GLASGOW UNIVERSITY

"PYELONEPHRITIS IN THE LATER MONTHS OF PREGNANCY."

THESIS FOR THE DEGREE OF M. D.

by

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Pyelonephritis, as a complication of pregnancy, has been recognised only within the last twenty-five years. In this country, indeed, it can scarcely be said to have become, even now, isolated as a distinct clinical entity. To a very great extent it has escaped notice in even the most recent Text books. In one or two, certainly, some slight mention of the condition is made, but in none has it received treatment, commensurate with its importance. This gap in our obstetrical literature is difficult to explain. It can certainly not be excused on the ground that the subject is of minor importance. Suppurative disease in the kidney, or its pelvis, must at any time be a source of grave anxiety, but especially so when it supervenes in the course of pregnancy. In this latter condition nothing is of greater importance than the maintainence of the functional integrity of the kidneys. Upon their condition depends, in a very large measure, the prognosis for both mother and child.

That pyelonephritis, as a complication of pregnancy, has received such scant attention in this country, seems to be due, not so much to rarity of occurrence, as to the fact that the possibility of its occurrence is not present in the minds of practitioners. The disease is consequently apt to escape recognition. Cases from time to time appear in the Journals, which conform in many particulars to pyelonephritis, about the real nature of which the medical man appears to have been in doubt. Generally the condition of the urine has been overlooked, or, at any rate, is not stated. For example, two cases were recently recorded (Lancet, 28th January 1905) under the title "A hitherto/

hitherto unrecorded complication of Pregnancy". Both patients miscarried, one at 6½, and the other at 8½ months. The cases simulated Typhoid Fever, but Widal's test was negative. In the first case the illness began with a rigor and the temperature rose to 103° F. For the first week the bowels were constipated but thereafter the stools were loose and typhoid in appearance. Two days before she miscarried the temperature rose to 104°. It dropped when labour began, and there was no further pyrexia. In the second case there was constipation throughout, and severe pain in the right upper lumbar region. The abdomen was distended and tender. The temperature varied from 100 to 102°. The symptoms entirely disappeared at delivery. Upon the information given, it is not possible to be certain as to the true nature of these cases, but it is significant that the urine appears to have escaped examination.

It is the purpose of the present thesis to discuss the clinical manifestations of pyelonephritis, as a complication of pregnancy, and thus to facilitate its recognition; to elucidate, or at least emphasise, some points in the etiology of the affection; and thus, to establish a basis for prognosis and treatment alike, in the majority of cases. The nature of the ailment, and the scope of the Thesis, will alike be best defined by giving at once a detailed description of a case.

CASE. 1.

The patient was a primipara aged 28. Her previous history contained no suggestion of renal trouble. At 13 years of age she suffered from chorea, which extended over many months, but was never very severe. There is no evidence of any cardiac lesion having resulted. Menstruation began at fourteen, and was always regular and normal. She has occasionally for a few weeks at a time suffered from constipation, but as a rule the bowels have acted with daily regularity. The last menstruation began on 31st Jan. 1905, and lasted for 5 days. For the succeeding six months she enjoyed perfect health. The urine was examined on several occasions and found normal. At the beginning of August, however, constipation became troublesome, and necessitated the almost daily use of laxatives. Towards the end of August she began to feel occasional pain in the right side, just above the crest of the ilium. For about a fortnight this pain came and went, and she noticed that a free evacuation of the bowels always caused it to disappear.

SEPT. 9th.

On Sept. 9th there was a sudden exacerbation of the pain, of such severity as to simulate true renal colic. It was aggravated by the slightest movement, and she was compelled to lie in bed. Examination showed a point of extreme tenderness just above the iliac crest on the right side, and about one inch behind/

the anterior superior spine. At this point and for a considerable distance around it, there was very marked cutaneous tenderness, evidenced when the skin was even lightly pinched. Palpation in the region of the right kidney caused very severe pain, but examination of this area was prevented by the size of the uterus. The pain was spontaneous and shot downwards to the external genitals and into the thigh. It was constant but subject to paroxysmal exacerbations of great severity. The left side was entirely free from pain.

The uterus in its development had reached a point midway between the umbilicus and the xiphoid cartilage and lay very distinctly more to the right side than to the left. The foetal movements were very active and caused considerable pain in the right lumbar region.

The skin was hot and dry; there was very slight headache, considerable thirst; temperature at 8.p.m. was 100$_0$-F pulse 94.

The bowels were constipated.

The urine had the usual febrile characters but was otherwise normal. It was dark in colour, strongly acid, of sp. gr. 1020, and threw down a deposit of urates. It contained no albumen.

The other organs were apparently normal.

SEPT 10th.

On the following morning the temperature was normal and the pain less severe. During the night there had been a copious motion of the bowels.

In the afternoon there was again an aggravation of all the symptoms:- pain very severe; skin hot and dry; temp. 100.8 pulse 100.

The diet was restricted to milk and water, hot poultices were applied to the right lumbar region, the bowels were kept active by Mag. Sulph. each morning.

During the succeeding three days there was a steady improvement. The pain became less intense and the paroxysms were fewer and less severe. The temperature remained normal. She passed 50 to 60 ounces of urine daily. This was examined each day and was apparently normal.

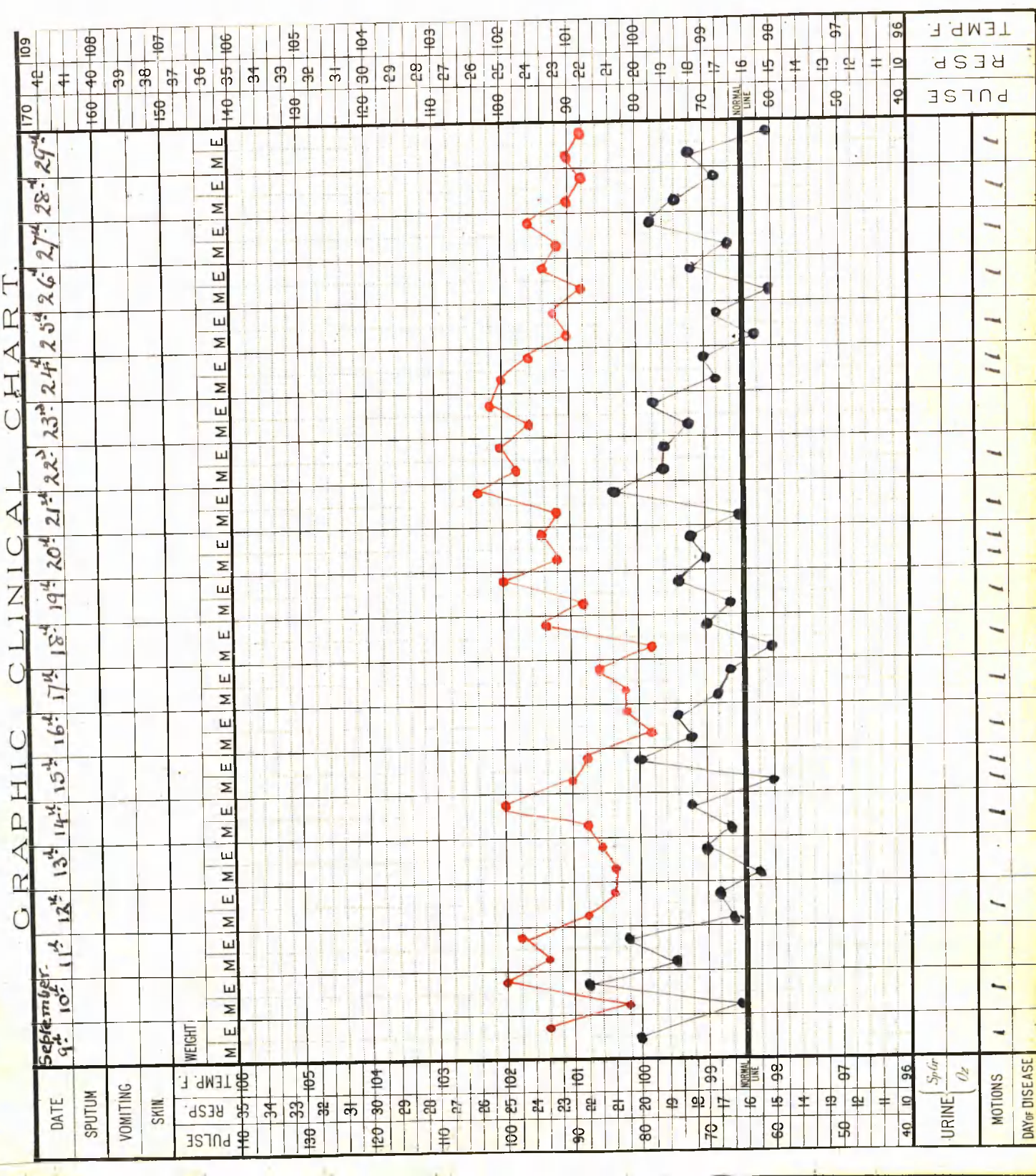
SEPT. 14th.

On the evening of September 14th a specimen of urine passed immediately attracted the nurse's attention by its foetid odour. This was examined and found to be very turbid throughout; on standing it threw down a copious deposit; the reaction was strongly acid, and a filtered specimen gave on boiling a dense cloud of albumen. The nitric acid test for albumen brought out two very distinct rings: one of albumen at the junction of the fluids, and another, presumably of mucin, situated just above the former. The microscope showed the deposit to consist of leueocytes/

C A S E I.

Temperature and Pulse Curves -

September 9th to 29th.



leucocytes and very numerous large rod-shaped bacteria. No tube casts were found. Several films were examined for tubercle bacilli but with a negative result. Cultures were made from the deposit. These showed, in twelve hours, an abundant growth of B. Coli, apparently in a pure state. Another twenty-four hours, however, brought out an equally abundant growth of Staphylococcus Pyogenes Flavus.

The patient was directed to avoid lying on the right side, the intention being thus to relieve the right ureter from the pressure of the gravid uterus, and allow a free escape of the purulent secretion.

From 14th to 20th September, there was a steady improvement in the patient's condition. The temperature remained normal and there was nothing in her general condition to suggest the existence of a serious septic process. She was almost quite free from pain. The urine rapidly cleared, and on September 20th, i.e. six days after the first appearance of pyuria, only a few globules of pus could be detected by the microscope.

SEPT. 21st.

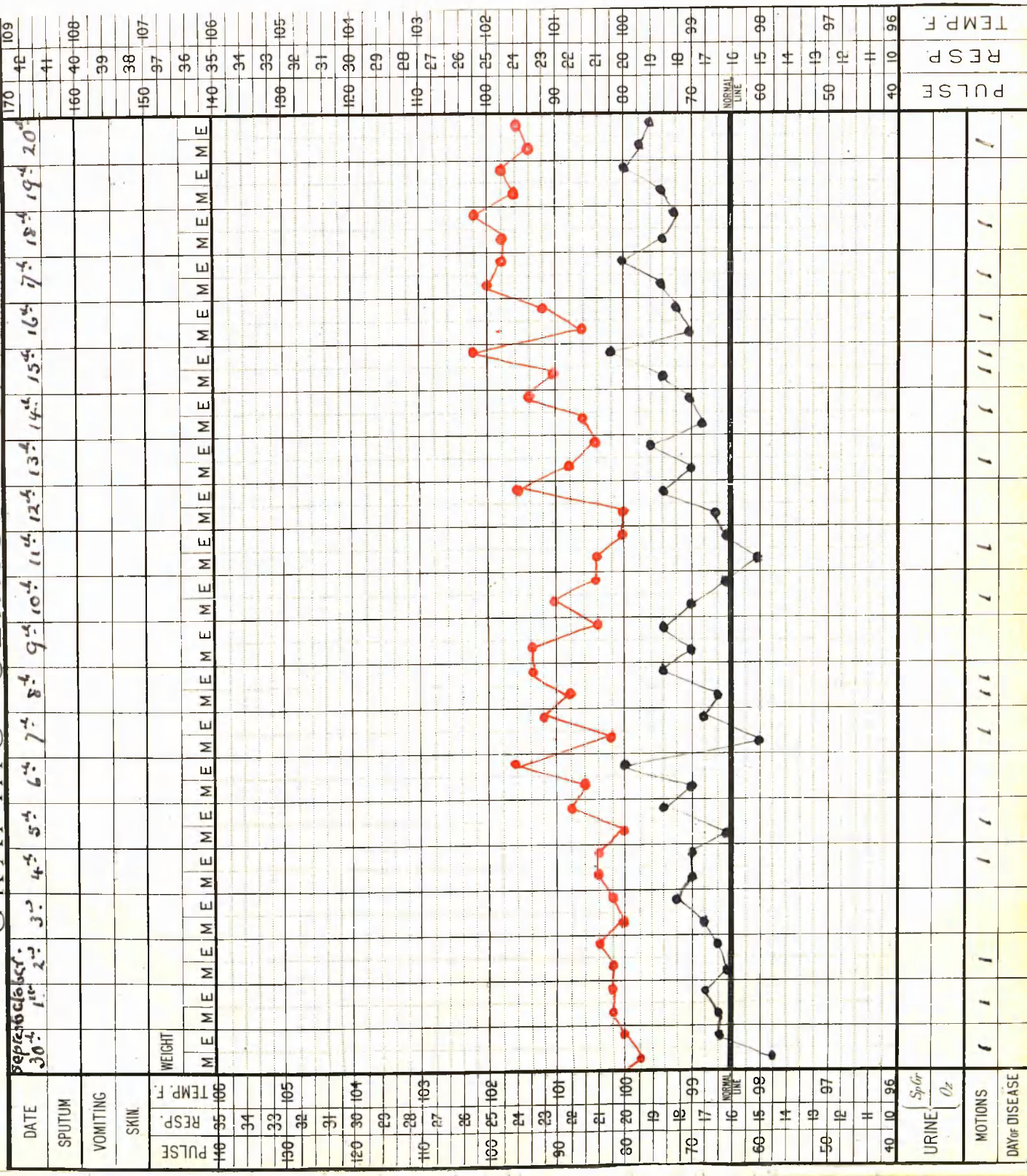
On September 21st there was a sudden outburst of pain on the left side corresponding identically in nature and in position to that previously experienced on the right side. There was the same point of great superficial tenderness above the iliac crest, and the same extreme tenderness to palpation in the region of the kidney. Pyuria and albuminuria were again copious and the deposit gave the same results to examination, microscopically and bacteriologically, as before. No tube casts were found.

Postural/

C A S E I.

Temperature and Pulse Curves -

September 30th to October 20th.



Postural treatment was at once abandoned. The diet was restricted to milk and water. Urotropine was prescribed in ten grain doses three times daily.

During the next week there was again a progressive improvement. The pus and albumen again almost entirely disappeared from the urine. The pain on the left side rapidly subsided, until there remained not even tenderness to palpation.

SEPT., 27th. On September 27th., there was another sudden paroxysm of pain in the right kidney region. The urine, on this occasion showed not so much an increase in the deposit of pus, as a very distinct increase in the albumen. A filtered specimen gave on boiling a deposit of albumen equal to half its volume. The quantity of urine passed in the succeeding 24 hours was 45 ounces: strongly acid, Sp.gr.1016, urea, approximately 2%. It should be mentioned that the specimen of urine which gave the above analysis was drawn off by catheter.

The paroxysm was not accompanied by any marked constitutional symptoms. There was a very slight rise of temperature - 99.8° in the evening of September 27th. There was no headache, sickness or visual disturbance. The fundi were examined but showed no abnormality.

For the succeeding three weeks her condition remained more or less unaltered. The intensity of the paroxysm abated but there remained persistent pain in the right hypochondrium. The pain was greatly aggravated by movement and especially by any attempt to turn on to the right side. The pyuria and albuminuria varied from day to day in amount but were always considerable. The treatment consisted in the restriction of the diet to milk and the administration each morning of a saline laxative.

OCTOBER 22nd. At midnight on October 22nd there was a large escape of liquor amnii without preceding pain. This was followed in an hour or two by the onset of labour pains which persisted steadily throughout the day. Labour was complicated by very violent sickness. The os dilated very slowly. The patient became much exhausted and her pulse rose to 120 per minute. At 11 p.m. under chloroform, forceps were applied to the brim and delivery effected with difficulty. Precautions were taken to protect the perinaeum but a considerable laceration occurred, not however, involving the sphineter. Half an hour after the birth of the child, the placenta was expressed with some difficulty and was apparently complete. The perinaeum was completely sutured.

For twelve hours after delivery the pulse remained at 130 and the patient was very weak, but her general condition soon improved. The temperature was normal and the pulse dropped to 90. The catheter was passed every eight hours to avoid bathing the ruptured perinaeum in septic urine. Before and after its use the parts were cleansed with 1 in 1000 perchloride of mercury.

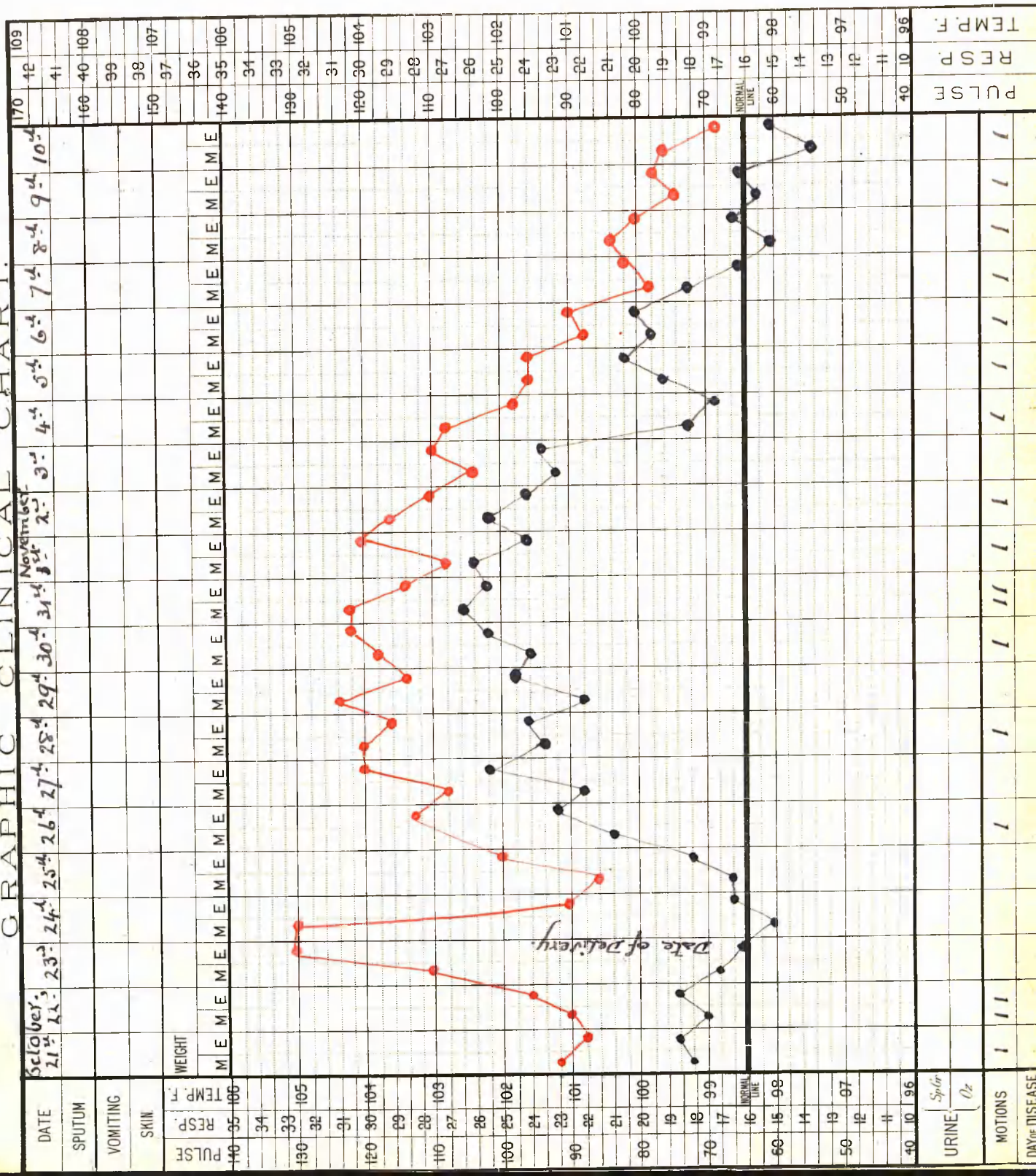
The puerperium was unfortunately of little value as supplying clinical evidence of the evolution of the renal lesion. On the third day after delivery the perinaeum showed signs of sloughing at the edges of the laceration and the temperature rose. The story of the succeeding fortnight will best be told by the accompanying chart. On October 27th the stitches were removed. For a day or two there was a copious secretion of pus but the parts rapidly became healthy. They were washed every few hours with a solution of lysol.

On October 29th the lochia, which had hitherto been abundant and/

C A S E I.

Temperature and Pulse Curves -

October 21st to November 10th.



and free from odour, became foetid. Vaginal douching failed to correct this, and on November 1st the uterus was washed out with boiled water. On the following day a small piece of placenta about the size of a sixpence came away, and thereafter the temperature steadily fell.

By November 7th the temperature curve had fallen to and remained on the normal line.

Three days after delivery, on October 26th, there was a recurrence of the paroxysmal pain in the right renal region. A purgative was given and the pain almost immediately disappeared.

For the first week after delivery the urine was regularly drawn off by catheter. During the first two days it contained abundant urates but very little pus. By the end of the first week, however, its condition was very much as before delivery. The deposit of pus varied from day to day but was always considerable in quantity. From October 26th there was a rapid disappearance of all discomfort in the renal region. Palpation of this region became possible after delivery but elicited nothing more than slight muscular resistance. On no occasion was the right kidney palpable.

A catheter specimen of the urine a fortnight after delivery showed a dense deposit of pus, and more albumen than would be expected from the presence of the pus. Cultures were again made and gave the same result as before - B. Coli and Staph. Pyogen. Flavus in abundance.

November 23rd. One month after delivery the patient's general condition was greatly improved. She had put on flesh and had a keen appetite. She slept well, and was free from all discomfort, even/

even on deep palpation of the right hypochondrium. The urine still contained both pus and albumen, the former varying between wide limits from day to day.

A more generous diet was now allowed - milk foods, fish, bread, and soups. Salol (gr. VIII) was given thrice daily and the patient was allowed to get up for a short time each day. Her health steadily improved and she was soon able to go about with comfort. The urine did not show any marked improvement from day to day, but there was a slight but steady diminution in the quantity of pus and albumen. Three months after the confinement the pyuria and albuminuria had both entirely disappeared.

To complete the story of this case, one or two points of interest about the child may be mentioned here, to some of which reference will again be made towards the end of the thesis. Although the mother's diet, for fully six weeks before delivery had been confined to milk, the nutrition of the child did not seem to suffer. He weighed 8½lbs at birth, cried lustily, and had all the appearance of vigorous health. The first specimen of urine passed was obtained for examination, and showed a slight trace of albumen, but no deposit. Several specimens were obtained during the first week. For the first five days the result of examination was always as above. On the sixth day, however, the child's urine showed a copious white deposit similar in appearance to that in the mother's urine. The microscope showed this to be entirely composed of large round flat cells. Professor Sutherland of Dundee, examined the deposit, and was of opinion that the cells were epithelial, most probably from the bladder. Cultures made from this deposit were entirely negative.

This urinary condition persisted for about two weeks. Thereafter the child's urine contained neither albumen nor deposit.

His health was good, and although fed artificially, he throve well.

Pyelonephritis, consisting, as it does, of a septic invasion of the ureter and pelvis, and possibly also of the substance of one or both kidneys, will obviously present wide variations in its clinical manifestations. In estimating the significance of the lesion in any particular case, numerous factors will require consideration. But an examination of the literature seems to show that the case which has just been described constitutes the commonest type of the disease, as met with in the later months of pregnancy. It has accordingly been thought well to give the case in complete detail, and utilise it as the text for many of the remarks which are to follow. Other cases, from the literature and from practice, will be cited to illustrate special features of the disease.

Etiology.

In this, as in any other disease, to determine the etiology, is to a great extent, to indicate the treatment prophylactic and curative. It may be asserted in the first instance, and the assertion is confirmed by all the literature on the subject, that this complication belongs in the main to the later months of pregnancy. Weill (Thèse de Paris 1899) collected 21 reported cases and found that they were distributed as follows:-

4	...	before end of 5th month.
13	...	after " " 5th "
1	...	after an abortion
3	...	during puerperium.

Bredier (Thèse de Paris 1901-02) reports a case which occurred in the beginning of the fourth month. One of Weill's cases was in the third month. These exceptions, however, leave untouched the general assertion that it is in the latter half of pregnancy that pyelonephritis is most apt to occur.

This predominance of the disease in the later months of pregnancy is obviously, for the most part, referable to one factor in its etiology - the anatomical relations of the parts involved. The ureters, running a course downwards, forwards, and inwards, from the kidneys to the bladder, pass into the pelvis just in front of the sacro-iliac synchondroses. This point is located by Cumston, on either side, at the point of intersection of two lines, one drawn horizontally through the anterior superior iliac spines, and the other vertically through the pubic spine. At this level the ureters are separated from the uterus on either side/

side by a distance of only 1½ centimetres. Thence the ureters become engaged in the broad ligaments, pass by the sides of the uterus and progressively approach each other to issue in the trigone of the bladder.

These relationships will obviously be completely distorted in the course of pregnancy. The uterus in its development, rises out of the pelvic cavity, and encroaches upon the neighbouring organs. The ureters, separated as they are by such a short distance from the walls of the uterus, will, even in the earlier months, be rapidly brought into contact with the latter. A point of great interest arises here - What degree of compression of the ureters is requisite to obstruct the flow of the urine? The ureters possess an extremely feeble muscular wall. The part they normally play in the passage of the urine is all but passive. It is consequently to be expected that a very slight pressure upon the wall of the ureter will occlude its lumen. Halbertsma, experimenting on dogs, found that "the weight of 5 grammes, compressing the ureter over a surface of 8 millimetres is sufficient to prevent the onward flow of a volume of urine, weighing 400 grammes." From such an experiment it is perhaps not possible to draw conclusions which will be applicable to the human subject. The ureter in man is scarcely comparable to that of the dog. The erect posture of the former will alone vitiate any comparison. It is nevertheless probable that a very moderate degree of pressure extended over a considerable surface of the ureter, would be sufficient to counteract the secretory pressure of the kidney and the force of gravity, and cause, not perhaps an acutal obstruction/

obstruction but a retardation of the flow, and some degree of dilatation of the lax ureteral walls. Even in the earlier months of pregnancy the ureters and especially the right, must very soon be brought into contact with the pregnant uterus. Here may possibly lie the explanation of those early cases of pyelonephritis which have already been referred to, especially if there exist a kidney already rendered vulnerable by antecedent disease.

The pregnant uterus, in its development, inclines more to the right side than to the left, and further it undergoes a rotation on its axis, bringing the left border forwards, and pushing the right border back towards the posterior wall of the pelvis - facts which, with others, will explain the enormous predominance of pyelonephritis on the right side.

It is perhaps not possible to assert that the ureters are always obstructed and dilated in pregnancy, although it is difficult to imagine how they can escape some degree of compression. The condition is at all events of very general occurrence. Olshausen, Löhlein and Pollak established this point in the course of their investigations into the cause of eclampsia. Cruveilhier says:- "I have observed that the ureters of all women dying in the course of labour or in the later months of pregnancy are remarkably dilated." He regards the condition as of universal occurrence. Commonly both uterers are found dilated, but the right more so than the left. In many cases only the right, in a very few cases only the left is dilated. The degree of dilatation varies within wide limits. Occasionally the ureter resembles the small intestine in size. More frequently it is about the size of a goose quill. The nature of the dilatation also varies. Usually the ureter is uniformly/

uniformly enlarged from the point or area of compression to the renal pelvis. Sometimes, on the other hand, it presents a series of pouches with intervening constrictions. It should be mentioned here that observations on the condition of the ureters have been made for the most part in cases in which the question of pyelonephritis did not arise.

It is difficult to name the exact point of compression. It has already been pointed out that the lateral displacement of the ureter, even in the earlier months of pregnancy, with its consequent flattening and elongation of the ureteral walls, may be sufficient to cause slight dilatation. In the later months, the ureter is prabably crushed against the pelvic wall as it passes in front of the sacro-iliac synchondrosis. At all events the dilatation has always been found above the level of the true pelvis.

There are many other factors which probably play some part in the causation of pyelonephritis. Possibly a kidney which has been more or less injured by antecedent disease may be thereby rendered specially vulnerable in pregnancy. In nearly all the cases of pyelonephritis in pregnancy which have been recorded, this point has been specially considered and in very few of them has there been found a definite history of previous renal disease. Professor Pinard, however, goes so far as to assert that pyelonephritis only occurs in pregnancy when there has been a previous affection of the kidney. This position scarcely agrees with the fact that pyelonephritis in pregnancy is most frequently unilateral. Any antecedent disease, other than movable kidney or a suppurative lesion, would almost certainly be bilateral and

would/

would leave both kidneys equally vulnerable. The deviation of the pregnant uterus to the right side might of course explain the escape of the left kidney. But the left kidney does not altogether escape embarrassment. The left ureter is usually found dilated although to a less degree than the right. At all events, most observers have failed to establish any history of preceding kidney trouble. The laterature contains no data to indicate the influence of preceding movable kidney. In one or two cases this condition has been found after recovery from pyelonephritis but whether it had existed previously was not known.

It is difficult to conceive what influence the age of the patient cam have in determining the onset of this complication, but Gaussel-Ziegelmann (Arch.Gen.de Med.July 1905) has collected 55 cases, and finds that of these 44 occurred in patients under 30 years of age, and 11 in patients over that age. The most natural explanation of these figures would appear to be that the disease is commonest among primiparae. This indeed seems to be the experience of most observers, although it is not supported by the investigations of Mme Gaussel-Ziegelmann. She found that in a series of 68 cases, 34 occurred in primiparae and a like number in multiparae. Her figures are however open to this commentary - how many of these multiparae had suffered from the same complication in their first pregnancies? The disease is notoriously apt to recur to successive pregnancies. Her figures may, hpwever, be held to show that the preponderance of the disease among primiparae is not very great.

Some authors have named various obstetrical causes - contraction of the pelvis, hydramnios, and twin pregnancy. These are/

are obviously conditions which might have the effect of increasing the intra-abdominal pressure, and, with it, the pressure upon the ureters. But, their part, if any, in the causation of pyelonephritis has not been demonstrated. Mme Gaussel-Ziegelmann had one case in which there was a luxation of the hip of long standing, but there was no appreciable deformity of the pelvis. Dr. Herman Brown (British Medical Journal, November 19th, 1904) reported four cases of albuminuria in pregnancy; all were primiparae, and in all the presentation was occipito-posterior. Their ages were 36, 27, 31, and 24. In none of these cases did the urine contain pus, but they suggest the possibility that urinary obstruction may occasionally depend upon the position of the foetal head.

But when everything possible has been said as to the causes of urinary obstruction in pregnancy, the etiology of pyelonephritis is still far from having been demonstrated. Obstruction of the ureter, per se, can produce nothing more than a dilatation above the point of compression. While the ureter and kidney remain in an aseptic condition, and still more while the other kidney maintains its functional integrity, little harm can result unless the dilatation becmme so extreme as to actually destroy the renal substance. Even a kidney, the seat of extreme hydronephrosis, in which the renal substance is represented by little more than the thin wall of a distended sac, commonly shows a remarkable power of recovering its functional activity. In pyelonephritis there is another element added. The dilatation remains no longer aseptic. There is added an infection by pus-producing micro-organisms. To determine the nature and source of/

of these is to name the most important factor in the causation of this disease. It is obvious that the conditions created by an obstruction of the urinary flow are eminently suitable for the localisation of an infection. The pressure of the retained urine and the consequent circulatory disturbance, will tend to lower the vitality of the lining epithelium of the ureter and pelvis. Added to this are the facts, that during pregnancy the functional activity of the kidney is greatly exaggerated, in accordance with the necessity for eliminating the waste products of both mother and child; and that the renal circulation shares to an exceptional degree in the generalised passive congestion of pregnancy.

The micro-organisms which will effect the transformation from a simple hydronephrosis to a pyelonephritis may be derived from various sources. The most obvious source is the lower urinary tract, although most observers are agreed that it is by no means the commonest.

At the Meeting of the British Medical Association at Leicester in July, 1905, Dr. Campbell of Belfast called attention to the prevalence of pus in the female urethra, and to its evil influence on the progress of obstetrical and gynecological cases. His examination of 534 consecutive cases in private practice showed the existence of pus in the urethra or in Skene's glands in 135, i.e. in 24.7%. A somewhat higher percentage was obtained in a series of hospital cases (36.2%). He had the pus of 100 cases examined and found that the bacteria implicated were as follows:-

Staphylococcus pyogenes albus 96

Streptococci	6
Gonococci	2

This means that in a large number of pregnancies there is to begin with a septic focus, and the possibility of other septic complications in the course of either the pregnancy or the puerperium.

Pyelonephritis, originating in an ascending infection from the lower urinary tract, will in all probability be preceded by symptoms of cystitis. From the bladder the microorganisms may reach the pelvis of the kidney by passing along the ureteral mucosa, or by the lymphatic vessels. This is, of course, the source of infection in many cases of suppurative disease of the kidney apart altogether from pregnancy. The lesions produced are usually of a more serious nature than that associated with the pyelonephritis of pregnancy. Numerous miliary abscesses in the renal substance, or possibly a single large abscess involving the entire kidney and its pelvis may be found. They belong to the category commonly referred to as "surgical kidney". Such lesions may supervene in the course of pregnancy, but they do not conform to the type of case here considered. The two following cases may be cited here, although they also differ, clinically and pathologically, from the type exemplified in Case I.

C A S E II.

Primipara, aet 20, pregnant 5 months. Complained of abdominal pain and sore throat; a few days later of pain in the Right Iliac Fossa.

Right Tonsil ulcerated.

One week later, vomiting and rigor.

Widal's test negative.

No bacilli from throat swab.

Leucocytes 21000.

Miscarriage on eightennth day of illness.

Foetus alive (nearer seven months).

Died two hours later.

P.M. Intestinal tract normal. Heart normal. Vagina normal. Bladder normal. Infarets (old) in spleen. Right kidney weighed 8 oz, was mottled and showed numbers of sub-capsular and cortical abscesses. Pelvis normal; ureter dilated and t thickened, with sub-mucosal leucocytic infiltration, which showed a non-Gram-staining bacillus.

Left kidney similarly, but less severely affected.

C A S E III.

Primipara, aet 27, 5 months pregnant. Previously healthy. Taken ill suddenly with abdominal pain and loss of blood. There was a suspicion that threatened miscarriage was not spontaneous.

Pain most marked in right Iliac fossa, local rigidity.

Vomiting/

Vomiting; Temperature 103°.

Symptoms suggested appendicitis or peri-renal abscess.

Operation - Ureter much thickened.

Right Kidney much swollen. In its substance were numerous abscesses and haemorrhages.

Drained -

Death 30 hours later.

In this case also there was a follicular ulcer of the right tonsil.

P. M. Kidney 10½oz. in a condition of haemorrhagic septicaemia".

Right Ureter dilated.

Uterus reached to 2" from umbilicus.

Bladder - submucous haemorrhages.

Lymphatics of ureteral wall filled with leucocytes and large Gram-staining bacillus, which was also found in the kidney and in the tonsil.

All other visera were normal.

In neither of these cases did the condition of the urine suggest the diagnosis. They both differ considerably from the type of case which it is the special purpose of this thesis to consider, but they suggest -

1. That the tonsil may be, in some cases, the primary site of infection.
2. That the lymphatissof the ureter may be the path of invasion.
3. That the renal pelvis may escape.

In/

In Case I. the infection was a mixed one - Bacillus Coli, and Staphyl. Pyogen. Flavus. This agrees, in part at least, with the observations of the majority of authors who have written on the subject. B. Coli seems to be the organism most frequently implicated. In several of the cases reported by Reblaud (Congres Francais de Chirurgie, Paris, 1892) this organism was found in pure culture. Cumston, in a case in which he found it necessary, after having induced labour, to perform a double nephrotomy, found the same bacillus in a pure state. Gaussel-Ziegelmann reports four cases in the Arch. Gen. de Medicine (July 1905). In only one of them is any information given of the organism involved, but in it B. Coli was present in large numbers. She mentions that she has found the same organism in many other cases of the same disease.

The mode of transference of the B. Coli from its habitual nidus in the intestine to the pelvis of the kidney, and the influences which facilitate this transference constitute the crucial questions in the etiology of pyelonephritis in pregnancy. Vinay (Congres d'obst. et de gynecol de Marseille, 1898) discussed the probable route by which B. Coli communis migrated from the intestine to the renal pelvis. He names three possible paths of invasion -

1. By the blood.
2. By the Lymphatics.
3. By continuity of tissue.

He further expresses the belief that the last named is the common est route. He asserts that the B. Coli passes directly through the wall of the intestine, and subsequently through the wall of the/

the ureter. He supplies no data in support of the theory. Others (Weiss, Weill, Gaussel-Ziegelmann) are of opinion that the blood stream supplies the avenue of approach to the renal pelvis and this explanation seems to be in better accord with clinical experience. The conditions which render possible a localisation of the infection in the renal pelvis have already been indicated. Once the organism has gained access to the general circulation, it is to be expected that it will find a suitable nidus in a viscus which is already more or less functionally incapacitated. Pathological observations on the question of the route pursued by the organism are entirely wanting. The probability seems to be that it does in the first instance invade the general circulation.

M. Bar has described a condition which he names "coli-bacillose gravidique", in which the symptoms are those of a well marked general infection, without evidence of any definite local lesion. He ascribes the condition to an increase of virulence on the part of the B. Coli, due to the intestinal troubles which are so common in pregnancy.

Mme Gaussel-Ziegelmann has described similar cases. The following case she gives at length under the heading "Toxaemia in Pregnancy, induced labour, Pyelonephritis after delivery".

C A S E IV.

Primipara, aet 22, entered Hospital 6 months pregnant. Pregnancy from beginning, marked by obstinate constipation, headaches, insomnia, and occasional pain in abdomen.

No/

No albuminuria.

Marked dyspnoea on walking.

Heart normal. Lungs normal.

Sudden severe attacks of dyspnoea.

Improved on milk diet and purgatives.

One month after admission dyspnoea reappeared. Worst during the night. No heart or lung lesion to account for it. Ether and caffeine given hypodermically.

Dry cupping of right base where a few moist rales were heard

Milk diet; Cachets of theobromine given. Her general condition got so bad that labour was induced. During labour she had a violent attack of dyspnoea. Forceps were used. The dyspnoea entirely disappeared after delivery. The puerperium was normal.

Twenty days after delivery pus appeared in the urine, with pain in the kidneys. There were no bladder symptoms.
Urine - reaction acid - contained both pus and albumen. B. Coli found in culture from pus.
She made a good recovery.

Mme Gaussel-Ziegelmann claims that it is a permissible presumption that the organism which was found in the urine after delivery, was also responsible for the symptoms which preceded delivery. These latter she ascribes to a general infection by the B. Coli or its products.

From the practical point of view, it is of much greater moment to determine, if possible, the conditions which permit the migration of the B. Coli. In Cases I. and IV, in both of which B. Coli was found in the urinary sediment, the onset of kidney symptoms was preceded by a period of obstinate constipation. In most/

In most of the recorded cases the same circumstance has been noted. Weill (Thèse de Paris, 1899) who collected 21 cases, found that obstinate constipation, usually over a period of some months, preceded the onset off pyelonephritis in the majority of cases. Bar (Obst. Soc. de Paris, June, 1904) is of the same opinion and regards pyelonephritis as analogous to appendicitis, nephritis, and pleuritis, all of which may be causes by the B. Coli. Orlowski (Polnische Monatschrift fur Gynakologie und Geburtschrifte, Jan, 1905) reports three cases, all of which were characterised by digestive disturbances. Gaussel-Ziegelmann makes the same observation. In two of the cases reported by her (Arch. de Gen. de Med. 1905) the appearance of renal symptoms was preceded of signs of severe intestinal irritation, characterised by vomiting and diarrhoea. There is indeed a consensus of opinion among observers that the intestinal troubles, which are so common during pregnancy, play a considerable part in facilitating the migration of the B. Coli.

The experiments of Cathala (Thèse de Paris, 1904) are of some significance in this connection. He ligatured the ureter of a rabbit, and found, when it was killed after a few days, that there existed only an aseptic distension above the ligature. In another rabbit, having ligatured the ureter, he also occluded the anal orifice by ligature, thus producing an artificial constipation. In this instance he found a well-marked pyelonephritis. The pelvis of the kidney was occupied by purulent urine which contained the B. Coli in pure culture.

Mme. Gaussel-Ziegelmann prefaces her discussion of this subject with the remark that it is easy to understand the

frequency of pyelonephritis in pregnancy, when one remembers the intimate anatomical relationship which exists between the urinary and the genital organs in the female. But this intimacy of relationship fails to explain the comparative infrequency of the disease. The parts are indeed so closely related in anatomical position, that, if compression of the ureters be the chief etiological factor, one would expect pyelonephritis to be among the commonest complications of pregnancy. It is almost inconceivable that in any case of pregnancy the ureters can escape some degree of compression. That the disease is so comparatively rare, seems rather to indicate that it depends for its causation upon some factor of less constant occurrence, although doubtless the urinary obstruction is the chief predisposing influence. The evidence already cited would indicate that this factor is either - 1. An increase of virulence on the part of the B. Coli, or

2. Some modification in its surroundings of such a nature as to facilitate its entrance into the circulation - haemic or lymphatic.

Clinically, constipation seems to be preeminently the condition which leads ultimately to the migration of the organism.

Here again, however, the difficulty is to explain the comparative rarity of the disease, for constipation of some degree is almost a normal accompaniment of pregnancy, and little harm seems to result in most cases. Pregnancy is a physiological process, and the adaptive powers of all tissues to physiological changes of circumstances, are well known. The possibility of the escape of the B. Coli from the bowel will probably depend upon/

upon the condition of the intestinal mucosa. The mere presence of a healthy mucous membrane will exercise a restraining influence on the activity of the micro-organism. Some degree of intestinal stasis is probably the starting point of the disease in most cases. If the restraining influence of a healthy mucosa be removed, the micro-organism will acquire an augmented activity of growth, and may conceivably penetrate through the thin walls of vessels which are already deteriorated in vitality. The appearance of the intestines, as seen in the course of a Caesarean Section, how they seem to be squeezed into odd and very limited corners, is such that it would be surprising if their physiological functions were not sometimes disturbed, if by some accident or incident of digestion, there did not now and then arise in them a condition of temporary obstruction or its equivalent, enough to give the Colon Bacillus its oportunity for exaltation of virulence and increased capacity for migration.

Adami showed that the Bacilli in a loop of intestine removed from the continuity of the tract, ligated at both ends, but still maintaining its vascular connections, rapidly underwent such an exaltation of virulence. Probably in the majority of pregnancies the compression of the ureters is not of such a degree as to render the ureter and the renal pelvis specially liable to infection. But given some slight additional factor, such as antecedent renal disease, movable kidney, a greater deviation than usual of the gravid uterus to the right side, or, indeed any condition which will, directly or indirectly, lower the resisting power of the mucosa of the pelvis and ureter, localisation of the infection will become a more likely accident.

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That constipation or other intestinal trouble plays a large part in the causation of the disease is further confirmed by the analogy of pyelitis in young children. At the meeting of the Edinburgh Obstetrical Society, in May 1902, Dr. Thomson referred to eight cases of pyelitis in children varying in age from 7½ to 20 months. In every case there was a history of obstinate constipation. In some there had been occasional attacks of diarrhoea. In 5 out of the 8 cases there was pain about the anus, pain on defoecation , or blood in the motions. All the children had been artificially fed. The temperature often reached 104° and was remittent in type. The patient was restless and distressed; appetite fairly good; emaciation steady but not rapid. In 5 cases there was a history of sudden screaming suggesting colic. In 4 cases there was uneasiness or pain on micturition. In 2 there was vulvitis.

Unine - always acid; once foetid. Albumen present always in small amount. No tube casts; pus in considerable quantity. B. Coli was found in all the cases, in pure culture. All the 8 patients were girls. The condition was found to be very amenable to treatment by milk diet and salol.

Symptomatology.

It is usually asserted that pyelonephritis in pregnancy may or may not be sudden in its onset. The remark is probably more scientifically accurate when applied to the leading symptom - pain. This, indeed, may appear so suddenly and be of such severity as to simulate renal calculus. The disease itself is probably in all cases insidious in its onset. M. Bar (Obst. Soc. de Paris, 1904) distinguishes a pre-suppurative stage in which the urine shows a bacteriuria without pyuria. It is to be expected that an invasion of the pelvis of the kidney by micro-organisms will in the first instance cause a bacteriuria, pus only appearing in the urine at a later stage. This early stage of the disease may be entirely free from subjective symptoms, but on the other hand, even before the appearance of pus in the urine, there may be rigors, pain, and progressive loss of flesh. Any such symptoms occurring in a pregnant woman, and attributable to no obvious lesion, call for a bacteriological examination of the urine. This is the more important because pyelonephritis in its early stages is eminently amenable to treatment.

As a rule the patient will seek advice because of pain. This may, on its first appearance, be of the nature of a true renal colic. More frequently it is a dull ache in the right lumbar region, and is frequently dispelled at once by the use of a laxative. There may at the same time be some vesical irritability. But slight bladder symptoms are so common in pregnancy, and the pain in the side is so inconstant, that the patient, and possibly also her medical attendant, may regard her/

her symptoms as being among the little miseries of pregnancy, to be endured rather than treated. Later the pain becomes more constant, but it has usually this characteristic - it is subject to severe paroxysmal exacerbations which may even show a distinct periodicity. This character of the pain was noted by Cumston. In Case I. there was for a period of some weeks, an almost daily recurrence of severe pain at approximately the same hour.. These paroxysms closely resembled renal calculus. The pain shot from the lumbar region down into the external genitals, and even down the thigh.

In addition to the actual pain in the kidney there may exist an area of superficial tenderness with a very definite point of maximum intensity. In Case I this was situated in the right flank just above the iliac crest. Very light pinching of the skin was sufficient to cause severe pain.

Sooner or later the patient shows the general signs of a septic process. The general symptoms will vary in severity with the freedom, or otherwise, with which the pus finds exit from the ureter. There is usually some degree of fever, but as a rule the temperature is not high. Occasionally it is accompanied by rigors and shows wide daily variations, reaching at times 105° F. The temperature in Case I never rose above 101° F.

The other symptoms show a similar wide variation. Headache, sometimes very intense, profuse sweating, vomiting, anorexia, and sight troubles are among the chief symptoms noted in the published cases. They are the signs of a general septic infection.

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The urine supplies the only features of the disease which can be regarded as pathognomonic. Frequency of micturition is often troublesome, and there may be some pain associated with the act. To begin with the urine may shows no special abnormality. Pus and albumen soon make their appearance. The pus is usually considerable in quantity, but has this special character - it varies greatly in amount from day to day. Frequently the amount of pus in the urine may become greatly reduced, although the patient's general condition shows the reverse of an improvement. The quantity of pus in the urine will depend upon the ease or otherwise with which the renal pelvis is drained. The urine, on passing is uniformly muddy and has often the characteristic odour associated with the presence of the B. Coli. On standing it throws down a heavy purulent deposit. Albumen is invariably present and may or may not exceed in quantity what might be expected from the presence of the pus. The urine is acid in reaction, and is usually of normal specific gravity. The microscope finds the deposit to consist of leucocytes and bacteria with possibly tube casts, hyaline or granular. Bacteriological examination will determine the particular organisms implicated. In the vast majority of cases B. Coli will be found, in pure culture or associated with other bacteria. In a fair number of cases streptococci and staphylococci have been found, and in a very few, gonococci.

The significance of the various signs and symptoms will be more particularly discussed in dealing with the question of diagnosis. In order to focus the discussion of the diagnosis, Case I, which presents all the usual features of the disease will be dealt with in detail.

D I A G N O S I S.

In the earliest stages the pain was the only symptom complained of. It was not severe, and was immediately relieved when a copious evacuation of the bowels was secured. The patient herself regarded it as due to the intestinal disturbance. The urine was examined at this stage and found to be free from albumen and sediment. It is possible, however, that a bacteriological examination might have detected the B. Coli. Even after the pain became severe and paroxysmal the urine remained for five days free from either pus or albumen. The diagnosis at this stage was difficult. The question of appendicitis was raised. There was an area of great tenderness around the anterior superior iliac spine. Light palpation called forth immediate and great muscular rigidity. The pain was not, as is so often found with deferred pain, relieved by pressure. It was at once aggravated by the slightest movement.

The temperature varied from normal to 101° F. The pulse varied with the temperature but was never rapid. The bowels were constipated and had been so for some time. A provisional diagnosis of appendicitis was under these circumstances not unwarranted.

On the other hand, the distinctly paroxysmal nature of the pain suggested the possibility of renal calculus. It was especially aggravated by the slightest movement or jolting of the body; it shot down the course of the branches of the lumbar plexus into the bladder, external genitals, groin and thigh. Further, the extreme tenderness in the right iliac region was not inconsistent with the presence of a calculus, which, from the/

the wide nerve connections of the kidney, may give rise to pain at a distance.

The urine at this stage was of no service in elucidating the diagnosis. It presented the characters of a febrile urine and threw down a heavy deposit of urates, but contained no blood, albumen or pus.

There was no previous history of haematuria or, indeed, of any renal trouble. The patient's general condition was compatible with the presence of a calculus, but there was an absence of the collapse so frequently associated with true renal colic. There was no nausea, or vomiting or profuse perspiration. The pain was not ushered in by a rigor.

While the possibility of appendicitis could not be dismissed, the seat of the pain, and the direction of its radiation, pointed rather to a renal lesion, the nature of which was uncertain. Calculus seemed to offer the most likely explanation, but early tubercular disease had to be considered. There was no sign of tubercle elsewhere.

The severe pain began on September 9th. On the evening of September 14th the urine was densely purulent. The pain had to some extent subsided, but there remained marked tenderness about the right kidney, and there were occasional paroxysms as before. The condition of the urine was such as might follow the prolonged irritation of a calculus, although there were no crystals in the deposit.

There still remained the possibility that the urinary condition/

dition had resulted from the bursting into the ureter or bladder of an abscess originating in the appendix. The patient's general condition was so good and the symptoms had undergone such a steady betterment that appendicitis seemed a remote possibility.

The sum of the clinical evidence seemed still to suggest a kidney lesion, and the bacteriological examination of the urinary deposit revealed at least the organisms implicated. Numerous efforts were made to find the tubercle Bacillus without success.

Reference to the literature revealed the fact that pyelonephritis in the latter half of pregnancy was by no meansrare, and was usually associated with just such symptoms as this case presented, and most frequently owed its origin to the B. Coli. There remained little doubt that the case belonged to this category. The progress of the case during the succeeding few weeks only confirmed the diagnosis. From the 14th ro 21st September postural treatment was adopted. With the object of relieving the right kidney, the patient lay almost continuously on the left side, with the result that there was an acute outburst of renal pain on the left side associated with the same role of symptoms as previously. The occurrence served alike to condemn the treatment and to confirm the diagnosis.

It is not pretended that a discussion of the diagnosis of this particular case exhausts the subject of the differential diagnosis of pyelonephritis in general. It has already been made sufficiently evident that the disease varies in its manifestations within wide limits. Frequently the difficulty lies

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in distinguishing it from cystitis. Or again it may closely resemble Typhoid Fever, or the gastro-intestinal variety of influenza. When it occurs after delivery it will almost certainly be confounded in the first instance with puerperal infection.

It is not surprising that some difficulty should arise in differentiating pyelonephritis in pregnancy from cystitis, or rather that it should frequently be mistaken for cystitis, which is probably the case. Difficulties of micturition of varying degree are of such constant occurrence in pregnancy, that when found associated with pus in the urine, cystitis immediately suggests itself as the most probable cause. The gravid uterus, rising out of the pelvis, drags with it the bladder, and, in the later months, the urethra is crushed against the posterior surface of the symphysis pubis. Symptoms of irritation follow. Frequency of micturition, and often considerable pain, commonly persist throughout the later months. If these symptoms become severe the patient will probably seek advice. The urine will be examined, and if it is found to contain pus, and especially if this be so in a catheter specimen, a diagnosis of cystitis is extremely probable. The well known prevalence of pus in the female urethra will only tend apparently to simplify the diagnosis of cystitis. The clinical picture, indeed, has such an appearance of completeness that a temptation will exist to ignore other possibilities. In this way it is just possible that some cases of pyelonephritis in pregnancy, in which distinctive symptoms are wanting may escape detection. The issue is still further confused by the fact that pyelonephritis does of itself frequently give rise to very great irritability of the bladder. Thus the whole/

whole tale of symptoms may be such as to place the diagnosis of cystitis apparently beyond doubt. Only a very minute and systematic examination of the urine will make the diagnosis certain. Such an examination will, in most cases only confirm the diagnosis of cystitis, but in a certain small percentage of cases it will be found that the symptoms are really referable to an invasion of the ureter and renal pelvis by pathogenic organisms.

If cystitis be the initial lesion the urine will usually have an ammoniacal odour, and an alkaline reaction. The deposit of pus may be very abundant, but the daily variation in quantity will be slight. The pus is usually associated with, and entangled in, a considerable amount of mucus. If the urine be allowed to stand for some hours, the pus will form a bulky deposit, but the mucus prevents the formation of a clear-cut line of demarcation between the deposit and the supernatant fluid. A bacteriological examination will probably show the presence of bacteria which point to an infection from the urethra or from without (e.g. by Catheterism). It is usually found that the pus of cystitis is not intimately mixed with the urine, but comes for the most part, with the last portion of the specimen passed.

The urine of pyelonephritis is free from ammoniacal odour, but it may present the characteristic odour of B. Coli. It is acid in reaction. On passing it is uniformly muddy, and, on standing, throws down a heavy purulent deposit, which is usually very abundant, but shows wide daily variations. The deposit shows a flat surface well marked off from the clear supernatant fluid. The microscope may detect tube-casts, or epithelium

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which can be identified as coming from the kidney, pelvis, or ureter. Cultures will in most cases give an abundant growth of B. Coli, alone or in company with other bacteria.

The differential diagnosis between cystitis and pyelonephritis will, in most cases, be aided by the presence or absence of other symptoms pointing to a renal or vesical lesion respectively. But there are cases in which no such aid is offered, and in which the diagnosis will rest entirely upon the condition of the urine.

The onset of pyelonephritis can closely resemble Typhoid Fever. A period of malaise, indefinite pains in the right iliac region, a steadily rising pyrexia with morning remissions, and obstinate constipation, are sufficient to keep the diagnosis in suspense probably for several days. The urine at this stage may offer no assistance, although it is possible that a bacteriological examination would be of the utmost service. Widal's test would give a negative result. The urinary condition will probably so declare itself in the course of a few days as to settle the diagnosis, at all events as between these two conditions.

Occasionally patients present all the other symptoms of pyelonephritis although the urine betrays no evidence of the disease. In such circumstances diagnosis will be a matter of great difficulty. The following case, reported by Ahlefelder (Monats. fur Geb. und Gyn. March 1905) is an instance of this.

CASE V.

Patient was seen by Ahlefelder during the ninth month of her second pregnancy. During her first pregnancy, a year previously, she had an attack of fever and pain in the right loin. Para-nephritic abscess was diagnosed and a lumbar incision made. The capsule of the kidney was laid open, and the organ itself punctured at several points withthe knife. No pus escaped, and the wound was closed. Three days after operation a male child was born spontaneously but symptoms of pyaemia followed, with plugging of a vein in the left leg, and later on, necrosis of a tarsal bone. The patient, however, made a good recovery. When Ahlefelder saw her, she looked in good health, but complained of pains in the right loin, which was very tender to touch. The uterus was normally evolved, the pelvis free from contraction or obstruction. The temperature rose and the pulse became very rapid. Labour was induced and a living child was born. Directly the uterus had emptied itself, the severe lumbar pains began to diminish. Profuse perspiration with fall of temperature and pulse was observed. For four days the right kidney could be felt enlarged. The amount of urine excreted was normal as were its contents. Then the patient was placed on the left side, the bladder having been emptied. Almost immediately the kidney began to diminish in size and the bladder filled again. The urine then drawn off was free from albumen or sugar. Convalescence was afterwards free from complications.

It is almost impossible to make a diagnosis of pyelonephritis/

pyelonephritis in the total absence of urinary symptoms. But the condition of the patient just described, and the rapid improvement which followed delivery, leave little doubt that the renal lesion was responsible for her symptoms, and these symptoms are scarcely compatible with an aseptic distension of the ureter and pelvis of the kidney. They point rather to a toxaemia. It is not stated whether the urine was examined bacteriologically. It is not uncommon to find that both the pus and albumen occasionally all but disappear in the course of pyelonephritis, and it is possible that some cases may run their entire course manifesting a pyuria so slight as easily to escape detection. In such cases only bacteriological methods will establish the diagnosis.

In this case of Ahlefelder's the symptoms in the first pregnancy were so severe, and pointed so distinctly to a septic condition in the right kidney, that nephrotomy was actually performed. The organ was punctured at several points and no pus found, but no note is offered of the condition of the pelvis of the kidney and the ureter.

The case seems at all events to illustrate this point, that even the absence of pyuria and albuminuria is not sufficient to absolutely exclude pyelonephritis.

If there be an invasion of the ureter and renal pelvis by bacteria, it is almost inconceivable that the urine can fail to contain these, unless there exists at the same time an obstruction of the ureter, absolute and constant. Consequently a bacteriological examination of the urine even in the absence of pus, is of the utmost importance.

T R E A T M E N T.

The whole story of the etiology of pyelonephritis as revealed in the cases here described, and as further revealed in the literature on the subject seems to indicate that it belongs largely to the category of preventable accidents. Cases will no doubt occur in spite of all precautions, but it is possible that most cases would be avoided by rigid attention to the hygiene of the pregnant woman. Constipation, especially, should be combated persistently throughout the entire pregnancy. However undesirable the persistent use of laxatives may be at other times, they constitute in pregnancy, the only possible method of combating the constipation. Massage, exercises, or electro-therapeutical measures are obviously impracticable. The particular drug employed will be a matter of little moment. The patient's own experience will probably be the best guide. Salines have possibly the advantage of especially relieving the kidneys.

The point which it is sought here to emphasise is that constipation in pregnancy cannot with safety be ignored, or patiently tolerated until the completion of the pregnancy, but is a condition fraught with danger to the patient. Other evidences of gastro intestinal disturbances will demand equally strict attention. Pyelonephritis is occasionally ushered in by diarrhoea and vomiting. A strict milk diet and the use of intestinal antiseptics might in such circumstances save the patient from further accidents. The aim of treatment should be

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to maintain the intestinal tract in as healthy a condition as possible.

In some cases pyelonephritis has seemed to be determined in its immediate onset by excessive fatigue or exposure to cold. These, and other circumstances, only emphasise the necessity for a strict surveillance of the hygiene of pregnancy, and especially so should there be any history or suspicion of antecedent kidney disease.

The treatment of the disease once it has become established, is still a matter of some controversy among authors. French writers mostly insist upon the importance of restricting the diet to milk. Other observers maintain that in most cases it is not necessary or advisable to so restrict the diet. They argue that the renal parenchyma is not usually involved, and that there is therefore no indication for such a restriction. In the presence of a purulent urine, it is scarcely possible to be certain to what extent the kidney is involved. The degree of albuminuria will offer some indication. Where the albumen is obviously out of all proportion to the amount of pus, still more where tube casts are found, the diet should certainly consist of milk only. Even in cases where the albumen amounts only to a trace, a milk diet seems to give the best results. It seems to be an almost universal experience that, when milk only, is given, the amount of pus in the urine diminishes, and, vice versa, that when this diet is departed from the amount of pus increases./

increases. The rationale of this treatment seems to depend, not so much upon its effect on the kidney itself, as upon the change it effects in the intestinal canal. Avisa (Wiener Klinik, Oct. 1904) discusses the effect of milk diet in Bright's disease, and declares that under its use the tendency to anto-intoxication is reduced, and that the bacteria in the intestine diminish in numbers, even to the extent of being only one sixieth of the normal. On this ground it is probably advisable to restrict the diet to milk in all cases of pyelonephritis. The milk should be given freely, - five or six pints daily, and this regime kept up so long as the general bodily condition does not seriously deteriorate. It is necessary to secure a free daily action of the bowels for which purpose a saline laxative should be given each morning.

These are probably the most important measures in the treatment, and are sufficient in most cases to produce a marked improvement in the condition of the urine. In addition some form of antiseptic is usually prescribed. Urotropine has been largely used, but nowhere in the literature is mention made of the risks involved in its use. In Case 1. it was given ten-grain doses every four hours, and for several days the urine showed a steady improvement. This was followed by a sudden outburst of acute renal pain, and a very great increase in the albuminuria, which rapidly sibsided when the drug was stopped. It has already been insisted upon as one of the features of the disease, that the urinary signs show wide daily variations, quite/

quite apart from any influence of treatment. But it is the quantity of pus which so varies, the obvious explanation being that the degree of compression of the ureter varies with the bodily position, and possible also with the pressure in the ureter itself of the retained column of urine. There is nothing in the known pathology of pyelonephritis to explain a sudden and very copious increase in the albuminuria, without a corresponding increase in the pyuria. Such a phenomenon only occurred once in the history of Case 1. and seemed to be directly referable to the use of urotropine. It was certainly preceded by a period of marked improvement which may possibly indicate that urotropine is of use in such cases, but must be employed with caution. The urinary condition should be carefully watched. Goldberg noted a similar effect from the use of urotropine in gonorrhœa and cystitis, and recommended hetralin which resembles urotropine in its action, but has the advantage of greater solubility.

In Case 1. greater benefit was derived from the use of salol. Under its use there was a slow but steady improvement in the urine. It was continued after delivery and seemed to have the effect of regulating the bowel.

Whatever improvement may be effected by treatment, pyelonephritis usually persists until the end of the pregnancy. Treatment may however prevent complications, and enable the patient to go to full term.

Pasteau/

Pasteau has suggested a means of draining the ureter by momentarily distending the bladder each day by the injection of fluid in successively increasing quantities (180, 210, 220, and 230 grammes). The object is presumably to raise the lower segment of the uterus and thus relieve the pressure on the ureter. M. Schwab reports having used this method in two cases, with good results.

Gaussel Ziegelmann suggests that the distension may provoke energetic peristalsis in the muscular wall of the ureter. The authors insist that the method must be used with caution. The distension must only be momentary and must be frequently repeated, if it is to be of value.

In several instances nephrotomy and even nephrectomy have been resorted to. The indications for such serious surgical intervention are very uncertain. It is seldom possible to be quite certain that the lesion is confined to one kidney. Possibly only the use of Luy's separater or the Cystoscope would settle this point. Even then a negative result would have little value, unless the examination was very frequently repeated. If the symptoms point to a bilateral affection nephrotomy becomes a much more serious operation, and nephrectomy is absolutely contra-indicated. Many of the very worst cases of pyelonephritis show a great improvement after spontaneous or induced labour. Induction of labour is a relatively simple procedure, and more likely to be of real service than nephrotomy.

The latter operation, however, sometimes becomes a necessity even after delivery.

Cumston (Journal of Obst. and Gyn. of Brit. Emp. Oct. 1905) reports a case in which delivery produced no alleviation of the symptoms. Both kidneys were exposed. The right was found considerably disorganised, its pelvis dilated to four or five times its natural size, and containing a large quantity of purulent fluid. The patient died on the morning after operation.

The following case also required nephrotomy after delivery. Further it is probably an instance of infection from the lower urinary tract by way of the lymphatic vessels in the wall of the ureter.

CASE VI.

Mrs. X. aged 24. Primipara.
First symptoms three months before term, haematuria, and severe pain in R. lumbar and inguinal regions.

Healthy woman, who, however, had suffered from chronic Cystitis of mild type for 7 years, due, in her doctor's opinion, to Gonorrhoea, but as the patient states that she passed a small calculus per urethram 7 years ago, nothing is certain save that there has been some disorder of the lower, and perhaps also of the higher urinary tract.

The earlier months of pregnancy were not remarkable in any way, except that constipation was severe and persistent.

Then pain became severe, and was increased by R. lateral decubitus. The dorsal position was the only one for comfort, and towards the eighth month only the semi-upright position could be tolerated.

A short time before labour commenced - one month before term - the urine became exceedingly foul, but no microscopical or bacteriological examination was made. Blood, but no pus, was detected until after labour.

The lochia was sweet from first to last.

On the 4th. day after parturition she was seized with severe pain in the left lumbar region. Temperature 99. Pulse 112.

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On examination the left kidney was felt enlarged; the right renal region rigid and tender.

The urine was extremely foul, contained a large amount of pus, and was acid in reaction. The pus contained, "Staphylococci," "Streptococci", and "Bacilli"; no Gonococci was observed.

A few days afterwards, the left kidney diminished and was no longer palpable. There was a considerable swelling of R. kidney, which was very tender. In view of the continuance of symptoms nephrotomy was advised.

The pus proved to be contained within a cavity beneath the kidney capsule. The pelvis was free, but the ureter was both thickened and dilated. The pus contained a bacillus which in its morphological characters, and staining reactions, resembled the B.Coli. No casts were present in the urine before operation.

The relief was immediate; the urine quickly cleared, and within a few days showed neither pus nor albumen. The constitutional symptoms abated.

Weiss. Gaussel-Ziegelmann, and others strongly advise the induction of labour, rather than nephrotomy, in the course of the pregnancy, and especially so, if the lesion be bilateral. Still more is it indicated if the child has reached the age of viability. A severe toxaemia entails grave risks to both mother/

mother and child. A continuance of the pregnancy will endanger the life of the mother and the chances of a living child will become steadily more remote.

The emptying of the uterus, spontaneous, or induced, is the one procedure which permits the kidney to return to its normal condition. Recovery is frequently very rapid. In some of the reported cases the urine became free of pus in the course of ten days or a fortnight. More frequently the improvement is slow, and sometimes the pyuria becomes chronic, and remains a very real source of danger in the event of subsequent pregnancy.

The general regime already indicated should be continued after delivery unless the general condition of the patient be such as to demand a more generous diet. This can be allowed with less hesitation after delivery. The kidneys are no longer impeded by the pressure of the uterus.

In Case 1. the patient only began to show any real improvement when a comparatively generous diet was allowed. In less than three months after delivery the urine was free from both pus and albumen.

The puerperium will obviously demand the strictest antiseptic precautions. Some observers advise the use of the catheter regularly for the first week, in order to avoid bathing the parts in septic urine. Catheterism is in itself objectionable, and, in spite of all precautions, frequently sets up cystitis. It was adopted without ill effects in Case 1. but it seemed/

seemed specially indicated as there was a bad rupture of the perinaeum. It is probably wiser to avoid the use of the catheter and depend rather on the free use of antiseptics.

PROGNOSIS.

It has already been indicated that most cases of Pyelonephritis in pregnancy have a favourable issue. Treatment may effect nothing more than an alleviation of the symptoms, and the progress of the case to full term; but delivery is usually followed by a steady recovery. Spalding has expressed the opinion that the outlook is in all cases very grave, but this opinion is not supported by the published records.

In a certain minority of cases the life of the patient is endangered. The pelvis of the kidney is for the time being an abscess cavity, and the prognosis will depend upon the ease or difficulty with which drainage is effected. Where the compression of the ureter is severe, the distension extends backwards into the calices and renal tubules; the lining epithelium is bathed in septic fluid and is subjected to a continued and unusual pressure. The effect is degeneration and shedding of the epithelial cells; which are often found in the urinary sediment. With the shedding of the epithelium of the tubules easy access is offered to the interstitial tissue of the kidney. The bacteria themselves may pass into the renal substance and lead to the formation of abscesses. This seems, however, to be a rare occurrence. More commonly some degree of interstitial nephritis is set up, probably as the result of the irritation caused by a solution of toxines. This element will considerably affect the prognosis. Should the/

the disease occur early in pregnancy, so that the kidney is for several months continuously subjected to the irritation of toxines, there is a possibility that after delivery chronic kidney disease may remain. The published cases have not been followed out for a sufficient length of time to show whether this is a frequent sequel.

Among the recorded cases which have been examined for the purposes of this theseis, there is no instance in which pyelonephritis was associated with puerperal eclampsia.

The prognosis for the child is, in the opinion of most observers, more serious than for the mother. There is a distinct risk of abortion occurring, and there is the further possibility that it may be necessary in the interests of the mother to induce labour. If labour proceed to term the child is further exposed to the risks incidental to artificial feeding; which will probably be necessitated by the mother's condition.

In Case 1. the child was well nourished at birth, weighing 8½ lbs. The prolonged restriction of the mother's diet to milk had no apparent evil effect on the nourishment of the child. The condition of the child's urine has already been described. Whether the catarrh which presumably existed in some part of the urinary tract was related in any way to the mother's condition it is not possible to determine. Abuminuria is not uncommon in newly born children. Some authors/

authors, (e.g., Edgar, Pract. of Obst.) even assert that it is found in 30% of all cases. Itseems to have no evil significance. It may continue for any period from a few days to two or three months.

The conclusions which seem to be warranted by an investigation of the cases here given, and of the literature are these:-

I. Pyelonephritis is a not infrequent complication of pregnancy.

II. In the majority of cases it occurs after the fifth month, but it may appear at an earlier period, and, on the other hand, may make its first appearance after delivery.

III. It is usually due to an invasion of the upper urinary tract by the B.Coli. In a minority of cases other organisms are implicated e.g. Staphylococci, Streptococci, Gonococci, etc.

IV. So far as infection by B. Coli is concerned, preceding constipation plays a large part in the causation of the disease.

V. The ureter and pelvis of the kidney may be infected.

1. From the blood.
2. From the lymphatics.
3. From the Lower urinary tract.

VI. The disease is usually confined to the right kidney occasionally/

occasionally it is bilateral; in a very few instances the left kidney alone is involved.

VII. The prognosis under treatment, is in most cases favourable but is rather less favourable for the child than for the mother.

VIII. The disease is apt to recur in successive pregnancies.

IX. A study of the disease illustrates the necessity for a careful study of the urine, especially by bacteriological methods in obscure cases.

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