knowledge of cardiac infection from its earliest days be acquired by our profession.

2. The establishment of some permanent organization for the study of rheumatism upon the broadest lines.

The treatment of the individual child with rheumatic heart disease has been written upon repeatedly by abler pens than mine. I shall only venture upon a few observations which are in no sense intended to be either new or startling discoveries, but which may be helpful to those who have had fewer opportunities of seeing these cases.

First, with regard to the tonsils—I believe that there are cases in which enucleation is of great value, though it must be confessed that those which are the most successful are scientifically inconclusive. A child, for example, has recurrent attacks of tonsillitis, with arthritic pains and other symptoms, which suggest—not more—the early invasion of the rheumatic infection. The tonsils are enucleated and health greatly improves. We cannot say that if the operation had not been done this child would have developed acute rheumatism, though we may feel convinced that we have warded off danger. More conclusive but less satisfactory are those cases in which a cardiac infection has already occurred, and which after operation remain free from further attacks and in good health. For such cases I can vouch. It is, however, certain that recurrences may take place, and I have conclusive records upon this point, but no statistical evidence to calculate the proportion. This investigation requires a very large number of cases, and should be a feasible undertaking of great practical value. Operations upon the tonsils in the active phase of inflammation may be promptly followed by an attack of acute rheumatism, upon which occurrence also I have conclusive notes.

There remains another group in which the tonsils are evidently unhealthy and giving trouble, but the child has a degree of heart disease which renders one anxious as to the operative risk. Each case is a matter for judgement, but in general these children take anaesthetics well. It is clear that we have no right to assure parents that enucleation of the tonsils will free a child from acute rheumatic attacks, but I am convinced that as a preventive measure it is of first importance.

It is very essential for the treatment of the individual that the public should have a clearer understanding of the disease, for a practical difficulty in obtaining success in convalescence lies in the fact that a child who is making a good recovery from a cardiac attack may appear to be "quite well," and unless the parents understand that the heart is softened by the disease they will be inclined to worry or even suspect the doctor. Again, if a boy is athletic the schoolmaster is sometimes an offender, for he knows the glory of school games and despises the fads of doctors. Nevertheless, what does it profit a boy if he wins the school hundred yards and dilates a convalescent rheumatic heart?

The question of diet in the rheumatism of childhood is somewhat mysterious. There is a widespread idea among the laity that meat is injurious, and I presume such an idea would not have arisen unless based originally upon medical opinion. In all acute febrile illness there is general unanimity that a light diet is the best, but when one turns for evidence that there is any particular danger to rheumatic children in a nitrogenous diet, that evidence is not forthcoming. I can see no more reason for this dread of meat for rheumatic children than for the tuberculous, and believe it to be a fallacy. The disease is very common in children of a class who are not in a position to obtain an excess of meat foods, and I have failed to obtain any history of an excessive love of them. When the acute illness is over, these children often remain pale and feeble for long periods of time, and if during this stage we curtail the diet I think we lose an opportunity. If any one can produce trustworthy observations showing that meat foods given during this stage with the discretion needed for the convalescence from any lowering illness are harmful, it would be a practical service. I cannot myself find any such evidence, and have not felt myself bound in any way by the vague statements which are in existence upon this point.

Turning to more detailed considerations, some of the points that have struck me are the following:

1. The salicyl compounds—preferably, I think, the salicylates—are of value in relieving rheumatic pains, but if

faith is pinned upon their specific value, we are logically driven in severe cases to large doses, and these are dangerous, particularly to fragile delicate children. No specific result will follow their use, though death may occur from drug poisoning.

2. Patience and dogged perseverance with excellent nursing are still the most valuable aids to recovery, and though rest will not prevent an acute attack (I have seen two attacks of pericarditis in a child kept in a Phelps box under a mistaken diagnosis), its value is attested to by all.

3. Pericarditis very rarely indeed will need operative interference.

4. Continued disturbance of a child with severe heart disease by external applications and drugs does more harm than good. We do not know how to cure the disease, and are therefore not justified in preventing Nature from having a share in the attempt.

5. Vomiting, digestive disturbances, and sleeplessness require prompt and early measures for their relief.

6. The leading principle during convalescence is not passive rest but cautious progress, and the ideal is to make the interval between absolute rest and a return to everyday life an inclined plane.

7. No forward movement is indicated while the area of cardiac dullness is still diminishing and the impulse improving in strength. A gain in weight and colour may be of even more value than slight changes in the physical signs. The aim is to obtain a steady level in the cardiac condition. This level must be dependent upon the condition of the heart before the particular attack, and, if the heart is already damaged, this must necessarily be but of relative efficiency. When we get a clear idea of this cardiac level then we can commence the cautious progress forward, testing each step as we go by the general condition of the child, the temperature, the pulse, and cardiac physical signs.

8. Small doses of digitalis are often, I think, helpful during the early forward steps in convalescence, but a rash or sudden over-exertion may delay recovery for weeks, and is the great danger in this stage.

9. The nervous element, so marked in aortic disease and myocardial affections, requires cautious handling and sympathetic attention.

10. When care has been exercised we find that the great cause for a failure in the cardiac power in childhood is a recurrence of rheumatism.

PRELIMINARY NOTE ON THE ASSOCIATION OF RICKETTSIA BODIES IN LICE WITH TRENCH FEVER.

BY

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AND

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IN connexion with the War Office Committee on Trench Fever, under the chairmanship of Sir David Bruce, F.R.S., we have had access to the trench fever clinical material at the New End Hospital, Hampstead. We are very much indebted to Major Byam and all the medical staff at the hospital for their constant help, and especially to Lieutenant Lloyd, who has been in charge of the entomological work at the New End Hospital.

Small bodies resembling diplococci or bipolar bacilli have been described in the blood of patients and in the insect vector in Rocky Mountain spotted fever by Ricketts (1909),¹ in typhus fever by Ricketts and Wilder (1910),² and in trench fever by Töpfer (1916).³ The morphology and behaviour of the forms found in these different diseases are very similar, according to those who have had the opportunity of working at more than one of these diseases. To the bodies occurring in connexion with typhus fever da Rocha-Lima (1916)⁴ gave the name *Rickettsia prowazeki*, in memory of two prominent workers who died of this disease, contracted in the course of their researches. The form found in lice believed to be uninfected or from trench fever patients he called *R. pediculi*. Rickettsia bodies are of very small size—0.3 by 0.3 to 1.5 microns—are non-motile, and are best demonstrated by staining for sixteen

to twenty hours with weak Giemsa stain (1 drop per c.cm.). Attempts to grow the parasite on artificial media have usually failed, but some successful cultures have been reported.

One of the most important characteristics of these bodies is the fact that, though very scanty and difficult to recognize in films of the blood of patients, they occur in great numbers in the intestinal canal of the louse, and sometimes elsewhere in the insect, which acts as an invertebrate host.

In the case of trench fever *Pediculus corporis* has been proved to be a very active agent in transmitting the disease by Davies and Weldon (1917),⁶ Byam and others (1918),⁶ and the joint British and American Medical Investigation Committee in France. A small quantity of the excreta of infected lice rubbed into scratches will almost invariably reproduce the disease in a healthy man. When infected lice are fed on a healthy man for a period lasting two or more weeks, infection follows in a certain proportion of cases, but in other instances infected lice may be fed twice daily on healthy men for four or more weeks without infection resulting, as was shown in experiments at Hampstead by Byam⁶ in 1918.

Töpfer,³ da Rocha-Lima,⁴ and a few other workers have shown that lice caught on trench fever patients contain large numbers of rickettsia bodies, and that if lice believed to be free from infection are fed on a patient rickettsia bodies appear in their guts after about five to eight days from the first infecting feed, provided that the lice are kept at a temperature of 30° to 32° C. between the feeds.

The German work was incomplete because the observers seldom, if ever, were successful in transmitting the disease to man by lice—Werner and Benzler (1917),⁷ Strisower (1918)⁸—and so were unable to correlate the appearances in the louse with the infectivity for man. Accounts of attempts to infect animals with trench fever have been contradictory and unsatisfactory. Moreover, most of the workers on the Continent have been handicapped by the prevalence of trench fever and typhus fever in the populations with which they have had to deal, and an uninfected stock of lice has been very difficult to procure.

For our work we have used a clean stock of lice bred in captivity and kept under observation for over three years. Our experiments have been made by feeding normal lice on trench fever patients both during and after febrile periods. Either the feeding on the infected person has been for one day only, followed by feeding on a healthy man, or after the first infecting meal the lice have been fed regularly on the same or another infected man, and between the feeds the lice have been kept in an incubator at a temperature of about 27° C., or in an inside pocket.

The lice have been examined microscopically daily by means of (1) films made from the excreta; (2) films from the gut contents, or (3) microscopic serial sections. The films have been treated with acid alcohol to fix and to remove haemoglobin debris, and have been stained with Giemsa stain.

The following observations have been made, confirming and extending those of previous workers:

1. If a box of lice is fed on a trench fever patient, and the excreta collected after a period of about ten days, large numbers of rickettsia bodies can almost invariably be found in films. Smears of the guts of lice from such a box contain large numbers of these bodies after about the same interval of time. Of 253 specimens from boxes of lice which had been fed on trench fever patients at least five days previously, 150 showed rickettsia bodies, 83 gave a negative result, and 20 a doubtful result.

2. The excreta from sixteen boxes of lice which were examined daily after an infecting meal showed rickettsia bodies for the first time twice on the fifth day, three times on the seventh, three times on the eighth, four times on the ninth, three times on the tenth, and once on the twelfth day from the first infecting meal. When first seen only small numbers were noted in the films, but three or four days later enormous numbers appeared. These experiments show that after an infecting feed there is a period during which these bodies are not recognizable on account of their small numbers, or of some difference in form. When a box has once become infected with rickettsia the excreta collected from it continue to show the bodies for two or three weeks, or till the lice which partook of the infecting feed are dead.

3. All lice from an infected box do not show rickettsia; only a small proportion do so in the first week; the proportion increases until after two and a half to three weeks the great majority show these forms. Experiments at Hampstead have also made it probable that after the same time a considerable proportion of lice are infective.

4. Trench fever patients can infect lice with rickettsia bodies during the fever, between the attacks, or even several weeks after an attack during a non-febrile period.

5. Normal lice, fed on persons who have not been exposed to trench fever infection, have remained free from rickettsia. Of 245 specimens from twenty-two boxes fed on seven healthy persons only one specimen of excreta was found to contain forms which closely resembled rickettsia microscopically. It is not surprising, considering the difficulty in recognizing such small bodies by their morphology, that occasional errors should occur. Four other specimens from two boxes showed these bodies, but they were being fed on a man who had been working with infected excreta in the laboratory for five weeks, and had also been feeding infected lice on himself for the same period. He developed trench fever three days after the first of the four positive specimens was found. It is most probable, therefore, that he had been infected for some days before the bodies were observed in the lice.

The Similarity of the Properties Possessed by Trench Fever Virus and Rickettsia Bodies, and Coincidences in their Occurrence in Lice.

1. Rickettsia bodies are very small, often about 0.3 by 0.3 micron in size, and approach the limits of filterability by a Berkefeld filter. There is also some difference of opinion as to whether trench fever virus and typhus virus can pass through a Berkefeld filter.

2. Rickettsia bodies can to a great extent be separated from larger bacteria in an emulsion of excreta in salt solution by differential centrifugalization. The Medical Investigation Committee in France states that blood plasma centrifuged free from cells still contains the virus of trench fever.

3. Lice do not, according to two series of inoculation experiments carried out by Major Byam,⁶ become infective (as shown by inoculation of their excreta) after an infecting meal for five to ten or twelve days, and rickettsia bodies do not make their appearance till about the fifth to the twelfth day.

4. All the lice in an infected box are not infective, nor do all contain rickettsia during the second week after the first infecting feed. In one experiment carried out at Hampstead, two lice, one showing and the other not showing rickettsia, were selected from a box on the eleventh day from the infecting feed, and they were inoculated separately into two different men. The louse with rickettsia caused trench fever and the other did not.

5. In fifty-three experimental inoculations of volunteers at the New End Hospital the lice or excreta of lice, used as virus, were also examined microscopically. In every case the lice had previously been fed on a trench fever patient.

Twenty-seven specimens showed rickettsia bodies and caused trench fever.

Ten specimens did not show rickettsia bodies and did not cause trench fever.

One specimen showed rickettsia bodies, but did not cause trench fever.

Two specimens did not show rickettsia bodies, but caused trench fever.

Four specimens gave a doubtful result microscopically, or the inoculation was followed by fever of a doubtful nature.

Nine specimens showed rickettsia bodies but did not cause trench fever, because the virus had been heated or treated with disinfectant, or because the volunteer inoculated had recently passed through an attack of trench fever, and was probably immune.

The agreement between the demonstrable presence of the virus and of the rickettsia bodies is very close. If the thirteen cases which gave a doubtful result or in which agreement was not to be expected, on account of disinfection of the virus or immunity of the patient, are excluded, then forty cases remain, and the agreement between the two methods of examination in thirty-seven is complete—that is, in 92.5 per cent.

These facts indicate the striking interdependence of trench fever virus and rickettsia bodies, though the proof

of identity is still wanting, and the inability to obtain definite cultures of rickettsia bodies up to the present hinders further advance in this direction.

CONCLUSIONS.

1. The constant presence, after a suitable lapse of time, of rickettsia bodies in lice which have been fed on a trench fever patient has been confirmed.

2. The absence of rickettsia bodies from lice bred in captivity and fed only on healthy men has been shown by our work, in contradistinction to observations made on the Continent where the population is much more exposed to infection and a clean stock of lice is more difficult to procure than in this country.

3. A very close correlation has been shown to exist between the presence of rickettsia bodies in lice or the excreta of lice and the virulence of these materials when inoculated into men.

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THE WORK OF A DEPARTMENT FOR EMPLOYING EXPECTANT MOTHERS IN A MUNITION FACTORY.

(Preliminary Report.)

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THE question of the employment of the working woman who becomes pregnant has always been a vexed one. Opinions have varied from that which considered a woman in this condition should not be employed at all to that which would afford no consideration whatever to a woman supporting the added strain of a pregnancy.

Since the outbreak of the present war the numbers of married women of child-bearing age who have entered into industrial employment have steadily increased. These women have in the large majority of cases entered factory employment in order to earn money for the adequate maintenance of themselves and their children, and as time goes on the need for their earnings has become more and more evident. They cannot without serious hardship to themselves and their children relinquish their earned weekly wages. A woman factory employee who becomes pregnant still more has need of her earnings to maintain her own nourishment and that of the developing fetus, and also to make adequate preparation for the inevitable expense entailed by the arrival of a new baby into the family.

Apart from the necessity for engaging in well-paid work experienced by these women, various industries have discovered that these married women are valuable servants, who are reliable workers in different processes and who cannot always be replaced by satisfactory substitutes if they leave work.

Up to a recent date there has been no fixed routine of procedure in dealing with women factory employees who have become pregnant. In some instances the condition has been ignored and the woman has been allowed to work at any process as long as she has wished to do so without any regard to the suitability of the work upon which she is engaged. In other cases the custom has been to dismiss an expectant mother directly her condition becomes apparent regardless of the question of her ability to work to a later date.

There has been in the past too little inclination to look on the question from the point of view that most factory workers when pregnant are still physically fit to undertake paid work and that they are in need of their earnings to maintain their fitness.

In carrying out the routine medical examination of women engaged on various engineering processes connected with shell, fuse, and gun manufacture, one of the writers became greatly impressed, first, with the number of women who were at work which was unsuitable while hiding their condition to avoid dismissal at the fourth month of pregnancy, and secondly, with the amount of illness of short duration among the workers which might be suspected to be due to miscarriage in the early weeks of pregnancy, although confirmation of this suspicion could in many cases not be obtained.

On going into the reasons, both these conditions appeared to result from one root cause—namely, the anxiety on the part of the women to retain their work and their earnings. If the pregnancy miscarried they were relieved of the necessity of ceasing work, and if it went on to term, then they did all in their power to conceal the true state of affairs, even though it entailed the performing of much unsuitable work.

One of the writers thereupon approached various employers to see whether suitable work could be given to expectant mothers, and was met with a flat refusal to undertake any such thing, on the grounds that their employment would lead to loss of money by the employer, and that it was unseemly for an obviously pregnant woman to be seen by other employees.

Thereupon the writer approached the Factory Inspection Department of the Home Office to ask whether it would establish a central workroom for the district for some needed war industry at which these women could be given employment. This department, while approving of the idea if started by private enterprise, refused to initiate such a scheme.

Finally, a copy of the letter sent to the Home Office was sent to Major C. P. J. Ovens, the superintendent of the National Ordnance Factories, Leeds, with a request that this group of factories should initiate a scheme to deal with cases of pregnancy occurring among its own workers. This request was seriously considered by the management and an experimental scheme was drawn up by the writers with the active co-operation of the superintendent, to deal with cases of pregnancy up to the birth of the child.

The regulations and terms of employment of these women were discussed with their trades union representative, and were also brought before a meeting of the workers' representatives. It was entirely approved by these women, who had an extremely broad-minded outlook on the whole question, and were able to give valuable opinions on various details of the scheme from the workers' point of view.

The prematernity scheme was opened for the transfer of women in April, 1918, and has worked without any administrative hitch since that date. The women themselves apply at each factory to their welfare supervisor to be enrolled for employment under the scheme. They fill in a form of application, and sign an agreement to accept the wages offered for this class of work. This form is forwarded to the lady superintendent in charge of the scheme, who notifies the factory medical officer of the applications. The factory medical officer examines all applicants as soon as possible, and sends in a report upon them as to date and number of pregnancy, date of expected labour, complications if any, and the grade or work for which they are then suitable, and the desirable dates for transfer to lighter work. From this tabulated list of applicants the lady superintendent of the scheme is able to transfer women to their special work as they become eligible provided there is a vacancy by the delivery of women further advanced in pregnancy working under the scheme.

As regards the choice of work, women on becoming pregnant are very adversely affected by night work apart from any degree of heaviness. Long before pregnancy is obvious to outsiders, and even to themselves, they begin to complain bitterly of the fatigue of night work. For this reason the aim of the scheme is to place expectant mothers on day work only as a routine at the end of the fourth month of pregnancy, and sooner than this date if there is a complaint of great discomfort due to night work.