organisms set up an arthritis early in the course of the illness.

Leucocytosis does not seem to be a marked feature; in two acute cases (Pilcher) there was no leucocytosis, whilst in one of our chronic cases there was a slight increase (19,000), but no increase of the polymorphs; and in an acute case of Wherry's there were 21,000, but he does not mention a differential count.

Agglutination Test.—In horses McFadyean has obtained positive agglutination phenomena in very weak dilutions—1 in 1,600 as compared with 1 in 300 in healthy animals. Dr. Eyre tells us that in 3 cases recently admitted to Guy's Hospital the serums agglutinated *B. mallei* in dilutions of 1 in 100. In our Case II no definite results could be obtained, and various observers have obtained different results; so at present the value of this diagnostic procedure must be regarded as indefinite.

Mode of Infection.

In none of our cases was there definite evidence of the point of inoculation or path of infection, and the general evidence, clinical and experimental, on both these questions is so conflicting that the time is hardly ripe for the expression of decided opinions. The hypothetical paths are by direct inoculation through a wound or by the hair follicles, by inhalation or by ingestion.

Direct wound infection is conclusively proved by laboratory accidents; glanders has been assigned as the most frequent cause of accidental death amongst laboratory workers.

As to the hair follicles, Babes performed numerous experiments on guinea-pigs, rubbing in an emulsion of *B. mallei*, and succeeded in producing infection. Nocard, however, repeated the experiments with indefinite results.

Infection by ingestion has been definitely proved, in horses, by MacFadyen, but the comparative frequency of respiratory lesions and the infrequency of abdominal, in man, suggests that the problem will be as difficult of solution as that which has to be faced in the case of tuberculosis. Gutowski pointed out that ward infection does not occur, and in this connexion we may record that one of our acute cases on several occasions was allowed to breathe through an apparatus containing glycerinated broth, which however remained sterile. It is obvious that no stress can be laid on an experiment under such conditions. The fact remains, however, that contact, not only directly with infected sputum and discharges, but even with soiled fomites, may be dangerous.

Weichselbaum and Phillipowicz have recovered *B. mallei* from the urine, and Cao from the milk of sick mares. Cao also observes that the *B. mallei* remains virulent after passing through the alimentary canal of flies and other insects.

Although it is generally recognized that knackers and others dealing with glandrous carcasses are rarely infected, yet the case is different with man, because the disease is necessarily allowed to proceed to the bitter end; and it is only in the latest stages that the organism becomes generalized in the blood, which is then highly infectious.

Extension from a primary local lesion, if it occurs, does so in the first instance by the lymphatic vessels; and this, unlike the blood infection that may ensue, is not necessarily fatal.

Latency of the bacillus in the tissues is well recognized, for the records show many cases in which entire quiescence was observed for several years, yet admitting of a fatal outburst. Babes states that he found encapsuled glandrous nodules in the viscera—especially the lungs—of knackers and others dying of some other disease, and discusses the question of occult glanders.

The incubation period varies within wide limits. For instance, in the recent Czernowitz laboratory accident the disease broke out amongst several of the staff in a few days after the scattering of the bacilli by the breaking of a centrifuge tube; in Stewart's case, after the autopsy on a guinea-pig, the first symptom appeared in six days; in Pilcher's case, six weeks after a bite by a glandrous horse.

In conclusion, we must express our thanks to Dr. Hebb for much valued advice; to Dr. Colcott Fox for kindly having had made for us the photomicrographs (Figs. 6

and 7); and to the staff of the hospital and to Mr. C. C. Choyce, for permission to make use of their cases.

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ANAESTHESIA IN THE HUMAN SUBJECT WITH KNOWN PERCENTAGES OF CHLOROFORM VAPOUR.*

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INTRODUCTION.

THE theory and practice of anaesthesia are too often spoken of as distinct and even antagonistic entities. This view is founded on a misconception. Theory is based on practice, and on that alone; and if in practice by careful and accurate measurement any facts appear that are not accounted for by the theory, this must be due to some error in the latter.

There is, however, a suppressed premiss in the statement of the case that is often the unconscious basis of such ideas. It does not necessarily follow that the facts observed on healthy animals can be applied without correction to the pathological conditions often met with in the human subject. It is, therefore, by no means waste of time to examine as carefully and accurately as may be, details of anaesthesia in man that have already been carefully studied in the lower animals, and this is what has been attempted in the observations that are recorded in the present paper.

It is, perhaps, a truism to say that our knowledge of any subject is in direct proportion to the accuracy with which exact measurement can be applied to it. Yet this

* Read before the Section of Anaesthetics, Royal Society of Medicine, on December 9th, 1908.

self-evident statement is sometimes lost sight of in cases like the present, where measurement is often difficult and in some cases still impossible. But the ideal should always be kept in mind, and one should not feel satisfied with our knowledge of anaesthesia until we are able to predict exactly what effect will follow from the inhalation and absorption of a known quantity of the drug employed.

We are still very far from this ideal, but in the present paper one of the initial steps is now taken—namely, that of measuring the percentage in the inspired air.

No attempt has been made to estimate the amount of chloroform absorbed or to trace the fate of such absorbed chloroform in the body, though these factors are of supreme importance in the action of the drug. Yet in justification of the limited scope of our subject it may be urged that the percentage in the inspired air is the only factor that is under the direct control of the anaesthetist, and it is the immediate cause of all effects produced.

APPARATUS.

In order to ascertain the strength of the chloroform vapour at any moment it is necessary to deliver this from some form of machine. Two methods are available for the construction of such apparatus. The first—that employed by Snow, Vernon Harcourt, and Levy—is that where the patient draws the air through the apparatus by means of his respiratory muscles, the so-called "vacuum" system. While this method lends itself to the construction of a small and compact instrument it has the disadvantage that it places some obstruction in the way of free respiration. Whether this does much harm or not, it at least introduces an additional factor, and accordingly the second method—which has been used by Dubois, Waller, and Röth-Dräger—has been preferred. In this case the mixture is supplied to the patient by mechanical power, the so-called "plenum" system.

The apparatus finally adopted after a long series of trials was of a very simple type. It has been already described in this JOURNAL.¹ Briefly, it consists of a circular copper vessel 5 in. in diameter and 4½ in. deep, which contains 150 c.cm. of chloroform; 1¼ in. from the bottom is fixed a shelf closed except for two oblong holes. Immediately above and touching this shelf is a circular plate, movable by means of a hollow rod in the centre, and pierced by two triangular apertures. These can be adjusted by the centre rod so as to expose more or less of the fixed oblong holes in the shelf, and so produce greater or smaller openings into the space below. Air (supplied from a small foot bellows or from an electric fan) enters the chamber by one tube opposite one aperture, and leaves by another tube, opposite the other, taking up more or less chloroform vapour according to the size of the apertures. A thermometer in the hollow rod indicates the temperature of the chloroform below, and a water jacket surrounding the chamber serves to keep the temperature between certain limits.

The first thing to be determined in an apparatus of this kind is the degree of accuracy with which it works under actual conditions of surgical anaesthesia, and this may be a very different thing from the accuracy obtained in a physiological laboratory. In the latter case all that is required to reduce the instrumental errors to a minimum is the careful application of the ordinary principles of physics, but in the anaesthesia of the human subject the first care is the condition of the patient, the second the necessities of the surgical procedure; and it is only when these requirements are satisfied that the observer can take the steps necessary to test the accuracy of the apparatus.

The possible errors can be classified under three headings:

1. Errors of the method used in testing.
2. Errors of the chloroform apparatus itself.
3. Unknown errors due to the necessities of the surgical procedure.

1. Errors of Method.

The percentage of chloroform was determined by means of the densimetric method introduced by Waller and Geets.² Levy³ has shown that this method gives practically identical results with that of the combustion method of Vernon Harcourt.⁴ The maximum error under ordinary conditions does not exceed 0.1 per cent.—that is,

2 per cent. vapour may be read by the densimeter as 2.05 or 1.95 at the worst. As the smallest variation that can be perceived on the patient is 0.25 per cent., this limit of accuracy is amply sufficient.

2. Errors of the Apparatus itself.

The following points were specially tested:

(a) *Errors of Repetition.*—Repeated determinations were made of percentages nominally the same. The results were:

1st Reading.	2nd Reading.	3rd Reading.	4th Reading.
Per cent. (a) 1.15	Per cent. 1.0	Per cent. 1.15	Per cent. —
(b) 1.3	1.15	1.35	—
(c) 1.65	1.6	—	—
(d) 2.5	2.4	2.4	2.4

These readings combine both possible errors, yet the greatest variation of any one reading was 0.2 per cent., and the usual variation about 0.1 per cent. or less.

(b) *Temperature Errors of the Densimeter.*—Waller and Geets give a formula for this correction, but as the conditions were rather different in the present series of experiments, direct determinations were made. The following values were found:

Temperature Fahrenheit.	Gram.	Mean Percentage Correction.
46.0° 44.5°	+0.0025 +0.0020	+0.23
66.6° 65.6°	+0.0010 +0.0005	+0.075
81.0° 81.2°	-0.0010 -0.0015	-0.2

Room temperature, 70° F.

These corrections have, therefore, been applied at the appropriate temperatures.

3. Variations in the Air Supply.

In the special form of apparatus used, air is pumped through the chloroform chamber in a steady stream by either a foot bellows or else by an electric fan. Both sources are apt to vary, so that the point was specially examined.

Air in Litres per Minute.	Percentage of Chloroform.	Mean.
20.0	(2.15) (2.05)	2.10
12.5	(2.15) (2.25) (2.20) (2.15)	2.19
8.5	(1.90) (2.00)	1.95

The percentage is therefore practically constant between 20 and 8.5 litres per minute.*

Below 8.5 litres per minute the percentage falls, so that if the assistant forgets to pump or the electric fan works badly no harm is done. The usual air supply is between 16 and 20 litres per minute; as it is given in a constant stream it is required to be double the normal ventilation of the lungs, which is about 10 litres per minute for the average adult.

4. The Presence of Impurities in the Chloroform.

After the apparatus has been in use for two or three hours the chloroform is often turbid from the condensation of the water vapour in the air. This in the quantities present causes a very slight error.

Normal.	With Water.
(a) 2.55	2.50
(b) 1.1	1.15
(c) 2.1	2.05

* A. G. Levy points out (*Lancet*, May 27th, 1905) that the percentage of chloroform will be independent of the air current when in any machine the stream of air is divided, so that part passes over the liquid chloroform and part direct to the patient, the perfection of adjustment depending on the relative velocity in the two paths and the amount in which viscosity comes into play in the chloroform airway. In his apparatus, which is of the "vacuum" type, the percentage was constant between the limits of 33 litres and 9 litres air stream per minute.

5. Unknown Errors in the Operating Theatre.

Finally, it might be said that under the exacting conditions in actual practice the apparatus might develop unknown errors. A typical case was therefore selected, and in the laboratory was rehearsed again in dummy, the conditions being exactly the same, except that a densimeter bulb was put in place of the patient.

Theatre Reading. Per cent.	Laboratory Estimation. Per cent.
1.0	1.1
2.5	2.4
2.5	2.55
2.5	2.4
2.0	2.1
1.75	2.7

This case is graphically represented in Fig. 1.

Fig. 1.—Case XXXIII. Boy, aged 9. (Undescended testicle, Mr. Collier.) Dr. Beaumont. Repetition of curve. Crosses mark the actual estimations in the laboratory.

TYPICAL CASES.

This preliminary work being disposed of, it was then possible to study the effect of known percentages on the human subject with some confidence that the nominal amounts were really administered.

The records of the first 50 cases form the basis of this communication. While this number may seem very small to the professional anaesthetist, who counts his administrations by thousands, and while it certainly is too small to allow any conclusions to be drawn as to the frequency of the more unusual occurrences, yet it is quite sufficient to provide a good deal of information on the more common features of anaesthesia in the ordinary type of case.

Full notes were taken of each administration in the customary manner. But on reflection it became evident that as two factors were accurately known—(a) the percentage inhaled and (b) the time—it was possible to plot these figures on squared paper so as to show the progress of anaesthesia in a graphic manner. Time in minutes is measured along the abscissa and the percentages of chloroform along the ordinates, and Fig. 3 may be taken as a typical curve from an average case.

Such a curve deserves a little study. The first thing that is evident is the little break in the administration that occurs about the eighth minute (more or less according to circumstances). This represents the passage of the patient from the anaesthetizing room to the operating theatre, and conveniently divides the record into two parts—(1) the period of induction, (2) the period of surgical procedure. Theoretically this break is a disadvantage, and it has always been made as short as possible. It serves, however, to mark the point at which the patient is ready for operation, and so it has been taken as the end point of the induction period.

During this time the curve indicating the percentage rises gradually, and in the majority of the cases a regular routine was followed. An arbitrary rule was made that the percentage should have the same figure as the time; in other words, during the first quarter-minute the percentage was 0.25, at the half-minute it was 0.5, in one minute it was 1, in two minutes 2. After this point the rise was made more gradually, and depended on the condition of the patient; in an average case 2.5 per cent. was reached in three minutes, and if necessary 3 per cent. in four minutes.

Several considerations determined this routine. It is necessary to remember, on the one hand, that a high percentage—over 2—is dangerous in the early periods of anaesthesia, as Waller has shown. The absorption of chloroform is most rapid in the second minute (Brodie and Widdowes), so here again a low percentage is indicated.

Further, if 2 per cent. is given at once, the patient is apt to cough and struggle, so that it is necessary to begin slowly. On the other hand, time is valuable; for most cases eight to nine minutes should suffice for induction, and no surgeon likes to wait for twenty minutes while the patient is being prepared for an operation lasting but ten. There are other reasons, which are under investigation at the present time, why it is undesirable to prolong the period of induction further than safety dictates. So that the apparently arbitrary rule that was adopted is not without justification on theoretical grounds, and experience proved that it worked very well in practice. The patients go under very evenly and gradually, there is no discomfort, and there is a marked lessening of the usual struggling or excitement; very often there is no struggling at all.

It is not possible yet to state definitely that this arbitrary rate is invariably safe, as the present series is too short to give definite data, but no sign of danger was to be seen in the induction of any of the cases. Sometimes a slower rate was used with good results, especially in very thin nervous subjects and in children. In the earlier cases this slower rate was tried in ordinary cases, but here no advantages were seen, and many disadvantages, so that the arbitrary rate was finally adopted.

The patient was usually ready for operation in about eight to nine minutes, the minimum time being six minutes, the maximum twelve and a half (Fig. 2), so that anaesthesia with these known percentages need not take an unreasonable time.

It is possible to make some interesting comparisons with the "open" method. It is usually supposed that this is specially expeditious, but in the cases I have actually timed the induction period lasted from eight to ten minutes, sometimes longer. To judge from the condition of the patient, one would guess (it is little more) that ordinarily during this time the open cone gives more than 2 per cent. in the first two minutes, and less than 3 per cent. in the last four minutes. Exact determinations

Fig. 2. Case XVI. Female, aged 30 (Appendicitis, Mr. Clayton-Greene) Dr. Beaumont. Stout patient taking much chloroform.

of what is really given would be of great interest. One would expect to find that while the skilled professional anaesthetist would give percentages not differing greatly from what has been suggested as the optimum, the less skilled learner is much less happy in his choice.

The second half of the curve, that which has been termed above the "period of surgical procedure," is usually (as is well shown in Fig. 3) marked by a gradually decreasing series of steps; 2 per cent. is generally required up to about the twentieth to the twenty-fifth minute

Fig. 3.—Case XXVII. Female, aged 37. (Tenoplasty, Mr. Pepper.) Dr. Beaumont. An average case. Figures on the ordinate represent percentages of chloroform. The abscissa shows the time; each division is equal to two minutes.

(Figs. 1, 3), then 1.5 per cent. to the forty-fifth minute, but the percentages in this part of the curve vary greatly. In Case XLIX, for example, 1.5 per cent. was used from the twenty-first minute till the sixty-sixth; in Case xxx, 0.75 per cent. was given from the sixtieth minute to the one hundred and thirty-sixth, but in the majority of the cases the values are of the order given. As in any other mode of administration the percentages must be increased a little if the patient vomits, and it is well to increase the amount slightly before the skin is sutured if the

patient is on a low percentage, or if, as in gastro-enterostomy, special relaxation is required; but usually this precaution has not been necessary.

INDIVIDUAL VARIATIONS AND UNUSUAL CASES.

The description given above applies to the great majority of the fifty cases. While it is true that no two cases are exactly alike, yet when the patient is an average specimen of adult age and the operation is not one of especial difficulty, it is found the anaesthetic curves show great similarity, and it is not necessary to describe each one in detail. One can therefore turn to the next chapter—namely, the consideration of the individual variations and the unusual cases. These can be classified under four main headings: 1. Age. 2. Build. 3. Alcoholism. 4. Operation required.

With regard to these subdivisions, it will be necessary to have a much larger series of cases to enable very precise conclusions to be drawn, still certain preliminary observations can be ventured upon with a considerable degree of accuracy.

1. The Effect of Age.

No very old persons were included in the series, but there was a very definite little group of five children, with an average age of 10 years, which can be compared with the typical adult. As a rule less chloroform was required

Fig. 4.—Case XI. Boy, aged 11. (Wiring fracture, Mr. Clayton-Greene). Dr. Beaumont. Takes less chloroform than the type.

(Fig. 4); one case, however, took an amount quite equal to the normal.

2. Build.

This appeared to have a marked influence. Fat persons took much more chloroform than thin, and Figs. 2 and 5

Fig. 5.—Case XIII. Male, aged 34. (Appendicitis, Mr. Clayton-Greene). Dr. Blumfeld. Slightly built and thin. Took very little chloroform.

are excellent examples. These cases had the same operation, on the same day, performed by the same surgeon, and the amount of chloroform required is much more in the case of the stout woman than the thin man. Of the 50 cases, 5 were distinctly spare and 4 very fat, and the same rule held throughout.

It must be remembered, however, that the number of cases is too few to enable a general inference to be made, and Dr. Levy has drawn my attention to a thin patient that took a quite abnormal amount of chloroform, so that other factors must have some influence on the result. Case III is, perhaps, an example of this—there was a slight tendency to goitre, and the percentage used was much less than the average.

The subject is one of considerable interest from the theoretical point of view, and experiments on the subject are in progress. The objection might be raised that all fat hospital patients are so because they are alcoholic, and should therefore be included in the next section, but on this point no certain information was forthcoming.

3. Alcoholism.

These persons took more than the average, even when not of especially stout build (Fig. 6).

One patient, a big, muscular man of 34, alcoholic, and requiring immediate laparotomy as the result of an "accident" (he had been stabbed in the abdomen just below the liver), took so much chloroform that the machine,

even at 3.5 per cent. did not give enough, and the case was finished with the cone (Fig. 7). Here the open method must have yielded more than 4 per cent. at the least.

Fig. 6.—Case XXIX. (Ventral hernia, Mr. Lane.) Dr. Beaumont. Alcoholic patient of average size. Takes more chloroform than the type.

4. Effect of the Operation.

The most obvious variation is shown where a very prolonged operation is necessary. Case xxx, lasting two and a quarter hours, was kept perfectly anesthetized at 0.75 per cent. for the last ninety minutes.

A very important point was observed by Dr. Beaumont, which had been previously suspected, but of which the proof had been wanting. A patient is being kept quite evenly under, and a steady percentage—say 1 per cent.—has been given for some time. The operation procedure is of an ordinary type, and the corneal reflex is just absent. Now if the surgeon, by pulling on the parietal peritoneum, excites violent afferent impulses, the corneal reflex comes back, and the patient becomes less deeply anaesthetized even if the percentage remains the same.

Dr. Mathison and I verified this on animals, and we observed in addition that the blood pressure falls, and the respiration is quickened and increased in depth.

The inference is important. Ordinary anaesthesia is due partly to the direct action of the drug and partly to a condition closely analogous to sleep. Violent afferent impulses remove this latter factor, exactly as in poisoning by morphine, where the patient can be roused by shaking, to sink back into narcosis when the stimulus ceases.

The reflex quickening and deepening of respiration is also worth noticing from a practical standpoint. The patient in this condition is taking in more chloroform than before, and every anaesthetist is aware of the possibility of an overdose being given under these circumstances.

The account of this series would not be complete without the notes of those cases where, by mistake or other cause, the result was not what was expected. Four cases were abnormal in this respect. Case xxxiv (Fig. 7)

Fig. 7.—Case xxxiv. Man, aged 34. (Exploratory laparotomy, Mr. Pepper.) Dr. Beaumont. Case requiring more than 3½ per cent.

has been already referred to, and it must be admitted that here the machine was at fault; such cases can only be dealt with by special means.

In Case xii induction was completed by the open method, but here the standard rate of increase was not adopted, and the case should hardly be counted a failure.

In Case xxxviii death occurred two hours after the patient had been removed from the theatre. The case

Fig. 8.—Case xxxviii. (Hydrocephalus.) Male, aged 22. Artificial respiration at arrow (38th minute). Death two hours after removal from theatre (2 hr. 43 min.).

was one of suspected cerebellar tumour; on opening the cranium no tumour was found, and the patient's condition

became so unsatisfactory that the anaesthetic was discontinued, and the incision rapidly closed. Eight minutes after this artificial respiration became necessary, and after two hours the heart stopped. *Post mortem* there was great dilatation of the ventricles of the brain, and the existence of basal meningitis prevented the opening of the cranial cavity relieving the pressure.

Case x presented some interesting features. The anaesthetist was using the apparatus for the first time, and

Fig. 9.—Case x. Man aged 36. (Ventral hernia, Mr. Clayton-Greene.) Description in text.

found some difficulty in translating his knowledge of anaesthesia into the percentages given by the machine. Induction was too slow (it was before the standard rate had been adopted), and when the patient was moved to the theatre a mask was placed over his face in transit. This evidently gave a higher percentage than was expected, and the result was that after a latent period of one minute the breathing became embarrassed, and artificial respiration had to be performed, ether being used to keep up anaesthesia. The patient came round in a very satisfactory manner, and then was given 1 per cent., and later 0.5 per cent. This latter amount, as can be seen from the other curves, was much too little for the stage of anaesthesia, and the patient began to recover consciousness; 3 per cent. was then hastily given, then 2 per cent., and finally the machine was abandoned and the mask used to finish the operation. The difficulties met with were evidently the result of the use of an unfamiliar method, but one valuable piece of information was disclosed, namely, that the effect of an overdose is not immediately seen, requiring about a minute to become evident.

CONCLUSIONS.

There are many things observed from time to time in this series that fall under the class of unmeasurable phenomena. It is hoped that future work may remove at least some of these into the category of accurate measurements, when they can be considered with more certainty than is now possible. Particularly would one wish that numerical values could be assigned to the individual variations and to the post-chloroform effects that are now so meagrely dealt with. But, from the facts recorded above, the following points may be noted as reasonably certain.

1. Anaesthesia with known percentages of vapour is in man at least as easy and certain as by the ordinary method, even when the latter is carried out with the greatest skill.

2. If it is desired to induce anaesthesia in from eight to ten minutes, the ordinary adult must be given percentages rising to 2 per cent. in two minutes, then to 2½ per cent. in three minutes. This amount usually will suffice. There is no objection to raising the percentage to 3 per cent. in five minutes (*not sooner*) if it is required, *provided due care is exercised*.

3. When induction is completed, 2 per cent. is usually ample, gradual diminution to 1.5 per cent. and 1 following in about twenty to twenty-five minutes, and the anaesthesia can be maintained in this way much more easily and regularly than by the open method.

4. Children generally require less than the above amounts, 2 per cent. for the induction and 1.5 per cent. for the later stages. Some thin adults will also require less than the average, some fat, muscular, or alcoholic adults more, but the data are not sufficient to furnish more precise rules.

5. From the above it is evident that the general features of anaesthesia are the same in man as in the other mammalia. Minor points of difference are seen in the greater individual variations and in the percentages required, 2½ per cent. in man being approximately equal to

2 per cent. in the cat. When due allowance is made for these differences, it is legitimate to apply the conclusions deduced from experiments on animals to the human subject. When it is remembered how conclusively Waller has shown the much greater safety of a known percentage in animals, the importance of the inference can be seen.

Finally, it is again my pleasant duty to convey my thanks to my colleagues at St. Mary's Hospital, who have in every way given me the kindest assistance. Particularly are my acknowledgements due to Dr. Blumfeld, Dr. Collum, and Dr. Beaumont, to whom the credit of the practical success of the method largely belongs.

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ATROPHIC RHINITIS COMPLICATED BY MASTOID ABSCESS AND EXTRA-DURAL ABSCESS.

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So far as I am aware atrophic rhinitis is not a common cause of mastoid suppuration, particularly in the absence of signs of middle-ear suppuration.

Mrs. M. A. S., aged 30 years, came to me on November 5th, 1908, complaining of pain over the mastoid and frontal areas. She had had atrophic rhinitis for twelve years, and had been treated in various ways without any benefit. The right ear had been partially deaf for four years, the deafness coming on gradually. She had had no pain in the ear until lately, and never had otorrhoea according to her own, her mother's, and her husband's testimony. No history or signs of syphilis or tubercle.

On November 5th she complained of intense pain over the right mastoid and frontal areas, tenderness over the same and on pressure on the right tragus. The post-auricular gland was enlarged, but as her head was infested with pediculi great weight was not attached to this, particularly as she said it had been in much the same condition for months. Temperature 103.5°, pulse 120. No rigors or signs of intracranial mischief. Both nostrils were wide and partly covered with stinking crusts. The left inferior turbinal had been removed. The septum was deflected to the right. By posterior rhinoscopy the Eustachian orifices were seen to be dilated and the walls and roof of the naso-pharynx dry, glazed, and covered with adherent crusts. On examining the right ear no perforation could be seen in the membrane, which was opaque, thick, white, and immobile with Siegle's speculum. Rinne's test was negative; the watch could not be heard at all; Weber's test was referred to the right side. There was no redness, swelling, or oedema over the mastoid process nor was the auricle displaced.

Leeches were applied in front of and behind the auricle, followed by large fomentations. Drops of a solution of cocaine and ac. carbolic. (āā gr. v in glycerine (j)) were instilled into the ear and a purgative given.

The patient felt much relieved, had a fairly good night, and next morning (November 6th) the temperature had fallen to normal, the pulse to 96. She still, however, had a great deal of pain and tenderness. The same night she became much worse, and a swelling became apparent above and behind the auricle, displacing it downwards and outwards. Operation was advised, and early next morning (November 7th) the mastoid antrum was opened, giving exit to over a drachm of thick yellow pus. Considerable bone destruction had gone on posteriorly, therefore the lateral sinus was exposed, and although there were some granulations on its external aspect, it was not thrombosed. The mastoid cells were thoroughly opened up, the mastoid antrum, almost as large as a Barcelona nut, was curetted, the patency of the aditus assured, and the cavity packed with gauze. The temperature, taken immediately before operating, was 100° F.; after the operation it was normal.

From this time until November 13th, she did well generally, except that the pulse was rapid (see chart), but still complained of intermittent frontal pain and tenderness. On this date facial paralysis of the right side was noticed, but it was by no means marked. I considered it might be due to inflammatory thickening near the stylo-mastoid foramen in the depth of other symptoms, and could not decide that the head pain was due to intracranial mischief, as she had no other signs of such trouble, such as rigors, vomiting, optic neuritis, spasms of limbs, vertigo, or the pulse or temperature of brain or meningeal disease, although the two last symptoms are known to be uncertain quantities. Her mental condition was clear and alert, but she was very restless.

On November 14th the facial paralysis was worse, and at night the pain was intense, and had extended over the right side of the head. There was tenderness on pressure over the squamous portion of temporal bone. The temperature was normal, and the pulse 110. There was no vertigo or other signs of involvement of the intracranial portion of the auditory