



THE UNIVERSITY *of* EDINBURGH

THE LEUCOCYTOSIS OF APPENDICITIS.

Its value in the timing of the operation, and
in post-operative Prognosis.

THESIS for the degree of M.D.,

by

JOHN DALGLIESH;

M.B., Ch.B., 1901.

1.

There are probably few problems which cause more anxiety to the medical practitioner than those met with in a case of Appendicitis. Three questions have to be considered and decided upon with as little delay as possible. First "Is operation necessary?" Secondly, "Should such operation be performed at once, or after an interval?" Thirdly, "What should be the length of such interval?" At the present time opinion is divided upon this subject, there being, roughly speaking, three methods of dealing with these questions.

The view held by the extremists of one type is, that removal of the appendix should be performed at once in every case of appendicitis, in which there is little or no possibility of error in diagnosis. Those, whose view might be described as extreme in the opposite direction, hold that operation is only justifiable where rupture of the appendix has occurred, with general peritonitis; or where a localised abscess has formed.

Probably the opinion of the majority of medical men lies between these two extreme views, the latter of which is now held by very few. No one disputes the absolute necessity of operation when rupture of the appendix has occurred. The vast majority further agree/

agree that operation is advisable, if not absolutely necessary after an attack, the severity of which points to the presence of ulceration of the mucosa of the appendix. The real difference of opinion is in the answer to the question "When should the operation be performed in these cases?"

Those who advocate immediate operation in all cases of appendicitis, bring forward in support of their view very strong arguments, which have not, so far, been confuted. In the first place they point to the utter impossibility of distinguishing in the early stage between the mild case, that will subside naturally, and that which will go on to rupture and general peritonitis. Hence, if immediate operation is always performed, general peritonitis will have been prevented in those cases that would otherwise have gone on to rupture of the appendix. Further, the operation is much easier, if done immediately, before there has been time for the formation of adhesions, and before the vessels of the parts around have become engorged with blood; a condition which causes much inconvenience in operations done at a later period, owing to the unavoidable oozing of blood from these engorged vessels. Lastly it is urged that the duration of the patient's illness is very/

very much shortened, the time usually allowed for the subsidence of the acute inflammation before operation is performed, being entirely done away with.

It has also been asserted that there is no greater risk (some go so far as to affirm that the risk is much less) in immediate operation, than in operation after the acute stage has subsided.

The chief arguments advanced against the advisability of immediate operation in all cases are:- first, there are numerous instances in which there has been no recurrence of the condition, and it is unjustifiable to run the risk of subjecting such cases to the unnecessary dangers and inconvenience of the operation; especially as, in the case of men, it is often of the utmost importance to have a little time to make suitable business or other arrangements. Secondly, it is a fallacy to state that there will not have been time for the vessels of the surrounding parts to become engorged, as this occurs at the very outset of the attack; and further, this engorgement extends to the vessels of the abdominal parietes, and adds considerably to the risk of a ventral hernia, owing to the impossibility of securing dryness of the wound, the condition most favourable to aseptic healing. Thirdly, the advocates of immediate operation/
tion/

tion cannot quote a sufficient number of cases to justify them in being dogmatic on the subject. In short, the only admittedly proved points in favour of immediate operation are the absence of adhesions around the appendix, and the shortening of the illness in those cases that will eventually require operation.

The view, held by that small, and daily diminishing class, who deny the need of operation in any case unaccompanied by general peritonitis or abscess, needs no further refuting than comes from a proper knowledge and appreciation of the pathological changes, and bacteriology met with in this disease.

Those who advise the steering of a middle course, and the adopting of a compromise between the principles of the two classes of extremists, have still to face the problem of deciding what interval should elapse between the acute stage and the operation. The usual advice given with regard to this is, that, in cases in which there is no palpable tumour, the operation may be performed as soon as the temperature becomes normal; whereas in cases with palpable tumour, about six to ten days should be further allowed to elapse.

This question may at first sight be regarded as trivial, but its importance may be easily appreciated when/

when the following points are taken into consideration. In the first place, both the ulcerated mucosa and the lumen of the appendix, and also the lymphatics in connection with it, are crowded with organisms in an active state of increase and virulence. Secondly, however perfect the technique of the operation, it is impossible to avoid liberating some of these organisms into the general peritoneal cavity, either from the divided portion of the appendix, or from lymphatics injured in the breaking down of adhesions. Hence, the degree of virulence of these organisms, and the resisting power of the patient, must be taken into consideration in gauging the risk of the operation, and in deciding the period at which this risk is reduced to a minimum.

The observations carried out in this series of cases, were undertaken with the view of ascertaining whether any light could be thrown on this question by a study of the leucocytes; and whether the difficulty of early diagnosis of rupture of the appendix can be diminished by a systematic study of the type and degree of leucocytosis. This difficulty is undoubtedly the chief cause of so many fatal errors on the part of the practitioner, and the very high death-rate in/
in/

in this disease. It was also intended to study the prognostic value of leucocyte counts in cases operated upon, whether the operation was performed in the acute stage, with or without general peritonitis, or at a subsequent period. Most of those who have previously investigated the leucocytosis of this disease have been limited in material to Hospital cases, sent in for immediate operation on account of the severity of the symptoms, or for operation during the quiescent period following an acute attack.

The method adopted in this series of cases has been, to take daily counts of the total leucocytes, and an estimation of the percentage of polymorphonuclear cells. In the cases that were operated upon, during the interval of an attack, a count was taken on the day before operation, then one on the same day, but about six hours after operation, and on each successive day, until, either there was a return to the normal, or some complication was observed, which accounted for any deviation from the observed rules. Similar observations were carried out in a certain number of other aseptic abdominal operations, in which there was no pre-existing inflammatory condition, nor invasion by micro-organisms of the parts concerned. These cases have been regarded as controls, showing the post-operative/

tive leucocyte counts to be expected, under the conditions of present day methods, in operations in which there is no pre-existing sepsis of the part operated upon. The technique was the same in all the cases. The blood was diluted to 1 in 20 by means of the usual solution of acetic acid and methyl green. The counting chamber used was of the ordinary Thoma type, and the leucocytes on the whole 400 squares were counted. After the total number was noted, a count was then made of the cells in this total which were not polymorphonuclear, and this number deducted from the total, the remainder being regarded as the number of cells of the polymorphonuclear and eosinophil types in the gross total count. This process was repeated in five different drops of diluted blood, so that the total of all the leucocytes in the five drops represented the number in $\frac{1}{2}$ c.m. of diluted blood. The actual leucocyte count of the patient's undiluted blood was then obtained by multiplying the last result by 40. The percentage of polymorphonuclears and eosinophils together to the total was then calculated, and, after a deduction of 1.5, which was regarded as an equivalent of the eosinophil percentage, the resulting figure was taken as a sufficiently accurate estimate/

estimate of the polymorphonuclear percentage. This was borne out by making differential counts of a stained film in several cases, when the result obtained by the two methods was almost identical. The method adopted was considered to be sufficiently accurate, and had the advantage of ease and rapidity, and could be carried out with little difficulty by any general practitioner, whose limits and difficulties were kept in view throughout. Further the polymorphonuclear percentage appeared to be the only variable factor of any importance. It is quite realised that in cases complicated by some type of intestinal worm, the eosinophilia that usually accompanies such a condition, might be a source of appreciable error; but such cases are so rare as scarcely to be regarded as a sufficient reason for adopting the tedious and difficult count by means of a stained specimen.

In those cases in which operation was performed, the appendix was slit up and carefully examined, especially with regard to the condition of its mucosa. The duration and extent of the operation, and difficulties from adhesions etc., were also noted.

It will be most convenient to divide the cases into two groups, the first group consisting of cases in/

in the acute stage, the second of cases operated upon, whether in the acute stage or later. With the second group of cases will also be included an account of the conditions found in the cases previously referred to as "controls".

The details of each case have been given as shortly as possible in the form of daily notes. Each case has a combination chart shewing temperature, pulse, leucocyte count and polymorphonuclear percentage. This method of description by means of charts was adopted, as it gives a clearer picture of the daily variations and their relations to each other of these four factors, than could be conveyed by a mere statement of the figures.

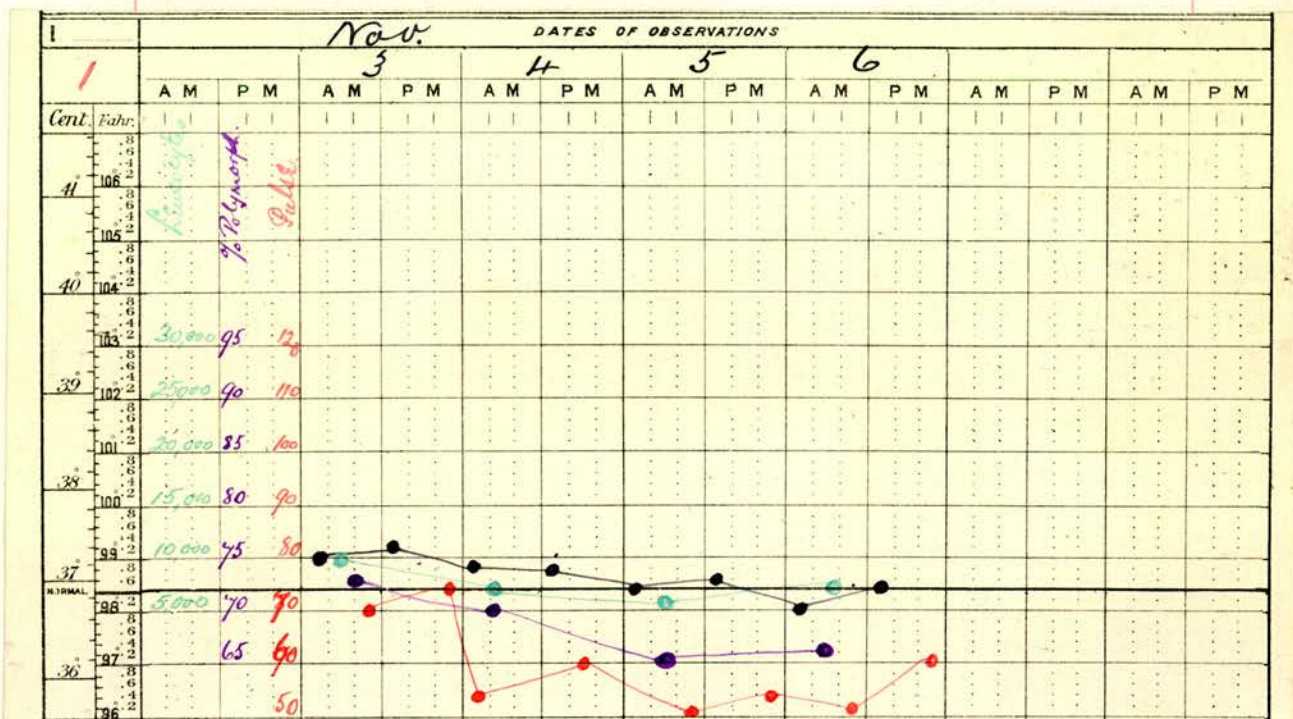
In all the cases, with the exception of those sent to Hospital from other districts, the treatment adopted was the same. Nothing but hot water was given for at least twenty-four hours, or longer if there was any vomiting at the end of this time. At the end of twenty-four hours barley water, whey, weak tea, beef tea and small fragments of dry toast were allowed; but neither milk nor any milk preparation was given until the temperature was normal, the tongue clean, and all abdominal distension had subsided. No drug of any kind was given, and no attempt made to evacuate/

evacuate the bowel even by enemata. If there had been no spontaneous evacuation at the end of 5 to 7 days this was obtained by means of a small enema of olive oil, usually about 2 ounces, which was repeated on the following day if deemed necessary. Local treatment consisted in the application of hot fomentations over the region of the appendix so long as the pain lasted.

FIRST GROUP.

Case I.

A. P. Schoolboy, aet. 13.



Nov. 3. Severe pain in right iliac fossa. No vomiting. Limited rigidity of muscle and tenderness at this point.

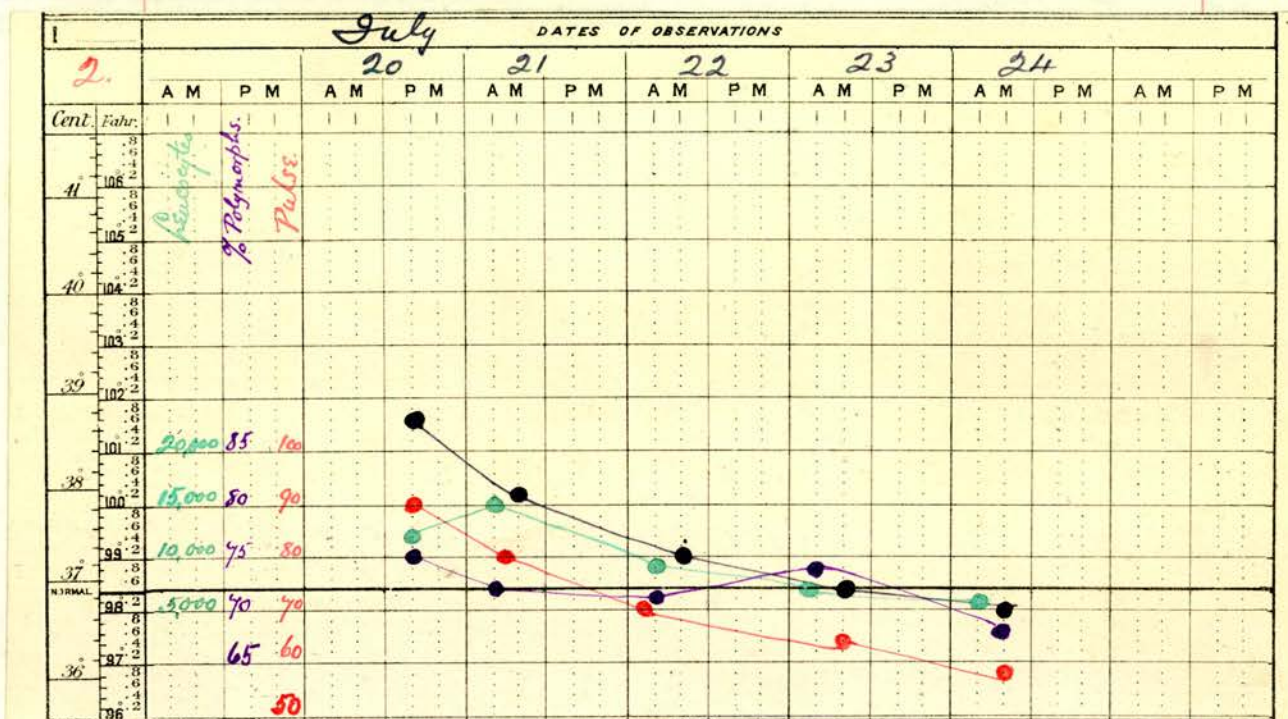
" 4. Less tenderness, no pain. Improvement continued and patient seemed perfectly well on November 12th when he was last seen.

Remarks

This was evidently a case of catarrhal appendicitis of extreme mildness.

Case II.

B. C. Factory girl, aet. 23.



July 20. Sudden onset of general abdominal pain at 6 p.m., followed by vomiting. At 11 p.m. when first seen, still vomiting, abdomen rigid and tender all over.

" 21. Pain localised to region of appendix and accompanied by frequency of micturition. No further vomiting.

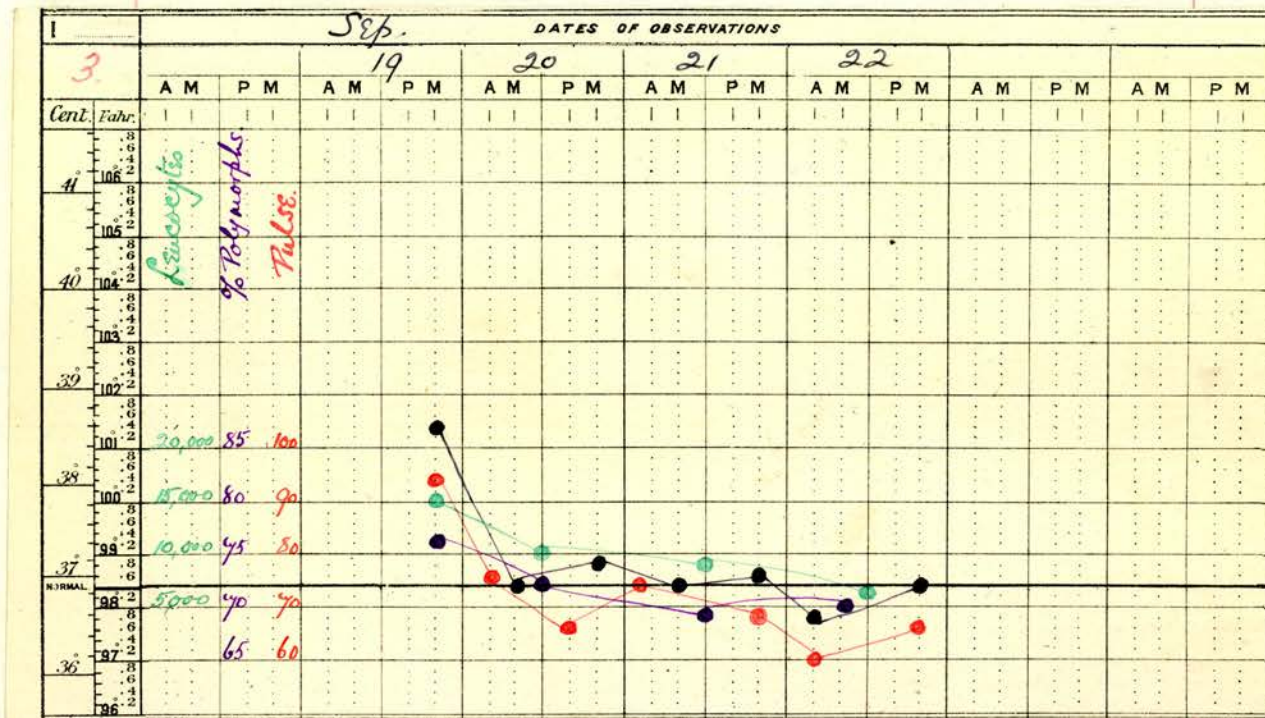
" 23. Slight return of pain, which seemed due to distension of bowel, and was relieved by a free evacuation. Continued improvement daily after this, and patient seemed quite well 10 days later.

Remarks.

There was probably slight ulceration of mucosa of appendix in this case, which conclusion is borne out by the length of time before which pulse and temperature returned to the normal, and by the presence of vesical symptoms.

Case III.

T. H. Miner, aet. 26.



- Sept. 17. Sudden onset of general abdominal pain followed by vomiting.
- " 18. Pain localised to region of appendix. No further vomiting. No restriction of diet had been adopted.
- " 19. Brought to Hospital and first seen. Tenderness on pressure over appendix where a slight thickening felt. A certain amount of distension of bowel.
- " 20. Less distension and tenderness.
- " 22. Improvement continued, but restricted diet obstinately objected to, and patient insisted on going home.

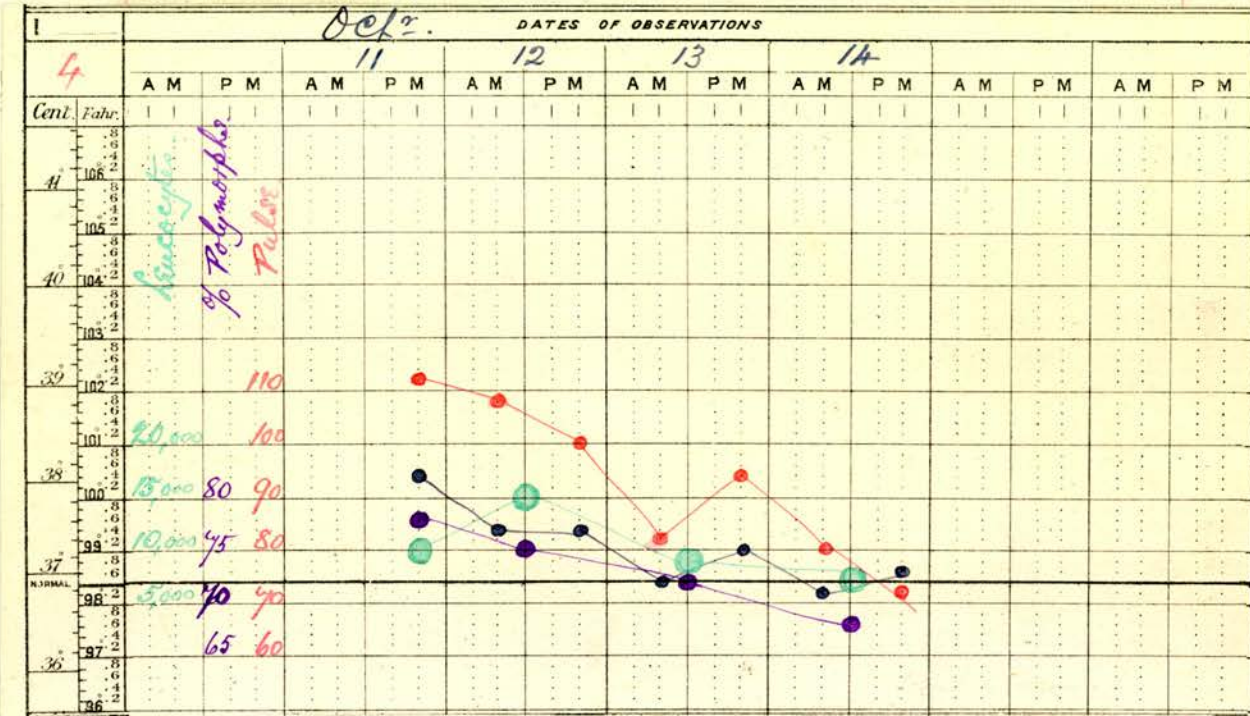
Remarks

There had probably been a very slight degree of ulceration of mucosa of appendix in this case.

Case IV.

R. P. Aet. 23, Miner.

First attack three weeks previously.



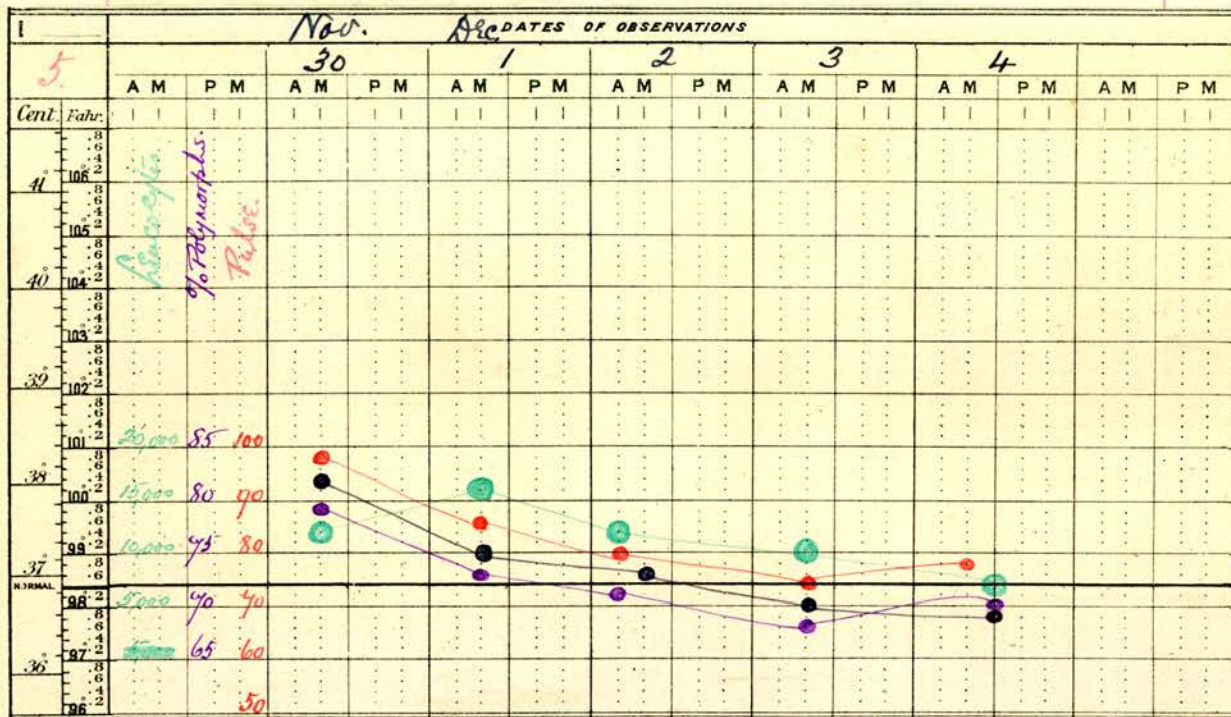
Oct. 11. Sudden onset of pain in region of appendix, followed by vomiting, but this only once.

" 12. Slight tenderness localised over appendix.

Continued improvement. Operation on 24th October. Vide Case 23.

Case V.

R. W. Aet. 21. Miner.



Nov. 30. Sudden onset of pain over whole abdomen followed by vomiting.

Dec. 1. Pain localised over appendix, where there was slight tenderness, and rigidity of muscles. Tongue not much furred.

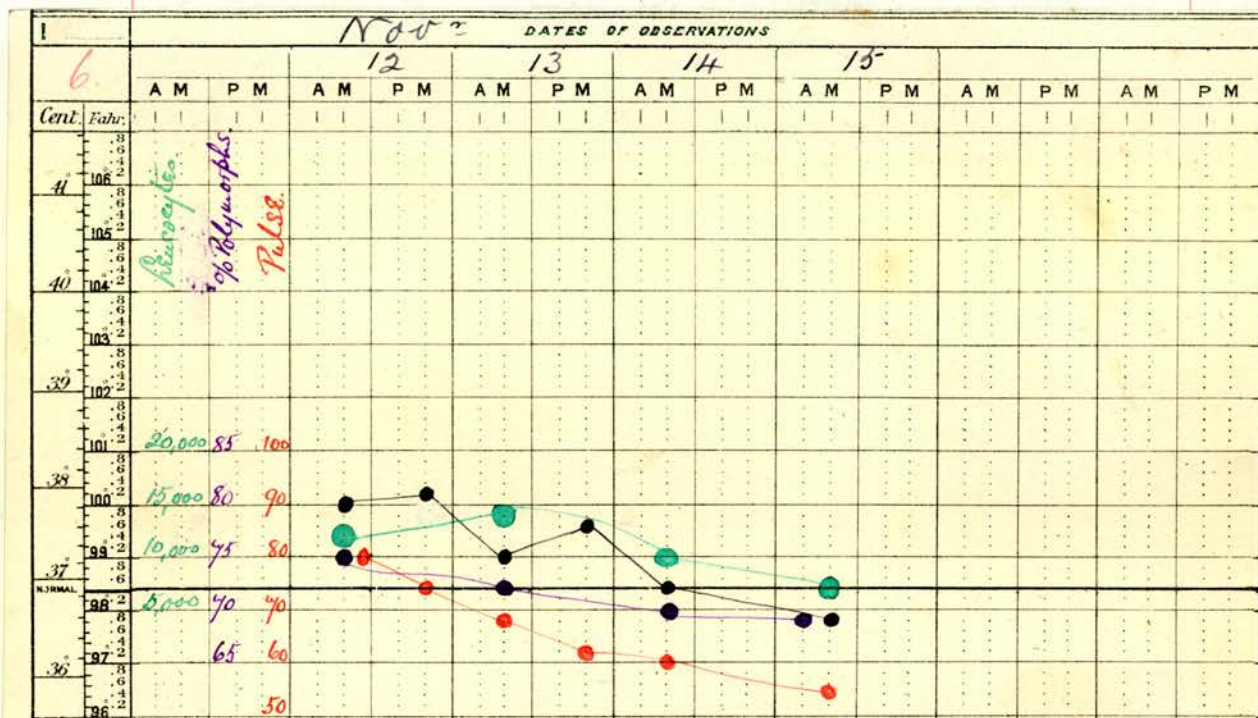
" 2. Improved. Tongue practically clean. No interruption to improvement. Operated upon on December 10th. Vide Case 22.

Remarks.

This appeared to be a very mild case, the symptoms subsiding very rapidly after the second day. The second day showed a rise in leucocytes, despite the obvious improvement in the other symptoms.

Case VI.

J. T. Aet. 22. Clerk.



Nov. 11. Sudden onset of pain all over abdomen, followed by vomiting. At night pain limited to region of appendix. Took castor oil, which produced three motions, but no relief of pain.

" 12. Vomited once in early morning. Seen at 11 a.m. Localised tenderness and rigidity of muscles over appendix.

" 13. Marked improvement, which continued.

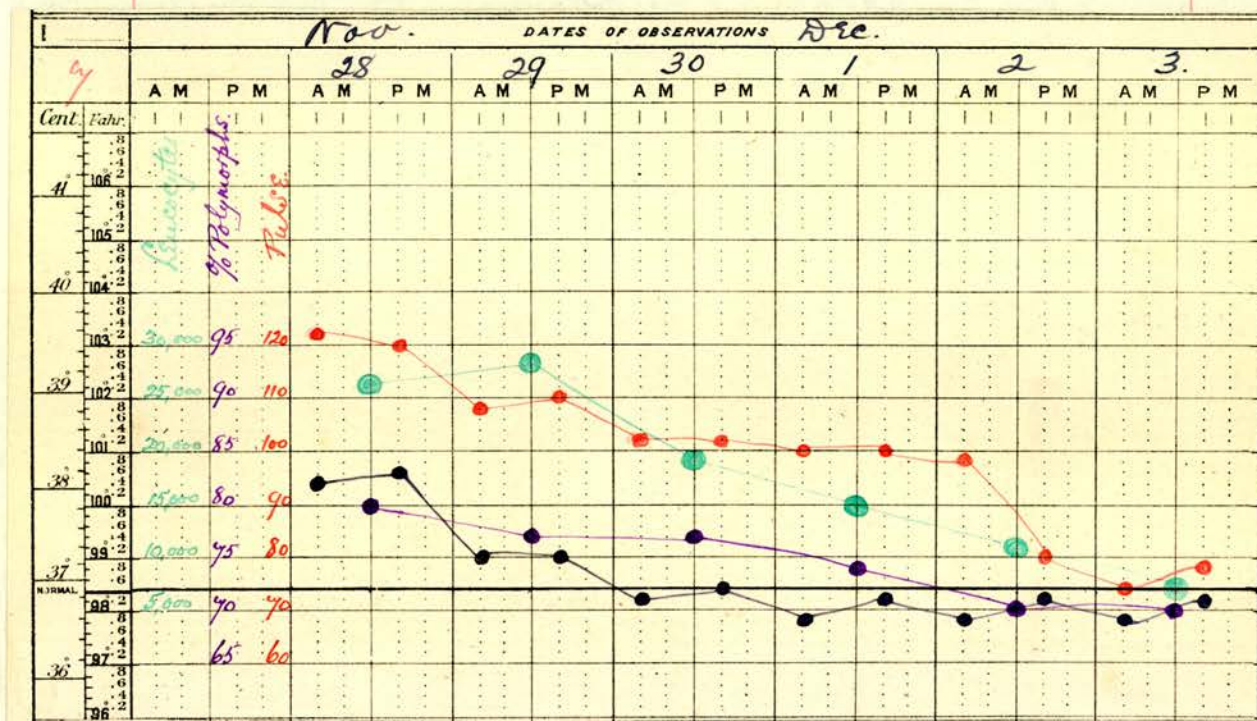
Operated on in Hospital on December 9th.
Vide Case 28.

Remarks.

The only noteworthy feature was the slight rise of the leucocyte count, despite the fall in pulse and temperature on third day of illness.

Case VII.

L. McL. Aet. 10. Schoolgirl.



Nov. 27. Sudden onset of pain on right side of abdomen, followed by vomiting. Castor oil given, producing free evacuation of bowel, but no relief of pain.

" 28. Great tenderness and marked rigidity of muscles over appendix.

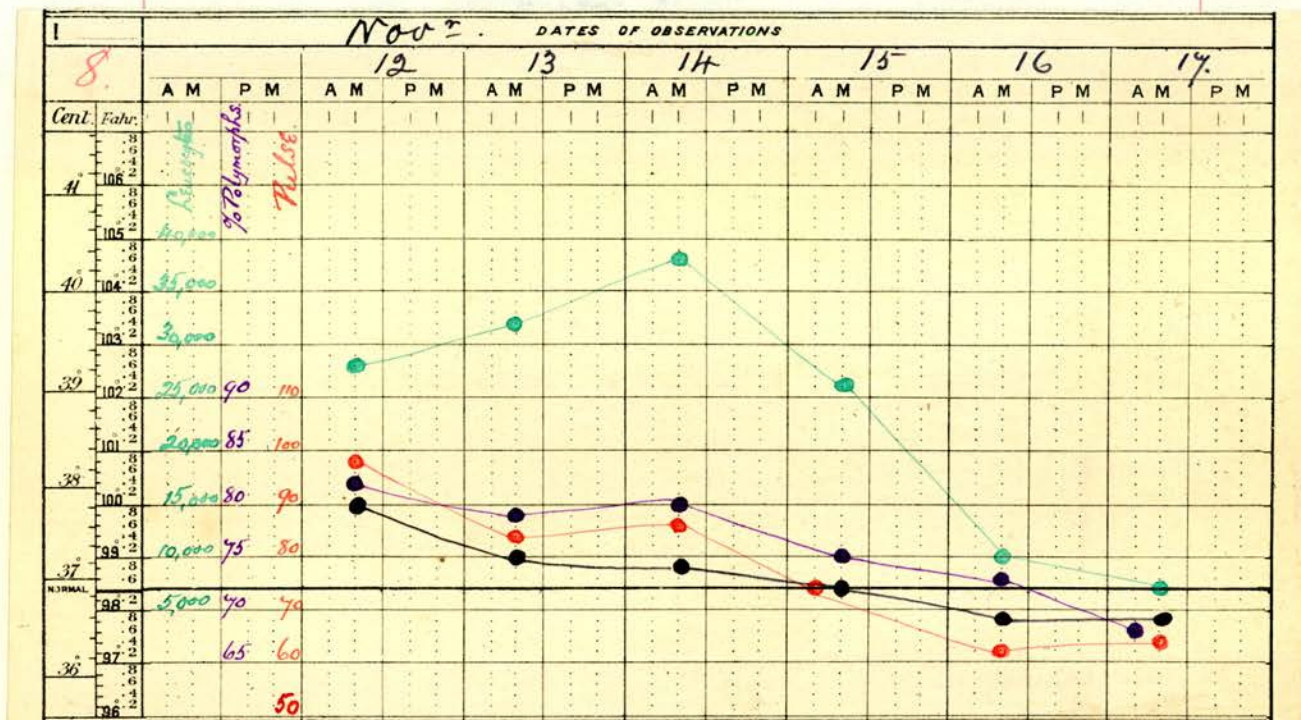
" 29. Condition improved, the improvement continuing from day to day. Operated upon on December 16th. Vide Case 26.

Remarks.

Nothing special in this case beyond the rise of leucocyte count on third day.

Case VIII.

L. C. Aet. 19. Factory Girl.



- Nov. 11. Sudden onset of pain all over abdomen, followed by vomiting.
- " 12. Pain localised to appendix, which was very tender. Vomiting continuing.
- " 13. No vomiting and pain now of a screwing nature and intermittent. The tenderness much the same.
- " 14. Condition much the same, but tongue a little cleaner.
- " 15. Marked improvement; pains entirely gone; tenderness as before. Tongue almost clean.

Continued improvement after this and patient quite well in about two weeks.

Remarks.

It was practically decided to operate on morning of 14th/

Case VIII continued.

14th, but by afternoon there was a marked improvement.

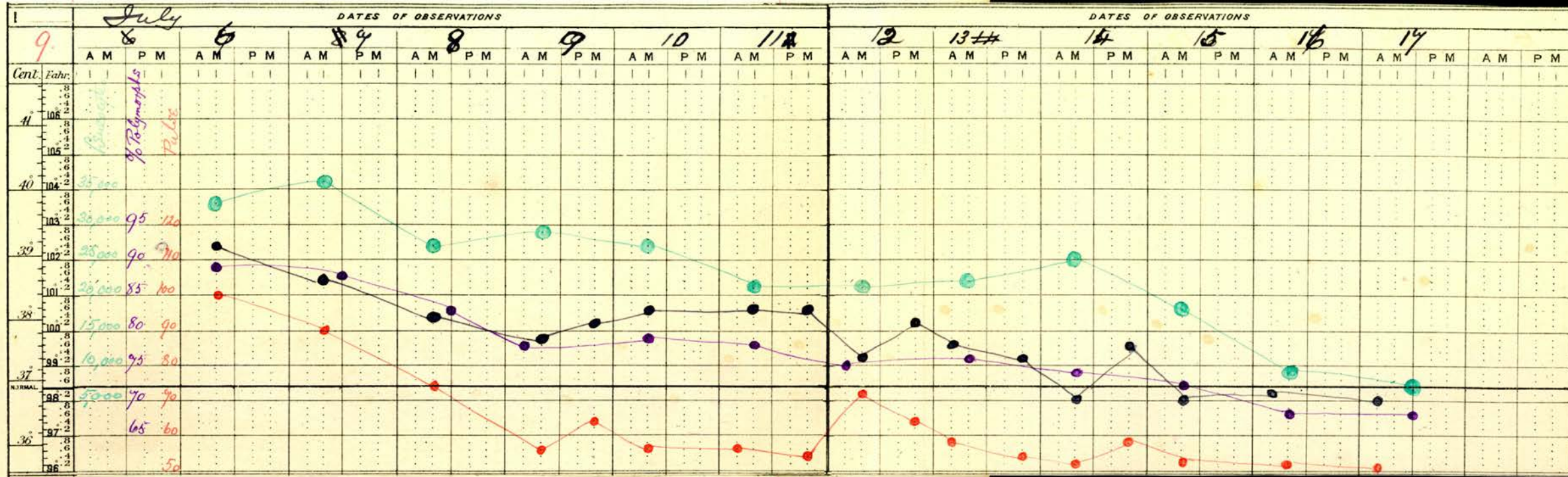
It seemed probable that the marked exacerbation of the symptoms at this stage was due to a too violent peristalsis set up by a dose of castor oil which the patient had taken on her own responsibility.

The leucocyte count was very high, but there was never any thickening to be felt in region of appendix, though there must have been deep ulceration of the mucosa, and lymphatic infiltration.

Operation, after acute stage had passed, was refused.

Case IX.

R. T. Aet. 20. Postman.



- July 5. Sudden onset, in early morning, of pain all over abdomen, followed by vomiting. The symptoms were attributed to a supper of meat pie taken the previous night. Licorice powder taken, resulting in two motions, but no relief of pain, which had by this time become localised to region of appendix. At night there was also frequency of micturition.
- " 6. Seen at 5 p.m. Only slight tenderness and rigidity of muscle over region of appendix, the point of maximum tenderness being midway between McBurney's point and the middle line. Considerable frequency of micturition.
- " 9. Had improved somewhat slowly, and was ordered a little increase in diet. Took rather much and had a return of pain, which was now of a screwing nature.
- " 10. Much better again, but abdomen slightly distended.
- " 11. Olive oil enema caused evacuation of a good/

Case IX continued.

good deal of very foetid dark faeces.

July 12. Another enema of olive oil, followed by one of Henry's solution and glycerine, got rid of a good deal of the distension and some more foetid faeces.

" 13. Very troublesome tenesmus accompanied by passage of a great deal of mucus. The whole length of the colon could be seen to be much distended, the distension of the remainder of the bowel having disappeared. Starch enemata ordered.

" 14. Marked improvement, which continued daily.

Remarks.

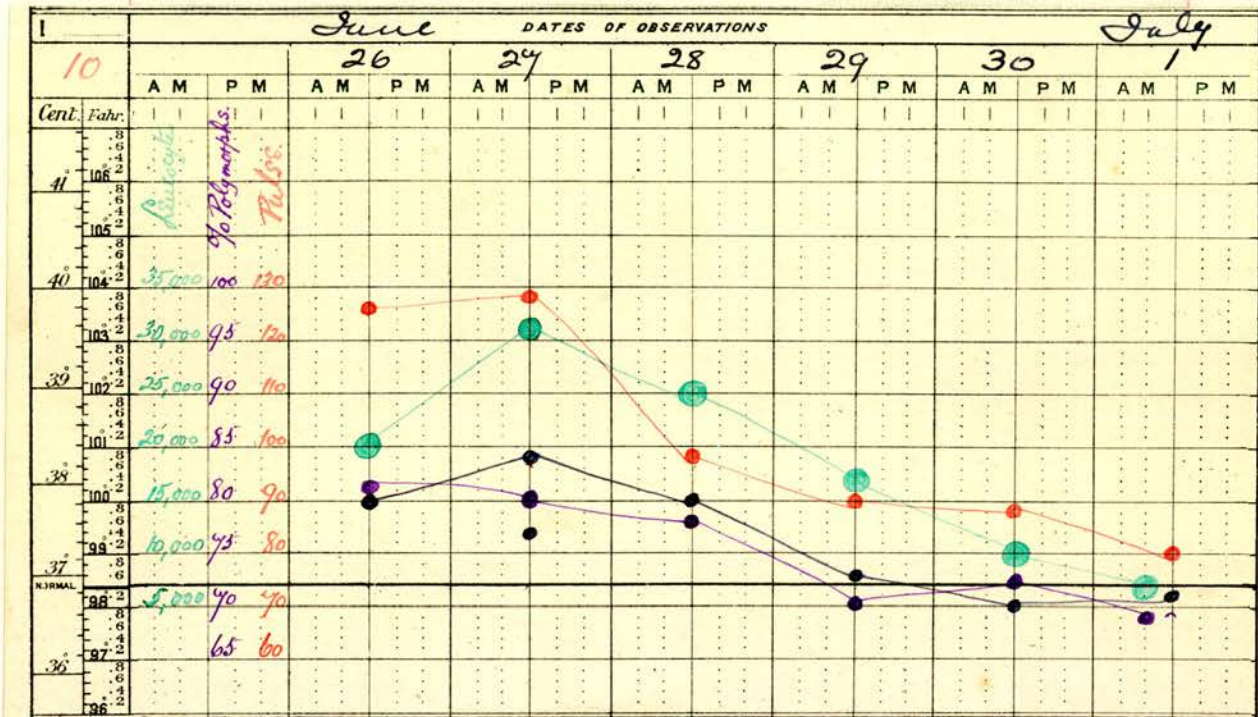
This case was a most troublesome one, as there seemed to be an unusual degree of constitutional disturbance, despite the very slow pulse rate, and small amount of tenderness over the appendix. There evidently was a good deal of putrefaction of the contents of the colon, which must have been very full at the time of the onset of the attack. Very possibly this might have been more speedily got rid of had the oil enema been used a day, or even two days sooner.

The case was subsequently operated upon on 12th August but unfortunately developed a pulmonary embolus during the operation, which had to be stopped. Possibly in trying to separate the appendix, which was very adherent and dipping into the pelvis, a clot in one of the pelvic veins may have been loosened. The patient died two days later.

This case has not been included amongst those of the second series, as it was thought that the pulmonary condition made the leucocyte count quite valueless.

Case X.

A. A. Boy. Aet. 5.



June 25. Sudden onset of abdominal pain, accompanied by marked frequency of micturition, and a good deal of pain at the end of the act. No vomiting.

" 27. Localised tenderness of a distinct tumour in region of appendix. Complete retention of urine.

" 28. Slight improvement which continued, as also gradual reduction in size of tumour. No further retention.

Operation performed on July 23rd. Vide case 29.

Remarks.

The bladder symptoms were very pronounced in this case, The very pronounced tumour mass to be felt on the third day, coupled with the rise in the leucocyte count/

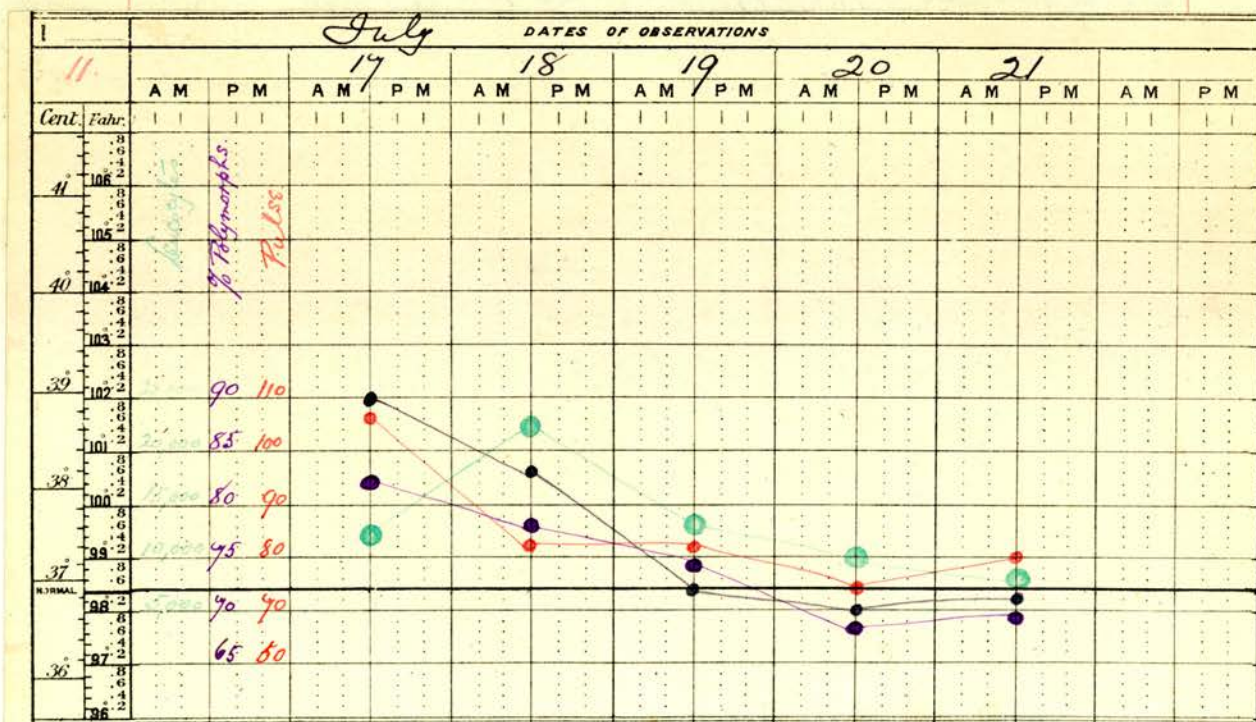
Case X continued.

count seemed to justify the suspicion of a localised abscess having occurred, and it was decided to operate on the following day. However, the improvement, slight though it was, noticed next morning, seemed to favour a postponement of surgical interference.

Case XI.

T. M. Boy, aet. 6.

This the second attack, the first having occurred about four weeks previously.



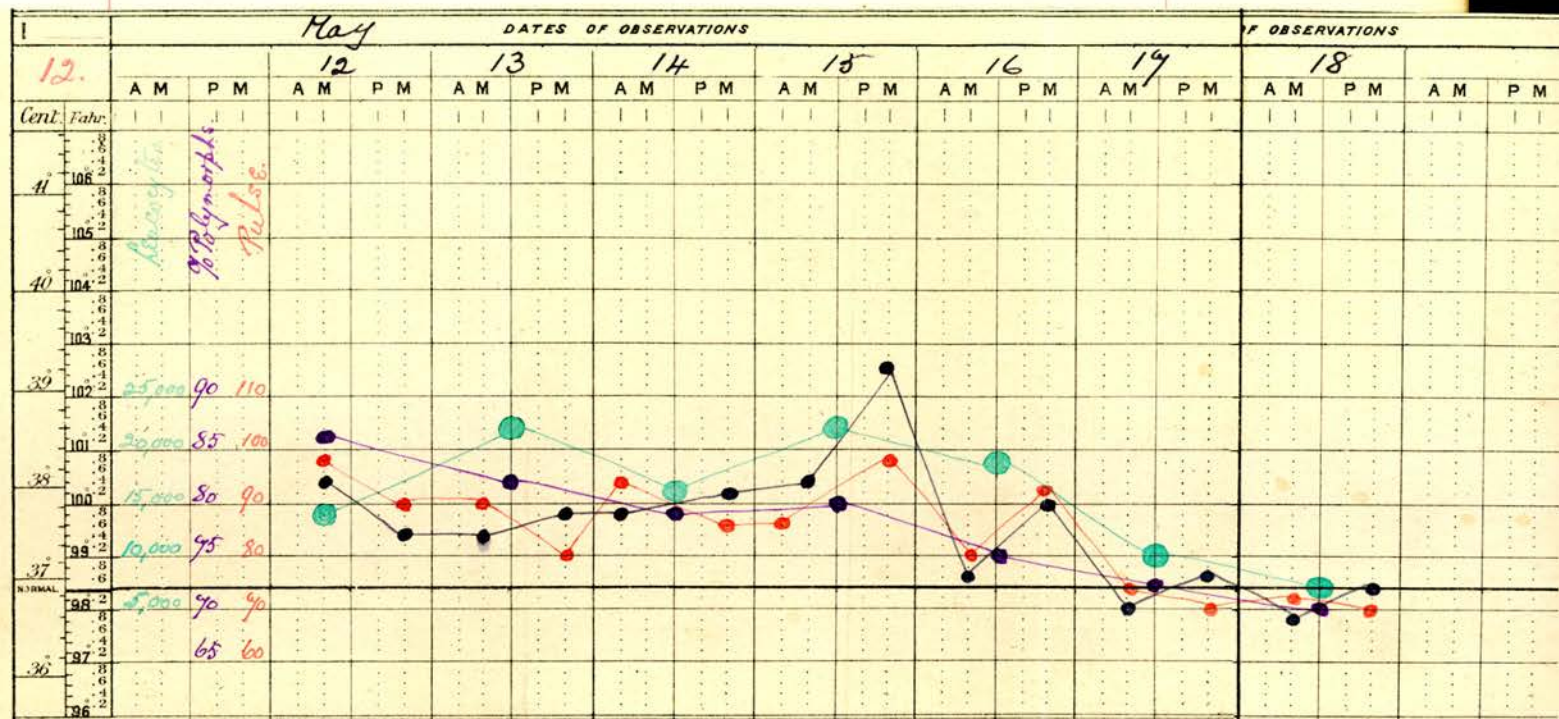
July 17. Sudden onset of general abdominal pain followed by vomiting.

" 18. - Localised tenderness over appendix, but no tumour to be felt. No more vomiting.

" 19. Slightly better, tongue cleaning. Steady improvement after this. Operated upon on July 30th. Vide Case 21.

Case XII.

J. H. Schoolboy, aet. 13.



May 12. Sudden onset, during the preceding night, of pain over the whole abdomen, followed by vomiting. The pain had become localised to appendix and vomiting had ceased when patient first seen.

" 13. Condition slightly better.

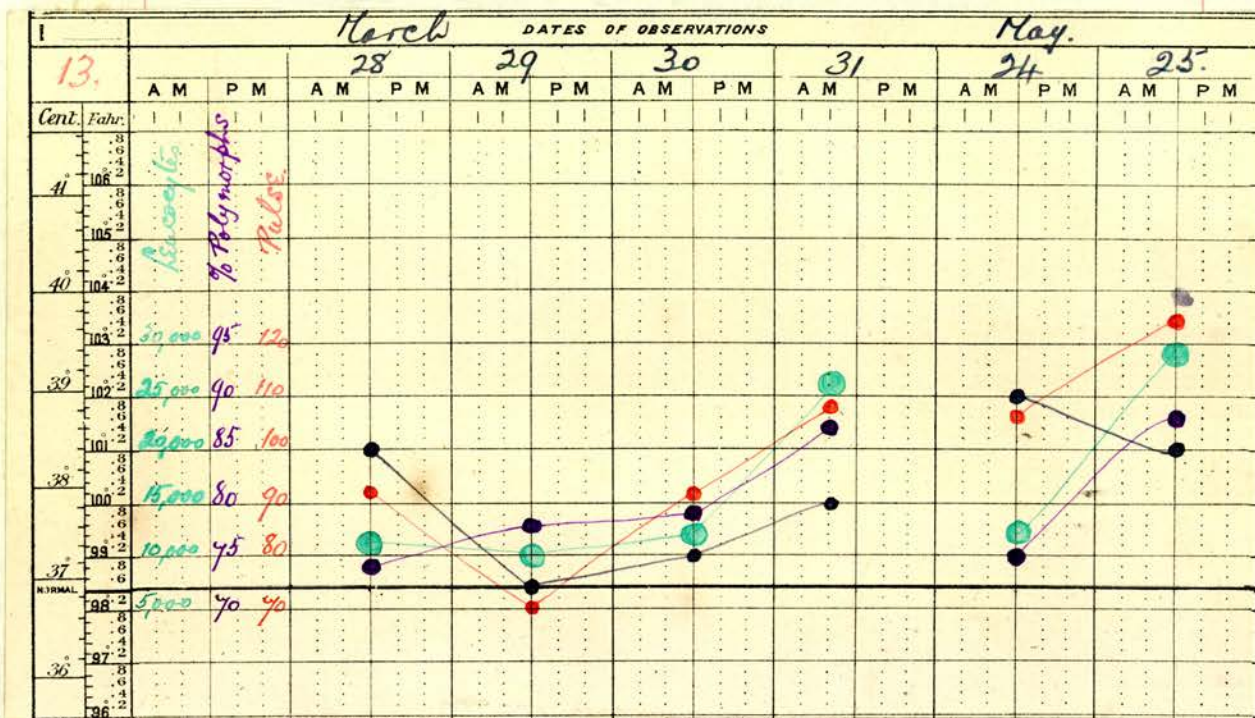
" 15. Patient not quite so well. Thickened mass felt in region of appendix. Very slight degree of distension, which was relieved at night by enema of Henry's Solution and glycerine.

" 16. Condition much better. Continued to improve daily. Operated upon on June 6th. Vide case 27.

Case XIII.

Mrs B. Aet. 35.

Instrumental labour two weeks previously; prinipara.



March 28. Sudden onset of diffuse abdominal pain, followed by vomiting. Symptoms all subsided in 24 hours. Slight return of pain on 30th, but subsided in 12 hours. On 31st return of pain, but now of screwing character. Appendix region very tender. No distension of abdomen.

" 31. Operation performed at 10.30 p.m. The appendix was adherent to the right ovary, and surrounded by a small pool of thick pus, on removing which a rupture through the lateral wall was disclosed. The amount of pus was not more than two teaspoonfuls, and was shut off from the general peritoneal cavity. General peritonitis was evidently just beginning, as there was a slight amount of sero-purulent secretion, in the general peritoneal cavity, and the blood vessels of the whole peritoneal surface were/

Case XIII continued.

were distended. The patient took chloroform very badly, and her pulse dropped to 58, so that it was deemed advisable not to attempt removal of the appendix, but simply to swab away all pus and drain the region where it had collected. The operation took 50 minutes. The patient made an uninterrupted recovery, and pleaded for delaying the removal of the appendix until a time more suitable to her.

May 24. Suddenly seized with screwing pains, accompanied by vomiting. Pains were chiefly to the left of middle line and accompanied by frequency of micturition.

" 25. Condition much the same, so operation was performed at 3 p.m., just 24 hours after onset of symptoms. There was a commencing general peritonitis. The appendix was lying with its tip below the brim of the pelvis, just to the left of the middle line. A small amount of rather thin pus seemed to surround the appendix, while the bowel which immediately surrounded it was covered in parts with recent lymph exudate. There was no rupture of the wall of the appendix.

During this operation also the patient's pulse dropped to 60, just after the peritoneal cavity had been opened.

Drainage was carried out through a separate opening just above the right Poupart's ligament. The operation took $1\frac{3}{4}$ hours. Recovery was uninterrupted.

Remarks

In this case it would seem that the ulceration in the appendix had continued to progress during the whole period between 26th and 31st March, although the symptoms entirely subsided during two separate portions of this time.

Rupture of the appendix had evidently occurred in the morning of 31st, to judge by the condition found at the operation performed that night.

The contrast between the pathological changes found at the two operations seems worth noting. At the first operation the infection of the general peritoneal cavity appeared to have travelled by way of the lymphatics, as the collection of pus around/

Case XIII continued.

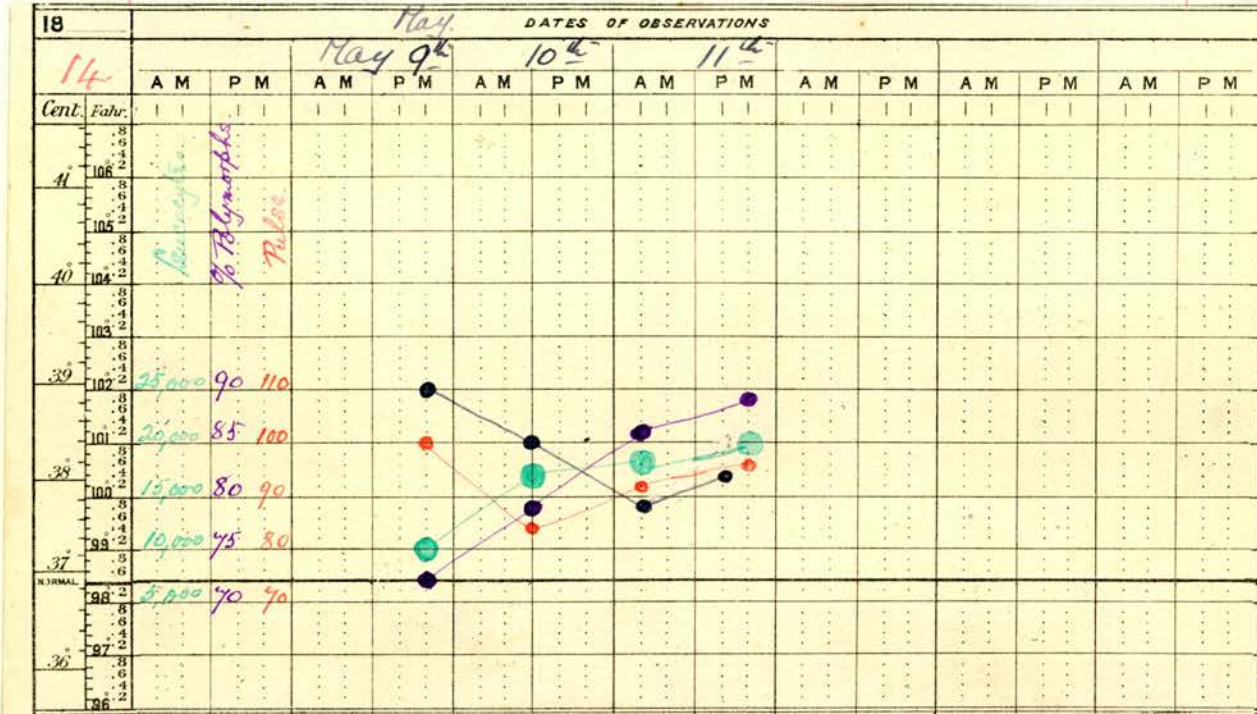
around the appendix was entirely shut off. The appendix had evidently become quite isolated before rupture had taken place.

At the second operation it appeared that pus had begun to form around the appendix lying free in the peritoneal cavity, and then had followed the attempt at localising indicated by the presence of lymph exudate on the parts of bowel nearest the area of infection. The appendix had not ruptured at all, so that the pus surrounding it must have been produced by infection by way of the lymphatics, the general peritonitis following by direct communication between the general peritoneal cavity and the infected area.

For history of this case after each operation vide case 39.

Case XIV.

R. M. Postman, aet. 21.



- May 9. Sudden onset of general abdominal pain at 3 p.m., followed by vomiting. Whole abdomen rigid when first seen at 6 p.m.
- " 10. vomiting ceased, slight movement of abdomen with respiration. Pain localised to appendix, over which the rigidity was most marked.
- " 11. Condition much the same, with a slight amount of abdominal distension superadded. Expression slightly anxious. Operated upon at 11 p.m. that night, i.e. 57 hours after onset of attack, and a rupture of side of appendix with a small amount of localised pus was discovered, also commencing general peritonitis. Vide case 40.

Remarks.

This case showed only a moderate degree of leucocytosis but the polymorphonuclear percentage was high, and/

Case XIV continued.

and there was a slight rise in the pulse rate. Furthermore, though there was no further vomiting there was no improvement in the other symptoms and the patient's expression was not so good. The conjunction of all these facts led to the decision to operate.

Case XV.

J. H. Boy, aet. 3.

Previous history pointed to tubercular peritonitis from which he seemed to have quite recovered.

Nov. 8. At 6 a.m. suddenly seized with pain over abdomen, followed by vomiting. At 6 p.m. an enema was given but child seemed to collapse after this. Brought to Hospital at 10 p.m. The child at that time was lying on its right side with legs drawn up, sweating profusely and quite exhausted. Abdomen flaccid except over the region of the appendix, where there was considerable tenderness. Temperature 97.6 Pulse 120. Leucocytes 39,000. Polymorphs. 94%.

On opening the abdomen a large amount of slightly turbid serum escaped. Several coils of small intestine had become strangulated by the appendix, which was adherent at its tip to an enlarged gland in the mesentery, thus forming a tight band between the caecum and the root of the mesentery. Several of the vessels supplying these strangulated coils of intestines had become thrombosed. The appendix was freed at its tip and then removed, and the abdomen sewed up without drainage. The child died at 7 a.m. next day.

Remarks.

This case was not one of appendicitis, the adhesion between the tip of the appendix and the mesenteric gland being probably due to a previous tubercular affection of the gland.

The/

Case XV continued.

The case is quoted on account of the leucocyte count, and because the conditions which existed were thought to be similar, only in an exaggerated degree, to those occurring in the case of an appendix distended with faecal matter, and becoming gangrenous.

SECOND GROUP.

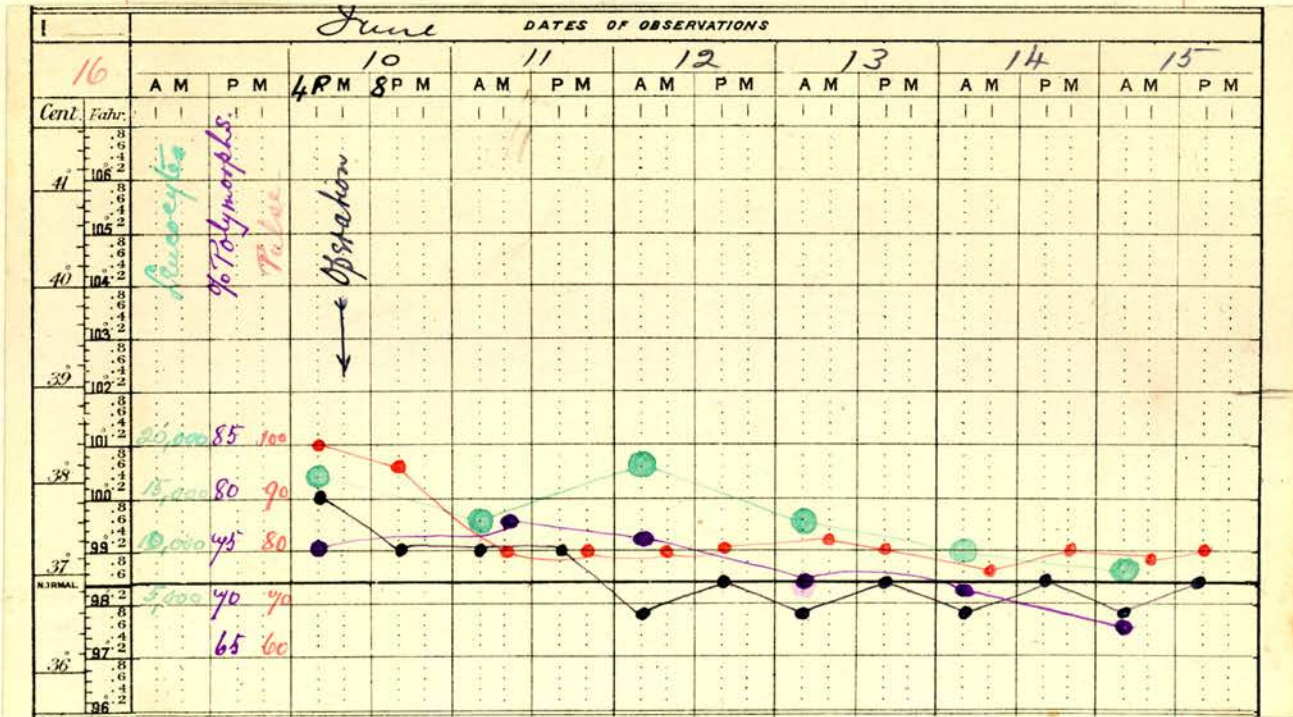
Case XVI.

Mrs A., aet. 22.

Had appendicitis two years previously.

June 9. At 10 p.m. had sudden attack of pain in region of appendix, followed by vomiting, but this only once.

" 10. Soap and water enema gave no relief of pain. Brought to hospital and operation performed at 4 p.m., i.e., 18 hours after onset of attack.



Appendix free and easily removed. On section showed scarring and contraction about its middle, evidently the result of previous attack. Mucous membrane was swollen, but not ulcerated.

Operation occupied 35 minutes. Recovery was uneventful.

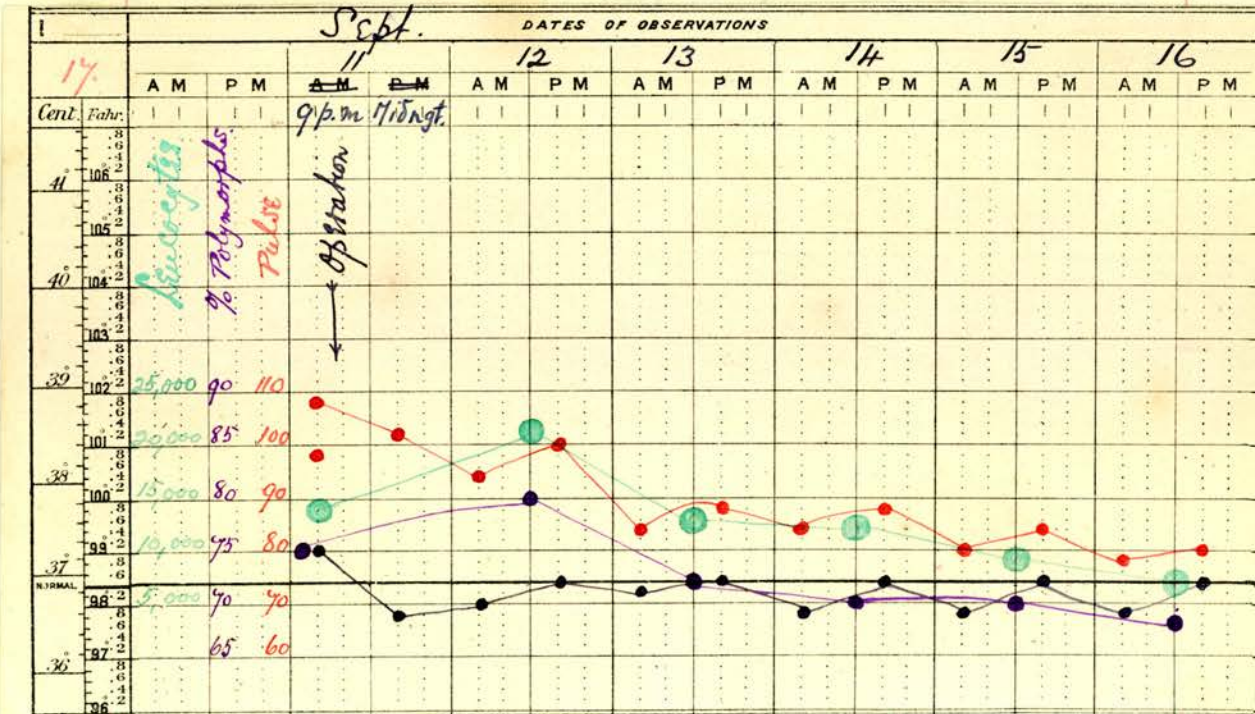
Case XVII.

H. H., aet. 16, factory girl.

Had suffered from constipation and a certain amount of indigestion of intestinal origin for about three weeks.

Sept. 10. About 9 p.m. had acute pain in region of appendix, followed by vomiting, which latter continued at intervals until the morning.

" 11. Brought to Hospital and operated upon at 8 p.m. At this time had tenderness and a slight amount of muscular rigidity over appendix.



The appendix was free and shewed no external signs of inflammation.

On section the mucosa appeared swollen, and in it were two small haemorrhagic areas, one of which was beginning to ulcerate. The lumen was full of mucofaecal matter.

The operation occupied about $\frac{3}{4}$ hour. Recovery was uneventful.

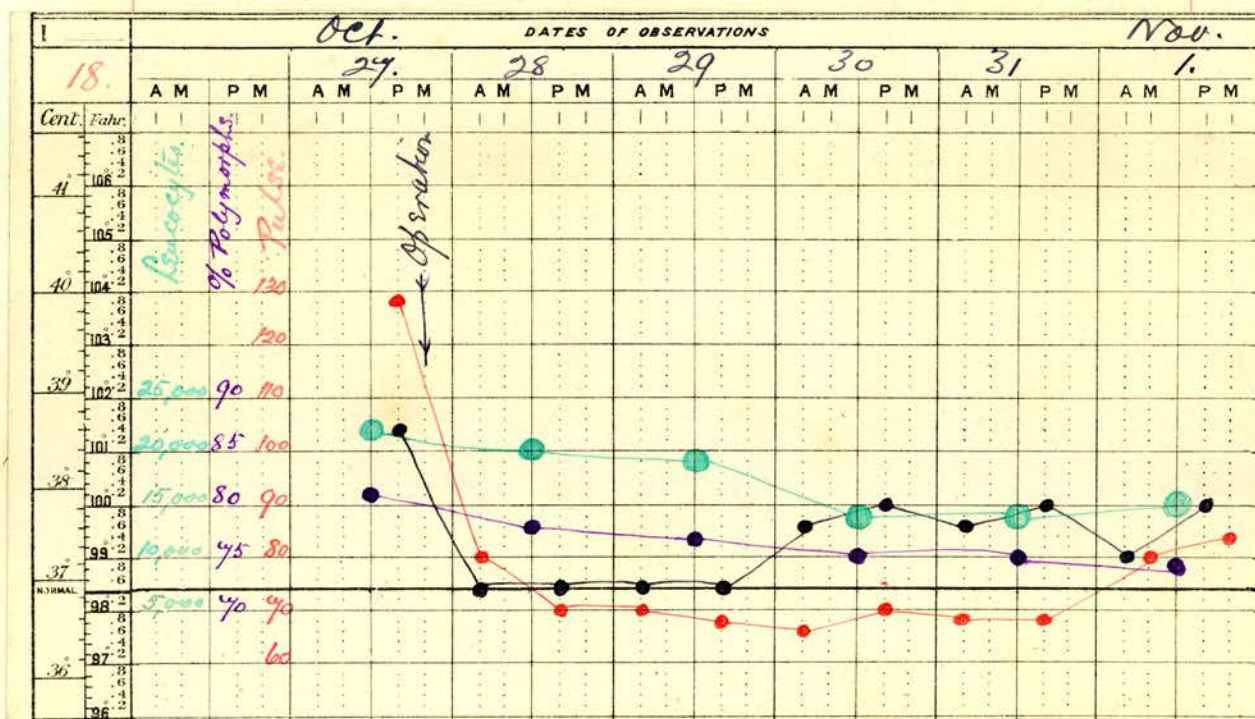
Case XVIII.

M. M. aet. 35, factory girl.

Had two previous attacks. The first 18 months previously, was less acute than the second, 3½ months ago.

Oct. 26. At 11 a.m. felt pain in region of appendix, accompanied by a rigor, and followed by vomiting which latter did not last more than three hours.

" 27. Sent to Hospital for operation. Tenderness and muscular rigidity limited to region of appendix. Operation performed at 8 p.m. i.e., 33 hours after onset of illness.



The appendix was adherent at its tip to a portion of great omentum, but was otherwise quite free and easily removed.

On section the mucous membrane appeared much swollen, but not ulcerated. The lumen was quite obliterated for about ¼ inch at the tip by scar tissue, evidently the result of one of the previous attacks.

The operation occupied ¾ hour.

Nov. 2./

Case XVIII continued.

Nov. 2. Wound was dressed, and a good deal of fetid pus escaped from the subcutaneous tissue, Recovery was otherwise uneventful.

Remarks.

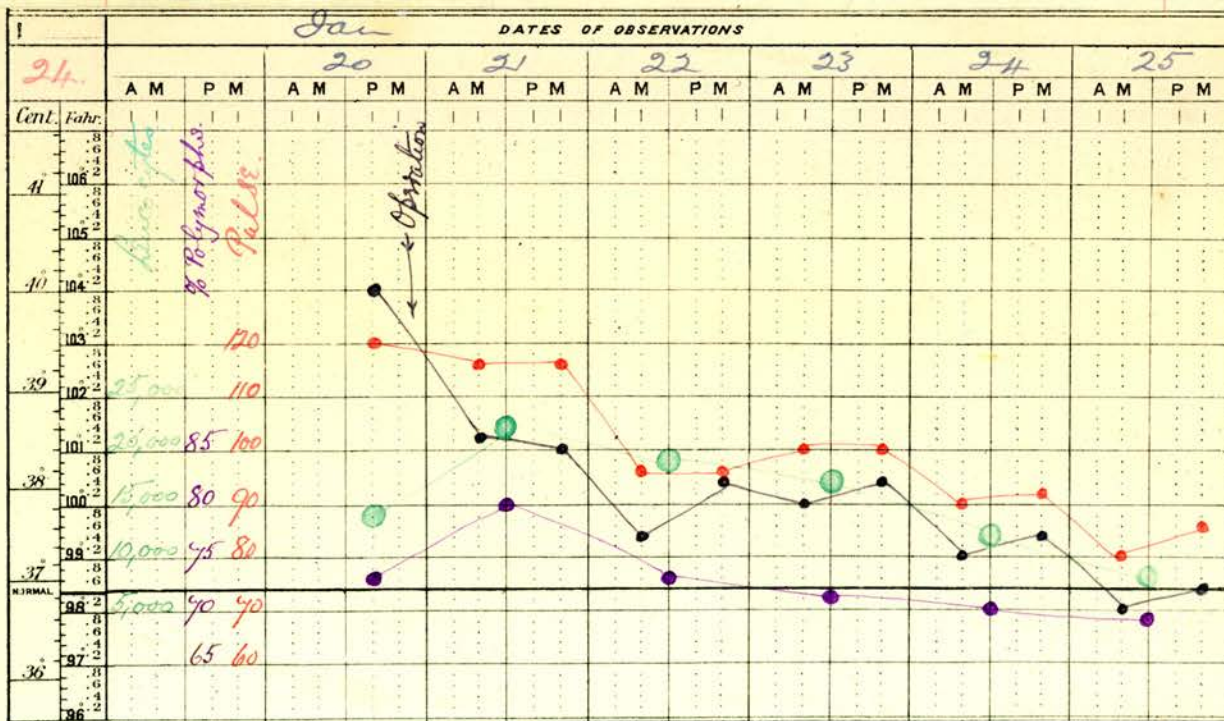
The Sepsis in the wound had occurred between the skin and deep fascia, and was evidently due to the B. Coli. This accounted for the continued high leucocyte count.

Case XXIV.

Mrs C. aet. 21.

Jan. 19. Sudden onset of pain over abdomen at 8 p.m. followed by vomiting, which continued up to time of operation.

" 20. Pain localised to region of appendix, which also tender and slightly rigid. Brought to Hospital and operation performed at 10 p.m. i.e. 26 hours after onset of attack.



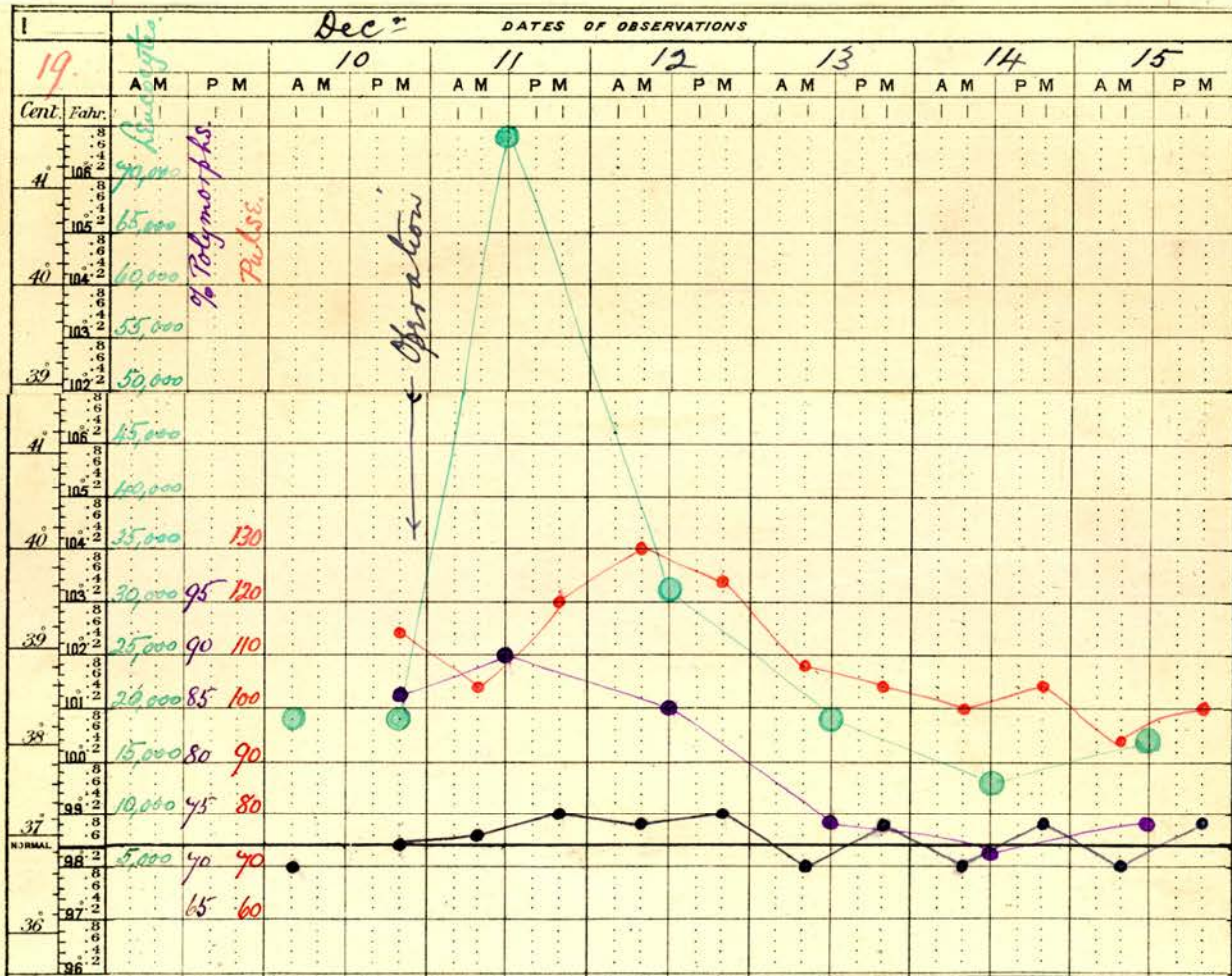
The appendix was quite free, and easily removed. On section the mucosa was much swollen, and there was a small area of ulceration at about the middle.

The operation occupied 1 hour. Recovery was uneventful.

Case XIX.

J. R., aet. 4 years.

Admitted to hospital at 11 p.m. on Dec. 10th. Two days previously had sudden attack of pain in abdomen, followed by vomiting. At the time of admission to hospital the abdomen was distended and evidently tender over the appendix. Morphia had been given, and the child seemed fairly comfortable, and did not look ill.



The operation disclosed a constriction of 3 loops of ileum by a Meckel's diverticulum, which was attached by a thin band to the posterior abdominal wall. It arose from the ileum at a distance of about 18 inches from the ileocaecal valve. There were no adhesions, and the constriction had not been sufficiently tight to interfere with the blood supply of the part of ileum involved; which, however, was swollen and full of retained faeces. The diverticulum was ligatured and removed/

Case XIX continued.

removed and the wound closed without drainage. The operation occupied 1 hour.

The child took Chloroform very badly, the air passages getting filled with mucus.

Dec. 15. There was a small patch of bronchopneumonia at base of right lung. Recovery was otherwise uneventful.

Remarks.

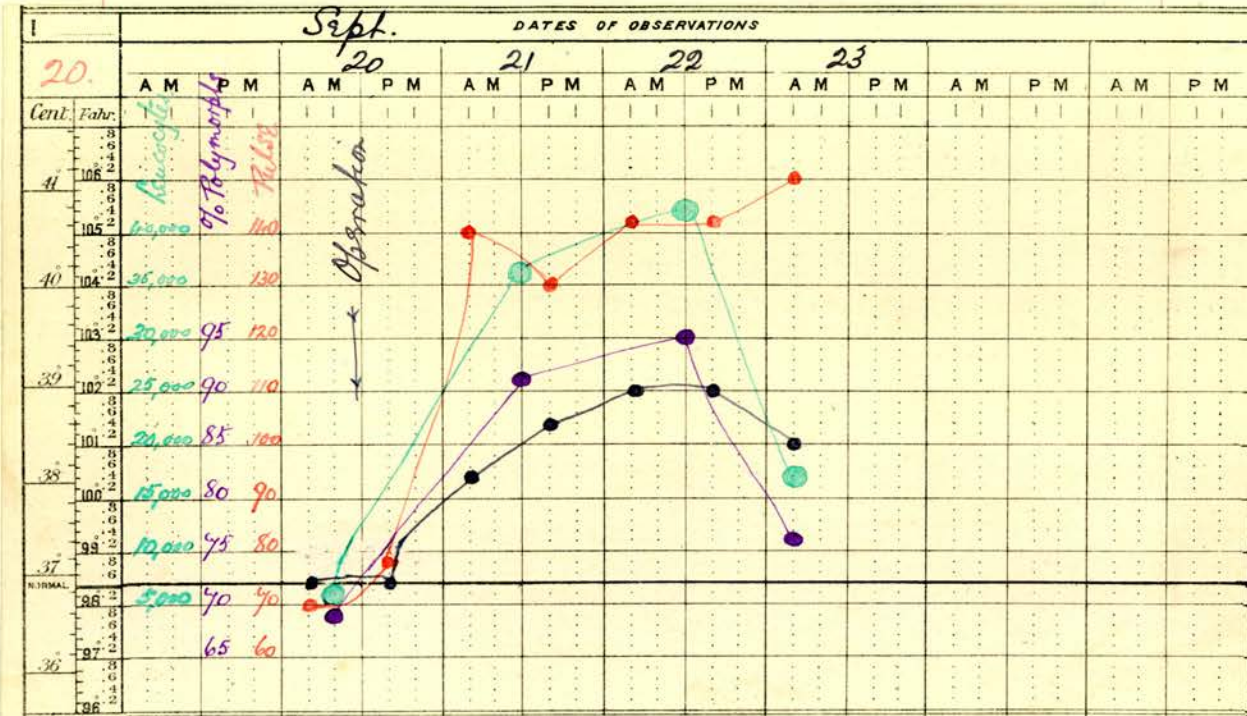
This case is very similar to Case 15 but of a much milder degree, as the mesenteric vessels were not thrombosed.

It seems feasible to regard it as analogous, but in an exaggerated form, to a case of Appendicitis, in which there is catarrh of the mucous membrane, and distension of the appendix by retained faecal matter and mucus.

Case XX.

P. McK., aet. 25. Miner.

Had three previous attacks, of which the first was the worst. The last attack was very mild, the patient remaining only four days in bed.



Sept. 20. Operation 10 days after onset of last attack.

The appendix was slightly adherent at about its mid point, but easily removed. Operation occupied about 1 hour.

" 21. Patient looked worn and very ill, but had neither pain nor vomiting. Antistreptococcus serum injected twice and saline solution given per rectum, also nutrient enemata and hypodermics of strychnine given.

" 22. Condition much the same, but patient obviously weaker.

" 23. Died at 9 a.m.

Post Mortem. Peritoneal cavity was full of thin pus, which/

Case XX continued.

which gave a pure culture of Staphylococcus Aureus. There were no adhesions.

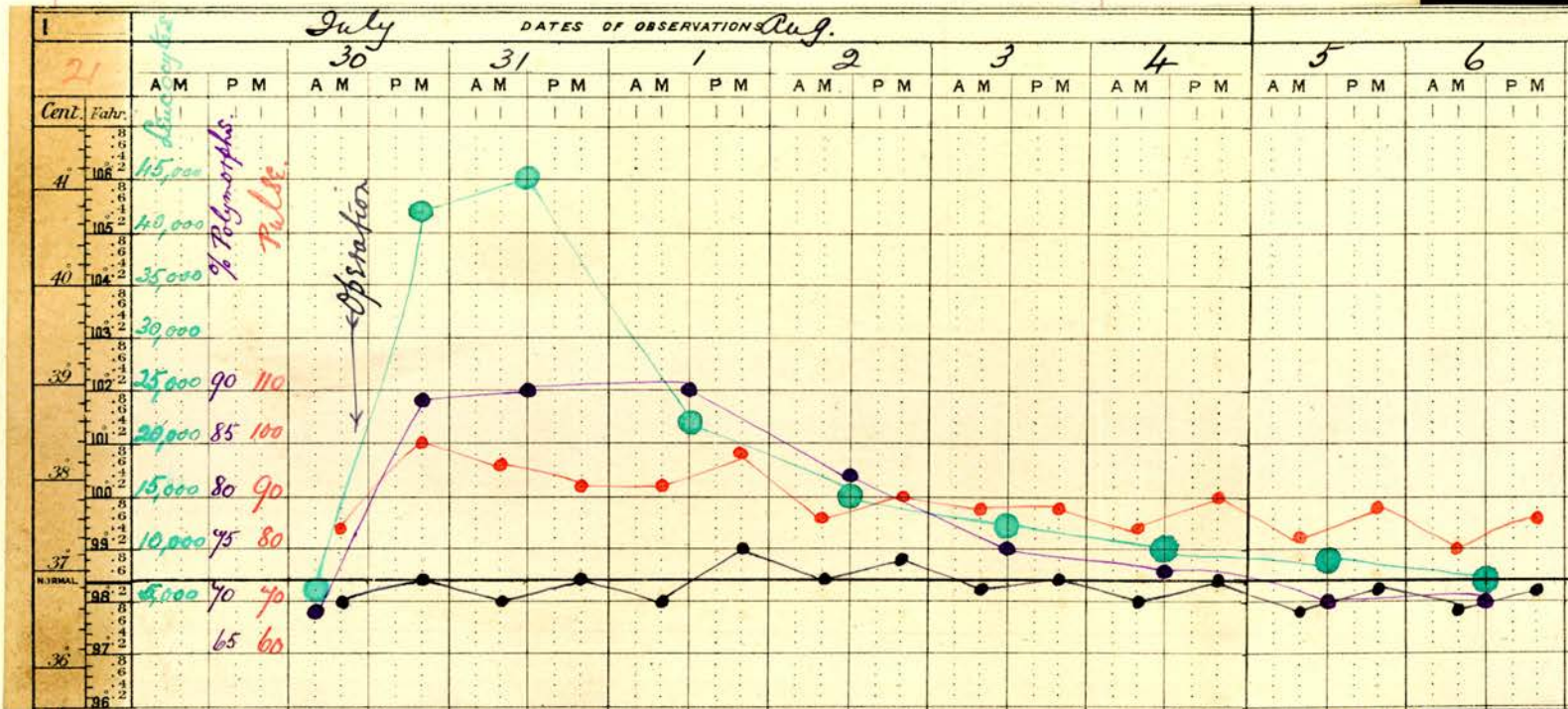
Remarks.

It was of course impossible to prove the source of the infection which produced a general peritonitis in this case, but it would appear quite feasible to attribute it to the escape into the general peritoneal cavity of a minute quantity of the contents of the appendix during its removal. This theory gained support from the fact that, of four abdominal sections on consecutive days, this was the only one which developed any complications, the two which preceded it, and the one which followed it, healing by first intention.

Case XXI.

T. M. aet. 6.

Operation performed on July 30th, 13 days after onset of attack. Vide case 11.



There was a very dense matting together of bowel and mesentery in the region of the appendix which was lying behind the ileo-caecal junction and the mesentery. The parts were all congested, and there were several inflamed glands in the adjacent mesentery.

No attempt was made to separate out the appendix, as soon as its position was ascertained. The operation occupied $\frac{3}{4}$ hours. Recovery was uneventful.

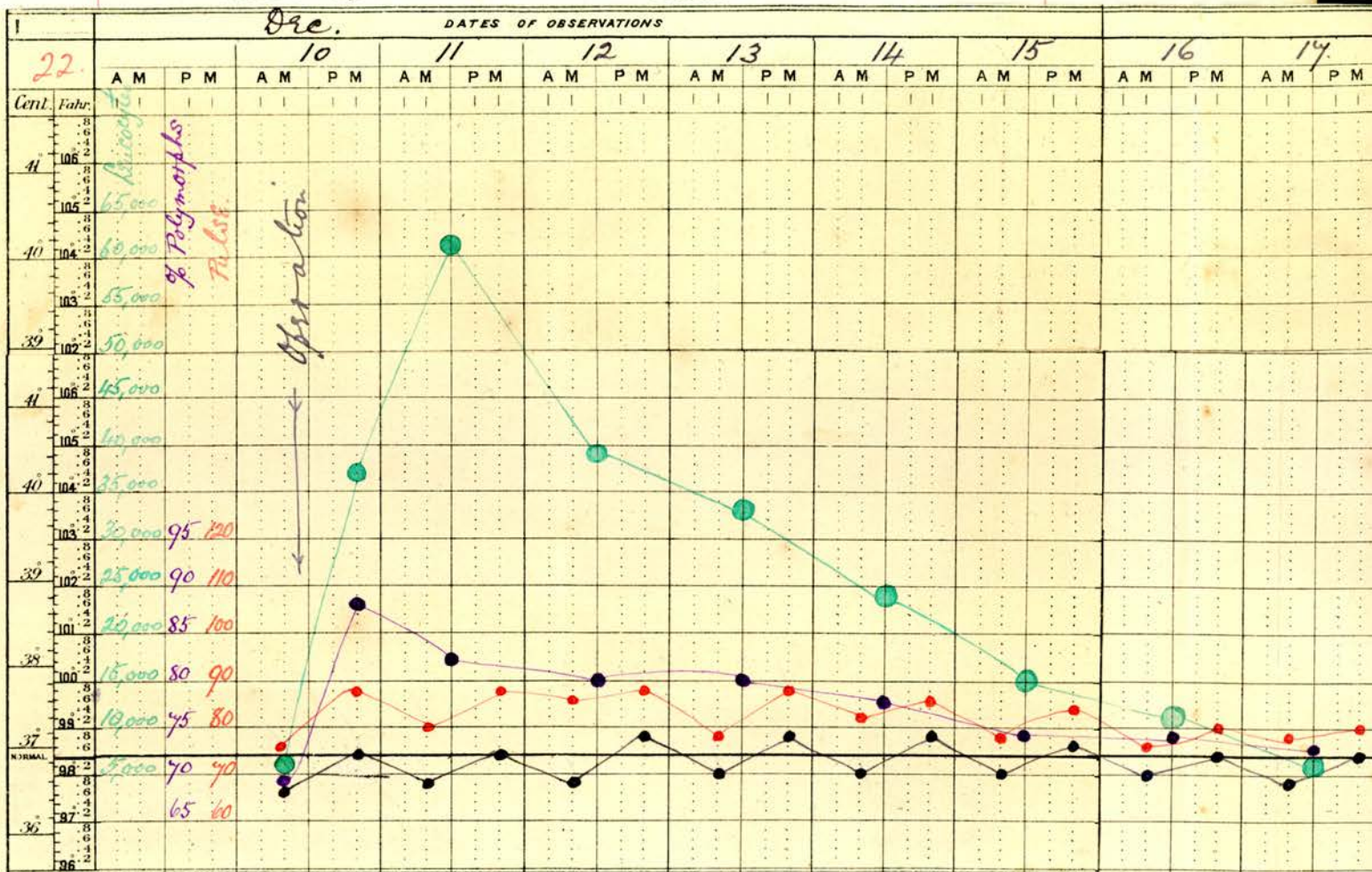
Remarks.

There can be little doubt that it would have been wiser to have delayed the operation in this case for at least ten days.

Case XXII.

R. W., aet. 21. Miner.

Operation performed on 10th December 2 weeks after onset of attack. Vide Case 5.



The appendix was quite free and very easily removed. All its vessels were congested and the whole appendix much swollen. On section there was found a constricted portion at the centre where the mucous membrane was ulcerated, and the submucous layer contained two small haemorrhages.

The operation occupied $\frac{3}{4}$ hour.

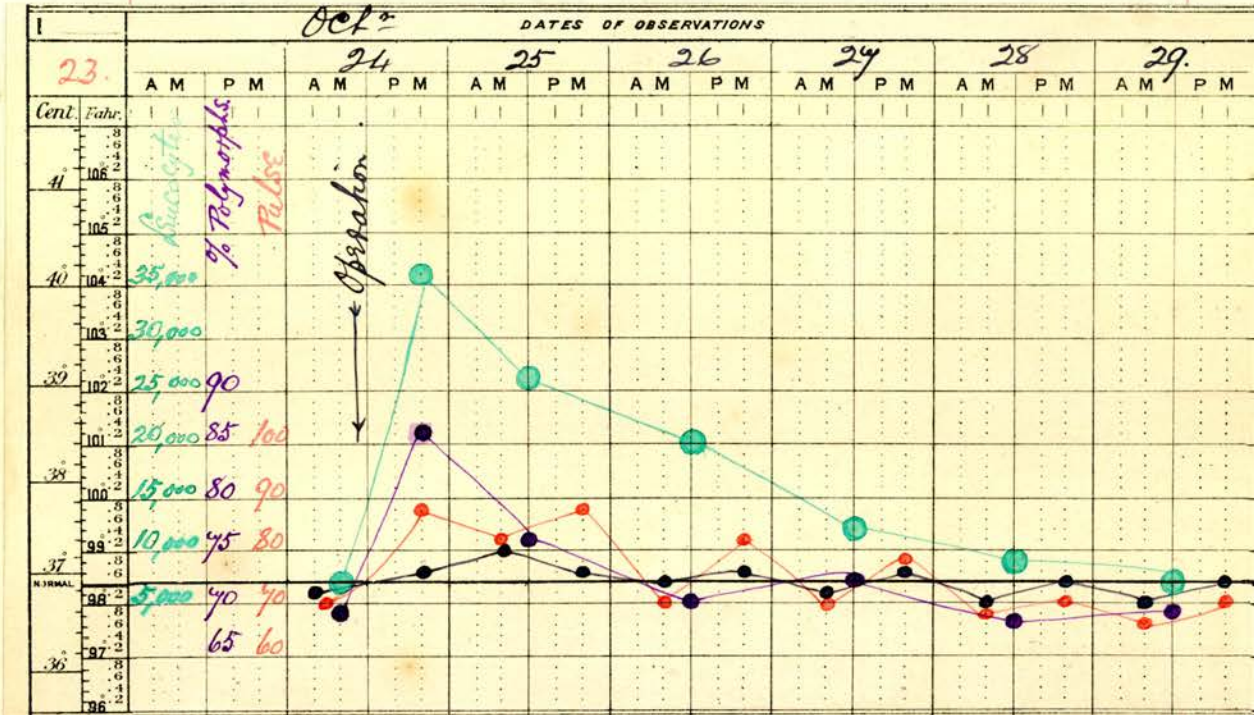
Remarks.

Owing to the mildness of the symptoms in this case it was thought quite safe to operate at the end of the second week. The appendix, however, shewed that there had been considerable ulceration of the mucosa, and that the inflammatory process had not yet subsided.

Case XXIII.

R. P., aet 23. Miner.

Operation on October 24th, 12 days after onset of last attack, which occurred three weeks after the first, Vide case 4.



The appendix was found to be completely tied down in a dense mass of adhesions to the inner side of the ascending colon. The adhesions were so dense, that no attempt was made to free the appendix.

The operation occupied 20 minutes.

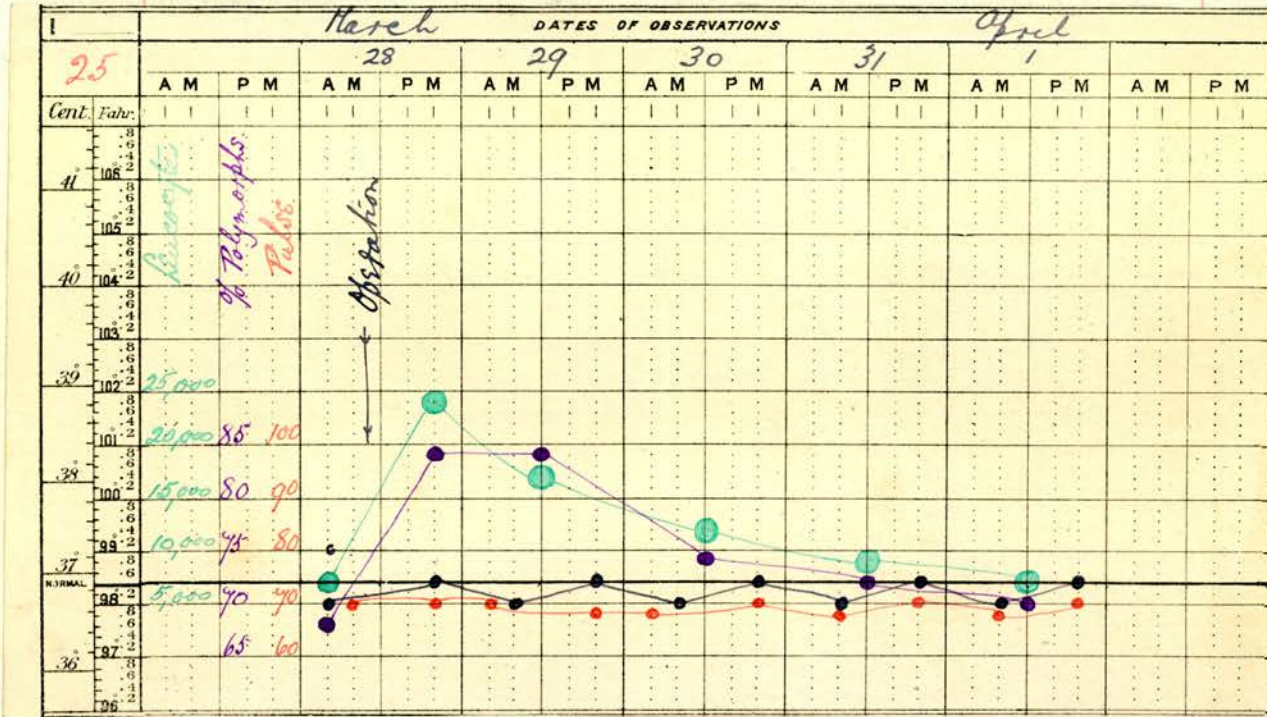
Remarks.

In this case there was evidently a good deal of lymphatic invasion, and no doubt in the manipulations made to ascertain whether or not it was possible to free the appendix, several of the less dense adhesions were broken down and allowed of the escape of a certain amount of infected blood and serum.

Case XXV.

Wm. McC., aet. 30. Miner.

Operation performed on 28th March, 2½ weeks
after onset of attack.



The appendix was quite free and was easily removed, which was done by drawing it right out of the wound and packing sponges around it before ligaturing and cutting it off.

On section it shewed merely a slight catarrh of the mucosa with no ulceration.

The operation occupied 20 minutes.

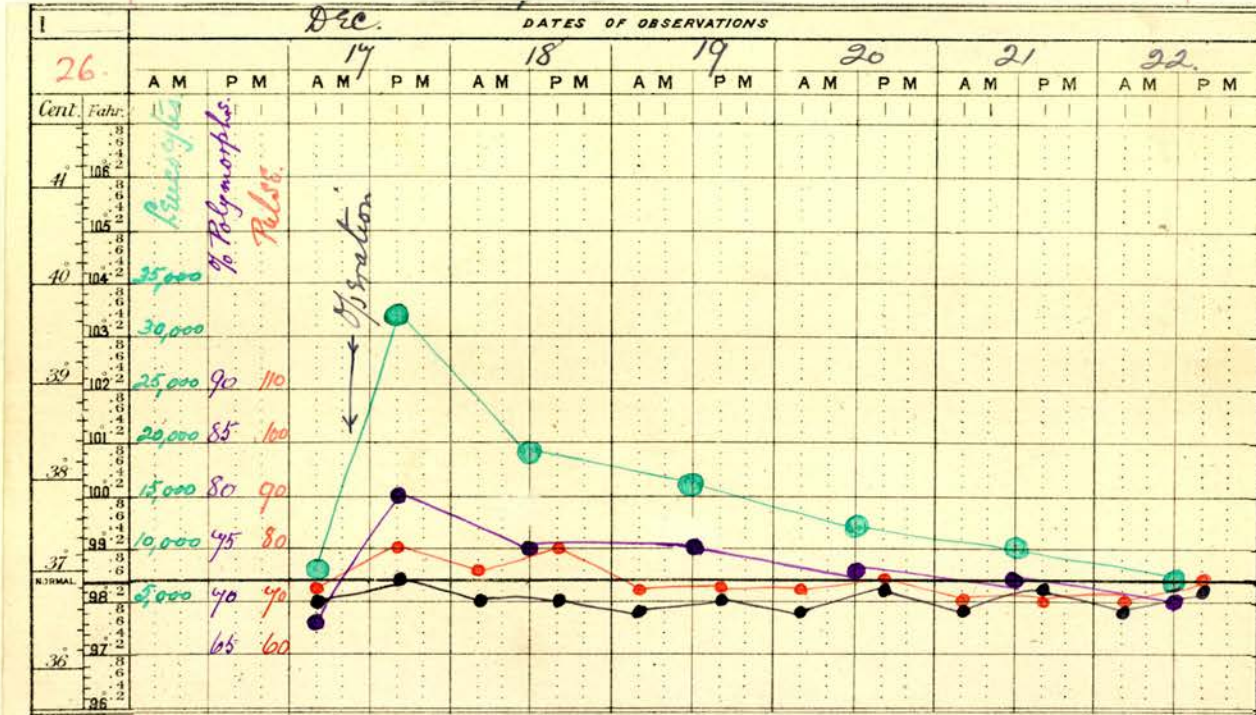
Remarks.

This was a very mild case, and, owing to the ease with which the appendix was brought to the surface there was probably little or no sciling of other structures.

Case XXVI.

L. McL.. aet. 10, Schoolgirl.

Dec. 17. Operation three weeks after onset of attack;
Vide case 7.



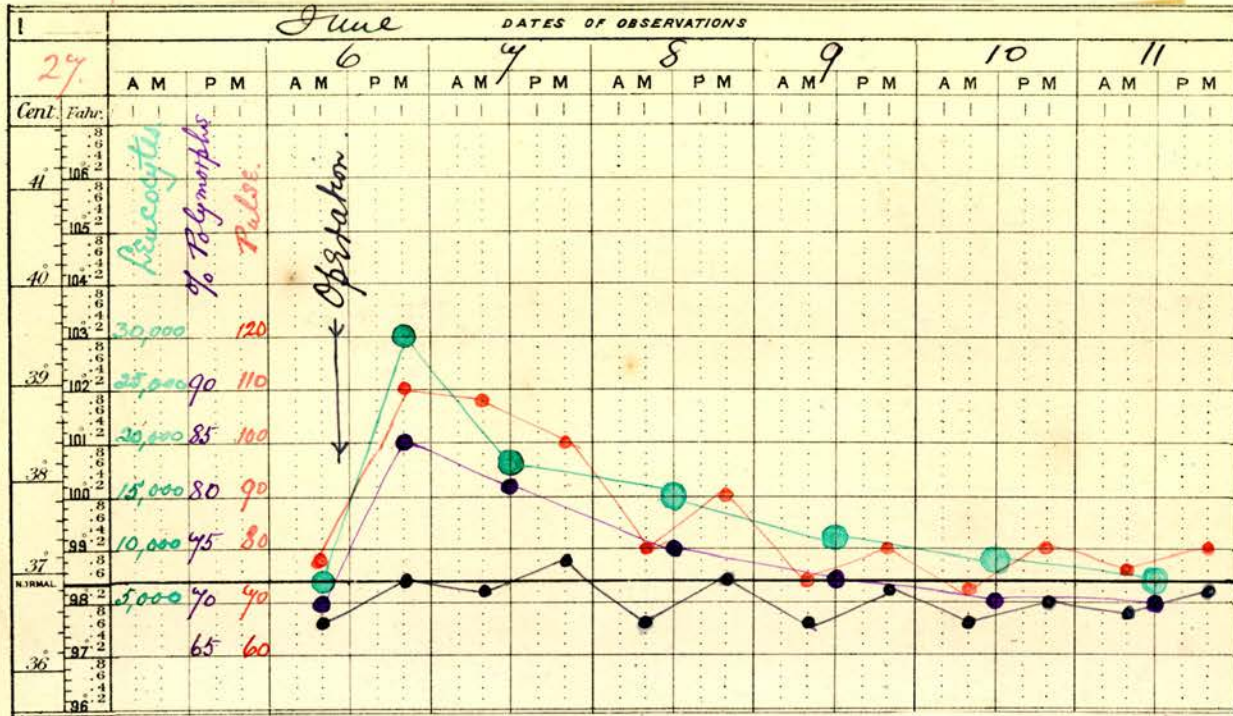
Appendix was quite free and easily removed. It was much swollen and congested, and contained a good deal of muco-pus.

The operation occupied $\frac{3}{4}$ hour. Recovery was uneventful.

Case XXVII.

J. H., aet. 13. Schoolboy.

Operation performed on June 6th $3\frac{1}{2}$ weeks after onset of attack. Vide case 12.



The appendix was tied down to the outer side of the ascending colon. In trying to separate it from this, it tore across at a point about $\frac{1}{8}$ inch from its base. It was found impossible to ligature it, so pure carbolic was applied, and the stump buried. The operation occupied two hours, was very difficult, and there was a good deal of bleeding from the adhesions.

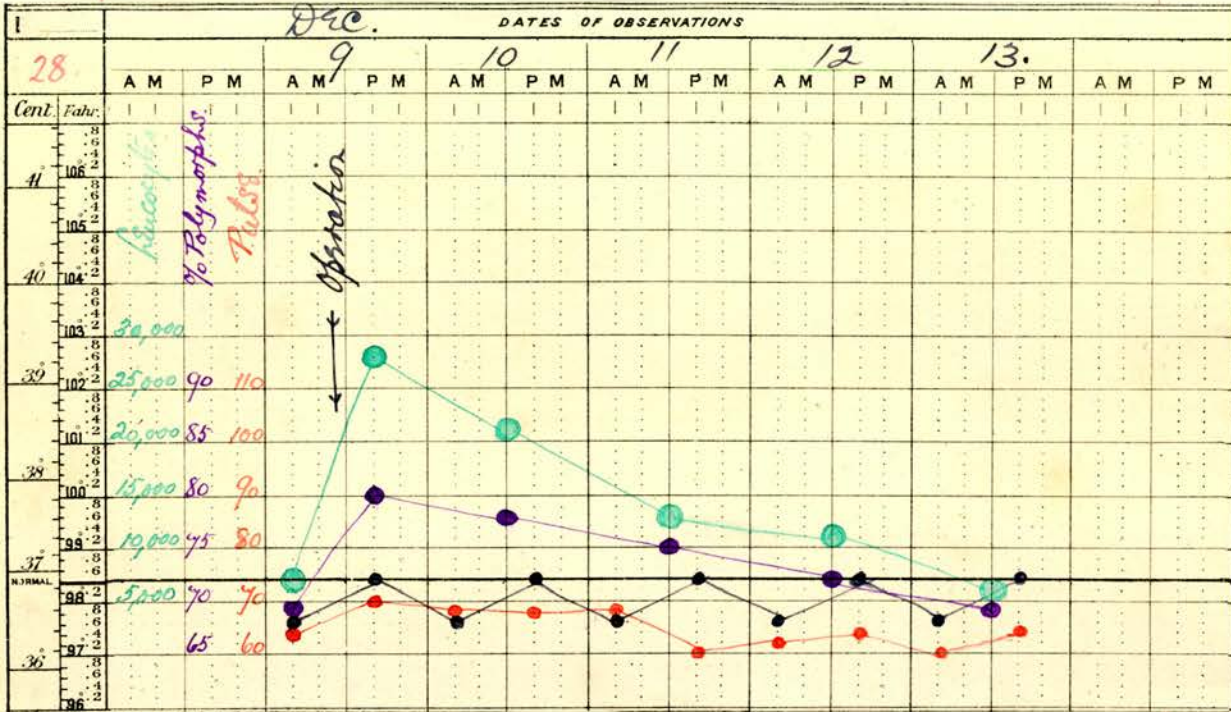
Remarks.

It was feared that the general peritoneum might have been infected as the result of the tearing of the appendix, and the haemorrhage.

Case XXVIII.

J. T., aet 22. Clerk.

Dec. 9. Operation performed four weeks after onset of attack; vide case 6.

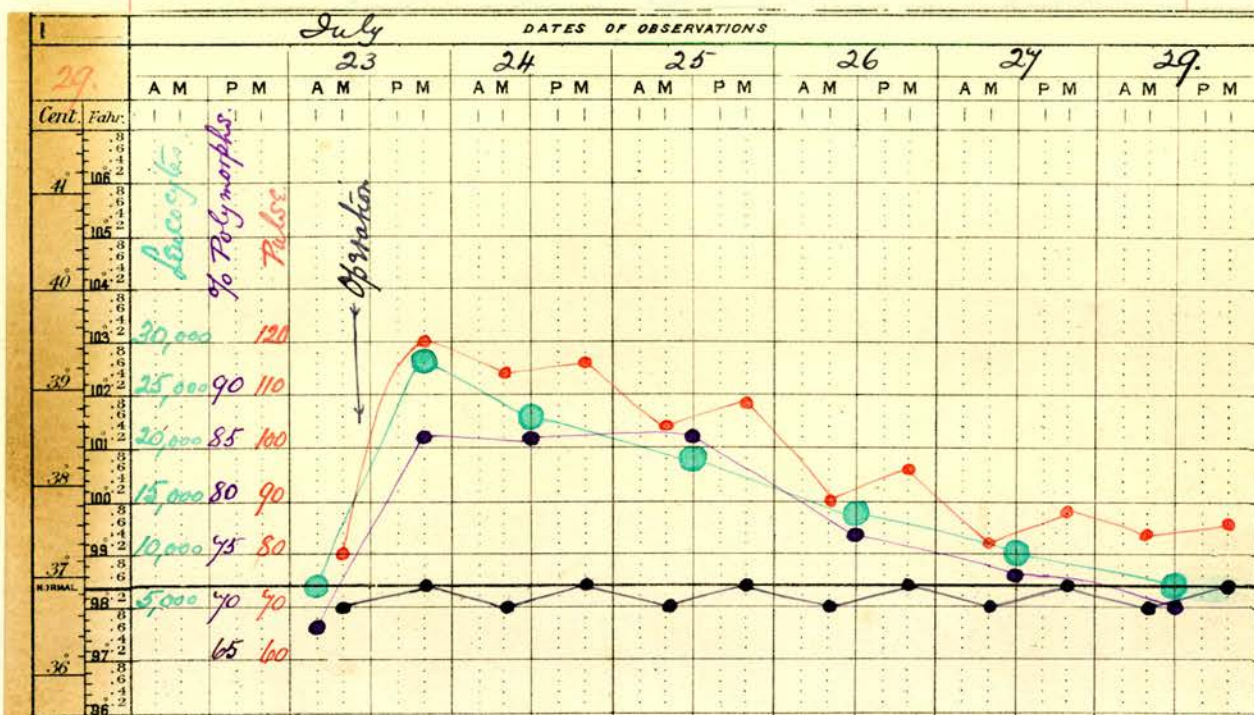


The appendix was adherent from about its mid point to the tip, the adherent portion being distended with mucus. There was a cicatrix at its mid point, causing an occlusion of the lumen, but there were no signs of active inflammation. The operation occupied $\frac{3}{4}$ hour. Recovery was uneventful.

Case XXIX.

A. A. aet. 5.

Operation performed on July 23rd, four weeks after onset of attack. Vide case 10.



The appendix was tied down into the pelvis in a dense mass of adhesions, which bled freely. The operation was difficult and prolonged, occupying 2 hours and the appendix was torn near its tip while being separated. Recovery was uneventful.

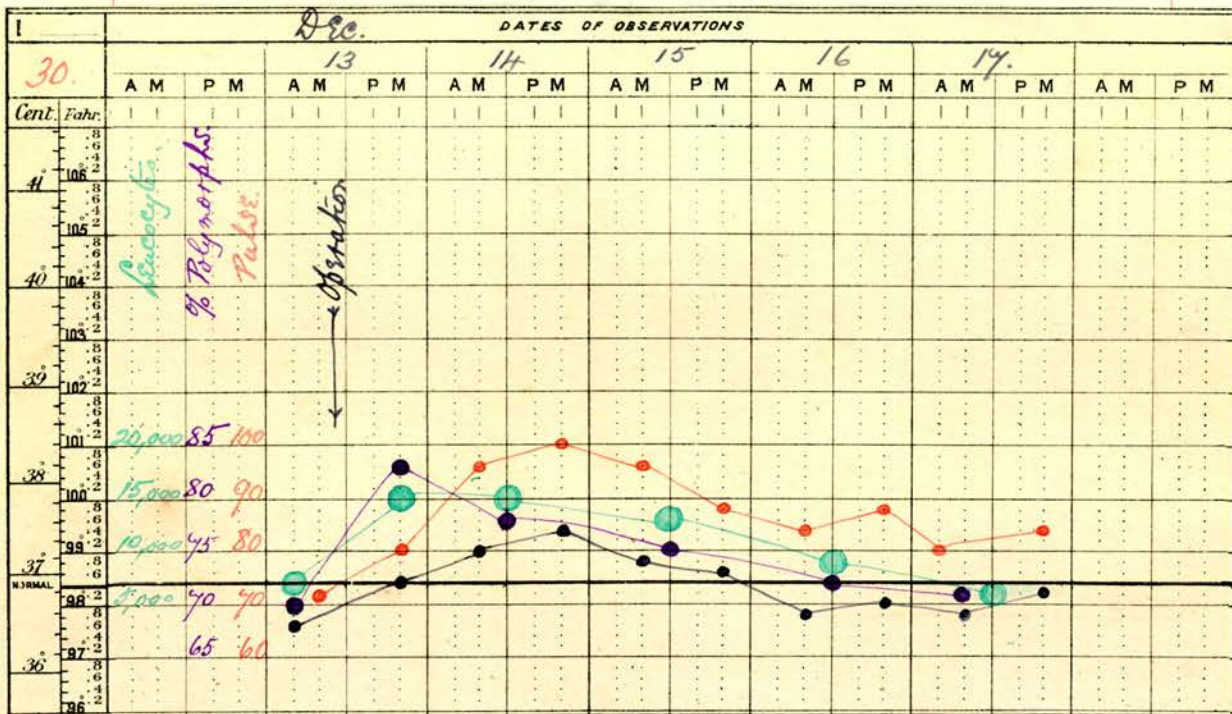
Remarks.

There was every chance of soiling of the peritoneal cavity during the operation, owing to the tear into the lumen of the appendix and the haemorrhage from torn adhesions.

Case XXX.

L. W., aet. 40. Domestic servant.

During the previous 12 months had six attacks, all slight. Operation performed on December 13th six weeks after last attack.



Numerous dense adhesions were present between portions of bowel in region of caecum, The appendix was at its middle incorporated with the side of the caecum, the portion of the latter involved in this dense adhesion being almost cartilaginous. It was deemed advisable to invert this portion of the caecum after removing the appendix. Several of the adhesions were so dense and vascular as to need ligaturing before division. There was a great deal of handling of the parts and considerable haemorrhage. The operation occupied 2 hours. Recovery was uneventful.

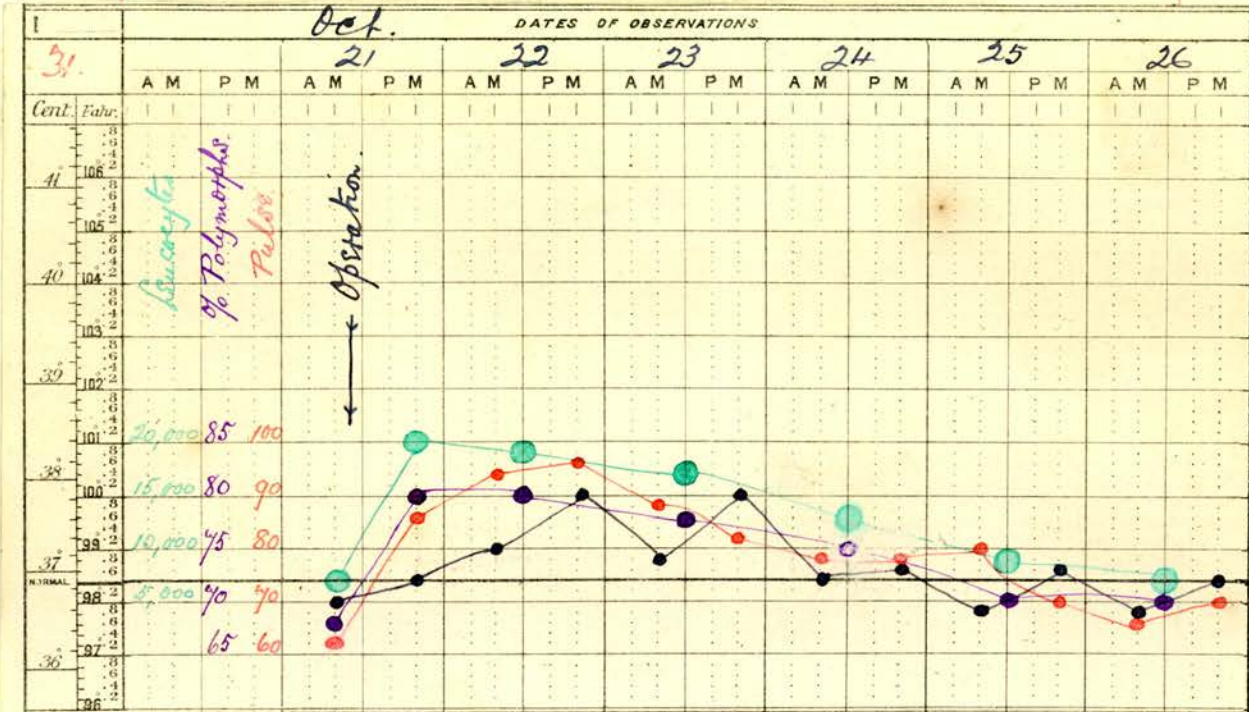
Remarks.

It was difficult to decide whether the condition was due to appendicitis, or to a stercoreal ulcer of the caecum, to which the appendix had become adherent.

Case XXXI.

J. P., aet. 28, Miner.

Operation performed on October 21st, six weeks after last attack, which had occurred about nine weeks after the first attack.

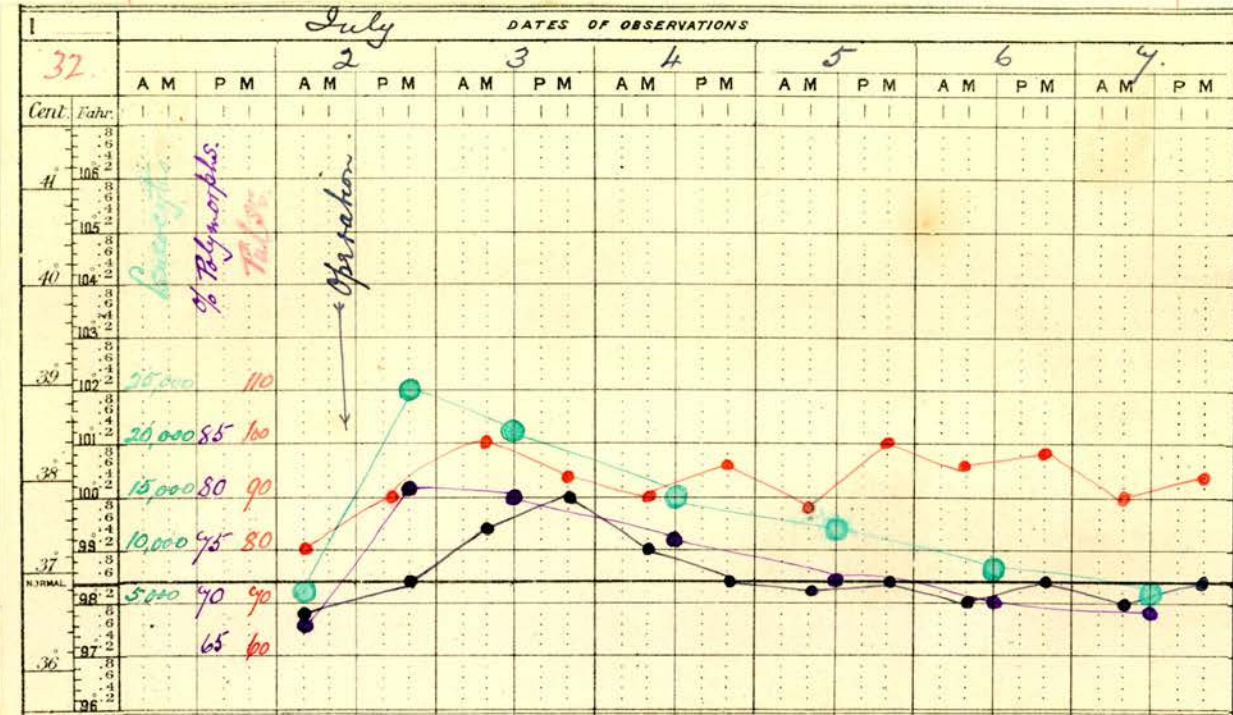


The appendix was completely bound down in a dense mass of adhesions lying to the inner side of the caecum and below the ileum. A few adhesions were broken down, but it was found impossible to free the appendix, and the attempt was therefore abandoned. The operation occupied $\frac{1}{4}$ hour. Recovery was uneventful.

Case XXXII.

Mrs Y., aet. 22.

Operation was performed on 2nd July, seven weeks after last attack, which occurred 2½ months after the first.



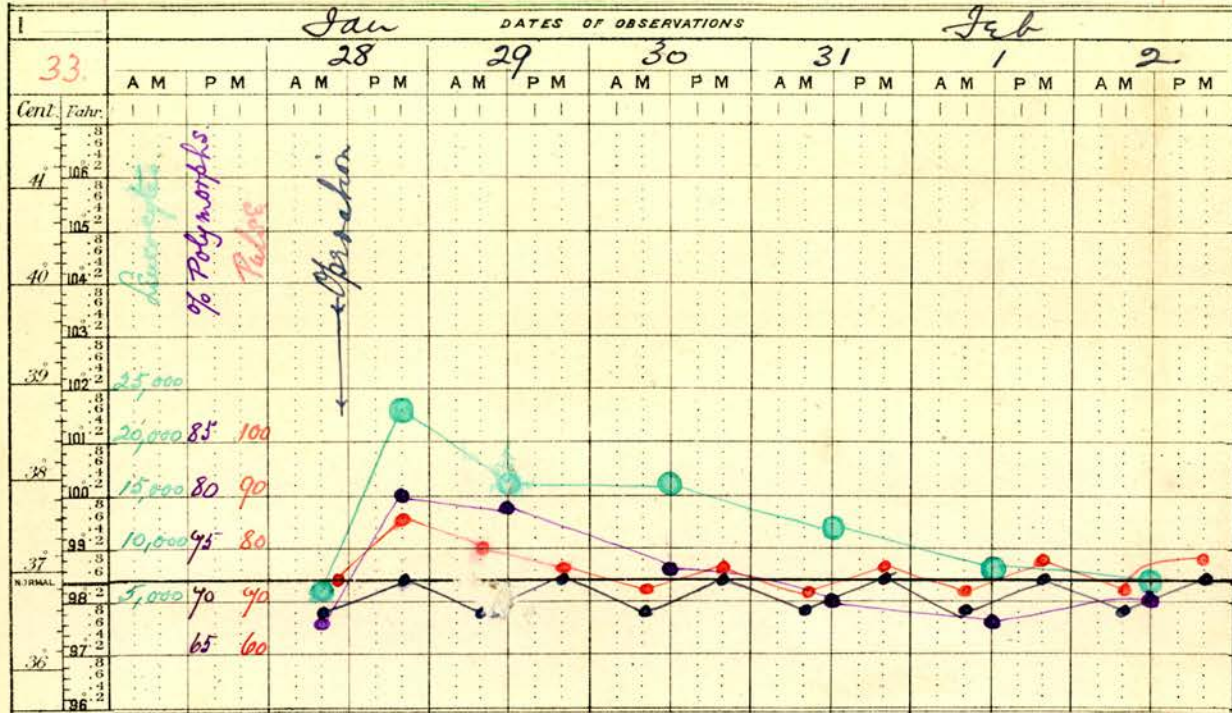
The appendix was much swollen and densely adherent. On section the mucosa shewed extensive and deep ulceration.

The operation occupied $\frac{3}{4}$ hour.

Case XXXIII.

Mrs B., aet. 28.

Operation on 27th January, four months after
severe appendicitis followed by mucous colitis.



The appendix was very densely adherent and much thickened. On section it showed deep ulceration of the mucosa.

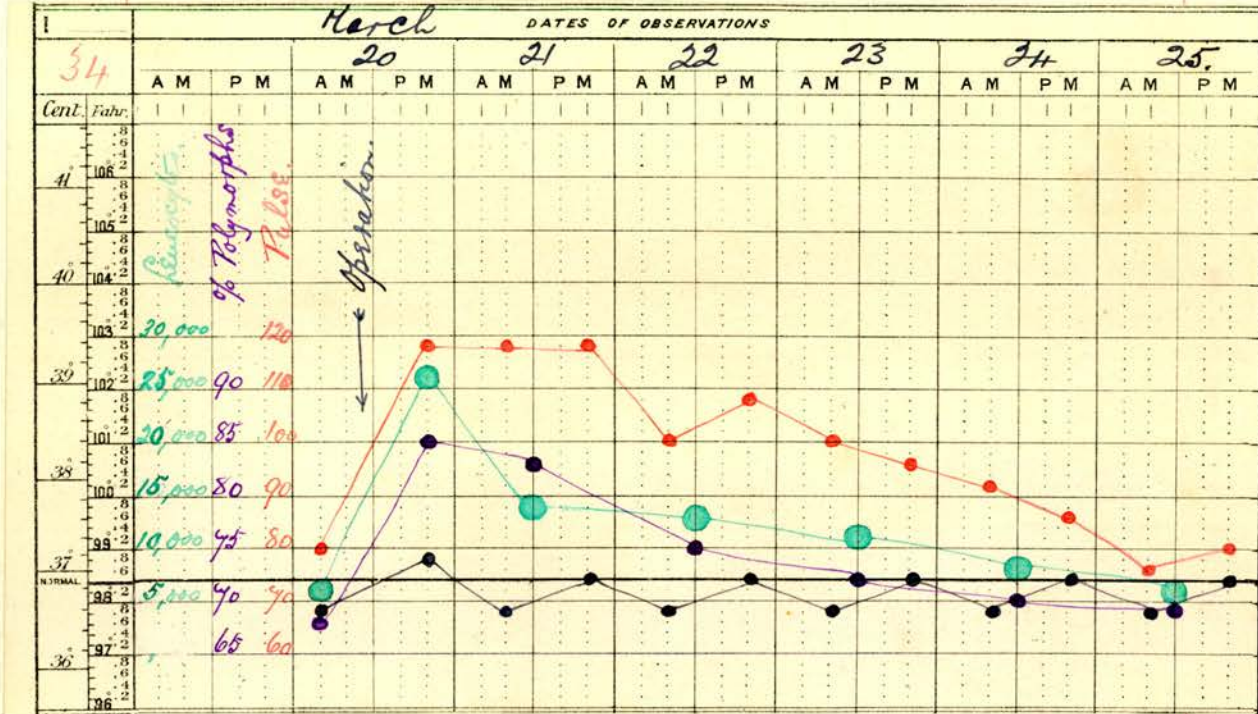
The operation occupied 1½ hours, and there was a good deal of haemorrhage from the necessary breaking down of the adhesions.

Recovery was uneventful.

Case XXXIV.

I. S., aet. 6.

Operation performed on 20th March, four months after last attack, which occurred four months after the first.



The appendix was densely adherent, and on section shewed deep ulceration of the mucosa. The operation occupied one hour. Recovery was uneventful.

Remarks.

In this case the ulceration had been very extensive, and in one part the wall of the appendix consisted solely of the serous covering.

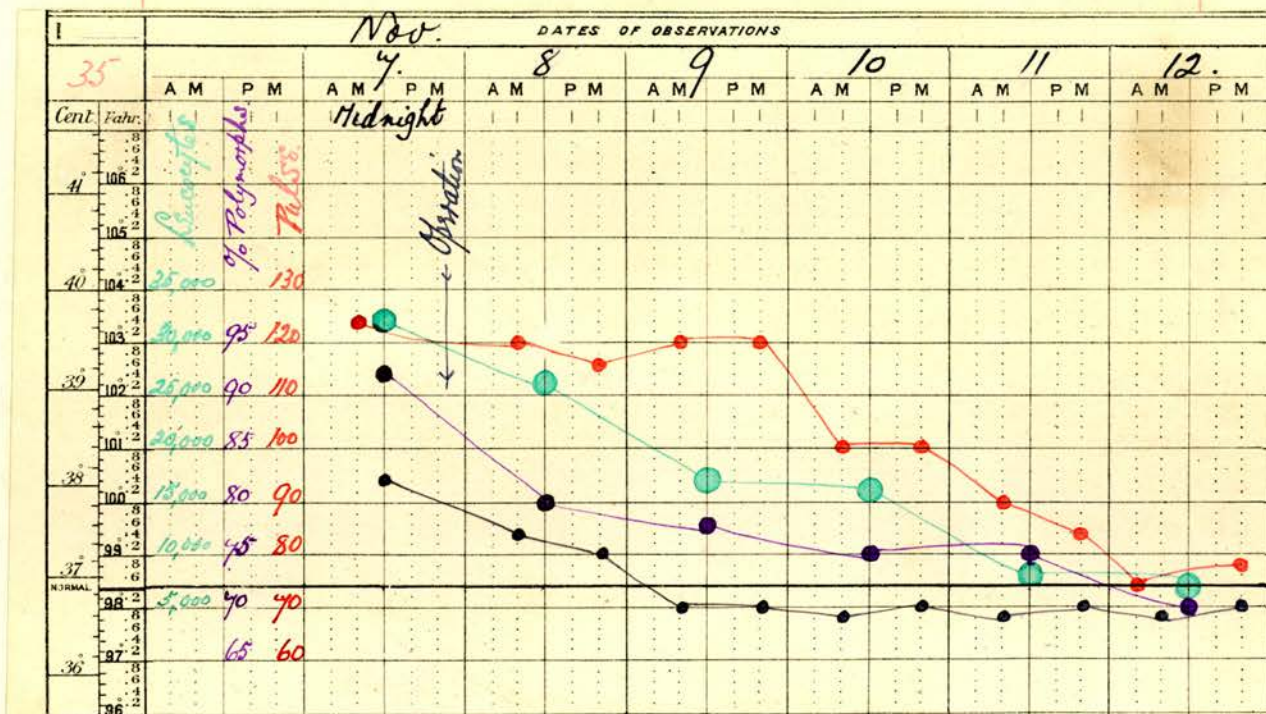
Case XXXV.

P. McF., Miner, aet. 28.

For about 18 months had suffered from chronic constipation.

Nov. 7. At 2 p.m. sudden onset of pain in right iliac fossa, followed by vomiting. Was sent into hospital for operation, which was performed at midnight, 10 hours after onset of attack.

The abdomen was rigid and tender, especially over the appendix. Expression anxious.



There was a general peritonitis with thick creamy pus in the peritoneal cavity, and flakes of lymph exudate on the portions of bowel nearest the caecum. There was a punched out hole in the anterior wall of the caecum, evidently a perforating stercoral ulcer. This was closed and the peritoneal cavity swabbed out, and drainage provided for. The patient made an uninterrupted recovery.

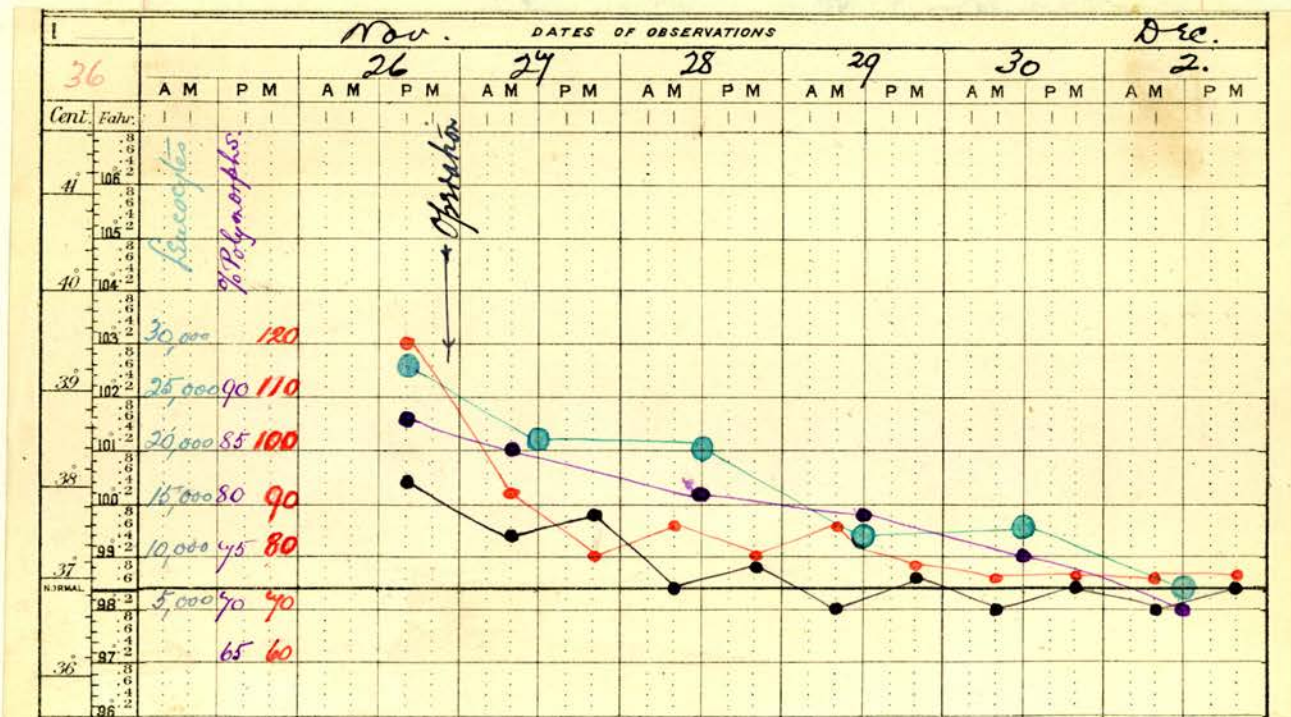
Remarks.

The chief interest in this case lies in the fact that the exact time was known at which the perforation of the ulcer had occurred. The case was diagnosed as appendicitis with rupture of the appendix, to which condition it may be regarded as analogous.

Case XXXVI.

H.A., aet. 15. Miner.

- Nov. 23. About 11 p.m. felt pain all over abdomen not very severe, and unaccompanied by vomiting.
- " 24. Pain easier and bowels had moved. Worked all day.
- " 25. At 6 p.m. pain became very severe and localised to region of appendix. Vomited once.
- " 26. Sent in to hospital and operated upon at 9 p.m., i.e., 27 hours after onset of acute symptoms.



There was general peritonitis, with thin pus in the peritoneal cavity, the recto-vesical pouch containing about a pint. There were a few feeble adhesions around the appendix.

The appendix was very short. It was not ruptured, but the mucosa was almost entirely ulcerated, the ulceration being deepest on the side of the attachment of the mesentery.

The wound was packed and left open, an additional drain being inserted from just above the pubis into the recto-vesical pouch.

The/

Case XXXVI continued.

The operation occupied 50 minutes. Recovery was uneventful.

Remarks.

It seemed clear that in this case the infection had travelled along the lymphatics of the meso-appendix, too rapidly to allow of the formation of adhesions. This was borne out by the situation of the deepest ulceration of the mucosa.

Case XXXVII.

H. C., aet. 18, Miner.

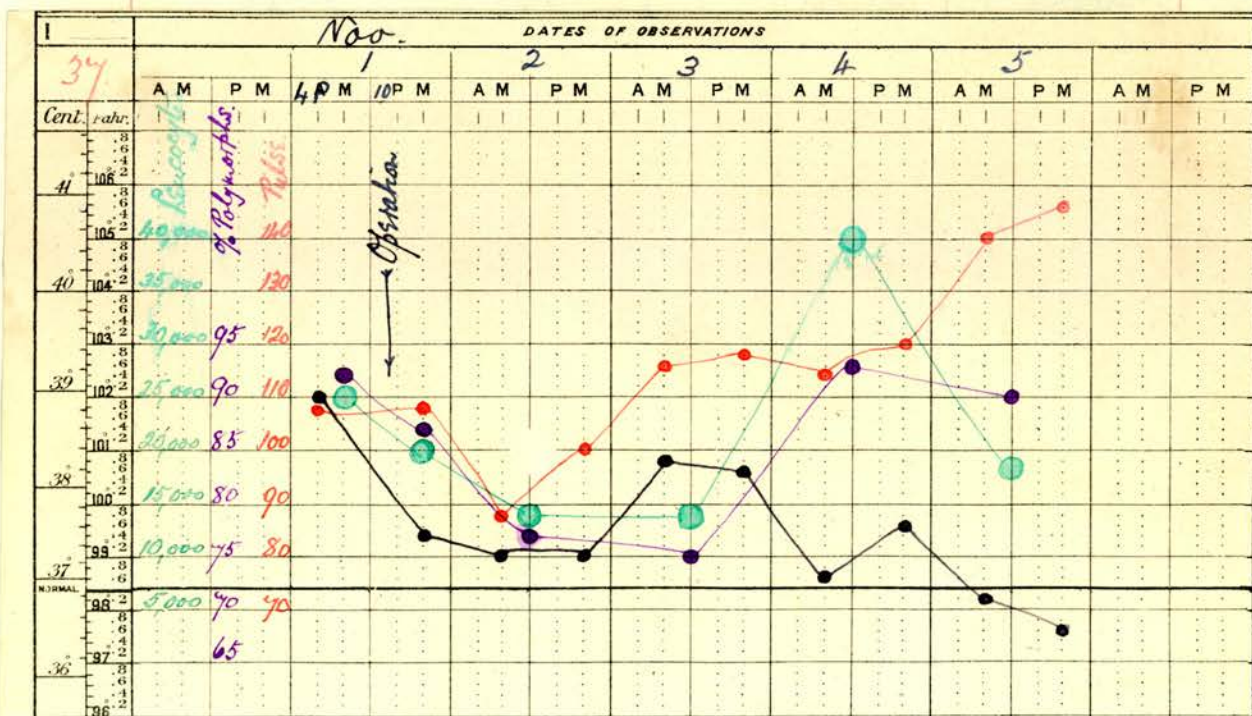
Oct. 29. Sudden onset of general abdominal pain at 9 p.m., followed by vomiting, which continued all night.

" 30. Worked all day, pain and vomiting having abated.

" 31. Pain became gradually more severe, and patient unable to leave his bed. No further vomiting.

Nov. 1. Admitted to hospital and operation performed at 8 p.m., i.e., 68 hours after onset of attack.

The abdomen was distended, and the breathing purely thoracic. There was marked tenderness over the appendix. Expression slightly anxious.



The peritoneal cavity contained a moderate amount of sero-pus. The appendix was quite gangrenous at its base. It lay in a pool of thick pus to the outer side of the ascending colon, shut off from the general peritoneal cavity by adherent bowel, which was covered with plastic lymph.

After/

Case XXXVII continued.

After removal of the appendix the wound was drained both behind and in front.

Nov 2. General condition seemed improved. A marked feature was the absence of pus in the wound, or on the dressings, and there was absolutely no shutting off of the wound from the general peritoneal cavity.

" 5. Patient much worse, shewing signs of obstruction. The wound was re-opened, and it was found that there was an advanced general peritonitis, with matting together of the bowel. The wound communicated directly with the general peritoneal cavity.

The patient died at 5.30 p.m.

Remarks.

This was evidently a case in which the infective agent was one of marked virulence. The only favourable feature, noted at the time of the operation, was the fact that there had been an attempt at localisation. It seemed as if this was just one of those cases in which a few hours might have made a difference in the result. Morphia had been used, and to it, no doubt, may be attributed a great part of the fatal delay.

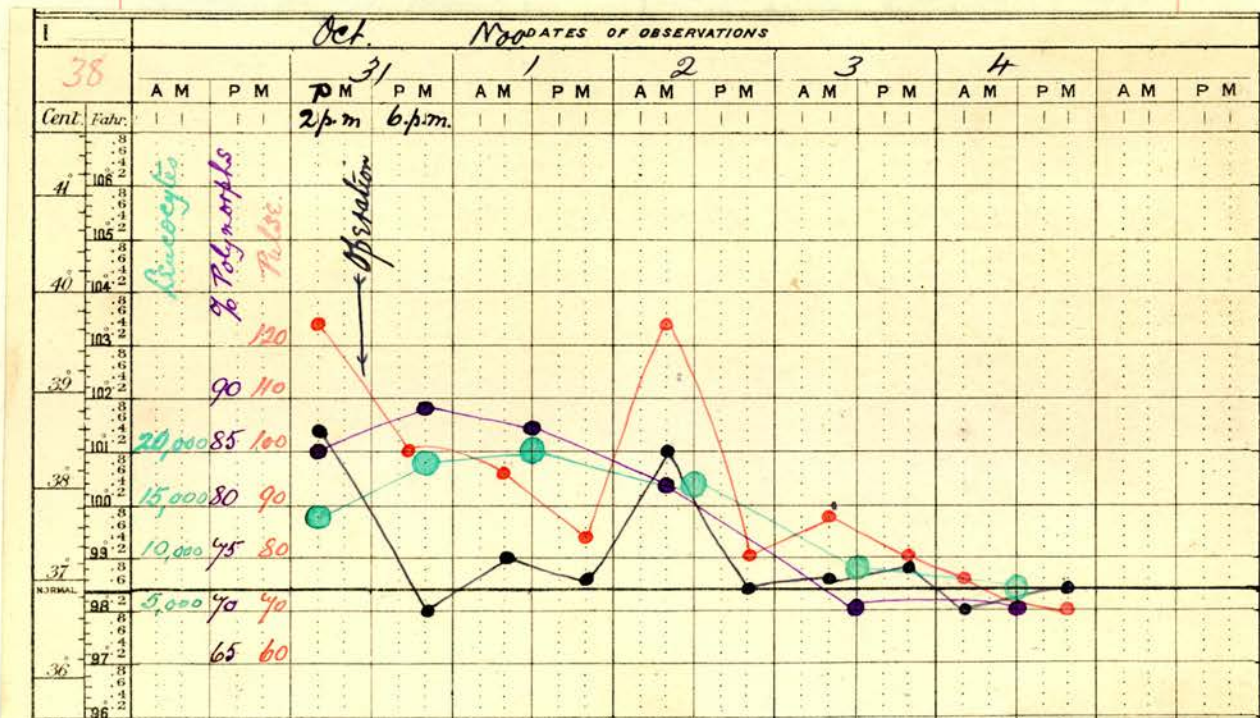
The leucocyte count was not very high, but the polymorphonuclear percentage was excessive, and was really the only sign which indicated the severity of the condition. The sudden rise of both on the 3rd day after operation seemed to indicate a final, but futile, effort to overcome the infection.

Case XXXVIII.

M. W., aet. 15. Factory girl.

Oct. 30. Occasional pain in abdomen during the day. Took ordinary meals. About 8 p.m. took Gregory's Mixture. At 10 p.m. pain became excessive over whole abdomen, and followed by vomiting, which continued all night.

" 31. Seen at 1.30 p.m. Pain and tenderness localised to appendix. No muscular rigidity. Expression placid. Operation performed at 3.30 p.m.



There was a small amount of serum in the general peritoneal cavity. The appendix was about 4 inches long, and at its tip was adherent to a piece of omentum and the posterior abdominal wall. The distal third of it was distended, of a greenish colour, and appeared at the point of rupturing. On section this portion shewed complete ulceration of the mucosa, the remainder of the wall containing several haemorrhages and being practically gangrenous. The lumen was distended by a good deal of mucus which surrounded a concretion. The mucosa of the/

Case XXXVIII continued.

the proximal portion was much swollen. A drainage tube was inserted at the lower edge of the wound.

The operation occupied 1½ hours. Recovery was uneventful.

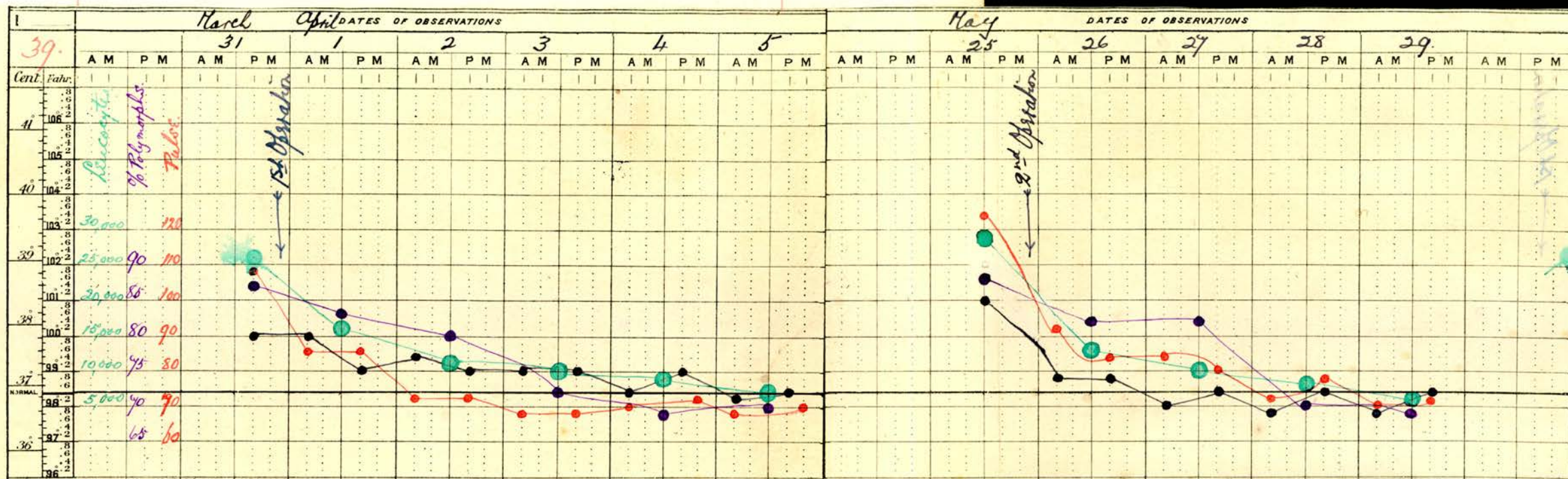
Remarks.

This case was very illustrative of the deceptive nature of this disease. The girl did not appear ill, had comparatively little tenderness and no muscular rigidity. The condition of the appendix was infinitely worse than was anticipated, and undoubtedly in another 12 hours, it would have ruptured into the peritoneal cavity. In fact the operation was looked upon as being performed while the condition was still in the catarrhal stage. The only indication of anything more than a mild infection was the high Polymorphonuclear percentage.

Case XXXIX.

Mrs B., aet 35. Vide case 13.

1st operation at 10.30 p.m., 31st March.



1st operation consisted simply of drainage of abscess. It occupied 1 hour.

2nd operation at 3.p.m., 5th May.

At this operation the appendix was removed, and, a drainage tube was inserted down to the part in which the appendix had been lying in a mass of adhesions.

The operation lasted 2 hours. Recovery was uneventful.

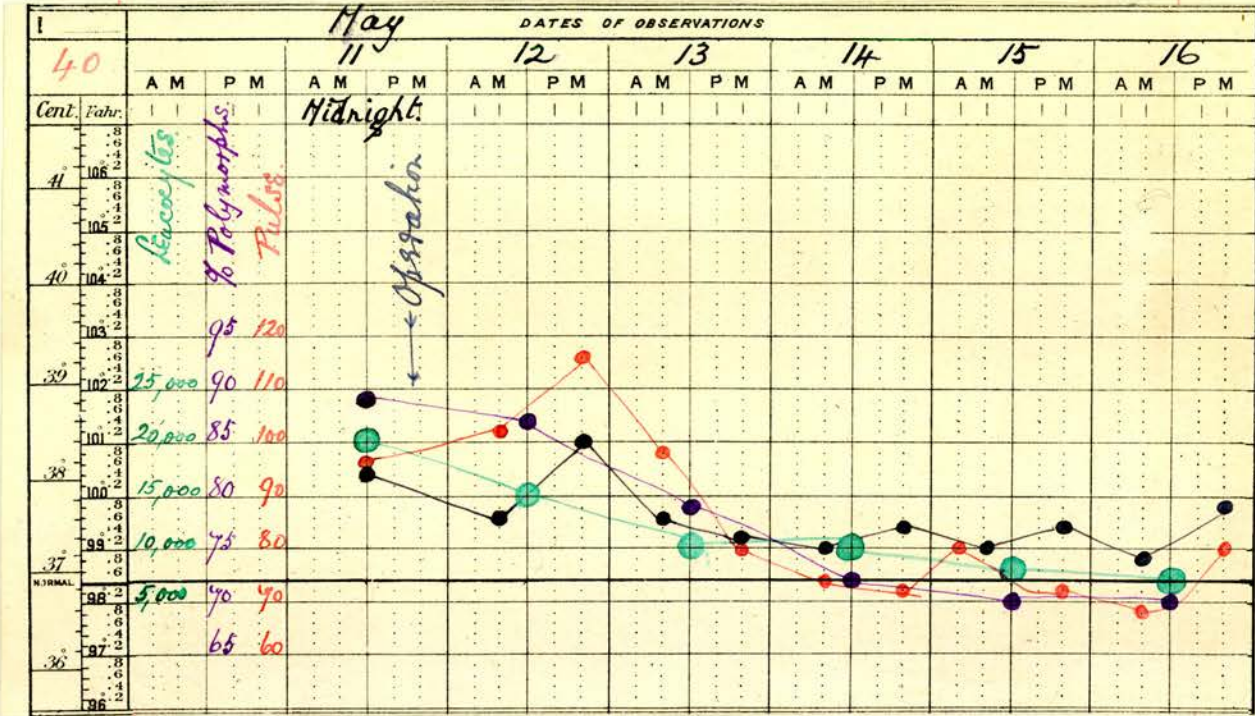
Remarks.

The chief interest in this case lies in the contrast between the conditions found at the two operations. Vide supra, under case 13.

Case XL.

R. M., aet. 21. Postman.

Operation performed at midnight of 11th May
57 hours after onset of attack. Vide case 14.



The appendix was tied down towards the pelvis in a mass of adhesions which surrounded a small pool of thick pus. There was a rupture at the side of the appendix at a point near its tip. There was commencing general peritonitis.

The wound was packed and left quite open, with only one stitch at each end of the incision. The operation occupied 1 hour. Recovery was uneventful.

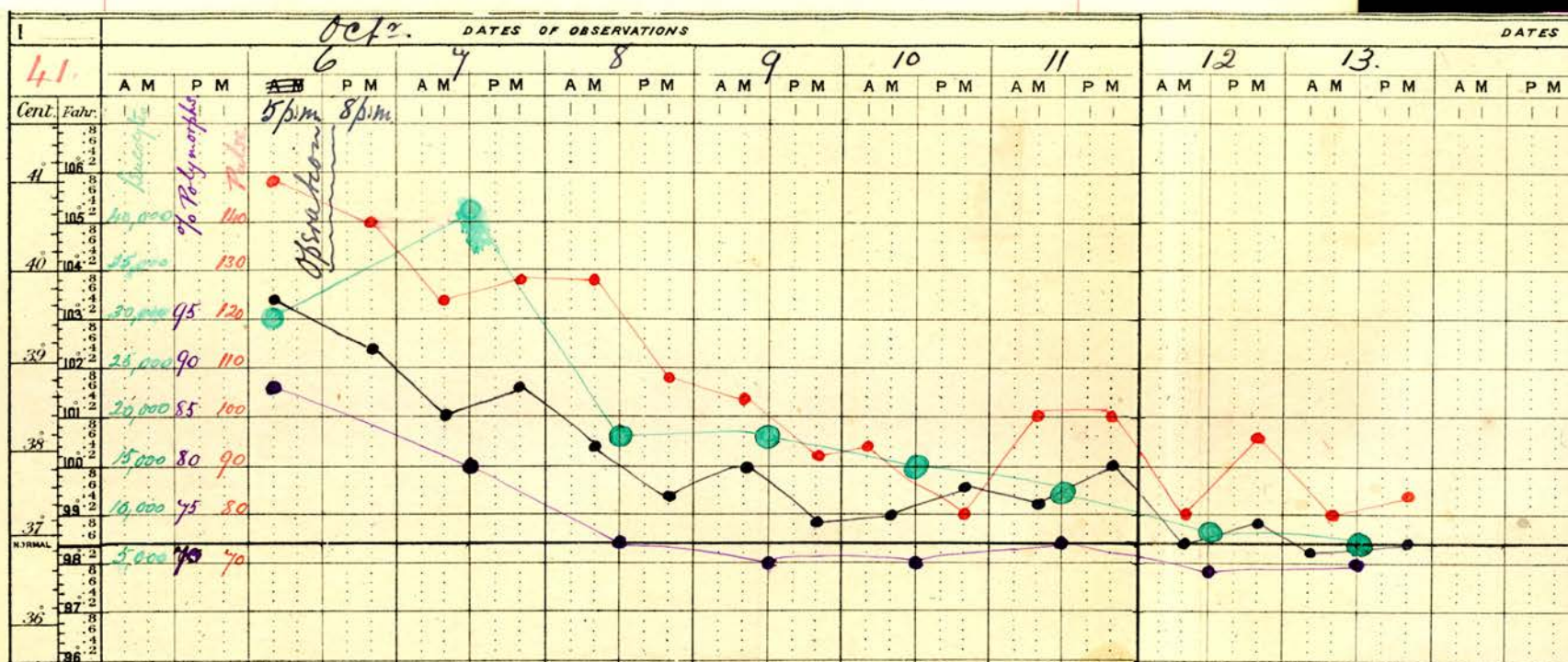
Remarks.

In this case there was almost complete localisation of the infection, which was evidently not of great virulence. The comparatively low leucocyte count, contrasts with the high polymorphonuclear percentage.

Case XLI.

A. P., schoolboy, aet. 13.

Oct. 3. Sudden onset of general abdominal pain, accompanied by rigor, and followed by vomiting.



Oct. 6. Sent into hospital for immediate operation. Marked tenderness over appendix, with rigid and distended abdomen.

Operation at 5 p.m. There was general peritonitis with thin turbid serum in the general peritoneal cavity. The appendix was lying to the outer side and behind the ascending colon, surrounded by thick pus. It was gangrenous and had ruptured and contained a concretion at the point of rupture. There was a good deal of lymph exudate on the bowel immediately adjacent to the appendix.

Removal was very difficult, and some of the pus in which the appendix lay escaped into the general peritoneal cavity. It was found impossible to bury the stump of appendix

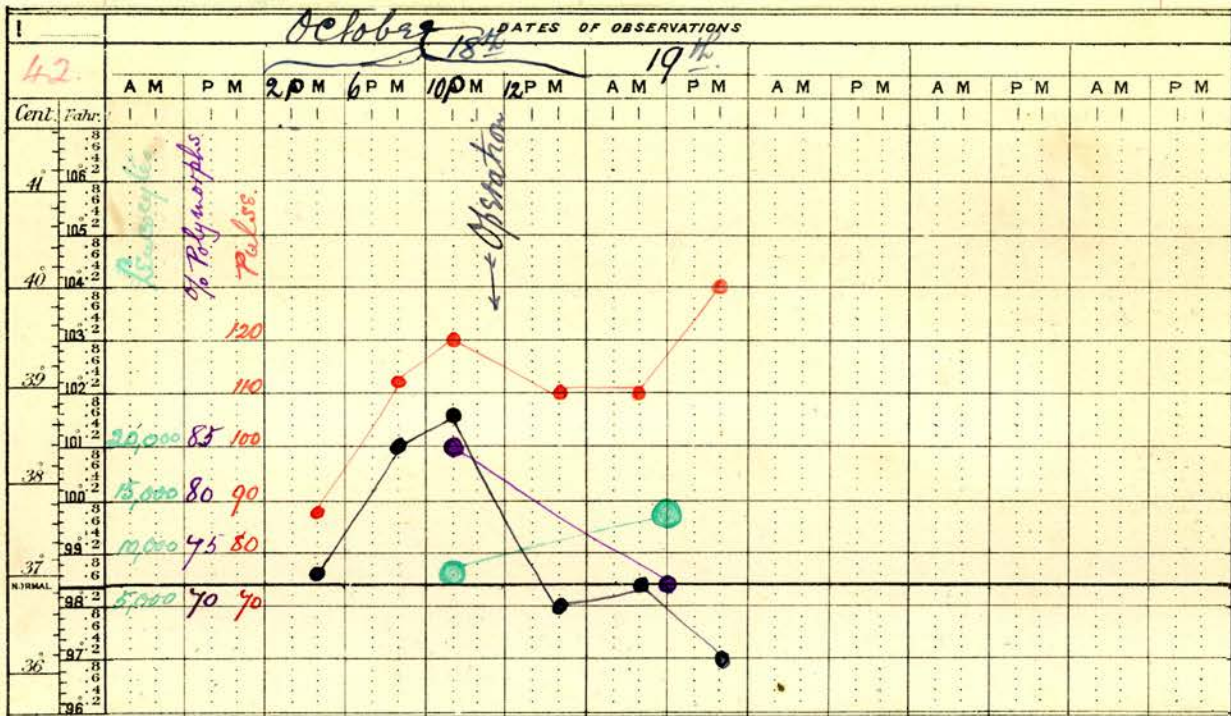
Large packs of Iodoform gauze were passed down to the bottom of the wound, which was left open. Progress was most satisfactory.

Case XLII.

Mrs D., aet. 30.

Five months pregnant.

Oct. 15. Stated to have had vomiting, diarrhoea and general abdominal pain all of which symptoms subsided to a great extent. The pain remained but was slight, and limited to region of appendix.



Oct. 18. At 1 p.m. sudden increase of the pain, which now became violent and accompanied by rigidity of the whole abdomen.

At 6 p.m. patient looked much worse, beginning to develop anxious expression. Sent in to hospital and operated upon at 11 p.m. There was general peritonitis with sero-purulent fluid in the peritoneal cavity. The appendix was ruptured at about its middle. It had evidently been adhering to the right ovary, but the adhesion had given way. There were flakes of lymph exudate on the portions of bowel adjacent. The wound was packed and left open.

Oct./

Case XLII continued.

Oct. 19. The patient's condition seemed one of severe toxaemia, she aborted at 8 a.m. and died at 7 p.m.

Remarks.

It is probable that the appendix was at first well shut off from the general peritoneal cavity, but that some uterine movement had caused the breaking down of the adhesions between it and the right ovary, and the supervention of a general peritonitis of a very virulent type. There was absolutely no reactionary leucocytosis before operation was performed, and extremely little afterwards.

THE TIMING OF THE OPERATION.

Before discussing the inferences to be drawn from the blood picture in the first group of cases, it will be more convenient to consider the question of the best time to operate.

The following charts give a graphic representation of the conditions following operation in the control cases, and those operated upon at varying periods after the acute onset of symptoms of appendicitis.

The cases in which it was deemed advisable to drain the peritoneal cavity, either by tube or gauze pack, have not been included in these average charts, as the comparison could not be a fair one, unless the technique of the operation were the same in all cases.

Chart A. Representing the average of 6 control cases i.e. 1 Enteric - Enterostomy, 1 Colotomy, 4 Ventrifixations of Uterus.

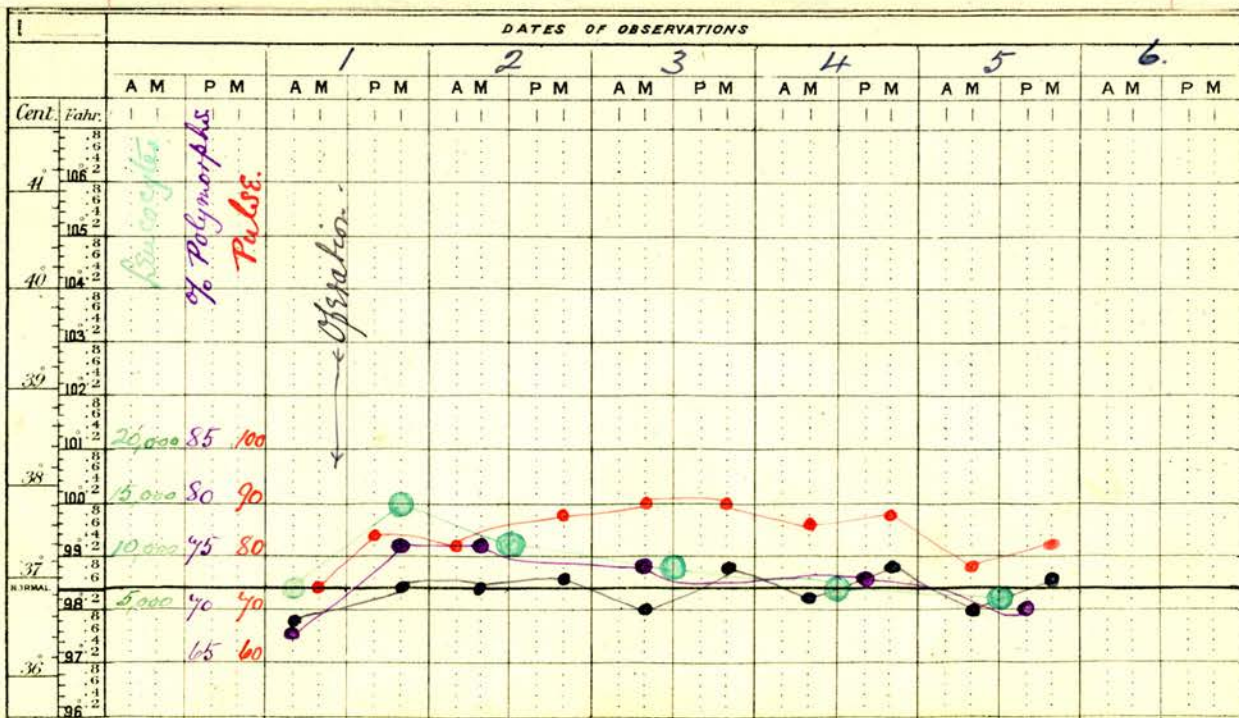


Chart B. Average of Cases 16, 17, 18, and 24, operated upon within 48 hours of onset of acute symptoms.

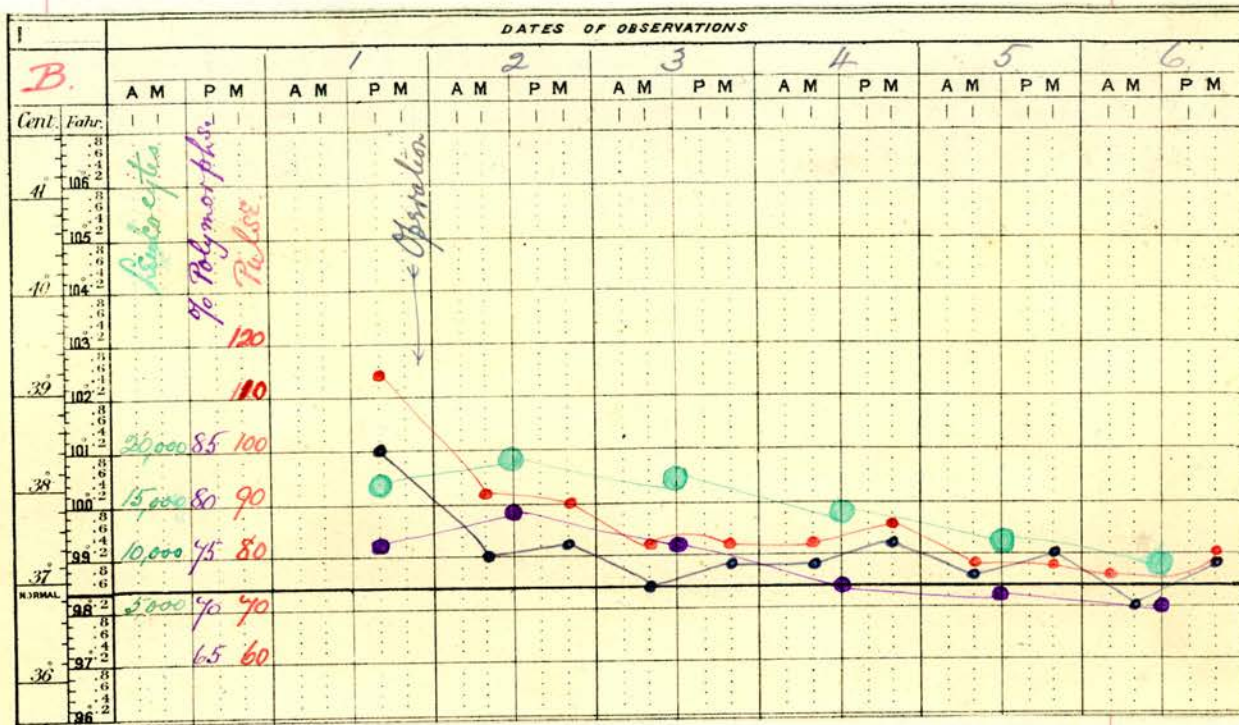


Chart C. Average of Cases 19, 21, 22 and 23 operated upon from 2 to 14 days after onset of acute symptoms.

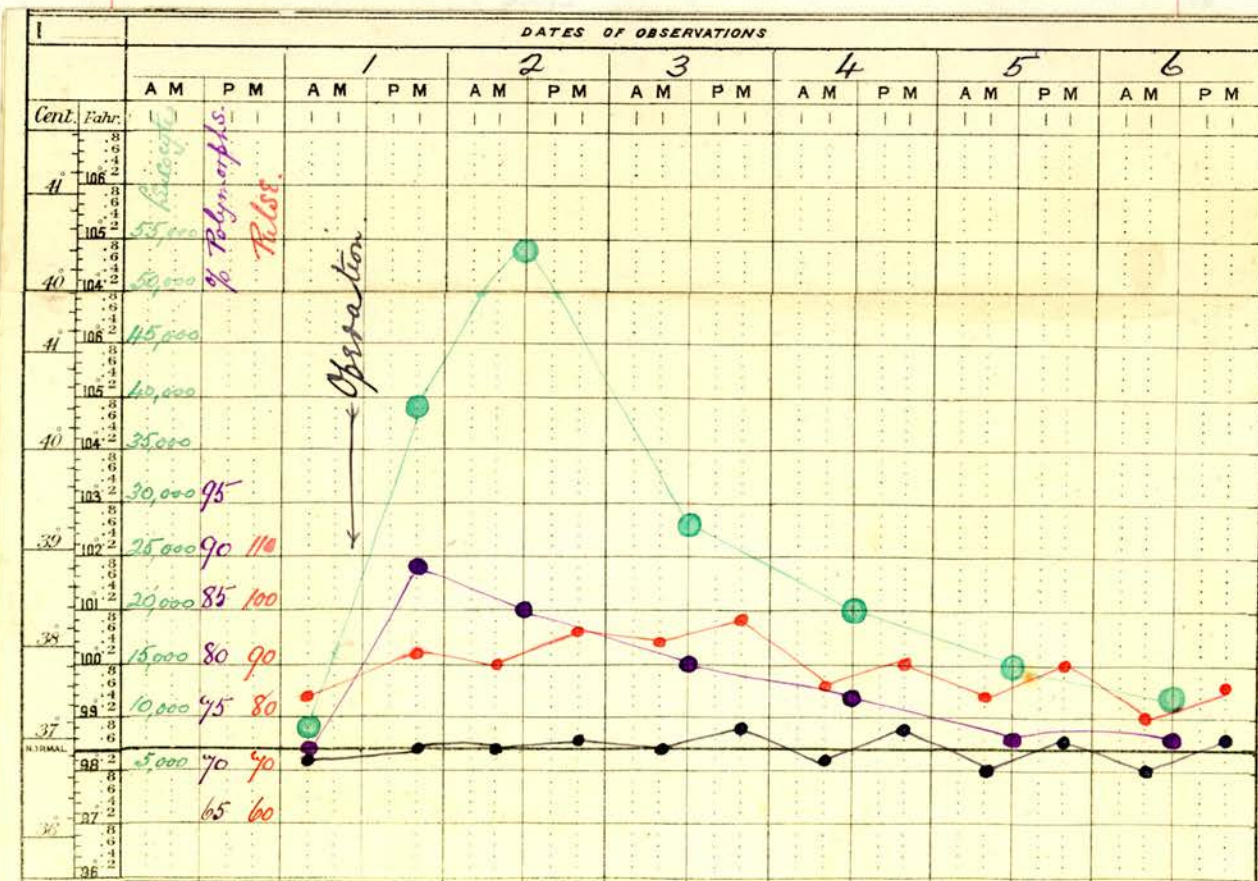


Chart D. Average of cases 25, 26, 27, 28 and 29. operated upon from 2 to 4 weeks after onset of acute symptoms.

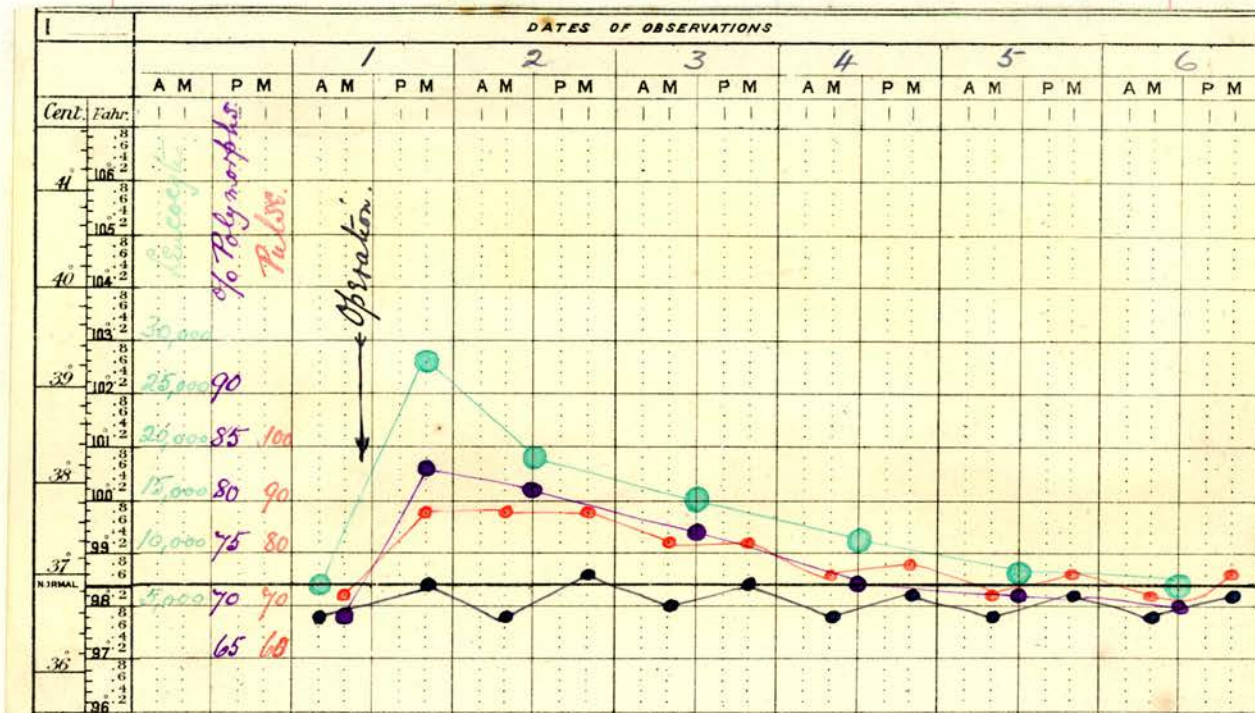
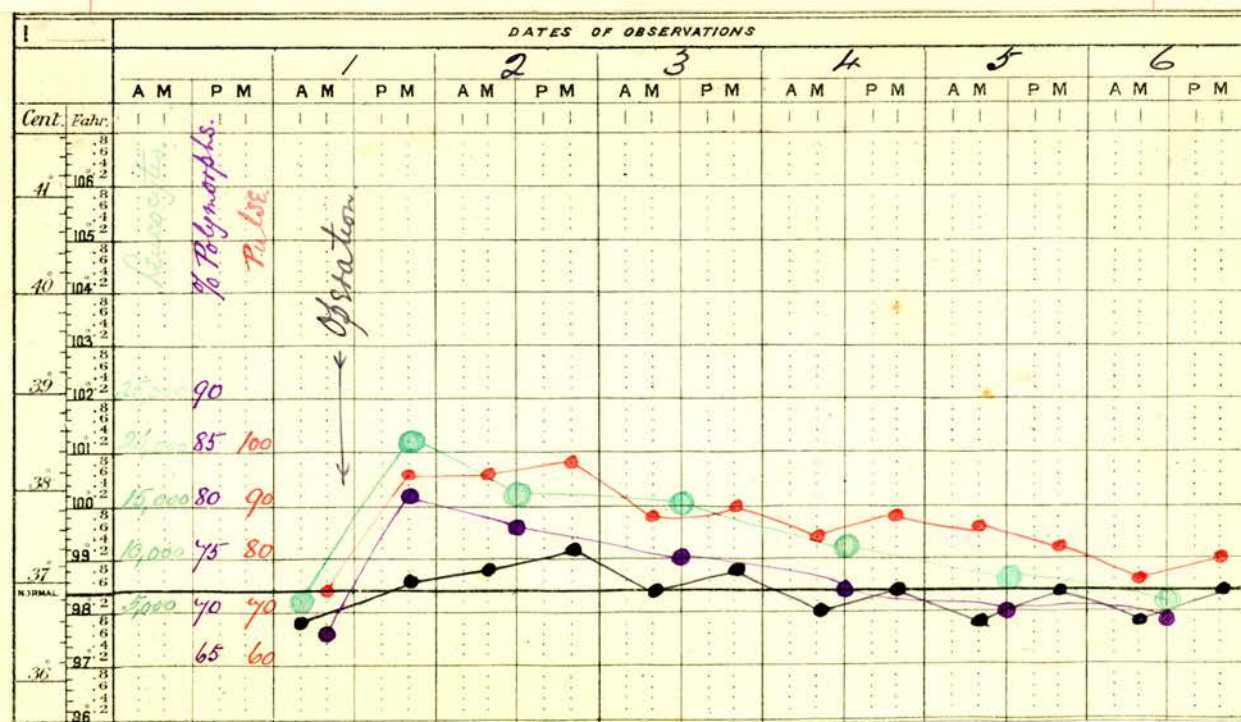


Chart E. Average of Cases 30, 31, 32, 33 and 34, operated upon later than 4 weeks after onset of attack.



Cause of Variation in Degree of Post-Operative
Leucocytosis.

The methods adopted for the preparation of the patient, and the sterilization of instruments, ligatures operating gloves, dressings etc., were identical in all these cases. Hence a consideration of them may be omitted in attempting to explain the difference between these average charts.

Of the variable factors, those which seem to be the most important are the duration of the operation, its extent and severity, and the length of time which had elapsed between it and the onset of the acute symptoms.

Post-operative leucocytosis is always present, and has been usually explained as due to the unavoidable contamination of the wound by micro-organisms, despite the most rigid care.

The explanation of the marked variations in the degree of this leucocytosis in the foregoing cases, must be sought in the variable factors of the operations.

The duration of the operation and its severity seem to have little or no effect upon the subsequent leucocytosis. One of the Control cases, an Enterocystostomy for constriction of bowel (possibly the result of a healed tubercular ulcer), showed a leucocytosis/

leucocytosis of merely 15,000 though the operation occupied 2 hours.

Cases 21 and 29 happened to be operated upon within a week of each other, and the contrast between them was most marked, and appeared of special value on account of the fact that the two patients were of much the same age.

In case 21 the operation occupied $\frac{3}{4}$ hour, and was in reality little more than exploratory, as the appendix was never even seen. The subsequent leucocytosis attained 45,000. In Case 29 the operation occupied 2 hours, was extremely difficult, there was considerable haemorrhage from torn adhesions, and the appendix was torn through while being separated so that there must have been soiling of the peritoneum. The subsequent leucocytosis attained only 28,000.

Again Cases 22 and 30 happened to be operated upon within a few days of each other and also showed an instructive contrast.

In Case 22 the operation was easily performed, and only occupied $\frac{3}{4}$ hour, whereas there was a leucocytosis of 61,000.

In Case 30 the operation was extremely difficult, necessitating a great deal of handling, and occupied 2 hours, but was followed by a leucocytosis of merely 15,000.

It must be admitted that neither the duration of the/

the operation, nor its severity will explain the varying degrees of post-operative leucocytosis.

Hence we are left with the only other variable factor, viz., the length of time which has elapsed between the acute inflammatory stage and the operation.

Now it will be noticed that the Control Cases show the least post-operative leucocytosis, and the most rapid return of the leucocyte count to the normal. In these cases there was no pre-existing acute inflammatory stage, and it is to be presumed that any soiling of the peritoneal cavity will have been by organisms of the ordinarily mild degree of virulence, or, in the case of Entero-Enterostomy, organisms to whose action the patient has become more or less immune. The somewhat high pulse rate in these cases may have been due to the fact that all the patients were women.

Next in order to the Control Cases, comes those cases included in Chart B, operated upon within 48 hours of the onset of the attack of appendicitis, showing an average post-operative leucocytosis of 19,000, which however was much longer maintained than in the Control Cases. Unfortunately there were only four cases which could be included in this group as these were the only ones operated upon within
48/

48 hours in which drainage was not deemed necessary. Case 38, however, may practically be included, as, though a drain was left in, it was removed in 24 hours as there was no discharge at all.

All of these cases including Case 38 had a certain degree of leucocytosis before operation, and the operation did not cause an immediate drop in the leucocyte count, which remained almost stationary for two days after operation, then fell gradually to the normal, which was reached by about the sixth or seventh day.

Chart E shows the next lowest post-operative leucocytosis. Then comes Chart D, and finally Chart C shows an exceptionally high count.

Hence it is clear that the mere length of time which has elapsed between the onset of the attack and the operation cannot alone explain the varying degrees of subsequent leucocytosis. The question arises "Why should the period between the 3rd and 14th days after the onset of the attack show such a marked rise in the post-operative leucocyte count?"

The Control Cases might be described as quite non-inflammatory, i.e., the part operated upon had not been previously invaded by micro-organisms, and it is quite reasonable on these grounds to explain the fact that they showed a much lower count than the other cases, in all of which the appendix and surrounding/
ing/

ing lymphatics had been thus invaded. It also seems reasonable to conclude that, in the early stages of this invasion, when the organisms are, so to speak, in the second or third generation, their virulence will be very much less than at a slightly later period, which would mean for them existence for several generations in a suitable nidus. As the patient recovers from the attack, escaping general peritonitis, a process of isolation of the infected area takes place. But in addition to this there are two other important developments taking place. The patient is, as rapidly as he can, immunizing himself to the particular organism, by the production of suitable opsonins, that circulate throughout his entire system in ever increasing amounts. Furthermore, the organisms themselves, being limited to a small isolated part, use up more and more of the portions of that soil most suitable to their growth. Thus they become more degenerate and less virulent with each generation, succeeding that in which they attained their maximum of strength and virulence. It is quite obvious that this particular stage will vary in every case, and it may be regarded as quite accidental to this series that the period would seem to be about the 3rd or 4th day after the onset of the attack. Based upon this theory an explanation of the varying counts is a very/

very simple matter. If the operation is performed early, before the organisms have had time to become a strong and virulent strain, those of them which are set free in the wound are easily disposed of by a comparatively small extra supply of leucocytes. The same applies if the operation is done a long time, e.g., 2 - 3 months after the acute attack, when the organisms are weak and only mildly virulent, and the patient's blood rich in suitable opsonins. But if the organisms have had time to develop into a very resistant and virulent strain, and the patient has not yet had time to immunize himself to any marked degree, then there will be a need for a very large supply of extra leucocytes to dispose of any of these virulent organisms that have been set free in the wound. And there can be no doubt that the organisms will increase in virulence at a greater rate than the patient can immunize himself. In fact, this period is exactly analogous to, if not identical with the negative phase of the opsonic index after the inoculation of living organisms.

CONCLUSION.

It would seem then that the best time to operate in appendicitis is either in the very earliest stage, before the infecting organisms have had time to become really/

really virulent, or at least three or four weeks after the onset of the attack, when their virulence is worn out, and the patient immune to them. This statement is of course based solely upon a consideration of the possibility of producing a general infection at the time of the operation. But as a matter of fact these two are the most satisfactory periods for other reasons. They are the period before which adhesions have formed, and that after which they have had time to become more or less absorbed. Either of these conditions means less handling of parts, less oozing of blood from broken down adhesions, and therefore greater chance of a dry wound and healing by first intention.

It now remains to decide which of these two periods is the ~~safer~~ safer one to choose.

The first of the two periods has been referred to as "Within 48 hours", but, as mentioned before, this stated time applies only to this series of cases. It is quite obvious that no hard and fast rule in the number of hours can be made to apply in every case. Each case must be judged by means of the sum total of its clinical signs. In many cases the dangerous period of what has been compared to the negative phase is reached much sooner than 48 hours after the onset of the attack. And of course in every case if the operation/

operation is to be done in the early period, then the earlier the better.

One of the chief arguments in favour of this period is the deceptive nature of the disease, making it an impossibility at the onset of the attack to prophesy how the case will go, and whether or not general peritonitis will supervene. This was well illustrated in case 38, in which the whole clinical picture seemed to point to a mild condition and speedy recovery, whereas, there can be no doubt that in another 24 hours or less, the patient would have had a very poor chance of recovery. Of course it often happens that an obviously mild case is met with, and it may be most inconvenient to perform the operation immediately. In such a case at least three or four weeks should be allowed to elapse before it is undertaken, however mild the case may be. In fact the question of convenience seems to be the *only* valid argument against immediate operation in every case of appendicitis, in which there is a suspicion that the condition is worse than a catarrh of the mucous membrane. If ulceration of the mucosa occurs, then that appendix should certainly be removed, and this can apparently be done with as great safety at the onset of the attack, as after a period of four weeks has elapsed/

elapsed; but should not be attempted between these periods. If the operation is done at the onset of the attack, then the patient has been saved at least four weeks, and this is undoubtedly another strong point in favour of the early operation.

THE ACUTE STAGE OF APPENDICITIS.

If it be granted that convenience is the only valid argument against immediate operation in every case of appendicitis, other than catarrhal, there still remains the difficulty of knowing exactly to what extent the question of convenience is to be allowed to have any weight. The already old dictum of "When in doubt operate", is still an excellent working rule, but would be made of greater value if it were possible to analyse the doubt and tabulate its component parts in order of merit. To do this it is of course obvious that every clinical feature of the case must be taken into consideration, and it is quite useless to pin faith to one sign and ignore others. It will be convenient to take the clinical signs separately and then attempt to formulate a more elaborated working rule than the one referred to above

1. Leucocytosis. (a) Degree of Leucocytosis.

This series of cases corresponded to those given by Cabot/

Cabot, Da Costa and others, in regard to the extreme variability of the leucocyte count. There was only one case viz., No. 42 of the fulminant type, which showed no leucocytosis, and proved fatal on the day after operation. A high leucocyte count alone cannot indicate with certainty the severity of the condition. Case 8 showed an extremely high count, and yet developed neither general peritonitis nor localised abscess. This case, as a matter of fact had the highest count of the whole series prior to operation. Of much greater importance than the degree is an increase of leucocytosis. This was found in the majority of cases on the third day of illness, but was relatively slight, and there was usually a marked fall on the next day. A rapid rise in the count especially if occurring in a few hours would justifiably be regarded as a sign of danger.

(b) Type of Leucocytosis. This would seem to be of much greater importance than the total Count. The percentage of polymorphonuclear cells need alone be considered. This was found to be high in every case in which the operation disclosed an advanced ulceration in the appendix, with commencing or already developed general peritonitis. In none of the cases in which the condition subsided was there a high polymorphonuclear percentage. In case 8, referred to above/

above, it was 80, when the total count was 38,000. Roughly speaking, a polymorphonuclear percentage above 80 is to be regarded as dangerous, and the higher it is above this figure the greater the danger. If it continues to rise, then there can be no doubt that the condition is advancing, and the sooner the operation is undertaken the better for the patient's chance of recovery. This was well exemplified in Cases 13 and 15; and even case 42 (the fulminant type with no leucocytosis) had a polymorphonuclear percentage of 85.

2. Pain. This is almost invariably the first symptom, and as a rule is diffused over the whole abdomen at the beginning of the attack, at which stage a precise diagnosis may be impossible.

The pain soon becomes localised to the region of the appendix. It is quite common to find painful and frequent micturition, or sometimes a tendency to retention. These symptoms usually mean that the appendix is lying downwards towards or in the pelvis, and may prove worth noting in view of the possibility of operation. The degree of pain is not of great value in estimating the severity of the condition, and may disappear entirely as the condition gets worse and the patient is being poisoned by toxic absorption.

3. Tenderness. Like the pain, this is diffuse at first/

first, and later becomes limited to the region of the appendix. What has been said of the pain applies equally to the tenderness.

4. Rigidity. This is coincident in degree, onset and localisation with the tenderness. Again, what has been said of the pain and tenderness applies equally to the rigidity.

5. Vomiting. This may be entirely absent, even in severe cases. If it occurs, it always comes on after the pain. If persistent, it is a sign of danger, but its abatement is no indication of safety.

6. Temperature. There may be no rise even in severe cases. It is always very variable, and little dependence can be placed upon it.

7. Pulse. This is the clinical sign, which singly can be most depended upon as an indication of the severity of the condition.

In this series of cases it was very noticeable how rapidly the pulse rate fell when the attack was subsiding, whereas it invariably rose where the condition was advancing. A sudden rise in pulse rate is a certain sign of danger.

8. Facies. An anxious expression means a very serious condition, so serious that it should be the aim of the medical attendant to operate before an anxious/

anxious expression has developed.

Conclusions. If all the Clinical features are of marked degree there is every reason to suppose that there is danger. The pulse is the most dependable factor, and a rising pulse rate should always be looked upon as a serious sign. The next most dependable factor is the polymorphonuclear percentage, which is seldom above 80 unless general peritonitis is imminent or has developed. A rising percentage is a particularly bad sign. Of the other clinical features little faith can be placed upon any save the facies, and though an "Anxious Expression" means a very serious condition, its absence does not mean safety, and there is no justification for delaying operation until it has developed.

PROGNOSTIC VALUE OF THE POST-OPERATIVE
LEUCOCYTE COUNT.

It will be most convenient to consider the question of prognosis under two heads, the first consisting of the cases uncomplicated by general peritonitis, the second consisting of those thus complicated, and requiring drainage of the peritoneal cavity.

(a) Cases Uncomplicated by general peritonitis.

If reference be made to Charts A.B.C.D. and E.
it/

it will be seen that in the Control Cases included in Chart A the leucocyte count returned to the normal on the 3rd day after the operation.

In the cases included in Charts D and E, it returned to the normal on either the 4th or 5th day. In all of these cases healing took place by first intention.

Of the cases included in Chart B one developed pus in the abdominal wound. The leucocyte count fell steadily for three days, then began to rise again on the 5th day, while the polymorphonuclear percentage remained stationary. The other three cases healed by first intention, and their leucocyte count had returned to the normal by 6th or 7th day after operation.

Of the cases operated upon between the 3rd and 14th day after the onset of the attack, one, No. 20, died, and one, No. 19 developed bronchopneumonia, the others showing no abnormality and their leucocyte count returning to the normal by the 7th day. Case 20 showed a continued rise of leucocyte count on the 2nd day after operation, and this was not seen in any other case of the series. The polymorphonuclear percentage also continued to rise steadily. Case 19 showed a fall of the leucocyte count on the second day after operation, but the count then remained stationary for two days and rose again on the fifth after operation. The polymorphonuclear percentage showed/

showed little change after the third day, when it had fallen to 74.

Conclusion. It appears then that a further increase of post-operative leucocytosis on the day after operation occurs in some cases apart from any complication, but a still further increase on the 2nd day after operation means general peritonitis has supervened. A complication of the nature of suppuration merely of the abdominal wound, or broncho-pneumonia shews itself by cessation of fall in leucocyte count after the 3rd day, and a rise two days later.

Where general peritonitis has supervened the polymorphonuclear percentage continues to rise, but other complications are accompanied by a stationary or almost stationary percentage.

(b) Cases complicated by peritonitis.

In all of these cases the peritoneal cavity was drained, the patient kept in the Fowler's position and a steady stream of saline solution allowed to flow into the rectum. In all the cases, except two, there was a fall in the leucocyte count and polymorphonuclear percentage on the morning after operation. The total count fell considerably on the second day after operation. In case 42, the fulminant case, the total count rose after the operation, but only slightly/

slightly, while the polymorphonuclear percentage fell from 85 to 72. This case however was complicated by the patient's aborting on the morning after the operation. In case 57 there was a fall of both counts immediately after operation, but a subsequent rise of both on the 3rd day seemed to point to a further spread of the peritonitis, and the patient died on the evening of the following day.

Conclusion. The rule would seem to be that the evacuation of pus and drainage of the peritoneal cavity is followed by an immediate drop in the total leucocyte count and polymorphonuclear percentage. A slight rise of the former seems of little account on the day succeeding operation, but there should certainly be a steady fall of both from this day onwards, unless some complication has arisen. A further rise on the 2nd or 3rd day after operation seems a particularly unfavourable sign, as localised abscess or lung complication does not usually occur so soon, and a further spread of the peritonitis is the probable cause of the rise.

The pulse is probably as good an indication as any of how the case is going, but there can be little doubt that the leucocyte count is a great aid, more especially in arousing suspicion of the existence of some pocket of pus, which may be insufficient to cause/

cause a rise in the pulse rate. Both the leucocyte count and polymorphonuclear percentage should reach the normal by the 6th or 7th day after operation, if the recovery is to be uncomplicated.

Finally it is worth noting that in this last group of cases, where general peritonitis was present, the leucocyte and polymorphonuclear count showed, as a rule, a more rapid drop to the normal, when the operation was performed early. This did not seem to depend upon the degree of general peritonitis. Cases 36 and 41 were very similar as to the extent of general peritonitis, but showed a marked difference in the post-operative counts. The difference seems to depend upon the time which has elapsed between the onset of the attack and the operation; that is whether or not the "negative phase" has had time to be fully developed.

There appears no doubt that such a "negative phase" exists in all cases of appendicitis, and should, as far as possible, be avoided; being the period of greatest danger in which to operate.

Bibliography.

- Da Costa. -- Clinical Haematology. 1905.
- Cabot -- Clinical Examination of the Blood 1904.
- Kelly -- The Vermiform Appendix and its Diseases. 1905.
- Lockwood -- Appendicitis -- Its Pathology and Surgery. 1906.
- Jacobson -- The operations of surgery. 1907.
- Gibson -- Annals of Surgery -- April 1906.
- Noehren -- Annals of Surgery -- February 1908.
- Burgess -- British Medical Journal, 1908, Vol. 1. p.188.
- Southam -- Lancet. 1908. Vol. 1. p. 491.