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A CLINICAL STUDY

of the

ACUTE PYELITIS OF INFANTS.

submitted by

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with a discussion of the means of organismal infection of the urinary tract, and especially of the pelvis of the kidney.

ACUTE PYELITIS has received but scant treatment in the many text books on the diseases of children, and, in pediatric literature generally, little or nothing has been written regarding the subject until within comparatively recent years. In 1894, in the Archives of Pediatrics, there appeared, from the pen of Dr L. Emmett Holt of New York, a description of three cases of a distinctly unusual type, and these he classed under the heading of Acute Pyelitis of Infants. Since then, several cases have been reported in this country and in Germany, and the special form which this disease assumes; particularly in very young infants, has become well recognised. The purpose of this paper will be to collect, as far as possible, the cases so far published, and along with two cases, detailed notes/

notes of which the writer is able to furnish, to discuss the various signs and symptoms of the disease. In addition, it may be well to recall the main features regarding organismal infection of the urinary tract and especially of the pelvis of the kidney.

Pyelitis in children may be due to several causes. Calculi may be responsible for the disease in children as in adults, and congenital malformations have long been recognised as productive of similar results. Acute Pyelitis has been observed to occur as a sequel to cases of perinephritis, and most authorities mention pyelitis as an occasional complication of typhoid, typhus, diphtheria, and other exanthemata. It has also been reported as occurring in cases of malaria. Many cases of pyelitis have been noted in patients suffering from tuberculosis, and, in pyoemia, the pelvis of the kidney may, and often does, share in the general organismal poisoning. A tumour in the pelvis of the kidney may act as the determining factor of a pyelitis, and the condition has been known to arise, even/

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even in infants, as secondary to an acute cystitis, the inflammation travelling upwards by the ureter and perhaps involving it as well. These, however, are occurrences which have been long known and recognised by the profession; while the type of Acute Pyelitis to which I am about to refer seems to occupy the position of a primary disease. That the cases are sufficiently uncommon in their symptoms and general course, as well as in the ease with which, as a rule, they yield to treatment, can hardly be gainsaid.

DESCRIPTION OF A TYPICAL CASE.

A female child of nine months, who has been previously in the enjoyment of good health, is suddenly taken with serious illness. There is a history of fairly obstinate constipation, but this has been only an accentuation of the child's ordinary condition as to bowel movement. Without any warning of illness, she has a marked rigor, followed by high fever and suggesting the possibility of an attack of pneumonia. The child shows signs of marked distress and discomfort. This, however, varies according to the degree of temperature, and for a time she may appear/

appear to be free from restlessness and even quite at ease. The discomfort and misery soon return, to be succeeded again by a period of comparative restfulness. When not obviously distressed, the child feeds fairly well and shows no sign of nausea. The temperature may vary between 100° Fahr. and 106° ; and is usually at some part of the day up to or over 104° . The type of the temperature has somewhat the appearance on the chart of a case of typhoid fever.

On examining the child, one sees a well-developed, fairly nourished infant, flushed and showing obvious signs of distress. The temperature is raised, and the pulse quickened. The tongue is coated with fur to some extent, but is not particularly dry. The skin is hot, but slightly moist. The eyes may be normal in appearance at one moment, and may, shortly afterwards, show some degree of strabismus. The child does not lie in any one definite position, and, beyond its general objection to being disturbed, shows no sign of special discomfort anywhere. Pressure in the kidney region on either side, however, elicits signs of tenderness, which one may have difficulty in being sure of, owing to the general restlessness of the child. The heart and lung sounds are found to be normal. The spleen/

spleen is not enlarged. There is no sign of any lesion of the abdomen beyond the indefinite tenderness in the flanks, already mentioned. There may be no history of urinary irritation, and no sign of vulvitis or vaginitis can be made out. The limbs are healthy. There is no sign of bone or joint trouble, and the reflexes are normally present. This meagre supply of abnormal physical signs, coupled with a distinctly suspicious temperature, is decidedly alarming, and may be impossible of explanation for some time, owing to the difficulty of obtaining a specimen of urine for examination. On obtaining a specimen, however, one finds the reaction markedly acid, and, on testing with the usual reagents, a trace of albumen may be demonstrated. Under the microscope, there may be seen numerous pus corpuscles, and the field may swarm with rod-shaped organisms. There may also be noticed epithelium from the bladder, and from the pelvis and tubules of the kidney, with, occasionally, a hyaline or a granular cast. There is, as a rule, no sign of blood either chemically or microscopically.

HISTORY OF THE DISCOVERY OF THE DISEASE.

As has been already mentioned, this disease was /

was first described by Dr Holt of New York in a paper published in the Archives of Pediatrics in November, 1894. He had observed it first in a male child, fourteen months old, in the New York Infant Asylum. The previous history had been perfect except for a slight attack of diarrhœa, and the child had been nursed by his mother. The illness began suddenly with a temperature of 103.5° Fahr. The only abnormality found on examination was a slight stomatitis, followed next day by the appearance of a few râles in the chest. These did not develop further, but the temperature still continued high. Quinine was ordered to the extent of ten grams daily. This for a time seemed to prevent an excessive degree of temperature, and was persevered with; but four days later, the child was noticed to be markedly restless, and the urine was found to be scanty and of high colour. On examination it was found to contain pus, a deposit of an inch in depth appearing in a conical jar containing two ounces of urine. There was a small amount of albumen, and, by the microscope, pus cells and epithelial cells were seen, but no tube casts. Despite these symptoms, the patient did not convey the impression of being seriously ill.

The/

The temperature now settled, the pus gradually diminished in quantity, until, at the end of two months, it was shown to be absent. In this case, no casts were found. Twenty months later the child was reported to have had no recurrence of its illness. Here the malady ran its course, practically without treatment.

The second case was, however, more complicated. A female, eight months old, hand-fed from birth, had had no previous illnesses. While apparently in perfect health, the child was seized with a rigor, followed by a very high temperature. When Dr Holt saw the child, she had been ill for nine days, during the latter six of which the temperature had varied - according to the record preserved by the medical attendants - between 103° and 106° Fahr., and, on the last four days, it had, at some part of each day, reached 105° . This was practically the only symptom, although slight intestinal indigestion and slight, inconstant cough had been noticed. Pneumonia had been suspected, but, so far, no signs were present. Under the circumstances, a diagnosis had not been ventured upon. Quinine had had no effect, and baths were only of temporary benefit.

The/

The physical examination was absolutely negative. The child did not seem seriously ill, and, when the temperature was not extremely high, was bright, playful, and inclined for her food. Despite the absence of signs, the suspicion of pneumonia remained. A second examination on the following day was equally unavailing, but, on the third day, the examination of the urine - only now for the first time obtainable - showed a heavy deposit of pus with a trace of albumen. The reaction of the urine was markedly acid. Microscopically, the urine showed pus corpuscles and bladder epithelium, but no casts. There was no reason to suspect an attack of Bright's disease, and there was no sign of cystitis or vaginitis. Under treatment with Potassium Citrate in doses of two grams every two hours, the temperature gradually fell, and in four days had reached the normal line. Some renal cells and a few hyaline casts were found, but a large quantity of pus was still being excreted. The urine became markedly alkaline, and with the exception of a temporary rise of temperature, probably due to constipation, the recovery was uninterrupted. There had been no recurrence of the ailment when the child was heard of sixteen months later.

Case/

Case III occurred in a female, aged nine months. The illness was preceded by a mild attack of influenza, but, apart from this, the child had never been ill previously. In this case, the most outstanding feature was that the disease was ushered in by a very marked rigor. Dr Holt says of it that "it was as typical a chill as one ever sees in an adult." To the rigor there succeeded a temperature of 103° Fahr. Almost as remarkable as the rigor, however, was the sudden complete cessation of symptoms which almost immediately followed. The chill and consequent prostration were first observed at noon. By 7 p.m., the child was sleeping quietly, with a normal temperature and the appearance of perfect health. On the second and third days of the illness, the rigors recurred, and this although no abnormal physical signs could be obtained on the most careful examination. Quinine had been administered on the second day, although there was no periodicity in the rigors to denote a definite malarial attack. The temperature varied in degree considerably, and, during the periods of lowered temperature, the child laughed and played as usual, took its food well, and seemed quite normal. Suspicion was directed to the urine by the patient's showing some straining and signs of pain on micturition/

micturition. On the evening of the fourth day, a specimen was obtained. It was markedly acid, showed a large deposit of pus, and contained a trace of albumen. Quinine was now discontinued and Potassium Citrate given. This produced a much greater flow of urine, which was distinctly acid in reaction. The vesical irritation, however, had passed off. The temperature still fluctuated widely and the rigors were repeated on several occasions. Even when the urine had become neutral in reaction, the general condition remained almost unaltered. The urine contained, in addition to pus cells, renal and vesical epithelium and some fragments of casts. No Tubercle Bacilli were found.

To control the temperature, quinine was again resorted to along with Potassium Citrate. This seemed to prevent the previous wide variations of temperature, but did not otherwise affect the general state of matters. Gradually, however, the pus diminished, the temperature began to keep under 100° Fahr., the patient's general condition improved and, at the end of a fortnight, the chart recorded a normal temperature. Frequent careful examinations of/

of the abdomen had never revealed any tenderness or tumour of the kidneys. There was no splenic enlargement. The blood was not examined. Two trivial rises of temperature afterwards noted - one of them due to a slight sore throat - did not materially interfere with the progress of the case, which ultimately went on to a complete recovery. The urine, a month later, still contained some pus, but no lasts; and pus was still present three months after the beginning of the illness, although the child, as well as the urine, seemed otherwise perfectly normal. Four months later, the patient was reported to have been continuously free from urinary symptoms since the last note was made.

These three cases have been quoted somewhat fully, since they would appear to be of special importance from the unusual character of their symptoms and course. Holt claimed for them that they were without parallel in medical literature at the time of his publishing them, and this one must, I think, concede. That the disease should not have been described before is the more remarkable when one considers that, only a few years later, another observer published notes of several cases, remarking in/

in his communication that, "since reading Dr Holt's paper, he had met with the condition eight times; it could not, therefore, be rare." Despite this statement, however, not a great deal has been added to the subject in the twelve years that have elapsed, and, so far as a cause for the condition is concerned there has been much conjecture without any definite conclusion being arrived at.

CASES.

I. M.C., a female child, one year and eight months old, was admitted to the Royal Hospital for Sick Children, Edinburgh, on May 3rd, 1904. The history, obtained from the child's mother was as follows:-

The child was brought because of "queer nervous turns" from which she had been suffering during the preceding fortnight. The family history was satisfactory, except that two children had died in infancy from convulsions, and a third had suffered from rickets with tetany and laryngismus. The home surroundings were comparatively poor, but seemed to be fairly healthy.

The following notes were recorded regarding the patient's previous health. The mother's pregnancy/

pregnancy was normal, except that it ended at the eighth month for no reason that could be ascertained. The child was fed on peptogenic milk up to the age of thirteen months. She contracted whooping-cough when fourteen days old, but this did not interfere with normal development to any appreciable extent. The child cut her first incisors, walked, and began to speak at the usual times. There were never any fits, vomiting, or diarrhoea. Indeed, the bowels were always inclined to constipation. This at times was so marked as to cause some injury to the bowel, as was evidenced by the occasional presence of streaks of blood in the motions.

The present illness began fourteen days before admission, up to which time the child had been quite well. She was then noticed to be unusually nervous, was afraid to go down a step, and sat panting for breath sometimes for two hours on end. If turned quickly while being dressed, the child screamed, and there was also a history of night terrors. There had been no fits, no vomiting, and no crowing respiration. The appetite was good, but some difficulty of swallowing was said to be present. Four days before admission, it had been noticed that the child had a shiver. She was also said to be getting paler.

On/

On examination, the child's weight was found to be 23 pounds. She was well developed, but very pale. The fontanelle was practically closed and there was no facial irritability. The chest was well formed, although there was slight beading of the ribs. The abdomen was normal. Temperature 98.4, Pulse 140. Respirations 36. The child was cross, fretty, and resented even the slightest disturbance. The lungs, heart, digestion, and nervous system called for no special remark. The urine was noticed on account of its heavy deposit of urates. From this time, the temperature gradually rose, reaching 103° Fahr. two days after admission. Thereafter, it continued to swing widely, the variations showing no regularity either in degree or in periodicity. (See chart.) The chest gave no sign of disease, although, on the 9th May, that is, six days after admission, the blood showed a leucocytosis of 32,000 to the cubic millimetre. That night, the child was noticed to start up from sleep screaming. Still, no definite signs of any nerve lesion could be made out, and the fundus oculi was found on examination to be perfectly normal. A fortnight from the date of admission, the temperature was still very irregular although never above 103°/.

103° Fahr., and the leucocytosis had increased to 33,400. About a week later, a thorough examination of the urine was possible, and pus was found in considerable quantity. The reaction of the urine was markedly acid. A provisional diagnosis of Acute Pyelitis was made, and the patient was given ten grains of Potassium Citrate every four hours. The following day this dose was doubled, and, within forty-eight hours of the two-hourly dose being employed, the temperature sank to normal. From this date, the temperature remained normal with the exception of two slight rises which appeared to be due to constipation. The child gradually mended. Three weeks after the commencement of the treatment with Potassium Citrate, the urine was reported to be gradually clearing up, and the white blood corpuscles now numbered 15,000 to the cubic millimetre. Seven weeks from the date of admission, the child was dismissed cured, the urine being quite clear and having a neutral reaction. The patient was seen fifteen months later for a "rash" on the face. This proved to be an attack of chickenpox. The mother stated that, since leaving hospital, the child had been free from any symptoms of her former ailment, and had been in perfect health otherwise.

Case II. A.H., aged twelve years, when seen on July 28th, 1905, at about four o'clock afternoon, was in a semi-unconscious condition. Her mother gave the following history of the previous health and of the ailment.

The child was healthy during infancy, and, beyond whooping-cough and measles, had had no illnesses. Her surroundings and upbringing were perfect, and she had led practically a country, open-air life. On July 22nd, six days before the present attack, she had a headache and slight temperature, but these disappeared after an afternoon spent in bed. There had also been constipation, but the child had always been the subject of this to a more or less marked degree. On the 28th, she rose in the morning as usual, and seemed in perfectly good health. She took her breakfast with ordinary appetite. During the forenoon, she began to get slightly confused, as was evinced by her attempting to sing and producing the wrong words. At 11.30, a.m., she complained of "trembling all over," which her mother considered to be a shiver. This passed off, and, very shortly afterwards, she went upstairs and again, in conversation, became confused and stopped in the middle of a word. She then went off by herself, and was next found standing undressed in/

in her bedroom. She was put to bed, and, at 12.30, p.m., she had a fit. Her face became livid, the body was in a state of flexed rigidity, and the left side of the face twisted. She foamed at the mouth and bit her tongue. Cold was applied to the head, and she gradually quieted down into a state of unconsciousness. There had been three other fits, similar to the first, before I saw her at 4, p.m. on the 28th.

On examination, she was found to be in a semi-unconscious condition, the pupils were widely dilated, the body and limbs were flaccid, but, by that time, there had developed sufficient reflex activity to enable the child to draw her feet away from contact with a hot-water bottle. The breathing was regular and easy, and the chest presented no abnormal physical signs. The pulse was irregular and fairly quick. She was occasionally crying out, and tossed about in her bed as if suffering some degree of discomfort. The temperature was subnormal. There was no sign of disease in any of the abdominal organs, and the supposition was that the seizure was epileptic in nature. An enema of soap and water was given to relieve the bowels. There was no sign of scarring or abrasion in the neighbourhood of the anus, nor was there any indication of the presence of vulvitis or vaginitis/

vaginitis. The enema was returned immediately, and an attempt was, therefore, made to give a grain of calomel by the mouth.

During this time and because the consciousness showed no signs of returning, I inquired as to the passage of the urine. I had intended my question to apply to the immediate circumstances of the child, but the mother, misunderstanding my meaning, informed me that there had been some irritation in the bladder for the past fortnight. This occurred in the evening just after the child had been put to bed, and she rose sometimes three or four times during the first two hours of her bedtime in order to pass water, usually with no result whatever. The irritation did not trouble the child during the day, and the mother had come to think that she might merely be encouraging a bad habit in allowing the child to rise thus often. So far, the only indication of any abnormality to account for the nervous upset seemed to be in the urinary system. The child, however, had passed no water during or after the convulsive seizures.

By 5.30 p.m., she became conscious. The temperature was then 97° Fahr., and the heart still irregular. She was given another grain of calomel.

A specimen of the urine was now obtained - about one and a half ounces in amount. It was extremely/

extremely acid, and contained a trace of albumen and some sugar. On being allowed to stand, a large deposit of pus formed in the bottom of the glass, and some of the deposit, examined microscopically, was seen to consist of pus corpuscles, bacilli, debris of cells, and crystals of uric acid. No casts were seen, and the albumen was not in greater quantity than could have been accounted for by the pus present.

By 9 p.m. the patient had had some sleep, but complained of pain in the head. The temperature was 100.2° , and the pulse 106. She remained quiet till 11 p.m., at which time she was given some food. Shortly thereafter, she became restless, vomited, and the vomiting was followed by two fits similar in character to those seen in the afternoon. She was given some chloroform, and, as the fits passed off, she gradually regained consciousness. Keeping in view the condition of the urine, the child was ordered to have twenty grains of Potassium Citrate every four hours. She had a dose of the alkali on returning to consciousness, after which she went off to sleep and, for the remainder of the night rested fairly well.

When I saw her again at noon on the 29th
July/

July, she still looked restless and uncomfortable, but there had been no recurrence of the fits. The bowels had moved and the temperature was now 99.6° . The pulse rate was 92 per minute, and the beats were practically regular. Heart and lungs showed no sign of disease. Except for slight tenderness over both kidneys, there was no physical sign of any note in the abdomen. No specimen of the urine had been preserved, and it was impossible to obtain one at the time of my visit. Patient was very hungry but was being kept on milk only. She had no memory of the previous day whatever.

30th July. There had been some vomiting in the early part of the day. "The bowels are not moving satisfactorily, and the tongue is thickly coated." For this reason, some Rhubarb and Soda were prescribed. There was still pain on pressure over the kidney region, but this was now slight. The patient's general condition was much better, and the temperature had not gone above 99° during the past twenty-four hours. The urine was now neutral in reaction, and contained a large quantity of pus. It was teeming with rod-shaped organisms. There was a trace of albumen discoverable, but sugar could not be detected. A culture made from the urine revealed/

revealed a pure growth of *Bacillus Coli Communis*.

On the following day, the patient seemed to have regained her ordinary health. The temperature came to normal and remained so. The dosing with Potassium Citrate, of which twenty grains were being given every four hours, was reduced, and, during the next fortnight, the patient continued to take ten grains thrice daily. No untoward symptoms made their appearance, and, at the end of that time, the drug was discontinued, and the patient went away from home on holiday. Prior to her leaving home, an examination of the urine showed that it was faintly acid, that it still contained a small amount of pus, but the albumen had gone. In a cover-slip preparation of the centrifuged urine, no bacilli could be detected, even after the most careful scrutiny. The bowels were being opened daily.

She remained in good health until the 19th. September of the same year. On the evening of that date, and following - as was afterwards ascertained - on an attack of Constipation of unusual severity, a train of symptoms, in every way similar to those of the previous attack, occurred. The illness was ushered in by a marked rigor, and, in about half-an-hour, the child became the subject of a convulsive seizure/

seizure similar in character to those previously described. This was followed by a state of semi-unconsciousness, after which there were noted increased temperature, headache, and vomiting. The stools obtained by the Enemata were green and offensive, and showed signs of marked Constipation. The urine was again purulent, and contained, in addition to pus cells and organisms, much cellular debris. There was again a trace of albumen, but no tube casts.

The treatment adopted was as on the previous occasion. Under the administration of the alkali, the urinary trouble subsided; but, owing to the fact that the symptoms had recurred so soon after the original attack, it was deemed advisable to continue the treatment for some months, and a small dose of the drug was, therefore, administered daily for two months from the occurrence of the second illness. Special attention was also paid to the bowels, and, under this treatment, the patient maintained the best of health, and has had no attack up to the present time. At the end of the two months treatment, no trace of pus could be found in the urine/

urine, which was distinctly alkaline. At no time during the second attack had any urinary crystals been found in any of the specimens of urine examined.

Both of the cases described may, I think, be fairly classed under the heading of the Acute Pyelitis described by Holt. The first case was typical in every respect, in the age of the patient, the previous history of Constipation, the sudden onset accompanied by a rigor, the prolonged temperature, the condition of the urine, the lack of signs or symptoms of disease in any other organ, and the rapidity and completeness with which a cure was effected under treatment with Potassium Citrate.

In the second case, the main factors in the deciding of the diagnosis were the suddenness of the onset, the initial rigor, the previous Constipation, the condition of the urine, the rapid disappearance of symptoms under treatment with the alkali. The degree and the length of continuance of the fever in both attacks was far from typical, but it must be kept in view that one was, in this case as compared with the others recorded, unusually fortunate in being able to procure a specimen of urine at a very early/

early point in the course of the illness. The patient was, therefore, put under treatment for the urinary condition much sooner than in any of the cases where the prolonged temperature so typical of the disease has been recorded. The recurrence of the illness was probably due to carelessness regarding the bowels, and also, perhaps, to a too early cessation of the treatment after the first attack. It was interesting, however, in so far as it seemed to point to the fact that none of the signs or symptoms accompanying the first attack was merely accidental. The rigor was repeated at the onset of the second attack. The bowels and the urine had returned to practically the condition in which they were when the disease originally manifested itself. The absolute freedom from any further attack after the second one had subsided may also be taken as additional proof that the nervous condition was most probably the result of the urinary state. And, further, it will, I think, be allowed that the recurrence of the purulent and extremely acid urine immediately prior to the second attack tends to disprove any idea of the nervous condition being merely an idiopathic epileptic state having, as an accidental/

accidental concomitant, the urinary condition described in the notes. Is it not also highly probable that, had this been the onset of epilepsy, a further recurrence would ere now have taken place, and that too without the concomitants which in both the first and second attacks seemed necessary to the determining of the convulsive seizures? Still further, as against the hypothesis that these attacks were the first appearances of epilepsy, one may mention the absence of any previous history of convulsive seizures either in the patient or her relatives, or indeed of any neuropathic diathesis of any kind in the family history or of signs of nervous instability in the patient herself.

That the presence of vesical irritation would suggest the possibility of a cystitis one would willingly admit, were it not for the fact of its extremely sudden disappearance under treatment. Much more probable was it, I think, that the irritation was due, not to any actual inflammation in the bladder, but merely to the gradually increasing and, ultimately, extreme acidity of the urine.

The main points, however, in leading to the conclusion come to in this case, as in every case of acute/

acute pyelitis in children, were the typical onset, the urinary condition, and the rapid and complete cure under the use of the alkali.

It may now be well to pass on to a consideration of the recorded cases and the general literature regarding them with the view of ascertaining the probable aetiology of the disease as well as a more detailed idea of its symptomatology and termination.

I. AETIOLOGY.

(a) INCIDENCE. Regarding the incidence of the disease, it seems somewhat striking that its occurrence in hospital should be so rare. During the past four years, there has been only one case of Acute Pyelitis admitted to the wards of the Royal Hospital for Sick Children, Edinburgh. The same conditions seem to hold good with regard to the cases described by Holt in America. One of them occurred in the New York Infant Asylum, while the other two were seen in private, and their treatment continued in private. The same remark applies to the patients, notes of whose cases are given in the Archiv für Kinderheilkunde by Baginsky. His four cases he saw in consultation with medical men in private; at least/

least, so much may be gathered from the fact that he expresses his indebtedness to them for handing to him their continued observations of temperature. This then would seem to point to the fact that the disease is one which less commonly affects the children of the poorer classes, and this despite the extremely frequent occurrence among them of colon pyuria and colon cystitis. Whether this may be accounted for by any diathesis in the parents is a subject which will be referred to later under that heading.

(b) SEX. The almost absolute limitation of the disease in the matter of sex is a point of interest. Of the seventeen cases of the disease which I have been able to procure notes of, only one patient was a male, the other sixteen being girls. It is a curious coincidence that the only case which occurred in a boy should have been the one in which Holt's attention was originally drawn to the unusual complex of symptoms. The prevalence of the disease in the female sex to such a preponderating extent has led to the expression of an opinion regarding the most probable mode of infection of the urinary tract. This will be discussed when we come to consider the various ways in which the organisms can effect an entrance/

entrance.

(c) AGE. As can be seen from a comparison of the recorded cases, the age limit of the disease varies comparatively widely. The earliest age at which any case has been recorded is $7\frac{1}{2}$ months, while, in the second case which I have already given notes of, the patient was twelve years of age. The former age however, would seem a much nearer approximation to the average than the latter. The great majority of the cases occurred in children under the age of two years. Over that age there have been, at least, four cases put on record, while twelve are definitely known to have taken place in patients under two years of age, and, of these twelve, six were under one year. The seventeenth case is one of Baginsky's, and, although quite careful notes have been given, he has, unfortunately, omitted to mention the age of the patient. He states regarding her, however, that "mentally, so long as the patient was not feverish, she was bright, talkative, and attractive." It is safe to presume from this statement that the child was more likely to be over than under two years of age. We would thus have, out of a total of seventeen cases, twelve occurring in children under two years of age. That the cases described by Baginsky should/

should not have approached more closely the ordinary age of those described in America and in this country is curious. All the cases in which he definitely records the ages were about five years old.

(d) INJURY. No history of anything approaching severe injury has been given in any case, but in many of the patients, it was noted at the first time of examination that some abrasion was present in the neighbourhood of the Anus. As a possible source of infection, the condition is of interest. Nor is it surprising that evidence of injury should be present in this situation considering the almost universal history of constipation, and usually obstinate constipation, recorded in every case. Enemata, simple and medicated, and glycerine suppositories had been resorted to in many of the cases to keep the bowels in order, and the possibility of injuries of a minor sort being inflicted, either in the course of treatment or as the result of the constipation itself, can be very readily understood. In addition to these external excoriations, the likelihood of some abrasion of the mucous membrane of the bowel by the hardened faeces must not be overlooked. And, while on this subject, it should also be mentioned/

mentioned that the extreme acidity of the urine and the presence of crystals of uric acid and oxalates recorded in some of the cases might explain the manner in which the organisms could, after gaining an entrance to the urinary tract, readily infect the pelvis of the kidney. Of this, however more will have to be said later.

(e) PREVIOUS ILLNESS. As a predisposing cause, any illness likely to weaken the patient's resistance to the attack of the bacillus should not be lost sight of. In some of the cases, infantile scurvy had been noted, and, in one or two, an attack of influenza had been more or less immediately antecedent to the onset of the acute pyelitis. In some infants, the feeding had been far from ideal, and this may undoubtedly have helped towards the accentuation of the condition of constipation invariably noted, as well as partly explaining the presence of the crystals of oxalate and uric acid present in the urinary deposit at the beginning of the attacks in a few of the cases. Baginsky notes in his cases the presence of a mucous colitis, in one case particularly severe, as immediately preceding the onset of the temperature and the urinary disturbance. Severe chronic dyspepsia and rickets were noted in more than one/

one case, but in many of the patients the previous health had been absolutely unexceptionable. Regarding the susceptibility to recurrence, in one case already noted and in another of the recorded cases, there was a recrudescence of the symptoms, but this may, almost certainly, be put down to the fact that the treatment was stopped or, at least, less rigorously continued at a time when the condition of the bowel and of the urinary tract was far from normal. The recurrence of the disease at a time remote from the first attack, and especially if the treatment of the first attack has been persevered with for a prolonged period, is unknown, or has not been so far recorded in the literature of the subject. In none of the cases was there any indication of a stone in the pelvis of the kidney or in the bladder.

In view of the difficulty in differential diagnosis which arose in one of Holt's cases it might be well to add that it was in that particular patient alone that any question of malaria ever required to be discussed. No case recorded in this country had ever any possibility of a malarial origin, and the same statement applies to the four patients mentioned in Baginsky's article on the subject. So far/

far as is known it may, I think, be safely assumed that malaria plays no part in the typical case of Acute Pyelitis.

(f). DIATHESIS. In not a few of the cases, a family history of Gout was obtainable, and in more than one there was a marked history of rheumatism. Whether the former of these two conditions may go to any extent towards the explaining of the frequency of the disease among the children of the wealthier classes, it would be very difficult to say. Certainly, if a rheumatic parentage be in any way predisposing, the disease should give evidence of its presence as readily among the poorer classes as among the well to do.

II. SYMPTOMS AND PHYSICAL SIGNS.

The symptoms and physical signs had, perhaps, better be discussed in the order in which they usually made themselves apparent, as this will probably supply us with a more realistic picture of the disease. Thus, those symptoms and signs referable to the general condition of the patient will be discussed first, leaving the local signs and symptoms to be spoken of by themselves.

A. SYMPTOMS AND SIGNS OF GENERAL DISTURBANCE.

(1.) RIGOR. The importance of the rigor as leading towards/

towards a correct diagnosis can hardly be overestimated when one takes into consideration the common age at which Acute Pyelitis in this form manifests itself. Under the age of two years, rigors are extremely uncommon. Even in malaria at this time of life, patients are not so prone to exhibit the typical rigors that one sees in adults similarly afflicted. So pathognomonic of this disease is the rigor considered to be that Holt says of it, in describing its occurrence in the third of his recorded cases, "The lips and finger-nails were blue, and there was a distinct chatter to the teeth, with shivering of the entire body. It was as typical a chill as one ever sees in an adult." Dr John Thomson has made observations regarding the same point, and writes of it as follows:- "The occurrence of rigors in young infants with Acute Pyelitis is an interesting point. Their place at this age is generally taken by convulsions, or they may be represented merely by a slight coldness of the extremities. In most other circumstances in which an adult would take a rigor, a young infant does not do so, although he may perhaps have a convulsion. The cases here referred to (Art. Scott. Med. & Surg. Journal, July, 1902) are the only instances in which I can remember to have seen young children/

children who had rigors: and I have not been able to find an account of any case in which this symptom occurred in a child under two years, who had not malaria, without there being pus in the urine."

In 50% of the cases, this symptom is made note of. In one or two the occurrence was slight and was not repeated, a fact which may account for its not being more frequently recorded, since, in almost every instance in which it is referred to, the rigor was noticed by the medical man himself, and, if slight, might readily have been overlooked by the untrained observer. In three cases, however, the rigors were not only severe, but were repeated on several occasions during the attack. So severe and so repeated were they in Dr Holt's third case as to lead to a suspicion of malaria despite the lack of periodicity in their occurrence. In my second case, the rigors were two in number, but, although quite well marked on each occasion, they occurred, as already noted, during separate attacks.

(2). TEMPERATURE. The rigor is usually immediately succeeded by a rapid and well marked rise of temperature. Indeed even in the absence of a rigor sufficiently severe to call for remark, the temperature is too sudden in its onset and too pronounced to permit of/

of its passing unnoticed. Holt's second case was ushered in with a temperature of 104.6° Fahr., and his third case recorded, at his first visit, 103° of fever. Similarly, in the second of Dr Thomson's cases, the earliest temperature observation noted was 102.4° Fahr. Apart altogether from the degree of initial fever, much may be learned from the temperature chart of a typical case. The disease does not seem to be bound by any particular limits of periodicity regarding temperature. The length of time during which the fever lasts seems to depend only on one thing, and that the commencement and continuance of suitable treatment. True, Holt's first case was slight and seemed to recover without any definite course of treatment being pursued, and it may be that many similar cases have been observed which, for lack of better diagnosis, have been classed as due to some vague gastro-intestinal disturbance, or to the much maligned process of "teething". But given a fairly severe case, the temperature seems to run on, unrestricted by any typical course so far observed in the disease. The daily curve of the temperature conforms to that usually seen in febrile ailments in that the evening temperature usually reaches a higher degree than that recorded in the morning. But while this is the case/

case, there does not seem to be any typical degree of temperature for any special day or week of fever, and there is no appearance of any high level of temperature being maintained for a fixed period. Thus the temperature chart in Acute Pyelitis differs from that of Pneumonia or Typhoid; for while, as in the former, the thermometer registers a fairly equable level of temperature during the acute stage of the symptoms, and, in both, one may reasonably expect that the fever will, in a more or less definitely fixed time, wear itself out; in Acute Pyelitis, no such recognised features are present to render the temperature chart characteristic of the disease.

When rigors recur frequently, as in more than one of the recorded cases they did, malaria can be excluded from the diagnosis either by the lack of periodicity in the recurrence of the chills, or by the fact that the patient has never been in any malaria-infected region, or by both of these factors combined.

One further remark may be made while one is referring to the subject of temperature. The remarkable disappearance of the fever under treatment with alkalies is one of the most interesting features of the disease. Under fairly large doses of, let us say, /

say, Potassium Citrate, one may almost absolutely predict a normal temperature within forty eight hours, the previous duration of the symptoms or the degree of their severity notwithstanding.

(3) NERVOUS SYMPTOMS.

(a) Fits. These have not been commonly recorded, and, so far as I have been able to find, in the literature there is no reference to anything approaching a regular convulsive seizure. My second case would therefore seem to be unique in this respect, and it is for that reason that the possibility of epilepsy in the differential diagnosis has already been referred to at some length. Squinting has been noted in two cases, but there the nervous symptoms seemed to cease. Some of the patients appeared to have become delirious, but no exact details of this symptom have been given beyond a general reference to the fact. In the first case of which I have given notes, the previous history seemed to point to the child's trouble having begun with nervous symptoms. Thus, the mother noticed that the child was afraid to go down a step, screamed on slight provocation, had what would appear to be attacks of dyspnoea, evidently nervous in origin, and also suffered from night terrors. Never at any time, however, had there been a/
a/

a convulsion.

(b) Restlessness and Distress. The obvious misery of the patient during the continuance of the high temperature, her freedom from distress and, indeed, appearance of general comfort and almost of normal health on the temporary decrease of the fever, and the repeated alternation of these states are worthy of note. This seems to be one of the most uniformly observable characteristics of the disease. So much is this feature in evidence and so closely do the alternations of misery and apparent well-being follow the variations in the temperature that, except for the registration of the exact degree of fever, one hardly need depend on the thermometer to demonstrate the actual presence of pyrexia.

(c) General Tenderness. This can hardly be considered a distinctive feature of the disease, as one so often meets with it in children, and, in fact, the presence of this symptom has been noted in many cases in which children are the subjects of a prolonged feverish attack. It has been, however, fairly constantly noted in the recorded cases, and is, therefore, worthy of mention.

(d) Kidney Tenderness. The pain which one elicits on pressure in the region of the kidneys is more distinctive/

distinctive of Acute Pyelitis, but is not always a reliable sign. In many instances, it is quite impossible to distinguish a special tenderness in this region as apart from the general tenderness and irritability of the patient on the slightest interference. In my second case, however, there was a distinct degree of pain on pressure over the kidneys, and this was the more easy to distinguish from the fact of its remaining for some little time after the acute symptoms had passed off. In addition to that, the patient being older than the average for those cases, was able to give verbal expression as to her feelings when the region in question was specially examined.

(4) DIGESTIVE SYMPTOMS. There is practically no gastric disturbance at any time during the disease. In one or two cases, vomiting has been noted, but mainly at the onset of the ailment and then it was never by any means an urgent symptom. Holt, in one case, remarks a slight amount of indigestion as evidenced by the passage of an occasional green stool. When the temperature is at its height, food is refused; but, with a return to a lower range of fever, the appetite reappears, and the proof of the stomach's continuing to perform its function fairly well throughout/

throughout an attack of Acute Pyelitis is to be found in the fact that, even after prolonged illness, the patients do not show any great degree of emaciation. Much more important is the almost universal history of constipation which one elicits in these cases, and the tendency to constipation persists during the attack and even after the child is quite well. In almost every case recorded, some slight rise of temperature, after the main fever curve had reached the normal and remained there, it may be, for several days, was usually noted as a result of constipation and disappeared immediately purgation had been resorted to. In one of Baginsky's cases, there was a severe colitis with excretion of large shreds of membranous-looking substance, fibrinous in nature. The faeces in this case were noted to consist of hard, nodular masses.

(5) SYMPTOMS REFERABLE TO THE CIRCULATION. There is nothing especial to note here, beyond what would be expected from the degree of temperature. The pulse varies with the fever, and may reach to 130 or 140 beats per minute while the temperature is at its height. There may be, as in the second case I have given notes of, some irregularity of the heart; but, since/

since no mention of any special heart symptoms is made in any of the other cases, it would be unreasonable to assume that this irregularity had any direct connection with the illness.

(6) SYMPTOMS REFERABLE TO THE HÆMOPOIETIC SYSTEM.

Almost no account has been given of the blood changes in Acute Pyelitis by any of the authors on this subject. So far as I am aware, the only observations recorded are those in the first case here quoted. In it, a leucocytosis of 33,400 was found, when the disease was at its most virulent stage. The next count, made when the temperature had been continuously normal for more than a fortnight, still gave 15,000 leucocytes to the c.m.m. This was the last blood count recorded. It would, of course, be unwise to draw too detailed conclusions from such limited observations, but one can, at least, allow that such a marked leucocytosis, if it be the rule in these cases, bespeaks a fairly severe toxæmia. That the count should still be as large as 15,000 at the end of seventeen days after the cessation of the fever would seem to point to its being uninfluenced by the changing phases of the disease as shown in the course of the temperature curve, and in the ever-varying appearance of the child during the acute stage of the/

the illness. There has been no record of splenic enlargement in any of the cases, and the glands, so far as could be examined, showed no abnormality on any occasion.

(7) RESPIRATORY SYMPTOMS. The main interest attaching to the respiratory system consists in the fact that undue prominence may be given to even the slightest symptoms referable to it in the early stages of the disease. The temperature - a sufficient cause for which it will baffle even the most careful observer to find in the absence of a large enough quantity of urine for the purpose of examination - certainly tends to the fostering of the idea that a pneumonia is developing. The lack of signs in the chest would not reassure one as to the absence of pneumonia, since one must always keep in mind the frequency with which physical signs remain undeveloped in cases of that disease among the young. And even when five or six days have elapsed and no appearances of inflammation of the lung have been made out, the diagnosis may still lean in that direction. In a few of the recorded cases of Acute Pyelitis, some râles, especially at the bases of the lungs, have been noted, and it may be recalled in one of Holt's cases that this led to the most careful observation of/

of the chest, until the matter was set at rest by the examination of the urine.

The rate of respiration varies greatly according as the child shows signs of restlessness and discomfort or is in a state of comparative ease. In the former case, the number of respirations and their type may well lead to a suspicion of pneumonia, as occurred in Holt's second case when he says, "The continuance of high temperature and accelerated breathing lead me to suspect pneumonia, notwithstanding the absence of all physical signs"; while, under the latter circumstances, breathing may be as deliberate and easy as in normal health.

B. LOCAL SYMPTOMS AND SIGNS.

(1) URINARY IRRITATION. In a few of the cases, there have been recorded some slight signs of urinary irritation, but, even in those cases, it was so slight and transient as almost to pass unnoticed. Some increased frequency of micturition, particularly at bed time, as well as nocturnal enuresis in one or two of the older children affected, has been noted. Others showed signs of uneasiness during urination or even of slight pain. These symptoms, however, may be entirely absent, and, subjectively, the urinary system/

system may be devoid of any abnormality whatever. Screaming has been recorded in many of the cases, and the suspicion of colic as a cause of this symptom has been suggested by one writer. Whether this may not be due to the general tenderness referred to earlier in this paper is a question, but certainly, in the first of the two cases I have given notes of, the screaming did not seem to be other than that associated with general movement of the child as in dressing. Tenderness on palpation of the kidney region has already been referred to under the examination of the abdomen.

A feature remarked in many of the cases was the presence of excoriations in the region of the anus. Mention has already been made of this symptom and its significance, however, under the heading of aetiology, and it, therefore, calls for no further remark here. In a few cases, there seemed to be some soreness and redness of the vulva. This is, however, the exception rather than the rule. Indeed, it is worthy of note with what regularity one reads in the cases that no sign of disease was to be found in the vulva or vagina, despite the presence of the urinary infection. This does not apply only to Acute Pyelitis, but is an outstanding feature of the ordinary colonecystitis/

coloncystitis of children.

(2) CONDITION OF THE URINE.

(a) Quantity. As has been already mentioned, it is not easy to give in any one case a systematic daily record of the urine. The common age at which the disease occurs renders it, as a rule, difficult to obtain any specimen at all, and, even when a specimen is procurable, it is often quite insufficient for anything like a thorough and detailed examination. Since difficulty is experienced in the preserving of one sample, it can readily be appreciated that anything like an exact measurement of the daily quantity is quite out of the question. The amount, however, does not seem to deviate greatly from the normal, and the essential features are sufficiently striking to be obvious in even a small specimen.

(b) Colour. The colour of the urine is usually somewhat darker than normal. This is to be expected considering that, at least, a certain degree of concentration will necessarily accompany the fever with which the disease is associated. Beyond this, there is nothing distinctive to be noted unless the urine be seen when recently passed and pus be in such amount as to render it turbid or milky in appearance.

(c) The smell of the urine is of interest since one might/

might quite reasonably expect a foetid or ammoniacal odour accompanying the large deposit of pus. Such, however, is not the case, the odour being of the ordinary aromatic type common to all acid urines. In one case, a foetid odour was detected at the commencement of the symptoms, but no note has been made in that instance as to any special cause for the condition. The odour evidently passed off quickly under treatment.

(d) Reaction. In every case, the urine was found to be acid, and in almost all a marked degree of acidity was recorded. This was evidently judged of only by the effect produced on litmus paper when moistened in the urine. It is worthy of consideration whether the slight symptoms of urinary irritation associated with some of the cases of Acute Pyelitis might not be explained by the hyperacidity. It is a fact that a degree of urinary irritation compatible with the presence of cystitis has often led to a mistaken diagnosis. Thus, Dr Thomas R. Brown of Baltimore, in a paper on "Cystitis, Pyelitis, and Pyelonephritis in Women", published in the New York Medical Journal for August, 1901, says:- "I have seen, during the past two years, nine cases which had been diagnosed by/

by the attending physician as cystitis, but which I found were not associated with any infection, and in which a careful determination of the reaction of the urine showed that the condition was due to its marked hyperacidity." That much of the importance of this disease depends upon the extreme degree of acidity present in the urine may be reasonably inferred from the prompt relief from the symptoms procured by the use of alkalies, and this despite the continued presence of pus and bacteria in the excretion. No facts regarding the quantitative estimation of the acidity are, however, available.

(e) Specific Gravity. As could be expected from the remarks already made on the difficulty of obtaining specimens of urine at all, the specific gravity is practically never recorded in any of the cases which occurred in infants. That it would be low, one might be led to expect from the frequency with which a low specific gravity has been recorded in ordinary pyelitis in adults. This was actually noted in the second of my cases, but is not to be held as of much import, since there was very little temperature and the alkali would tend, along with the large quantities of fluid which the child was encouraged to consume, to/

to produce a very dilute urine. No observation of specific gravity is recorded in any of Baginsky's cases, despite the fact that most, if not all, of them would present little difficulty in the procuring of sufficient samples of urine for the purpose.

(f) Deposit.

I. NAKED-EYE CHARACTERS. The outstanding feature of the deposit as seen by the naked eye is, of course, the presence of pus. When the urine has been allowed to settle, the amount of pus even in a small specimen may be astonishingly large. Holt found as much as an inch of deposit in one specimen of two ounces of urine, and, in another sample from a different case, he refers to the pus as forming one-fifth of the entire volume of urine. Other characters of the deposit are entirely obscured by the presence of this large quantity of pus, even should there be sufficient uric acid or urates to present a typical appearance. Other writers, in speaking of the quantity of pus, refer to it as rendering the urine turbid or even milky in appearance, and Baginsky speaks of a newly-passed specimen as "turbid and flocculent urine."

II. MICROSCOPIC CHARACTERS.

(1) URINARY CRYSTALS. Some interest naturally attaches to the condition of the urine immediately prior/

prior to the onset of an attack of Acute Pyelitis, for, as has been already mentioned, the presence of crystals of uric acid or oxalate might have a certain oetiological importance in the disease. The only reference to this point has been made by Dr John Thomson, when he says that at least two of his cases were known to have passed large quantities of uric acid and oxalates shortly before the symptoms of Acute Pyelitis began. The only other remark as to previous condition of urine has been made by Baginsky, and is to the effect that, in his second case, the doctors in attendance had certified the urine as being perfectly normal prior to his visiting the child. Crystals have, however, been recorded as present in some of the cases during the attack. In one of Baginsky's cases, uric acid formed quite a large part of the deposit, and, in both of the cases of which notes have been given here, uric acid was found on microscopic examination. Considering the commonly noted state of constipation in which these patients are, it is not surprising that both uric acid and oxalates should be found in the urine. Nothing, however, in any way approaching to a condition of calculus has ever been recorded.

(2) EPITHELIAL CELLS AND CASTS. Cells derived from all/

all parts of the urinary tract have been found in the urine in these cases. Bladder and pelvis epithelium have been noted, and, in some cases, renal cells have been described as appearing in the deposit. Casts also are mentioned as being present. Holt speaks of hyaline, granular, epithelial, and blood casts in his cases, and Baginsky in all of his cases found casts present although in only one does he condescend on the type and then it is recorded as granular.

Thomson did not find any tube-casts in his cases, but admits that the scanty nature of the specimens obtained may have rendered their detection more difficult. In neither of the cases here recorded were casts found, although careful examinations were made on many occasions.

(3) BLOOD has been noted in one of Holt's cases, but its presence is not definitely explained unless by the severity of the inflammation. Thomson has also recorded a case in which blood cells were found in the urine, but here there was a previous history of infantile scurvy from which the patient had not fully recovered when the symptoms of Acute Pyelitis supervened.

(4) PUS/

(4) PUS CELLS. The outstanding feature of the deposit, microscopically as well as macroscopically, is the large number of pus cells. In any ordinary case of the disease, the field is seen to be crowded with them in all stages of disintegration. Mixed with them one sees, here and there, collections of amorphous urates and debris of all kinds, but everywhere the pus cells predominate.

(5) BACTERIA. Striking, also, on account of their constant presence and numbers, are the organisms seen in any single field. They are rod-shaped and are usually seen moving about rapidly under the microscope. In culture, they give a pure growth of *Bacillus Coli Communis*. This is an absolutely constant feature in all the recorded cases, for in them all careful cultivations have been made with the most uniform results. As to the causal relationship existing between the *Bacillus Coli* and the disease of Acute Pyelitis, something will be said at a later stage of the discussion of the ailment.

(g) Albumen. In all cases of Acute Pyelitis, albumen has been found in the urine. Rarely has it been more in amount than a trace, and, in every/

every case, the remark has been made that the albumen was not more than could be accounted for by the large quantity of pus present. Rosenfeld, quoted by Dr Brown of Baltimore in his paper on "Cystitis and Pyelitis", states that, while in the severest cases of Cystitis the amount of albumen is never over 0.1 per cent, in Pyelitis it is often 0.3 or even more. No record, however, is available of any exact estimation of the amount of albumen present in any one case. Its rapid disappearance on the diminution in amount of the pus is, possibly, the best proof of the unimportance of its presence.

(h) Blood has already been referred to under the heading of urinary deposit (f,II,3). Its presence in cases where such was recorded would be as readily revealed by the ordinary chemical tests.

(i) Sugar: Only in one case, the second here recorded, has sugar been noted in the urine, and in that case its presence was very temporary. In the literature, it is not stated as having been looked for, but it is not likely that such an abnormality would have been missed, had it been of any duration or/

or importance. The probability is that its presence in the case recorded was merely an accidental occurrence.

III. DIAGNOSIS.

The main points in the diagnosis have been referred to fully in the description of the disease; it is necessary here only to tabulate them, referring at greater length to the differential diagnosis.

The main features are as follow:-

- (1). The rapidity of the onset of the disease, accompanied by a usually well-marked rigor.
- (2). The establishment of a high degree of temperature, and its continuance for a prolonged period with irregular intermittences.
- (3). The lack of any physical signs in the heart, lungs, abdomen, or nervous system to account for the fever.
- (4). The varying state of the patient, ranging, as already remarked, from extreme discomfort and/

and even signs of acute pain to a condition in which the child would appear to be in almost normal health. The coincidence of higher and lower degrees of temperature in association with the varying state of the patient is also worthy of note.

(5). The previous and present condition of the bowels in all cases is also of importance, a long history of constipation being usually elicited.

(6). The condition of the urine is, of course, the outstanding point in the diagnosis, the presence of a large quantity of pus and of the *Bacillus Coli Communis* in pure culture being practically pathognomonic of the disease.

(7). The striking ease with which the symptoms can be combated and normal health restored under suitable treatment with large doses of alkali may also be considered an aid to diagnosis, since the cause of the symptoms may only be arrived at, in the first instance, by a process of exclusion owing to a suitable specimen of urine being unobtainable at the earlier examinations of the patient.

IV. DIFFERENTIAL DIAGNOSIS.

AS regards the differential diagnosis, one has to keep in mind the possibility, in the earlier stages of the disease, that the patient may be developing an attack of pneumonia. Typhoid fever may also be suggested by the continued and, for some time, unexplained temperature. Paratyphoid fever and meningitis would also have to be discussed. Malaria and epilepsy have already been fairly fully referred to, and need only be mentioned again here.

(1). PNEUMONIA. The early symptoms of slight gastro-intestinal disturbance with some pain referred to the abdomen, the increased temperature, pulse rate, and respiration rate, and the possible presence of a few rales in the chest, unaccompanied, however, by any dulness, would quite naturally give rise to a suspicion of pneumonia. This opinion would be combated by the fact that no further evidence of the disease would be found in the lungs as time passed, that the pulse and respirations did not maintain a continuous and typical relationship as in any ordinary pneumonia, that the usual appearance of a pneumonia was absent from the patient's face, and that, periodically, the temperature was subject to remissions/

inflammation of remissions of a quite unusual nature for a case of the lungs. The urinary condition would be unlikely to escape notice so long as to allow for the usual time of occurrence of a crisis; but, should this actually be the case, the absence of a crisis coupled with the absence of physical signs of consolidation would point to the necessity of searching for some other possible cause.

(2). TYPHOID FEVER. It would be under just such circumstances as those now mentioned that one would be led to the opinion that typhoid fever was a likely cause for the symptoms. The absence of any of the complications of typhoid usually associated with the second or third weeks of the fever might attract attention. The marked constipation, the absence of any distension of the abdomen, the normal percussion area proving that the spleen was not enlarged, would suggest doubts, however, of the existence of typhoid. Further, the fact that negative results would be got from repeated widal tests would tend to rule typhoid practically out of court.

(3)/

(3). PARATYPHOID FEVER. I have been led to mention the question of paratyphoid fever, since my attention was directed to a paper published on this subject by Dr Edmund Cautley in the British Journal of Children's Diseases for June, 1905. He there records a case of a child, four months old, who suffered from fever and abdominal pain of one week's duration. The temperature chart was that of mild typhoid fever, but no positive result was got with Widal. Despite the fact that no special bacteriological tests were adopted, he claims this as a paracolon infection. There were pus cells and many motile bacilli in the urine. The fever subsided without special treatment. In his comments on the cases quoted, he very rightly remarks of this one that "the association of bacilluria and pus cells is of interest and importance." He adds that "the suspicion arises that perhaps some of the cases of Acute Pyelitis in infants are really cases of paratyphoid fever" While not seeking to suggest that DrCautley's suspicion may not be a reasonable one, it might have been well in this case had opinion of its nature been based on a more thorough bacteriological research, and, even if only for purposes of diagnosis, the administration/

administration of an alkali might have led to an earlier disappearance of the fever and other symptoms, and, possibly, to a more absolute clearing up of the case.

(4). MENINGITIS. The possibility of meningitis might come under discussion, especially if the attack were ushered in by fits or squinting or other evidence of nervous involvement. The continuance of the case, however, without the supervention of any further nervous symptoms would quickly lead to the exclusion of meningitis from the diagnosis.

V. PROGNOSIS.

However distressing the attack may be to the friends of the patient, however apparently uncomfortable the symptoms to the sufferer, and however puzzling the condition to the physician prior to the establishment of the diagnosis, once that has been accomplished, there can be little doubt as to the prognosis. Under the very simplest of treatment and usually within a comparatively short space of time, an improvement may be looked for, and the chances of ultimate recovery are of the very best possible kind. There/

There has been no record of any fatal case, and, in the one patient, known to have suffered from the disease, who died some months later from other causes, no sign of abnormality in the urinary tract could be made out, and there was certainly no recurrence of pyelitis. It is right, however, that the prognosis should be guarded on one point, namely, the clearing away of the pyuria. Although a definite improvement in this respect will follow more or less immediately on the adoption of suitable treatment, it may be months before the urine again becomes absolutely clear. The longest record of such a case was one in which there was still a trace of pus to be made out with the microscope six months after the onset of the disease, and that despite the fact that there was never any recurrence of the acute symptoms. The child does not seem to be any the worse of the small amount of pus present, however, and is in all other respects perfectly healthy. The prognosis may thus be said to be a particularly good one.

VI. TREATMENT.

Various methods have been used by the different writers on Acute Pyelitis, but that which seems fraught with best results is a plan of treatment based on the probable causes of the disease. Two outstanding features have been noted in the disease, namely, the marked constipation and the extreme acidity of the urine; and the most successful treatment so far has been that which keeps those main points in view, due attention, however, being paid to the dieting and general health of the child.

The rigor with which the attack is initiated calls for the routine treatment of that symptom, regarding which it is unnecessary to enter into details.

Obviously, the patient must be kept in bed, comfortably warm, and fed on a simple and easily assimilable diet. In most cases, considering the age of the child, some preparation of milk will be called for; but, if the child be beyond the age of suckling or hand-feeding, the food should consist entirely of milk. To relieve the thirst consequent on the temperature, as well as to flush out the urinary apparatus, it is well to encourage the child to consume large/

large quantities of fluid of a bland nature. Thus, barley water, either plain or, preferably, flavoured with lemon juice, lemonade, plain cold water, or similar drinks may be given freely.

Medicinal treatment would be limited to the giving of purgative and alkaline diuretic drugs. Thus it would be well to begin with a good dose of Castor Oil, with the object of clearing the bowels thoroughly. When this has been accomplished, mild aperients, such as magnesia in one or other form, should be resorted to in order to prevent any such severe constipation as existed when the illness first manifested itself. It cannot be too carefully borne in mind that anything approaching to a costive state of the bowels is, for these patients, a most dangerous condition.

The other department of the disease calling for drug treatment is the urinary tract, and here the task set the physician is usually comparatively simple. Difficult almost to impossibility as it sometimes is to render an alkaline urine acid, it may be said, generally speaking, that the rendering of an acid urine alkaline is a fairly easy matter. For this purpose, in this country and in America, the usual/

usual drug employed in the cases of Acute Pyelitis has been Potassium Citrate. The dose, of necessity, varies with the age of the patient, but, practically, the drug may be used without fear of inconvenient symptoms arising except in one respect. One has occasionally seen vomiting follow the administration of large doses of the drug, and that this was due to the Potassium Citrate was borne out by the fact that the symptom disappeared on the discontinuance of the drug or the diminution of the dose. Apart from this somewhat exceptional occurrence, the drug may be pushed freely, and, in the great majority of cases, a very rapid change is noticed in the urinary symptoms. The first mark of improvement is seen in the disappearance of the urinary irritation in those cases in which this symptom was present. The occurrence is of interest as testifying to the probability that the urinary irritation was more a result of the extreme acidity of the urine than of any actual cystitis. Indeed, it is but an added proof of the absence of a condition, doubts of whose existence were suggested by the very small degree of irritation noticeable from the outset. This disappearance of local symptoms is coincident with a marked decrease in the degree of acidity of the urine. By the end of forty-eight hours, or in less time if the drug has been freely/

freely administered, the urine may be found to be neutral or even alkaline. The effect of this on the general symptoms is also well marked. The temperature gradually comes to normal as the urine approaches in reaction to the alkaline, and a continuance of the drug, implying an increase in urinary alkalinity, ensures, practically, an uninterrupted convalescence.

One exception to this statement may be found in the reappearance of temperature should the bowels be allowed to go unattended to for even a comparatively short time. When exactly one may cease the administration of the alkali is a point of some difficulty to pronounce upon. After a period of two or three weeks from the cessation of the fever, during which time the urine has been continuously alkaline in reaction, it may be deemed safe to discontinue the use of the drug; but, even then, the friends of the patient must be seriously enjoined regarding the care with which bowel movement must be seen to, since much more will depend upon the reappearance of constipation than on any recurrence of acidity of the urine, which must sooner or later take place normally. Indeed, the necessary thing for the parents to remember is that, while a slightly acid urine/

urine is always classified as a normal condition, a constipated bowel never can be included in that category.

MODES OF ENTRANCE OF ORGANISMS
to the
URINARY TRACT.

Much discussion has been indulged in by many writers on the subject of infection of the urinary tract, but all are agreed that this may be produced in three ways, namely by the blood stream, by the lymphatics, and by the urethra. In connection with each and all of these, much experimentation has been carried out, and many observations have been made both in man and in animals. To collect some of this information, and, if possible, to apply it to the case of Acute Pyelitis will be the object of the following remarks.

More than one observer has put it on record that organisms can be excreted in the urine, and that without damage to the urinary tract. Cohnheim has found organisms in the uriniferous tubules, and remarks that "it is certain that they can be excreted from the blood". In favour of this, he cites the case/

case of animals suffering from splenic fever. Adami believes that "a function of the kidney parenchyma is to remove bacteria circulating in the systemic circulation". Sampson has injected the *Bacillus Coli Communis* into the jugular vein, and has afterwards found it in the urine, while the kidneys and bladder remained absolutely normal. He further experimented on the kidney and its pelvis by injecting organisms into the circulation, having previously tied one ureter. This, he found, produced an infection on the side of the tied ureter. Such an experiment is of interest in view of Rovsing's opinion, quoted by Morris, that the *Bacillus Coli* has only very slight power in attacking the mucous membrane of any part of the urinary tract. He considers that infection with *Bacillus Coli* is always secondary to some slight injury of the renal pelvis.

Posner and Lewin, and Wreden have experimented on the subject of the infection of the urinary tract from the intestine. The two former produced an artificial obstruction by occlusion of the rectum and found the *Bacillus Coli* in the urine within twenty-four hours. The latter produced injuries of the rectum in dogs, and thereafter watched the urine for the/

the appearance of intestinal organisms. He found in every case that organisms appeared in the bladder provided the injury to the rectal mucous membrane was at or above the level of the prostate. As has been pointed out, however, by another observer, Wreden's opinion, that the infection was carried directly through the recto-vesical tissue, is somewhat vitiated by the fact that no examination of the blood was made in any of his cases.

What strikes one in considering these three observations is that they seem to fit in most remarkably with much that has been noted in the Acute Pyelitis of Infants. Rovsing presupposes the occurrence of a slight injury to the renal pelvis. There has been noted, early in many cases of Acute Pyelitis the presence of urinary crystals, and one could readily allow that these would produce much irritation in a renal pelvis already rendered abnormal to some extent by an extremely acid urine, the result, in most cases, of injudicious feeding. An artificial obstruction of short duration, as produced by Posner and Lewin, finds its counterpart in the persistent and severe constipation of a typical Acute Pyelitis. Again, the presence of hardened masses of faeces in the/

the bowel can readily explain injury to the mucous membrane of the intestine, similar in nature to that produced experimentally by Wreden. Thus, all the conditions necessary for the production of an infection of the pelvis of the kidney are present in any ordinary case of Acute Pyelitis. That the Bacillus Coli can find its way into the blood from the bowel when any abnormality of the intestinal mucous membrane is present has been demonstrated in the case of children suffering from enteritis.

In favour of the opinion that the disease is also producible by means of lymphatic infection, much importance has been placed on the observation, in many cases of Acute Pyelitis, of the presence of injuries and excoriations of the anal mucous membrane. That such would be a possible source of infection cannot be denied, but it is interesting in this connection to note Wreden's opinion. In his experiments on dogs with the view of infecting the urinary tract by injury to the mucous membrane of the bowel, he found that injuries to the mucous membrane in the region of the anus itself, even when frequently repeated, had no influence on the urine whatever. Although one cannot draw any definite conclusions for the/

the human subject from such experiments as those which Wreden reports, the point is still worthy of notice, since the suggested importance of the anal excoriations in children suffering from Acute Pyelitis is, after all, merely conjectural. The question of Acute Pyelitis resulting from an infection produced from the bladder through the lymphatics need not be considered here, since one can say in every case, practically without hesitation, that no cystitis was present.

The last possibility to be considered is that of the mechanical immigration of organisms from the bowel to the urinary tract by the urethra. The introduction of bacteria into the bladder and their spread in that viscus and from it to the upper portions of the urinary apparatus is a commonly recognised occurrence. Such is the course of affairs in the condition familiarly spoken of as "surgical kidney". Here, however, one has already to deal with a much damaged set of organs, as well as with a definite source of infection in the shape of a questionably organism-free urethra and, perhaps, also a questionably aseptic catheter. The usual argument put forward, however, in the case of Acute Pyelitis is/

is that the infection is carried from the bowel to the urethra, and that without any active interference such as instrumentation. That infection could occur in this way is not denied, but the likelihood of the pelvis of the kidney becoming involved is open to serious question when one considers the very adverse circumstances under which the organism has to find its way so far up the urinary tract. Every fresh flow of urine from the bladder would tend to the expulsion of the organisms from that viscus. A similar remark applies to the ureters, where the constant jetting of fluid downwards into the bladder would minimise the chances of the bacillus ever reaching the pelvis. The fact, however, remains that almost always the disease has been recorded in the female, and that some anatomical peculiarity may be at work in the production of this very one-sided distribution of the ailment must be conceded. The majority of writers on the subject certainly favour the mode of infection by the urethra as being probably the most frequent, while those who give no definite opinion on the matter are, at least, forced to admit the possibility of such an occurrence.

Whichever be the actual pathway taken by
the/

the organisms, however, it must be allowed that all three methods are possible; and, while care must be exercised as to external cleanliness, the importance of attending to the bowels and thus avoiding the possibility of a blood infection must never be lost sight of. Finally, the facts stated regarding the condition of the urine in the cases of Acute Pyelitis point most conclusively to the importance of a systematic examination of that excretion even in very young infants.

APPENDIX.

I. LITERATURE.

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II. CHART OF CASE I.

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