressure was applied above and below, the artery lifted up again, when it was seen that there was a small longitudinal tear in the vein. This was stitched up with a fine linen stitch for want of better material, as it was considered that ligation of both artery