head pains have been less and she has only on one occasion (February 7th, 1910) had a fit, after which she was unconscious for about two hours.

Treatment.

I removed the polypoid tumour, but this has since re-formed; apart from this there has been no intranasal treatment. Potassium bromide has been given when the head pains were bad.

Report on Fluid.

Dr. Rupert Collins, honorary pathologist to the hospital, very kindly examined several specimens of the fluid, and reported as under:

"Various specimens from the nasal discharge of K. P. have been examined by me at different periods.

"The first specimens contained a considerable amount of mucin, as shown by a precipitate with acetic acid in the cold, and gave no reduction with Fehling's solution. When centrifuged a deposit of leucocytes and nasal epithelium was obtained. All this pointed to the condition being a nasal hydropyorrhea. Later specimens were different, sometimes clear, sometimes turbid a few hours after being passed owing to the enormous number of micro-organisms present.

"The analysis of the clear specimens was as follows: Acetic acid in the cold yielded no precipitate whatever, showing absence of mucin. Heating and acidulating with acetic acid gave a precipitate showing the presence of proteid. If the fluid was saturated with $MgSO_4$ and filtered it no longer gave any reaction for proteid, showing that the proteid present was a globulin. The fluid reduced Fehling's solution, and did not ferment with yeast. I twice tried to obtain crystals of pyrocatechin by evaporating and extracting with alcohol, but failed to do so.

"The fluid was quite clear, like water, specific gravity 1006, reaction alkaline. On centrifugalization a few leucocytes only. It was rich in chlorides, and contained a trace of sulphates. Two cultures were taken by letting the fluid drip straight into culture tubes of agar-agar, and both grew cocci and bacilli luxuriously. The fluid was always collected by letting it drip into a sterile flask, but it invariably was turbid with micro-organisms in six hours, and had accordingly to be examined at once. I found the fluid to be turbid on two occasions as it dripped from the nose when I was present.

"I conclude that this is a case of cerebral rhinorrhoea with a septic condition of the mucous membrane of the nose which caused the presence at intervals of mucin in the fluid. Why the fluid did not reduce Fehling at first I do not know; there was no difficulty in getting plentiful reduction in later specimens, and I can only conclude pyrocatechin was not present in the first two specimens tested."

I also failed to obtain a reduction of Fehling's solution from the first specimens, but later obtained a definite reduction. With regard to the turbidity, I found that the fluid collected shortly after the use of an antiseptic nasal douche remained clear for several days.

It is due to the excellent monograph, *The Cerebro-spinal Fluid, its Spontaneous Escape from the Nose*, published in 1899 by StClair Thomson, that the true nature of these cases has been recognized. He records one case of his own and twenty others collected from the literature both English and foreign.

He divides them into 9 undoubted and 12 probable cases. In 17 there were cerebral symptoms, and in 8 eye symptoms. The flow was from the left side in 10 cases, right side in 4, both sides in 1; the side was not mentioned in 5.

The cerebral symptoms presented a great similarity in most of the cases, the most marked being severe headache, drowsiness, vomiting, delirium, convulsions, and coma. A striking point was that in all the cases there was an absence of fever, and that the headache and other cerebral symptoms were relieved by the flow.

In these respects my case agrees, also in the eye symptoms, there being always either a neuritis or a post-neuritic atrophy. The pathology suggested by StClair Thomson is a meningitis serosa, giving rise to idiopathic internal hydrocephalus, optic atrophy being due to a pressure on the optic chiasma, caused by the dilated third ventricle.

The condition with which "cerebro-spinal rhinorrhoea" will be most easily confounded is that known as "nasal hydropyorrhea." But there are such marked clinical differences in the two conditions that I felt from the first that I was dealing with a true case of cerebro-spinal rhinorrhoea, in spite of Dr. Collins's first reports on the analysis of the fluid, and so, at my request, he very kindly examined further specimens, and our perseverance was rewarded by finding the Fehling-reducing substance in the fluid.

The true nature of the condition is established by the analysis of the fluid, the main characteristics being that cerebro-spinal fluid is a perfectly clear, transparent, tasteless fluid, with no sediment. It has a low specific gravity,

contains no mucin, but a trace of globulin, and has a substance which reduces Fehling's solution, but does not ferment with yeast and therefore is not a true sugar. This reducing substance can be obtained in a crystalline form resembling pyrocatechin.

I would suggest that in some of the cases classed by StClair Thomson as "probable," if a repeated examination of the fluid had been made, this sugar-reducing substance would have been eventually found. Notably in two cases recorded by Priestley Smith in the *Ophthalmic Review*, 1883, both with double optic atrophy, and in neither of which was a reducing substance found. In both of these cases StClair Thomson comments that it is "difficult to lay aside the hypothesis of cerebro-spinal fluid, but not tenable in view of analysis."

Anyway my case is of special interest from the fact that some specimens did not show the reducing substance, while others did. One must remember that we are dealing with a diseased condition which may alter the character of the cerebro-spinal fluid; in general paralysis of the insane there is no reducing substance.

The case was shown at a meeting of the Gloucester Branch of the British Medical Association in October, 1909.

THE DIAGNOSTIC VALUE OF THE LEUCOCYTOSIS OCCURRING IN WHOOPING-COUGH.

BY

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The following observations on the blood of children suffering from whooping-cough during an epidemic were made in the early part of this year in the out-patient department of the Manchester Children's Hospital. The blood from nearly 100 cases was examined, and a differential count of the white blood cells made in each case. The age of the children varied from about 9 months to 8 or 9 years. The blood was taken from cases in various stages of the disease so far as possible, and the blood of the same case was examined repeatedly during the progress of the disease and during the convalescence. The number of red blood cells and the haemoglobin percentage were estimated occasionally, but yielded no results of special significance; patients suffered from no more than a "slight anaemia." The blood was taken from the ear and was stained by Leishman's method or by eosin and methylene blue after fixing in formalin vapour.

In a fair proportion of cases the number of leucocytes per c.mm. was estimated, and in every case where this was done there was a leucocytosis of between 15,000 and 30,000 white blood cells per c.mm. The number of white blood cells in children suffering from bronchitis and other febrile chest cases was also estimated, but in only rare instances did the numbers reach such a height as that observed in whooping-cough. The results, therefore, confirm those made by Fröblich¹ in 1897, who examined the blood of 55 children suffering from whooping-cough, and found a leucocytosis varying from 7,000 to 40,000 white blood cells per c.mm. This leucocytosis in itself is a valuable aid in the diagnosis of a suspicious case of whooping-cough. In examining the blood of a child suffering from whooping-cough the preponderance of lymphocytes over the polymorphonuclear cells is at once noticed, and in nearly every case which had a well-marked whoop the lymphocytes formed about 60 per cent. of the total white blood cells, the rest of the white cells being made up of polymorphonuclear cells with an occasional eosinophile cell. The excessive lymphocytes were nearly all of the small variety, but there was at the same time a greater proportion of large lymphocytes than is found per c.mm. in normal blood, and in some cases these cells amounted to 10 per cent. of the lymphocytes present. This excess of lymphocytes was found in cases which had not reached the spasmodic or whooping stage of the disease, and also in mild cases, when it was difficult to make a definite diagnosis from the history the parent gave.

An interesting example of this happened when I was examining the blood of a child aged 3½ years, who had

anaemia and a slight cough. The blood contained 15,000 white blood cells per c.mm., and on making a differential count of the white blood cells I found that the lymphocytes formed nearly 60 per cent. of the total white cells. The next week the child was brought back to the out-patient department, having started with whooping-cough two days previously, or five days after the blood examination was made. The lymphocytes in this case, therefore, formed an unusual percentage of white blood cells five days before the whooping began. Thus, if a child who has been known to have been exposed to the infection of whooping-cough starts with a cough, a blood examination will very likely show whether it is going to begin whooping-cough, and then isolation can be undertaken early.

On examining the blood of the cases after the whooping stage had been passed it was found that the lymphocytosis persisted for a short time and then gradually diminished, so that by the end of two months after the whooping had stopped the white blood cells had returned to normal proportions.

Blood changes in infants and children develop more easily and more quickly than in adults, so that the leucocytosis with a relatively large proportion of lymphocytes helps in making an early diagnosis of the disease, especially in doubtful cases without a definite whoop; as whooping-cough is a very infectious and serious disease, the early diagnosis is most important. Thus, in the Report on the Health of the City of Manchester for 1909, Dr. Niven² says: "This is not only a fatal but a most

Diagram showing the rise and fall in the number of lymphocytes in a typical case of whooping cough. C, Cough; W, whooping.

distressing disease, and the figures are most disquieting;" in fact, the number of deaths from whooping-cough and its sequelae far exceed the deaths from any other infectious disease except measles.

In infants, however, the lymphocytes normally form between 40 and 50 per cent. of the total white cells in the blood; but even here, if the lymphocytes form nearly 60 per cent. of the white cells and there is a larger proportion of large lymphocytes than normal, it is confirmatory evidence of the existence of the disease. The blood from children suffering from some septic trouble was examined, and here the excess of white blood cells was found to be made up by the polymorphonuclear cells and not by the lymphocytes as in whooping-cough.

If the total number of polymorphonuclear cells and lymphocytes in normal blood and then in the blood of a case of whooping-cough be estimated, it is found that the excess of white cells in the blood of whooping-cough is almost entirely made up of the lymphocytes; the total number of polymorphonuclear cells remaining but slightly increased. Thus, if there are 10,000 white blood cells per c.mm. containing 60 per cent. polymorphonuclear cells and 35 per cent. lymphocytes, there will be 6,000 polymorphonuclear cells and 3,500 lymphocytes per c.mm. Comparing this with the blood of a whooping-cough case containing 25,000 white cells per c.mm. with 40 per cent. polymorphonuclear cells and 60 per cent. lymphocytes, there will be 10,000 polymorphonuclear cells and 15,000 lymphocytes per c.mm. The lymphocytes have thus increased by nearly 12,000 per c.mm., while the polymorphonuclear cells have only increased by 4,000 per c.mm. In septic conditions the total number of polymorphonuclears are increased and the lymphocytes are but slightly increased. Whooping-

cough without serious complications is not often fatal, so that the exact state of the blood-forming organs is difficult to study. It is also difficult to say how far there is an excess of lymphoid tissue or hypertrophy of the lymphatic glands, but there is no marked enlargement of the glands to be made out on clinical examination.

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CELLULITIS OF THE ARM, COMPLICATED WITH PNEUMONIA, TREATED BY VACCINE.

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THE following is a report of the first case in which I have had occasion to use vaccine treatment (staphylococci and streptococci). The result was sufficiently striking to make it worthy of record.

H. J., a farmer, aged 35, who had enjoyed excellent health, accidentally cut his hand whilst sharpening a cross-cut saw. The wound was very small and was situated over the fourth metacarpal bone of the left hand. He paid no attention to it and continued his work all day without feeling any inconvenience. The following day (February 9th), as he was killing a pig, he began to feel ill, shivering and getting very weak, in fact to use his own words, "I was getting worse and worse every five minutes." He returned to the house and had a foot-bath (hot water and mustard), and went to bed. The shivering continued, and he felt desperately ill. The next day (February 10th) I was urgently summoned to his house, a distance of 6½ miles. He was then complaining of pains in his left side, slight hacking cough, and difficulty of breathing, the temperature was 101.5°. His hand, which was very red and swollen, had become extremely painful. There was, in my opinion, pus in the back of the hand, and I proposed to let it out, but as this suggestion was declined I advised it to be kept in a warm bath constantly; a purgative was given. On my next visit (February 12th) the arm had swollen up to the elbow and the inflammatory process extended. The pain was excruciating and the man had had no sleep from the first day of his illness. I now got his consent to make two incisions on the back and side of the hand, with the result that a good amount of pus came out, and through the opening on the back of the hand the rusty piece of a tooth of the cross-cut saw was extruded. The temperature was 103°, pulse 98, respirations 36. I saw the patient again the following day and found him very weak; the inflammatory process was still extending up the arm, which had swollen to an enormous size. The skin was very red and the whole limb was indurated and most tender. I made another incision near the elbow, but no pus was obtained. I recommended them to carry on the hot baths continuously, night and day. Temperature was 103.5°, pulse 98, respirations 40. On February 14th the temperature fell to 101.5°, pulse 84, and respirations 32, but there was no improvement in the condition of his arm.

I suggested getting another opinion, fearing that it would be necessary to amputate at the shoulder. At the same time I thought of trying what vaccine therapy might do, and to this the patient consented. I asked my friend Dr. Lloyd Smith to see the case with me. We decided that it would be an excellent case to treat by vaccine. On February 16th some stock vaccines were obtained (Wright's, from Parke, Davis and Co.). After taking the necessary preliminary precautions I inoculated the patient with 250 million staphylococcus and 20 million streptococcus in the flank. On my next visit, February 18th, I was told that he became very ill about four hours after the inoculation, and that for some time he was quite delirious. After about ten hours pus oozed out freely, in fact most profusely, through all the three incisions. The arm had considerably diminished in size and there was less pain. The temperature was 100.4°, the pulse 84, and the respirations 18.

I saw the patient on February 21st, and decided to cleanse all the pus pouches with a solution of lysol and give a thorough irrigation. On February 23rd, however, I received a note that the arm was getting much worse, and I found the temperature 99.5°, pulse 84, arm swollen and very painful. I decided to give him a further inoculation of vaccines (150 million of staphylococcus and 5 million streptococcus); this was thirteen days after the first inoculation. After eight hours there was profuse perspiration, free discharge of pus, and a feeling of intense weakness and thirst.

On March 3rd the temperature was normal for the first time, and he began to feel himself improving; the pulse was 72 and the respirations 18.

On March 5th he got up for an hour, but was too feeble to stand and had to be put back to bed.

On March 10th his condition showed marked improvement, and he was downstairs.

The signs and symptoms of the pneumonia were ordinary in character and were treated on general lines