cheerfully afforded me during my investigation of the outbreak. My thanks are also due to Dr. P. F. Graham, physician to the institution, for his assistance and the trouble he took in collecting the patients' serum. I desire also to thank Dr. Shanahan for helping me at the autopsies and in other ways.

THE SCIENCE COMMITTEE

OF THE

British Medical Association.

REPORT CXIII.

THE CONDITION OF THE BLOOD IN EXPERIMENTAL RICKETS.*

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CONCERNING the condition of the blood in rickets there is much diversity of opinion. The majority of authors consider that there is invariably a certain degree of anaemia. Ewing¹ and Cabot,² in their textbooks on haematology, say that there is always a certain degree of anaemia proportionate to the severity of the disease. Cabot, in addition, mentions that examples of polychromatophilia, myelocytes, and nucleated red blood corpuscles are not infrequently observed. Holt,³ Cheadle,⁴ and Ashby,⁵ in their writings on rickets, express practically the same opinion. Not one of these authors, however, quotes any specific example, but merely the conclusions of other observers. Hutchison,⁶ on the other hand, states that severe rickets is often accompanied by no appreciable degree of anaemia; and Pfaunder and Schlossmann⁷ say that in rickets there is nothing characteristic of the blood.

Considering the frequency with which rickets occurs, the blood picture has comparatively seldom been the subject of study. In the literature I have only been able to find three papers based on anything like extensive observations.

Morse⁸ in 1897 reported the result of an investigation into the condition of the blood in 20 cases of active and uncomplicated rickets occurring in children between the ages of 7 months and 2 years. He found the percentage of haemoglobin (as estimated by the apparatus of von Fleischl) to vary between 48 and 77, the red blood corpuscles to vary between 3,508,000 and 5,528,000 per c.mm., and the leucocytes between 5,500 and 18,800 per c.mm. He observed nucleated red cells in three of the cases, all of which presented some enlargement of the spleen, and in some of these, in which the spleen was greatly enlarged, nucleated red cells, both megaloblasts and normoblasts, were very numerous. In nearly all the cases mention is made of some variation in the size of the red cells, and occasionally poikilocytosis was observed. Morse concludes from his observations that most cases of rickets present some anaemia, which, as a rule, varies with the severity of the disease, and that there may or may not be a leucocytosis.

Felsenthal (quoted by Morse⁹) investigated 12 cases of rickets, varying in age from 9 months to 2 years. Three of the patients were very markedly rachitic and had large spleens. He got practically the same result in all the 12 cases. The red blood corpuscles were not decreased in number, or only to a very slight extent, but the haemoglobin was always diminished. Nucleated red cells only occurred in the most severe cases.

Esser,⁹ in a recent paper on the etiology of rickets, discusses the condition of the blood—at least, so far as the number and character of the leucocytes are concerned. He asserts that there is almost invariably—at least, in the early stages—a marked leucocytosis, amounting in some instances to 30,000 per c.mm., and that the nuclei of the polymorphonuclear leucocytes are more lobulated than normal. He does not, however, give any table of his results, nor does he make any mention of the percentage of haemoglobin or number of red blood corpuscles.

According to Cabot,¹⁰ Hock and Schlesinger found that in a considerable number of cases of rickets, with and without splenic enlargement, the number of red blood cells per c.mm. was 2,500,000.

As for the rest of the literature, it consists of reports of isolated, or at most two, examples of rickets examined by

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the one author. Not infrequently, too, some mention is made of splenic enlargement, and in not a few the blood picture was similar to that found in "splenic anaemia of infancy," so that these results are of very doubtful value. More especially is this the case when one considers that the degree of splenic enlargement in splenic anaemia bears no definite relation to the severity of the anaemia, and also that it is very doubtful, in view of recent observations,¹¹ if uncomplicated rickets is accompanied by any degree of splenic enlargement; and, finally, as Starck¹¹ has shown, that enlargement of the spleen is as common in non-rachitic as rachitic children.

Moreover, much of the diversity of opinion regarding the relationship of rickets to von Jaksch's anaemia is due, in my opinion, to the want of exact knowledge regarding the blood picture in uncomplicated rickets.

Owing to this scarcity of information regarding the condition of the blood in active and uncomplicated rickets I was led to conduct an investigation into the subject both from the clinical and experimental aspect. In this paper I intend to deal chiefly with my experimental results, but it will be advisable to give in addition a brief summary of the results obtained in the case of spontaneous rickets in children.

I examined 30 cases of active and uncomplicated rickets in children between the ages of 12 and 42 months. In order to control these observations I also investigated the blood of 12 children, who to all external appearances were quite healthy, and who most certainly did not present the slightest rachitic manifestation, and who, it may also be stated, belonged to the same class of society. In only 9 of the 30 rachitic cases was there any degree of anaemia. In 2 of these the amount of haemoglobin was only 5 per cent. below the accepted average, and the red cells in no instance were less than 4,100,000 per c.mm. The majority of the cases, on the other hand, gave notably high blood estimations, so far as the amount of haemoglobin and number of red cells were concerned. For better comparison the cases were divided into five groups, each group comprising an age-period of six months, and the average of each group compared with the average of the controls and the reputed average of authors for corresponding ages. For each age-period the average amount of haemoglobin and number of red cells was in excess of the reputed average, and also of the controls, excepting in one series composed of children between the ages of 18 and 24 months, where the red cells, though still above the normal, were some 800,000 per c.mm. below the average number as found in the controls. Nucleated red corpuscles were exceedingly rare, only being discovered on one occasion, and myelocytes were notable by their absence. In only 2 of these cases was there an unequivocal leucocytosis, the white cells numbering 20,000 and 30,000 per c.mm. The child in one of these cases had been suffering for some days prior to the examination from diarrhoea. Of the other 28 cases, 9 gave a normal or subnormal estimation, and in 19 the leucocytes were moderately increased in number, the maximum being 19,000 per c.mm. Differential counts failed to reveal anything characteristic.

As uncomplicated rickets in children is comparatively rare, I considered it important to corroborate the clinical findings with observations in experimental rickets.

Rickets was induced experimentally in puppies, and periodic examinations of the blood were made before and after the development of the disease. When the rachitic manifestations became very marked the animals were killed, and the histology of the haematopoietic organs studied. In the results recounted below, however, I have not discussed the histological findings in these organs in any detail, as I intend in a later communication to deal with that aspect of the subject.

The blood examinations were always made at about the same time of the day, between 3 and 5 p.m. The sample of blood was taken from a vein of the ear, after the part had been shaved, the haemoglobin estimated by Gowers's haemoglobinometer, and enumerations of the red and white cells made with the Thoma-Leitz haemocytometer. Gowers's solution was used as the diluent for the red cells, and a 3 per cent. solution of acetic acid, tinted with methylene blue, for the white cells, the dilutions being 1 in 100 or 1 in 200 and 1 in 10 respectively. Films were also made and stained with Jenner's fluid, and a differential

count of 400 to 800 leucocytes made. Films were also at first stained with Ehrlich's triacid fluid, but as it entirely failed to reveal any neutrophile granulations its use was early discarded. The best results were obtained in films stained for two or three minutes with undiluted Jenner's fluid, and then for about ten minutes with the diluted stain and thereafter washed thoroughly. Invariably the eosinophile granulations stained well, but the demonstration of the neutrophile granulations left much to be desired. They always appeared faint and very scanty, but in undoubted polymorphs were sufficiently definite to enable a diagnosis to be made. In no mononuclear cells, either in the blood or marrow, were neutrophile granules detected, so that it was found impossible to distinguish between myelocytes and hyaline cells. This absence of neutrophile granulations in the myelocytes of dog's blood I find is also mentioned by D. Noël Paton¹² in his work on digestion leucocytosis.

In the results of the differential counts I have classified the leucocytes under four headings:

1. *Neutrophile Polymorphonuclear Leucocytes*.—These cells are characterized by a variously-shaped and darkly-staining nucleus, and by the presence of faintly-staining and scanty neutrophile granulations throughout the protoplasm.

2. *Eosinophile Polymorphonuclear Leucocytes*.—These cells only differ from the preceding in the type of granulation, which is large, spherical, and markedly oxyphile in its affinity for dyes.

3. *Lymphocytes*.—Under this heading I have classified all cells, irrespective of their size, which have a relatively faintly-staining circular, oval, or slightly-indented nucleus surrounded by a relatively small amount of markedly basophile protoplasm.

4. *Hyaline and Transitional Cells*.—This class includes the large mononuclears, with fairly abundant clear protoplasm, and cells, which seem exactly similar in type, excepting for the markedly indented nucleus.

EXPERIMENT I.

Male pup. Born May 11th, 1906. This animal was weaned at the age of 4 weeks, and thereafter fed on porridge and milk and subjected to modified confinement. Rachitic manifestations were apparent on July 14th. The pup steadily increased in weight till July 31st, when it weighed 6,997 grams, but from that date until August 23rd it lost 420 grams. The following charts (Nos. 1 and 2) show graphically the results of the weekly blood examinations.

Chart 1: ——— Red cells; ——— haemoglobin; ---- leucocytes.

It will be seen that in spite of the development of severe rickets no anaemia supervened, but that the blood continued to improve steadily in quality. Nucleated red blood corpuscles were met with at almost every examination, but they steadily decreased in number from 1 in 20 leucocytes during the first week to 1 in 600 on the second last day of life. The leucocytes remained fairly steady throughout the development of the disease until just before death, five weeks after definite rachitic manifestations were observed, when there appeared a moderate leucocytosis. Chart No. 2, comprising the absolute counts of the different varieties of leucocytes, shows that the variation in the leucocytic picture depended on the polymorphs and lymphocytes, the other varieties remaining fairly constant. The polymorphs varied between 8,000 and 17,000 per c.m.m. until the final observation, when they rose to 26,000 per c.m.m. As regards the lymphocytes there was

a gradual rise until the animal was 5 weeks old, after which they diminished in number, and they continued to be scanty during the development of rickets, but during the last two weeks of life they increased again.

The animal was killed on August 23rd. Weight 6,577 grams. Bones showed marked rachitic changes. Heart and lungs were normal. The liver, which weighed 265 grams, was passively congested and the seat of fatty infiltration. The spleen weighed 44.7 grams, and, excepting some passive congestion, seemed normal. The thymus gland weighed 3.9 grams. Sections of the femur marrow, which was unduly abundant, showed it to be slightly more fatty than normal.

EXPERIMENT II.

Male pup, born May 11th, 1906. It was weaned at the age of 4 weeks, and thereafter treated by modified confinement and fed on porridge and milk. It showed undoubted rachitic symptoms on

Chart 2.—Showing absolute number per c.m.m. of the different varieties of leucocytes. ——— Neutrophile polymorphonuclears; ---- eosinophile polymorphonuclears; ---- lymphocytes; ——— hyalines and transitionals.

Chart 3: ——— Red cells; ——— haemoglobin; ---- leucocytes.

July 14th, but with exercise these in great part disappeared, only to reappear on again being confined. It steadily increased in weight till July 31st, after which it lost during four weeks 453 grams.

It will be seen from the charts (Nos. 3 and 4) that in this case also there was not the slightest evidence of anaemia. The leucocytes, too, remained fairly constant until three weeks before death, when there was a temporary leucocytosis, due both to a polymorphonuclear and a lymphocytic increase. There was also, as in the former experiment,

a gradual rise in the number of lymphocytes from birth,

Chart 4.

with thereafter a fall, which persisted until the final rise three weeks before death.

Killed August 28th. Weight, 4,536 grams. Bones showed marked rachitic changes. Heart and lungs were normal. The liver weighed 155.9 grams, and was fatty. The spleen weighed 18.1 grams, and was slightly fibrosed. The thymus weighed 12.1 grams. The axillary and mesenteric lymphatic glands were enlarged, and on minute examination were found to show some lymphatic hypertrophy. The femur marrow was more fatty and more abundant than normally.

EXPERIMENT III.

Female pup, born May 11th, 1906, and treated similarly to animal in Experiment I. This pup was distinctly rachitic by July 14th, and for the last twelve days of life could not walk. She increased steadily in weight until within two and a half weeks of death, during which time she lost 453 grams.

In this case, as in the two preceding experiments, the blood continued after the development of the disease to improve in quality (during the final two weeks of life the red cells averaged 6,400,000, and the haemoglobin 100 per cent.), and, unless on the occasion of the final examination (two days before death), there was no increase in the number of leucocytes; in fact, there seemed to develop a leucopenia after the onset of the rachitic manifestations. During the last week of life the lymphocytes increased enormously, rising from 3,000 to 20,000 per c.mm., but otherwise the differential counts revealed nothing characteristic. Nucleated red blood corpuscles varied from 1 in 25 leucocytes on first examination, when the animal was four days old, to 1 in 500 leucocytes during the last week of life.

Killed August 17th. Weight, 4,309 grams. The bones showed marked rachitic changes. Heart and lungs were healthy. The liver, which weighed 198.4 grams, was fatty, and the spleen, which weighed 8 grams, showed nothing abnormal on microscopic examination. The thymus weighed 3.9 grams. The lymphatic glands were normal. The marrow presented a slight degree of leucoblastic hyperplasia.

EXPERIMENT IV.

Female pup, born March 7th, 1907, and kept under observation from the age of 5 weeks. It was fed on porridge and milk and treated by confinement. Rachitic manifestations were apparent about May 14th. This pup increased steadily in weight till within two weeks of death, after which it lost 652 grams.

In this case there was during the last week of life a fall in the number of red cells, but not sufficient to be described as an anaemia, especially as the haemoglobin still maintained its former level (see Chart 5). The leucocytes throughout remained fairly steady. The leucocytic picture shows a tendency towards a gradual rise in the proportion of the polymorphs, with a corresponding fall in the lymphocytes after the development of rickets (see Chart 6). On May 7th there occurred a marked rise in the number of

Chart 5: — Red cells; — haemoglobin; --- leucocytes.

large mononuclears and transitionals, but with this exception the charts do not present anything abnormal. Nucleated red cells were observed on all occasions except the last three, and varied between 3 in 400 leucocytes on the day of the second examination and 1 in 400 on May 24th, fourteen days before death.

Killed June 9th, 1907. Weight 3,230 grams. The bones showed marked rachitic changes. The heart and lungs were normal. The liver weighed 170 grams; it was markedly fatty, and presented some passive congestion. The spleen, which weighed 14 grams, was congested. The thymus, whose weight was 6.5 grams, was markedly atrophied, the follicles being widely separated and much diminished in size; relatively the corpuscles of Hassall

were increased in number. The femur marrow, which was more abundant than normally, was gelatinous in type, and microscopic examination revealed extensive myxomatous degeneration.

EXPERIMENT V.

Female pup, born March 7th, 1907, of same litter as animal in previous experiment, and treated in a similar fashion. It showed signs of rickets on May 14th, and steadily increased in weight until within three weeks of death. During the last three weeks it lost in weight 793 grams.

The condition of the blood in this case simulated very closely indeed that found in Experiment IV. There developed during the last three weeks of life a slight degree of anaemia, the red cells falling from 6,270,000 to 5,100,000 per c.mm., and the haemoglobin declining from 85 to 75 per cent. A leucopenia, which appeared before the clinical manifestations of rickets, was noted during the last six weeks of life. The differential counts revealed that the leucopenia was mainly due to a diminution of the lymphocytes, the number of neutrophile polymorphonuclears, on the other hand, continuing throughout fairly constant. Nucleated red cells were observed on almost all occasions, and varied between 2 in 400 and 1 in 400 leucocytes.

Killed June 13th, 1907. Weight 2,568 grams. The bones showed marked rachitic changes. Heart normal. Both lungs showed patches of bronchopneumonia. The liver (weight 113 grams) showed numerous polymorphonuclear leucocytes along the portal tracts. The spleen, which weighed 9.5 grams, presented nothing abnormal, excepting for some diminution in the size of the Malpighian bodies. The thymus gland appeared unusually small. The mesenteric and axillary glands were hypertrophied; the lymph sinuses contained many catarrhal cells with blood pigment. The femur marrow presented a slight degree of leucoblastic hyperplasia.

EXPERIMENT VI.

Female pup, born March 7th, 1907, of same litter as two previous animals, and treated in a similar fashion. This animal was undoubtedly rachitic on May 14th. It steadily increased in weight till within seven days of death, but thereafter it lost 595 grams.

In this case also there is a tendency towards the development of anaemia after the appearance of the rachitic manifestations, but not what one would call severe (see Chart 7). There was a leucocytosis, which developed three weeks before death and persisted until the end. This leucocytosis, it will be seen, was entirely due to an increase in the neutrophile polymorphs (see Chart 8). It is most probable that the leucocytosis was due to bronchopneumonia, from which the animal died. Two nucleated red corpuscles were observed on first examination, while counting 500 leucocytes, but they rapidly diminished in number, and were entirely absent on the last three examinations.

The pup died suddenly on June 21st. Weight, 2,948 grams. The bones showed marked rachitic changes. The lungs were the seat of bronchitis with patches of bronchopneumonia. The liver, which weighed 212.6 grams, was congested and presented a slight degree of general

Chart 6.

Chart 7: — Red cells; — haemoglobin; --- leucocytes.

fibrosis. The spleen weighed 14.17 grams; the Malpighian bodies were small, and throughout the pulp were many endothelial cells, containing blood pigment.

No thymus gland was detected. The femur marrow showed extensive myxomatous degeneration.

EXPERIMENT VII.

A male pup, born March 18th, 1907, and kept under observation from the age of 4½ weeks. This animal was treated as Experiments IV, V, and VI. By May 14th it was undoubtedly rachitic. This animal lost in weight 907 grams during the last two weeks of life, but before that had steadily put on flesh. It seemed ill for some time before death, which occurred on June 9th.

In this case there occurred a very slight diminution in the number of red cells during the last four weeks of life and immediately after the appearance of rickets; the haemoglobin also during the same period showed a slight average decrease. For two weeks prior to the onset of rickets the red cells had averaged 5,600,000 per c.mm., while afterwards they averaged 5,250,000 per c.mm., and the haemoglobin fell from 90 per cent. to 80 per cent. The most striking feature in the condition of the blood, however, was the leucocytosis which appeared some fourteen days before death. The leucocytes until then had been fairly constant in number, averaging 22,000 per c.mm. Two weeks before death they rose to 56,200, but gradually fell again to 27,000 per c.mm. Differential counts revealed this rise to be due almost entirely to an increase of the neutrophile polymorphs, consequent most probably, as in the preceding case, on the development of bronchopneumonia.

Nucleated red corpuscles were only observed on two occasions; on day of first examination they numbered 2 in 500 leucocytes, and on third last examination 1 in 500 leucocytes.

Died June 9th. Weight 1,672.5 grams. The bones showed marked rachitic changes. The lungs were the seat of an extensive bronchopneumonia. The liver, which weighed 75 grams, was congested, and the spleen, which weighed 3.5 grams, had a normal appearance. The femur marrow was the seat of extensive myxomatous degeneration, with here and there patches of leucoblastic hyperplasia.

EXPERIMENT VIII.

Male pup, born October 2nd, 1907; kept under observation from age of 2 months, and subjected to similar conditions as

prevailed in the other experiments. Shortly after coming under observation this animal developed diarrhoea and lost weight, but the diarrhoea ultimately passed off, and there was thereafter a steady increase in weight. Rachitic manifestations were observed on January 7th, 1908.

In this case there developed an anaemia subsequent to the diarrhoea, but on the animal's recovery this disappeared and in spite of the development of rickets the blood continued to improve in quality. (Chart 9.)

Excepting for the fall in the number of leucocytes soon after the onset of diarrhoea, their number continued very

steady throughout. The differential counts revealed a fall in the lymphocytes, which took place shortly before the onset of rickets and continued until the end, and practically synchronous with this a relative increase in the polymorphs. (Chart 10.) Three nucleated reds were observed on the first examination while counting 500 leucocytes, but on no other occasion was a nucleated red corpuscle observed.

Killed February 4th, 1908. Weight 3,150 grams. The bones showed marked rachitic changes. The heart and lungs were normal. Spleen (weight 5.7 grams) showed nothing abnormal. The thymus was atrophied, weighing 3.7 grams. The femur marrow showed a slight degree of leucoblastic hyperplasia.

The following points emerge from a general survey of the above experiments:

In 4 of the 8 animals there was a steady rise in the amount of haemoglobin, and in the number of red cells, in spite of the development of marked rickets. In one case there was a slight fall in the number of red cells at the time of the last observation; in another of the cases the haemoglobin and red blood corpuscles remained constant. In two only did there develop a slight degree of anaemia, and one of these animals, it should be remembered, died from bronchopneumonia, but in the other no cause could be assigned for the anaemia. Nucleated red corpuscles were seldom or never seen after the development of the disease; all the cases presented a certain degree of variation in the size of the red cells.

A degree of leucocytosis appeared in two of the experiments after the rachitic manifestations were detected, but in both this was no doubt due to the bronchopneumonia discovered *post mortem*. On two occasions there developed as a terminal event a leucocytosis, but in four of the animals there was absolutely no leucocytosis. The differential counts failed to reveal anything characteristic in the blood picture. In four of the cases the absolute number of lymphocytes fell shortly before the appearance of the rachitic manifestations, and this low count persisted, but from a consideration of non-rachitic cases, this diminution of the lymphocytes seems, like the disappearance of the nucleated reds, a physiological occurrence in the earlier weeks of life, and not a pathological phenomenon. Chart No. 11, which is compiled from the average number of neutrophile polymorphs and lymphocytes of five non-rachitic animals, shows that after the age at which the rachitic manifestations usually appeared, the lymphocytes are, as in the experiments, comparatively scanty.

Chart 8.

Chart 10.

Chart 11.—Chart showing the average absolute numbers of neutrophile polymorphs and lymphocytes in five non-rachitic animals. Rickets usually appeared in the experiments when animals were between 10 and 11 weeks old. Upper curve represents polymorphs and lower curve lymphocytes.

In the earlier experiments (three in number) the lymphocytes increased somewhat after the onset of rickets, while in the later ones (five in number) the polymorphs underwent the increase, but in two of these latter cases a bronchopneumonia was discovered after death, and probably accounted for the leucocytosis.

Thus experimental rickets is not necessarily accompanied by any anaemia, and when anaemia does appear it is, as a rule, of minor degree, and may frequently be accounted for by some complication. There may or may not be a leucocytosis, and this also when it occurs may be the result of some complication. It can at least be truly said that in the blood of animals suffering from rickets there is no marked pathological change and absolutely nothing characteristic.

It is thus seen that these experimental results are in entire accordance with those obtained in the cases of spontaneous rickets, and which I have briefly reviewed above. Of 30 children suffering from active and uncomplicated rickets, only 9 presented anaemia, in not one of which was the number of red cells less than 4,100,000 c.mm. As a rule, however, the blood estimations were abnormally high. Nucleated red cells were exceedingly rare. In only 2 of the cases was there an unequivocal leucocytosis, 9 presented a leucopenia, and 19 a slight increase in the number of white cells.

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THE TREATMENT OF SLEEPING SICKNESS:

A SUGGESTION.

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I HAVE read with much interest the account of the discussion on cerebro-spinal meningitis at the Sheffield meeting last August. More especially have I noticed the results obtained by Drs. McKenzie and Martin by their method of introducing locally by spinal puncture a highly immune serum which they obtained from the blood of patients who had recently recovered from the disease or, as in two successful acute cases, who were still running a course. These latter were injected with their own serum taken on the sixth and seventh day of their illness respectively.

It has occurred to me that a somewhat similar method of serum-therapy might be tried in cases of trypanosomiasis and sleeping sickness.

Although cerebro-spinal fever and trypanosomiasis differ very markedly—the one being a bacterial, the other a protozoal disease—yet there are certain points of resemblance between them. In both the organism producing the disease is found in the blood and in the cerebro-spinal fluid; at least, this is so in advanced cases of sleeping sickness. In both there is that "lymphatism" described by Westenhoeffer and Symmers in cerebro-spinal fever; and in both the mesenteric glands may show marked hyperaemia and haemorrhage. In both also the final stress of the disease falls on the cerebro-spinal system, and, though the one is an acute, the other a chronic disease, cerebro-spinal fever may run a very chronic course, producing an extreme marasmus which cannot be surpassed even in the closing scenes of typical sleeping sickness. At the same time this resemblance is of minor importance. The question is, If in sleeping sickness the cerebro-spinal canal is a *locus minimae resistentiae*, does the cerebro-spinal fluid show a marked lack of trypanocidal substances? So far as I can ascertain, this matter has not been fully investigated. We know that the blood of patients suffering from trypanosomiasis possesses trypanocidal bodies, and blood serum has been used therapeutically both by subcutaneous and intravenous injection. Why should it not be tried intraspinally?

In the past great difficulty has been experienced in attacking the trypanosomes present in the cerebro-spinal canal, and Kopke has made special efforts to overcome the difficulty when treating patients with atoxyl and other chemical substances. It is true that comparatively few cases of human trypanosomiasis recover, but a suitable serum might be obtained from the blood of patients subjected in the first instance to chemo-therapy. A combined treatment might prove useful, attacking the trypanosomes in the blood by some of the more promising of our present drugs, and attacking those in the cerebro-spinal fluid by performing lumbar puncture and injecting the patient's own serum, or the serum from a case which is improving, obtained by defibrinating and centrifuging the blood. The latest work on the cerebro-spinal fluid in sleeping sickness is that by Broden and Rodhain, but they do not approach the subject from this aspect. The cellular content of the fluid seems to vary, and Nattan-Larrier has reported a very severe case with cerebro-spinal symptoms in which the fluid was very poor in cellular elements. This may point to the canal being a *locus minimae resistentiae*, to employ once more the phraseology of Drs. McKenzie and Martin.

It would seem that, so far as the cellular contents go, the fluid in human trypanosomiasis may approximate to the conditions found in cerebro-spinal fever, a fact which is rather in favour of adopting the line of treatment indicated. I admit it is merely a suggestion, and one possibly based on none too stable a foundation; but in the present state of our knowledge, everything likely to prove beneficial should be tried in cases of sleeping sickness. I am sending a copy of this note to Sir David Bruce in Uganda for his consideration, and I propose to carry out experimental work in this direction here as soon as possible.

If the idea has been voiced beforehand, I can only plead the difficulty of getting at the full literature on the subject, and apologize for having, as one may say, "carried coals to Newcastle."

INJURY TO THE VESSELS IN DISLOCATION OF THE SHOULDER.

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THIS short account of a case of injury to the axillary artery and vein possesses considerable interest, serious injury to the larger vessels of the axilla in ordinary simple dislocation of the shoulder-joint being fortunately rare. When the vessels are torn local signs vary a good deal. In the less common variety a swelling appears a few days or weeks after the injury, and increases rapidly with pulsation; in the second kind a diffused fluctuating swelling forms immediately or within a few hours, without bruit or pulsation, and reaches a large size, pushing forward the pectoral muscles. If this tumour pulsates, the diagnosis of a ruptured artery may be made; if in addition the radial pulse is present, it is extremely probable that the injured vessel is not the main artery; beyond this it is not possible to go (Stimson).

E. M., a stout woman of 70 years of age, was admitted to St. Thomas's Hospital on November 26th, 1908. She stated that on the day before admission she had fallen down and hurt her left shoulder; previously she had been in good health. When examined in the casualty department, it was discovered that she had sustained a subcoracoid dislocation of the shoulder. This was reduced by Kocher's method without anaesthetic. Immediately after reduction, a swelling appeared in the axilla, which increased somewhat rapidly in size; it was also noticed that the radial pulse was absent on that side. When seen in the ward on the same evening, 9 p.m., the swelling in the axilla was said to be larger, and the left radial beat was still absent. She was suffering from shock; the right pulse was small and rapid, 124, and the temperature subnormal. There was, however, no proof that the swelling was rapidly increasing. On the following day the patient was placed under an anaesthetic and the axilla opened, both pectoral muscles being divided. A large tear in the axillary vein was found under the lower border of the pectoralis minor muscle. No wound was present in the artery, but all pulsation had ceased at a